Initial Environmental Examination Report

Project Number: 42439
August 2012

Republic of Palau:
Koror–Airai Sanitation Project

ABBREVIATIONS

ADB	–	Asian Development Bank
BOD	–	Biological oxygen demand
BNPL	–	Basic needs poverty line
CA	–	Conservation area
EA	–	executing agency
EA	–	environmental assessment
EIA	–	environmental impact assessment
EIRR	–	economic internal rate of return
ENSO	–	El Niño Southern Oscillation
EIS	–	Environmental Impact Statement
EMC	–	environmental management consultant
EMP	–	Environmental Management Plan
EQPB	–	Environmental Quality Protection Board
GDP	–	gross domestic product
IA	–	implementing agency
IEE	–	Initial Environmental Examination
IEM	–	independent environmental monitor
IUCN	–	International Union for Conservation of Nature
NBSAP	–	National Biodiversity Strategy and Action Plan
MFWQ	–	Marine and Freshwater Quality Regulations
MPIIC	–	Ministry of Public Infrastructure, Industry and Commerce
PWSC	–	Palau Water and Sewerage Corporation
PALARIS	–	Palau Automated Land Resource Information System
PMO	–	Project Management Office
PPTA	–	project preparation technical assistance
RP	–	Resettlement Plan
ROP	–	Republic of Palau
SBR	–	Sequencing Batch Reactor
SPS	–	Safeguard Policy Statement
SPS	–	Sewage Pump Station
SS	–	Suspended Solids
STP	–	Sewage treatment plant
TDS	–	total dissolved solids
TN	–	total nitrogen
UV	–	ultraviolet
WWTP	–	wastewater treatment plant

WEIGHTS AND MEASURES

ha	–	hectare
kg/d	–	kilogram per day
km	–	kilometer
km^2	–	square kilometer
m	–	meter
m^2	–	square meter
m^3	–	cubic meter
m^3/d	–	cubic meters per day
m^3/s	–	cubic meters per second
mg/m^3	–	milligrams per cubic meter
mm	–	millimeter

NOTE

In the report, “$” refers to US dollars.

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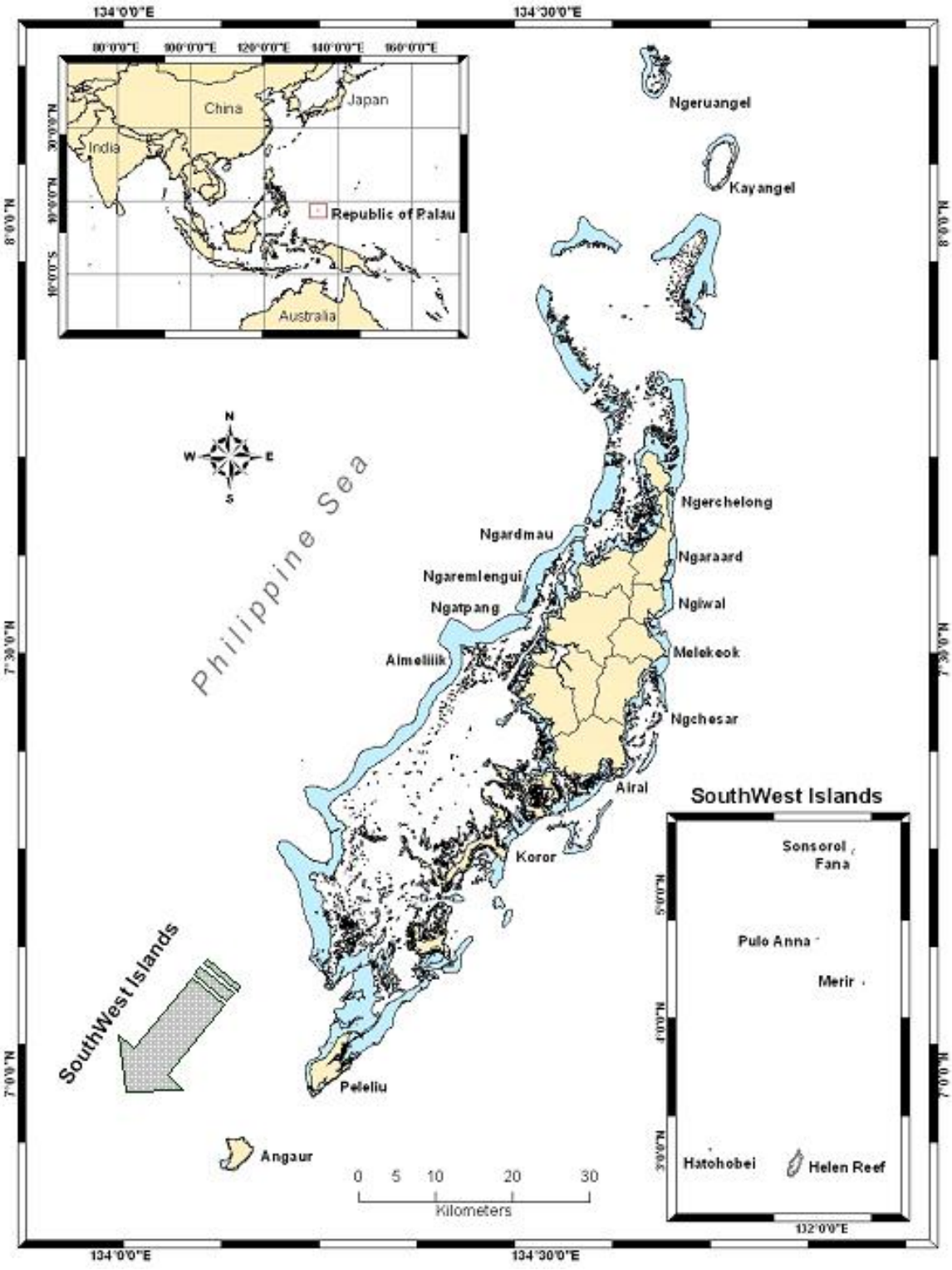
Figure 1: Palau



EXECUTIVE SUMMARY

1. This initial environmental examination (IEE) presents the potential environmental impacts and appropriate mitigation and enhancement measures for the replacement of existing and installation of new sewerage infrastructure in the States of Koror and Airai, Republic of Palau. The IEE has been prepared in accordance with the requirements of the Asian Development Bank (ADB) Safeguard Policy Statement (SPS, 2009) and the conforms to environmental assessment requirements defined in Palau's Environmental Quality Protection Board (EQPB), Environmental Impact Statement (EIS) Regulations (1996), and related guidelines. The project is classified as Category B under SPS 2009.

2. Palau has a fragile natural environment which, to a large extent, remains free of environmental degradation, however, inadequate sewerage collection and treatment along with increasing erosion and sedimentation, illegal fishing with dynamite, and extensive sand and coral dredging are putting the environment at risk.

3. The only urban centers with a sewerage system and treatment works are Koror and Melekeok. All other population centers use onsite sanitation systems such as septic tanks or pit latrines. The Koror sewerage system, which services approximately 2,431 residential customers and 578 commercial and government customers, is inadequate, with hotels being asked to store sewerage until off-peak times.

4. Similar concerns exist in the Kesebelau and Ked developments in Ordomel Hamlet, Airai State, on Babeldaob Island, where poorly planned development has led to sanitation issues associated with individual septic systems which do not provide adequate treatment, given the density of development and the unsuitability of soils for these systems.

5. Addressing these issues, this project will develop more efficient, effective, and affordable sanitation services for Koror and Airai. Strengthening basic infrastructure will facilitate tourism sector investment in Palau and particularly in Koror, the country's center of tourism activity. The project will improve the health and safety of the resident population currently experiencing sewage outflows. The project is expected to provide environmental benefits such as improved coastal marine water quality, improved freshwater quality, reduced odor nuisance, reduced public health risk from exposure to untreated sewerage, and increased public safety. Associated and cumulative benefits included increased tourism potential, improved planning and management of future sanitation infrastructure, and improved development planning. The project will also help develop the capacity of the Palau Water and Sewerage Corporation (PWSC) to manage and monitor environmental performance of the sanitation system.

6. Adverse environmental impacts of the project will mainly be construction impacts, which are expected to be minimal and adequate mitigation measures will be implemented. Adverse environmental impacts associated with the project will be prevented, eliminated, or minimized to an acceptable level if the Environmental Management Plan (EMP) required under the IEE is effectively implemented, particularly through the mechanism for the continuous refinement and effective implementation of the environmental mitigation measures.

I. INTRODUCTION

1. This initial environmental examination (IEE) presents the potential environmental impacts and appropriate mitigation and enhancement measures for the replacement of existing, and installation of new, sewerage infrastructure in the States of Koror and Airai, Republic of Palau (the Project). The IEE has been prepared in accordance with the requirements of the Asian Development Bank (ADB) Safeguard Policy Statement (SPS) (2009) and the conforms to environmental assessment requirements defined in Palau's Environmental Quality Protection Board (EQPB) Environmental Impact Statement (EIS) Regulations (1996) and related guidelines. The project is classified as Category B[1] under ADB SPS (2009).

2. This IEE provides an assessment of potential environmental benefits, potential adverse environmental impacts, and risks associated with the proposed sewerage system infrastructure improvements, and includes (i) a summary of the local, national, and international policies, standards, and guidelines; (ii) due diligence review of existing environmental impact assessments undertaken to meet local approval requirements; (iii) description of the project and anticipated environmental impacts and mitigations measures; (iv) information disclosure, consultation and participation, (v) a grievance redress mechanism, and (vi) a detailed environmental management plan (EMP), including an implementation schedule and performance indicators.

A. Background and Rationale

3. Palau is a small nation located in the North Pacific Ocean, with an estimated population of 20,000. The main population centre of Koror is located on the smaller of the main islands. Koror and Airai (the main subject areas of the project) contain 80% of the population. Its economy consists mainly of subsistence agriculture, fishing, and tourism and relies heavily on financial assistance from the United States and international aid. Expansion of air travel in the Pacific and the rising prosperity of leading East Asian countries have greatly improved the long-term prospects of the tourist industry and has the potential to strengthen the economy of this small Pacific nation.

4. Palau has a fragile natural environment which, to a large extent, remains free of environmental degradation, however, increasing erosion and sedimentation, illegal fishing with dynamite, inadequate disposal of wastes, and extensive sand and coral dredging are putting the environment at risk. Palau's diverse but limited natural resources and fragile ecosystems are under considerable pressure from rapid population growth, increasing tourism, and associated large-scale development. These changes also put pressure on failing wastewater infrastructure (intended to protect the environment and public health), which is further compounded by underinvestment in the wastewater / sanitation sector.

5. The only urban centers with a sewerage system and treatment works are Koror and Melekeok. All other population centers use onsite sanitation systems such as septic tanks or pit latrines. The Koror sewerage system, which services approximately 2,431 residential customers and 578 commercial and government customers, is inadequate, with hotels being asked to store

[1] Category B (OM 20): Projects judged to have some adverse environmental impacts, but of lesser degree and/or significance than those for category A projects. An IEE is required to determine whether or not significant environmental impacts warranting an EIA are likely. If an Environmental Impact Assessment (EIA) is not needed, the IEE is regarded as the final environmental assessment report. Category C (OM 20): Projects unlikely to have adverse environmental impacts. No EIA or IEE is required, although environmental implications are still reviewed.

sewerage until off-peak times. Although construction of the present Koror sewer system alleviated sanitation issues present in the 1960s, when untreated sewage was being discharged directly to lagoon waters, its current state of deterioration has led to a similar situation of haphazard sewage discharges threatening the environment and public health. The Koror sewerage system has had some improvements (including upgrading of the Malakal treatment works and some of the pump stations), however, frequent sewage overflows and infiltration and exfiltration from sewers still occurs. The collection system requires augmentation to meet existing and expected load growth, and to reduce reliance on sewage pumping. Maintenance and upgrading of Palau's wastewater systems, is reactive rather than planned and is impeded by lack of a sewerage master plan with sufficient planning horizon to guide these activities (the last master planning study was prepared in 1994). There is growing concern about the lack of planning, maintenance, and upgrading of the wastewater collection and treatment practices to meet the demands of development in Palau and the consequent adverse impacts on the fragile environment particularly in the Koror and Airai states. The key constraints to addressing these issues and to improving and sustaining wastewater management in Palau include: (i) poor overall land use planning and unresolved land rights issues; (ii) inadequate sanitation (master) planning; (iii) lack of public awareness; (iv) lack of financing; (v) inadequate technical capacity; and (vi) ineffective institutional arrangements.

6. Similar concerns exist in the Kesebelau and Ked developments in Ordomel Hamlet, Airai State, on Babeldaob Island, where poorly planned development has led to sanitation issues associated with individual septic systems, which do not provide adequate treatment, given the density of development, and the unsuitability of soils for these systems.

7. Hardships are faced by both the Koror and Airai communities by the ineffective treatment of sewage, causing nuisance odors, and a high level of health risk from direct exposure. Additional impacts to the quality of life include the inundation of taro farms and home sites with untreated sewage.

8. Site photographs in Figure 2 illustrate current undesirable social impacts to the communities.

Figure 2: Examples of exposure to undertreated sewerage in Koror and Airai

Notes: Photos A and B: Koror community and environment exposed to continuing sewer overflows.
Photos C and D: Airai neighborhood with septic system overflows and poor stream water quality from sewage runoff.

9. Palau is undergoing rapid changes and it must adequately address these emerging issues related to the management of its wastewater systems if it is to create and maintain a sustainable future. Palau's economy, and in particular the tourist industry, is highly dependent on providing and maintaining a high level of municipal services. Palau has already embarked on programs (projects) to improve the supply and management of potable water. However, sewerage and sanitation conditions continue to impair residential development in Palau and accommodate its burgeoning tourist industry.

10. Characteristics that make Palau's tourism sector such a large contributor to gross domestic product are the same characteristics that are at risk from poor land use practices and environmental degradation. The tourism sector has developed largely around diving, and there is a need to manage watersheds and land use, to protect coral reefs and marine resources.

11. Addressing these issues, this project will develop more efficient, effective, and affordable sanitation services for Koror and Airai. Strengthening basic infrastructure will facilitate tourism sector investment in Palau and particularly in Koror, the country's center of tourism activity. The project will improve the health and safety of the resident population currently experiencing sewage outflows. Ongoing environmental impacts of the poorly maintained treatment works will be mitigated as part of the project.

II. POLICY, LEGAL, AND ADMINISTRATION FRAMEWORK

A. National and Local Legal Framework

1. National Environmental Framework

12. The EQPB is the governing body for environmental protection in the Republic of Palau. The Palau National Code, Chapter 24 Environmental Protection Act administered by the EQPB contains a set of regulations for protection of surface and marine waters, air quality, and managing of potential impacts from earth works, sanitation systems, waste and new infrastructure development. These regulations along with the Koror Mangrove Act and state level conservation area legislation provide the framework for protection of resources and environmentally sound development in Palau, and are directly applicable to this project.

13. **Environmental Impact Statement (EIS) Regulation (Chapter 2401–61).** The EIS Regulation is Palau's central environmental planning legislation with the aim of ensuring that environmental concerns are given appropriate consideration in decision making for all new infrastructure projects. The EIS Regulation applies a two-step assessment process to determine the level of assessment required, similar to the ADB environmental safeguard policy.

14. In the first step, an Environmental Assessment (EA) is required for planned activities that propose: (i) use of national or state lands; (ii) use of national or state funds, with some exceptions; (iii) any use within any land which has been or may be classified as conservation district by the Republic or one of its state's land use commissions; (iv) any use directly or indirectly impacting coastal waters and wetlands as defined in the Republic of Palau Marine and Fresh Water Quality Regulations; (v) any use within any historic site as designated by the Palau Historic Preservation Office; or (vi) any required action which the Board determines may have a significant impact on the environment. The EA is an initial evaluation to determine whether an action may have a significant environmental effect. The EA is evaluated by the EQPB to determine if the action has the potential to have a 'significant effect on the environment', in which case a second stage of assessment is required and an EIS must be completed.

15. The project is considered by the project preparatory technical assistance (PPTA) team to have the potential for impact on the environment and will likely require an EIS. An initial EA should be conducted and submitted by the executing agency for the consideration of the EQPB Board.

16. **Marine and Freshwater Quality Regulations (Chapter 2401–11).** The Marine and Freshwater Quality (MFWQ) Regulations provide classification of both surface water and groundwater quality criteria and standards. The purpose to the MFWQ regulations are to (i) identify the uses for which the various waters of the Republic of Palau shall be maintained and protected, (ii) specify the water quality standards required to maintain the designated uses, and (iii) prescribe regulations necessary for implementing, achieving, and maintaining the specified water quality, and to protect health, welfare, and property, and to assure that no pollutants are discharged into these waters without being given the degree of treatment or control necessary to prevent pollution. The regulation requires for any new point source of pollution, that the source shall meet and maintain the highest statutory and regulatory requirements, does not discharge into a drinking water source (groundwater or surface water), and sewage must receive the degree of treatment necessary to protect the beneficial uses of waters of the Republic of Palau before discharge. These regulations are directly applicable to the project design and implementation, and have been considered as part of this IEE.

17. The regulations define water use classifications for freshwater and coastal marine waters, based on the beneficial uses. The coastal marine waters which may be impacted by the project include Class AA, Class A, and Class B waters. At the point of discharge of the sewerage treatment plant effluent outfall, the marine waters are classified as Class B. In other coastal marine waters around Koror and Airai, the marine waters are classified Class A or AA. The surface waters which may be impacted by the project are classified as Class 2, as they are not used for or likely to be used for drinking water supply, food processing, or aquaculture.

18. The MFWQ regulations define the following water quality standards for each classification.

Table 1: Summary of Marine and Freshwater Quality Standards

	Coastal Marine Waters		Freshwater	
Class	**AA**	**B**	**1**	**2**
Fecal Coliform	230/100 ml 70/100 ml[m]	400/100 ml - 200/100 ml[m]	230/100 ml – 70/100 ml [m]	400/100ml - 200/100ml[m]
Enterococci	60/100 ml 33/100 ml[gm]	- -	60/100 ml	-
Shellfish Areas	Where shellfish for human consumption is harvested the micro-biological standard for Class AA and 1 Waters shall apply			
pH	7.7 – 8.5	7.7 – 8.5	6.5 – 8.5	6.5 – 8.5
Nutrients - Ratio N:P	11.1 – 27.1	6.1 – 18.1	< 10% var.	< 10% var.
Nutrients - Total P mg/l as P Total N mg/l as N	< 0.025 < 0.4	< 0.500 < 0.8	< 0.2 < 0.75	< 0.2 < 0.5
Dissolved Oxygen (mg/l)	> 6.0 / 75%	> 4.5	> 6.0 / 75%	> 5.0
TDS, Salinity	< 10% change from natural isohaline conditions or outside the range of 29 – 35 ppk			
Temperature	< 0.9 °C change from natural conditions			
Turbidity	< 1 NTU	< 2 NTU	-	-
Oil & Petroleum Products	• Concentration of oil should not be detectable as a visible sheen or discoloration of the surface or cause an objectionable odor. • Concentrations should not cause tainting of fish or other aquatic life, be injurious to indigenous biota or cause objectionable taste to drinking water. • Concentrations should not form an oil deposit on beaches or shorelines or on the bottom of the body of water.			

Source: Palau EQPB Regulations.

Notes: [m] Median total for 10 consecutive samples. [gm] Geometric Mean for 5 samples in a 30 day period. var. variation from the natural conditions. Groundwater Quality Standards are not included and may be referenced in Republic of Palau, EQPB Regulations.

19. The MFWQ regulations require any point source pollution discharge to maintain a pollution discharge permit issued by EQPB. The permit includes specific point source discharge limits, along with monitoring and reporting requirements. The existing Koror sewerage treatment plant was issued a five-year pollution discharge permit in 2002. The permit was not renewed in 2007, and the plant is currently operating without a permit.

20. The project will be required to apply for a pollution discharge permit for both the Koror and Airai systems.

21. **Earthmoving Regulations (Chapter 2401–01).** The earthmoving regulations apply to any construction or other activity which disturbs or alters the surface of the land. The regulations require preparation of an erosion and sedimentation control plan by a person trained and experienced in erosion and sedimentation control methods and techniques. The plan should outline a description of the project works and required control measures to mitigate the potential impacts of sedimentation. The plan must be submitted to the EQPB Board along with clearance from the Historical Preservation Office of the State Planning Commission, for review. A permit is required from the EQPB prior to any excavation works commencing.

22. All excavation works including tunneling and horizontal drilling will require an earthmoving permit from EQPB. The project will not include any marine related excavation works.

23. **Toilet Facilities and Wastewater Disposal System (TFWDS) Regulations (Chapter 2401–13).** The TFWDS Regulations establish standards for toilet and wastewater disposal systems. The regulations require minimum standards governing the design, construction, installation, and operation of toilet and wastewater disposal systems for the purposes of (i) minimizing environmental pollution, health hazards, and public nuisance from such systems and facilities; (ii) protecting the health of the septic tank user and all neighbors; and (iii) ensuring that sewerage will not contaminate drinking water supply, be accessible to insects, rodents, or other possible carriers of disease which may come into contact with food or drinking water, pollute or contaminate the waters used for swimming, or generally pose a public health nuisance or hazard.

24. The TFWDS regulation is focused on household sanitation systems, such as septic tanks, and connection requirements to the public sanitation system in areas where it is available. The regulation does not provide discharge standards or design specifications for the larger scale public sewerage infrastructure works under this project.

25. **Air Pollution Control Regulations (Chapter 2401–71).** The most relevant section of the Air Pollution Control Regulations to sanitation planning is the prohibition on odors, which forbids the emission of odors causing a nuisance and/or negative impact to public health.

26. **Solid Waste Management.** With regard to the project, local solid waste management legislation requires that sludge and biosolids from sewerage treatment systems be disposed of at the M-Dock solid waste landfill.

27. **Koror Mangrove Protection Act.** The Koror Mangrove Protection Act prohibits the cutting and/or harvesting of trees and vegetation below the high tide line, in mangroves and within wetland areas. The Project will not include clearing any areas of existing mangroves.

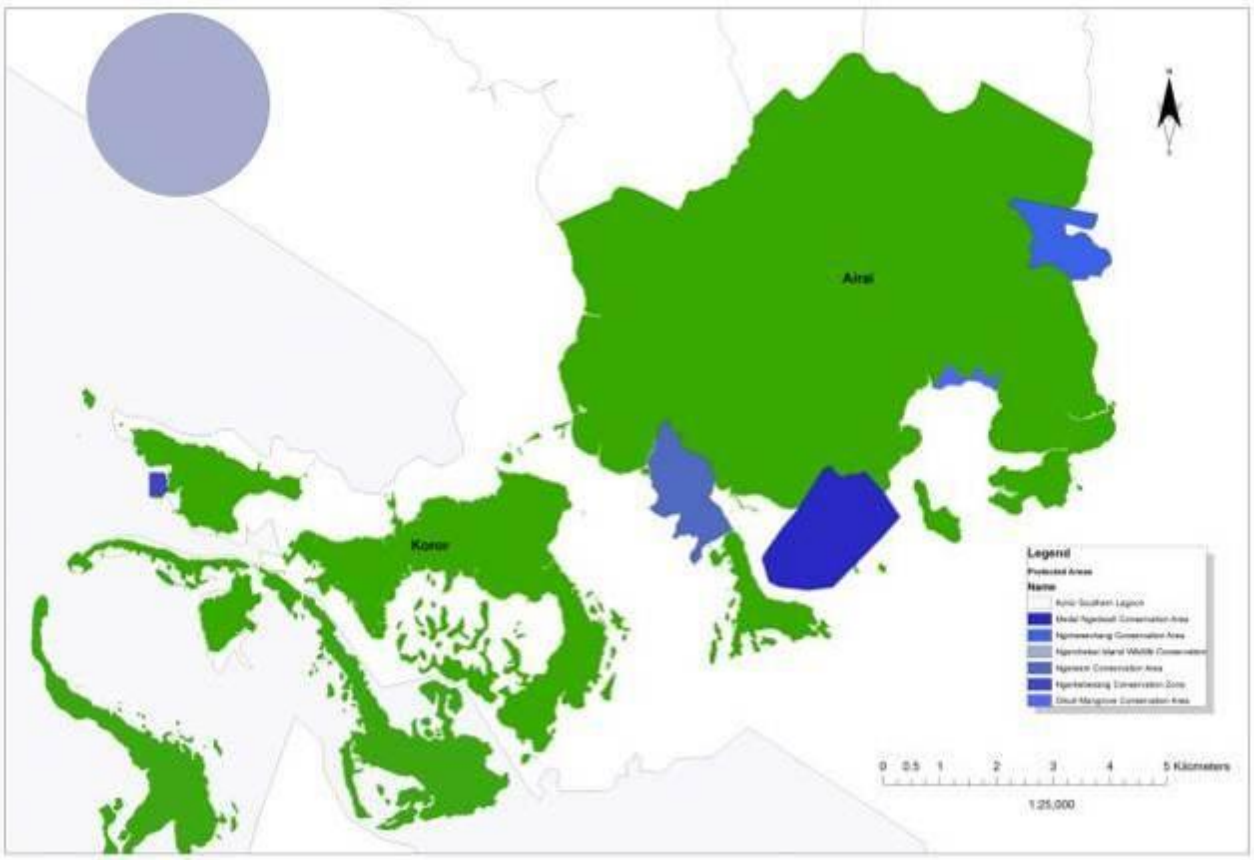
28. **Conservation areas.** There are six conservation areas protected by the state and/or national legislation in the Koror and Airai area. The conservation areas protect marine and terrestrial areas of ecological importance from potential impacts, as summarized in Table 2. The extent of each conservation area is shown in Figure 3.

Table 2: Applicable Protected Areas

	Conservation Area	Scope
1	*Ngerekebesang Conservation Zone*	Protects an area off the eastern shore of Ngerekebesang Island, adjacent to the Palau Pacific Resort. The law “prohibits the fishing, hunting, taking, or disturbance for any marine flora and fauna”.
2	*Ngeream Conservation Area Act*	Designates an area in southwest Airai to be “conserved and preserved for the current and future generations of residents of Airai State”. Traditional and subsistence uses of the conservation area will be allowed. Activities are prohibited that may “adversely affect that area”.
3	*Medal NgedeiullConservation Area Act*	Designates an area off south-central Airai where boat travel and fishing activities are prohibited. This protection is afforded due to the knowledge of the natural habitat being “a home for a variety of fish and other water creatures”, and as “a source of reproduction of fish and a place where fish grow before moving on to different locations”.
4	*Oikull Mangrove Conservation Area Act*	Designates an area of mangroves off southeast Airai, to “conserve and preserve the natural and traditional value of designate area for the use

	Conservation Area	Scope
		and benefit of all current and future generations of citizens of Airai".
5	*Southern Lagoon Protected Area*	If enacted, may have implications on the placement of any discharge outfalls, as the protected areas proposed lie adjacent to several Koror islands, including Malakal Island, site of the existing outfall.
6	*Ngrimel Reservoir Watershed CA & Ngrikill River Watershed CA*	Two areas in Airai State are currently proposed for conservation area status due to the following considerations:. ◗ Provides protection for the watershed upstream of the dam, which supplements supply to the Airai/Koror water system. ◗ Provides protection for the watershed upstream of the main water system intake for the Airai/Koror water system.

Figure 2: Protected Areas in Airai and Koror States



B. ADB Guidelines and Policies

29. The ADB SPS (2009) provides a basis for this IEE. With respect to environment, these policies are accompanied by ADB Operations Manual on Environmental Consideration on ADB Operations (2006). The policy promotes international good practice as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health, and Safety Guidelines.

30. All projects funded by ADB must comply with ADB Safeguard Policy as set out in the SPS (2009). The purpose of the environmental safeguards is to establish an environmental review process to ensure that projects undertaken as part of programs funded under ADB loans are environmentally sound, are designed to operate in compliance with applicable regulatory requirements, and are not likely to cause a significant environmental, health, or safety hazards.

31. The ADB SPS (2009) requires a number of additional environmental considerations to that generally undertaken in accordance with Palau EQPB Environment Protection Act and related legislation. ADB requirements include: (i) identification of project environmental risks and respective mitigation measures and project assurances; (ii) development of a project level environmental grievance redress mechanism (GRM) including documentation in the EMP; (iii) definition of the project area of influence; (iv) undertaking a physical cultural resources damage prevention analysis; (v) identification of climate change mitigation and adaptation strategies; (vi) identification of biodiversity conservation and natural resources management requirements; and (vii) ensuring that the EMP includes an implementation schedule and (measurable) performance indicators.

III. DESCRIPTION OF THE PROJECT

32. The project area is confined to (i) the islands of Koror, Malakal, and Ngerekebesang, within Koror State; and (ii) the Kesebalau area in Airai State, which is located on the southern end of Babeldaob Island. The project will be implemented over 2 years, and is expected to start in 2013 and be completed by 2015. The total project investment is US$28 million, focusing on new sewerage infrastructure and rehabilitation of existing infrastructure.

33. The project will be implemented by the PWSC with assistance from the Ministry of Public Infrastructure, Industries, and Commerce (MPIIC), and guided by a Project Steering Committee which includes Minister of Finance, the Governor of Airai State, the Governor of Koror State, the Minister for Natural Resources, Environment and Tourism, Director of Capital Infrastructure Projects, and the Executive Officer of EQPB.

34. The guiding principles in the design of the project were to: (i) significantly reduce incidence and severity of sewage overflows and improve public health conditions; (ii) improve conditions to allow for a more proactive approach to system maintenance and dealing with emergencies; (iii) provide a logical pathway for improving system efficiency and performance over time – i.e., components should provide a foundation (and form a logical part) of future improvements to the system; and (iv) implement improvements in as short a time as possible (less than 24 months).

A. Koror Sewerage System Upgrade

35. The existing sewerage treatment system is described in detail in the PPTA Sanitation Masterplan Report (ADB, 2012). The existing sewerage treatment system was upgraded by consultants, Winzler & Kelly, Guam, in 2003 and comprises (i) a lined primary lagoon with an area of 6,550 m2, (ii) two trickling filters. The current system was designed to support an equivalent population (PE) of 10,000, however due to population growth and additional commercial operations (primarily hotels) the current estimated PE is 16,500. Further design criteria for the existing plant in 2003 included:

(i) Average dry weather flow 8 ML/d
(ii) Peak wet weather flow 22.4 ML/d

(iii) Influent BOD 200 mg/L
(iv) Influent SS 200 mg/L
(v) Final effluent BOD 30 mg/L
(vi) Final effluent SS30 mg/L

36. The current estimated dry weather daily inflow volume is 6 ML/d.

37. The characteristics of the influent waters have not been recorded by the MPIIC. It has been necessary to assume values typical of domestic and commercial waste water derived for other countries. As the system connects residential and commercial (primarily small retail business and hotels) within Koror, the influent water quality is expected to have an average biological oxygen demand (BOD_5) concentration of 200–250 mg/L and suspended solid concentration (SS) of 200–300 mg/L. Other influent wastewater parameters are listed in the following table.

Table 3: Influent Sewerage Quality

Parameter	Abbreviation	Estimated average values (mg/L)
Biochemical oxygen demand	BOD_5	250
Suspended solids	SS	300
Total nitrogen	TKN	60
Ammonia nitrogen	NH_3	30
Total phosphorous	TP	12
Sewage temperature (fairly constant all year)	T	22°C

38. The effluent discharge quality limits are defined in the pollution discharge permit issued by EQPB, including BOD_5 <30 mg/L and SS <30 mg/L (see Table 3). Compliance monitoring has not been undertaken on a regular basis. Only two sets of effluent discharge test results were available for review from March to April 2008, both of which showed exceeding the SS criteria, 38 mg/L and 40 mg/L, respectively. BOD_5 was not tested during these monitoring events. The non-compliance with the EQPB discharge permit and absence of ongoing compliance monitoring is an issue which must be addressed as part of this project.

39. In addition to these issues, the PPTA team identified numerous design deficiencies and a severe lack of capacity for the existing Koror sewerage system to accommodate the existing volume of flows, let alone potential increases in sewage flows. These design deficiencies include: (i) the main gravity collection sewer in Koror Island appears to have only 1/3 of the current dry weather capacity needed, especially taking future growth into account; (ii) the main gravity collection sewer on Malakal Island appears to have only 1/3 of the current dry weather capacity needed, especially taking future growth into account; and (iii) the minor pump stations do not appear to have adequate overflow facilities—excess sewage flows out through the wet well cover into the surrounding bounded areas and then through an outlet hole generally into adjacent public or private areas, wetlands, and marine waters; (iv) the inlet pond (primary sedimentation) has become anaerobic and does not have adequate provision for removal, handling, and disposal of fats, grease, solids; (v) the trickling filters are not functioning properly and are well past their use by date and the type of filter media is not suitable for the Palau situation; (vi) the pond system does not appear to be working effectively and does not appear to provide any further treatment of the effluent stream; and (vii) the effluent outfall appears to be working adequately although it is likely that the outfall pipeline is past its expected life. The dispersion of effluent appears good with no visible signs of environmental damage.

40. To address these issues the project will comprise the following infrastructure improvements:

1. Gravity interceptor sewer replacement

41. The existing gravity trunk sewer which runs the length of the Koror main road will be sectionalized and flows diverted to a new gravity interceptor sewer. The project will construct the new gravity interceptor sewer with significant increased capacity. The new sewer line will be constructed with directional drilling with minimal surface disturbance. The interceptor sewer will be connected to the existing main sewer at a number of existing sewer manholes in order to divert flows to the new sewer. The new sewer will not require any land acquisition. Traffic management and safety have been identified as key areas for appropriate management.

2. Major pump station and force main upgrade

42. The major pump station upgrade will include construction of a new pump station at the existing SPS 1 site, construction of an overflow treatment facility at SPS 1, replacement of the existing pumping equipment and electrical control panel at SPS 2 including upgrade of pipework, steelwork, and electrical cabling, where needed. A new pump station will be constructed at SPS A8 to serve the Ngerekebesang PPR area, which will replace existing pump stations A7 and A8 which will be decommissioned. The major force main upgrade will include construction of a new force main for new pump station SPS 1 and connecting it directly to the new sewage treatment plant, construction of a new force main for pump station SPS 2 and connecting it directly to the new sewage treatment plant, and extension of the existing force main (from Meyuns) for pump station A1 to connect directly to the new gravity interceptor sewer.

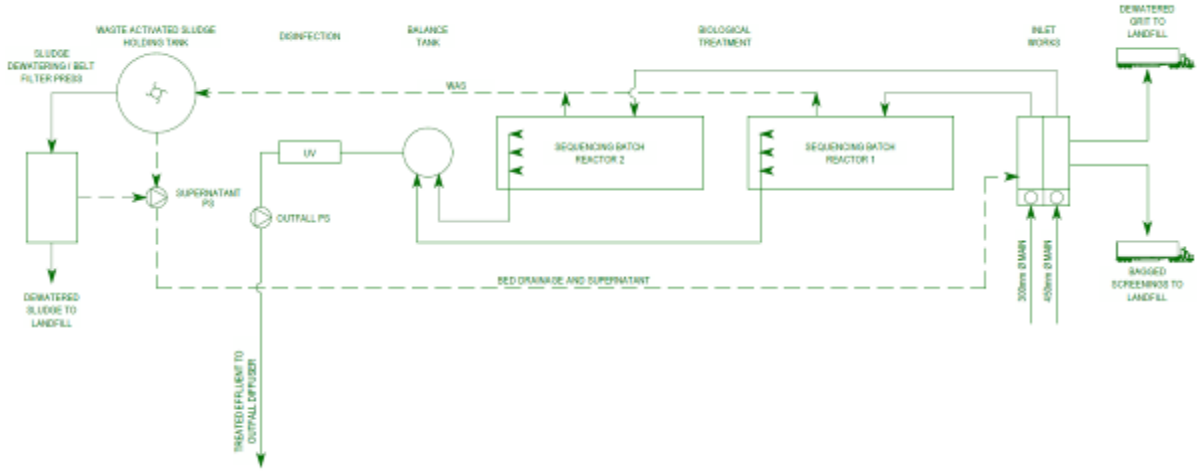
3. New sewerage treatment plant

43. The project will include the construction of a new advanced treatment plant on the existing inlet pond site, which is located on high ground above the existing trickling filters. The proposed sewerage treatment system is described in the PPTA Feasibility Report (ADB, 2012). Some aspects of the design will continue to be refined during the detailed design phase.

44. The replacement treatment plant will include two sequencing batch reactors (SBR), ultra violet (UV) disinfection, and a belt press sludge drying unit. UV disinfection is a preferred option of chemical dosing, as it reduces the need for use of hazardous chemicals. The SBR will include a denitrifying cycle to remove nitrogen from the wastewater, designed to achieve total nitrogen (TN) concentration of around 10 mg/L. The system is designed to remove phosphorous, resulting in concentrations of around 10 mg/L. The Sanitation Master Plan (ADB, 2012) includes recommendation for banning phosphorous based detergents, which if implemented will further reduce total phosphorous in wastewater.

45. The existing sewerage treatment plant will be decommissioned and the site rehabilitated including the removal of ponds. The site of the new plant will require some cut and fill excavation works however, no land acquisition will be required. Figure 5 provides a schematic of the proposed layout. The package plant will be transported to site and assembled on site.

Figure 3: Proposed Malakal Sewerage Treatment Plant Layout



46. The plant will be designed to achieve 90% compliance with discharge standards listed in Table 4. These discharge standards are sufficient to be protective of the environment, and are recommended for inclusion in the pollution discharge permit as monthly averages.

Table 4: Proposed discharge limits for key parameter

Parameter	Proposed discharge[a] limit (mg/L)	SPREP Guidelines[b] (mg/L)	EQPB STP 2002 Permit[c] (mg/L)
Biological Oxygen Demand (BOD_5)	<30	<5	<30
Suspended Solids (SS)	<30	<10	<30
Total Nitrogen (TN)	<10[d]	<26	<10[d]
Total Phosphate (TP)	<10[d]	<5	<10[d]
Fecal Coliform	-	<106 MPN /100 ml	700 MPN /100 ml
Enterococci	<60 MPN/100 ml	-	-

Notes: a - Monthly average, not to be exceeded by individual tests in 90% of samples, b - SPREP, 1996, *Water Quality Protection Criteria for the South Pacific, including standards for discharge of sewerage effluent, Guidelines for Effluent Discharge Guidelines into Class C waters*, c - Average Monthly, d - Daily maximum.

47. The new sewerage treatment plant will connect to the existing treated sewage effluent ocean outfall pipe, and no new discharge pipe will be required. The existing outfall pipe is about 400 m in length buried beneath rip-rap and sand which reaches from the shore to the right hand corner of reef shown in the Figure 6 vertical aerial photograph. The outfall discharges down slope at 15–16 m depth.

Figure 4: Malakal sewage treatment plant outfall pipe

48. **Energy Efficiency.** The largest energy consumption at the plant will be for the aeration cycles of the biological treatment process. Some advantages of the proposed intermittent activated sludge process are:

(i) The provision of 2 reactors, each out of phase with the other, will result in an even power draw. If only one tank is provided in lieu of 2 tanks, the instantaneous power draw would double.
(ii) During the 2-hour aeration off phase of each reactor, there is a 20% recovery of oxygen due to the denitrification phase when nitrate is converted to nitrogen gas and oxygen. This oxygen recovery reduces the overall power requirements by 20%.
(iii) The aerator for the WAS sludge holding tank would be provided with cyclic operation to denitrify the WAS and minimize power consumption.
(iv) The aerators would be the low speed type (motor driving a gearbox) because of their higher oxygen transfer efficiency and lower noise levels compared with high speed units (Direct drive).

49. **Climate Change.** All the new treatment facilities will be located well above the most likely rise in sea level projected to 2030.

50. **Minor pump station rehabilitation and Telemetry / Remote Monitoring.** Minor pump station rehabilitation works will include rehabilitation of station covers and security fences where needed to preclude unauthorised entry, rehabilitation of electrical control panel security measures to preclude unauthorised entry, installation of subsurface overflow pipes to discharge to suitable areas to minimise public nuisance and facilitate overflow cleanup, and where needed the installation of new pumps and valves to achieve a more acceptable pumping regime. The project

will include installation of a remote monitoring telemetry system to serve the pump stations and the sewage treatment plant including: installing wireless transmitters at each pump station and treatment plant, upgrading equipment control panels to collect relevant alarms and signals, and installing a central computer based mimic panel and monitoring station.

51. **Public Toilet Facilities.** Construction of 3 new public toilet facilities is planned to serve the shopping area, the Malakal recreation area, and Koror tourist precinct. Rehabilitation of 3 existing public toilet facilities serving Long Island recreation area, KB Bridge and T Dock recreation areas is also to be undertaken.

52. **Sewer assessment works.** These works will include: (i) global positioning system survey of sewer networks to determine the size, location, and level of collection sewers and force mains, (ii) closed-circuit television inspection of critical sewers to determine the condition hence future ongoing sewer upgrade and rehabilitation program, (iii) sewer smoke and/or dye testing at strategic locations to identify and locate unauthorised connection of roof and parking area storm drainage to the sewer network, and (iv) sewer gauging program at strategic locations to determine infiltration / inflow component of sewage flows, and unit sewage flows from different types of development (residential, commercial, etc).

B. Airai (Kesebelau/Ked) Centralise Sewerage System

53. Airai State government sought assistance in addressing existing sanitation issues in the Kesebelau and Ked development areas in Ordomel Hamlet. The density of housing, coupled with poor septic system design, has led to continuing complaints from residents and impacts to the quality of life for residents and the surrounding environment. Several factors have led to the current situation, where sewage is not receiving adequate treatment including the fact that the soils through the developed area are generally classified as silty clays that are poorly to moderately well drained. These types of soils have poor characteristics for the siting of septic tank absorption (leaching) fields due to the tendency for ponding as the depth to the saturation zone (water table) is shallow. Other factors include: (i) the density of existing housing units precludes the proper sizing of absorption fields that are necessary to provide adequate treatment of septic tank effluent, given the constraints imposed by the poor soil characteristics, and (ii) ponding of sewage from non-performing septic systems has led to untreated effluent flowing overland and into drainages and streams. High levels of fecal bacteria were found in recent water quality testing of streams draining the Kesebelau and Ked areas (described in the following section).

54. The number of existing and likely future septic tanks in Airai region has been derived in the following table as well as the estimated annual volume of septage. During tank desludging, about 10% of septic tank contents should remain as anaerobic seed sludge to seed new wastes entering the septic tank.

Table 5: Airai Current and Future Septic Tanks

Item	Current (2012)	Future (2035)
Number of people on septic tanks	3,000	1,300
Number of septic tanks at 4 persons per household	750	325
Frequency of pump [(1)] out for a 3,600L septic tank	2.3 years	2.3 years
Annual volume of septage requiring tankering	940 kL	407 kL
(1) From Pennsylvania data, and no sink grinders		

55. The Kesebelau/Ked sewerage system infrastructure works will include construction of a gravity sewer network which will connect existing dwellings to the network and feed into a package sewage treatment plant to serve the Kesebelau/Ked villages. The treatment system will include two 0.60 ML/day package sewage treatment plants with physical screening, biological treatment and UV disinfection, along with two septage lagoons. The treatment system will be designed to achieve the same effluent discharge standards as the proposed Koror system.

56. The treated sewerage outfall will discharge to the stream flowing east from the village areas. The water quality discharge limits outlined in Table 4 will apply to the new treatment system. The current septic tank systems will be disconnected from existing houses. Disconnected septic tanks will be decommissioned and remediated.

C. Construction Supervision and Capacity Building

57. The project will also include components for procurement support, construction supervision and capacity building. The supporting services will include preparation of a sewer network model and analysis of overall system capacity and performance using both static flow and dynamic extended period analysis. These analyses will assist in determining(i) the capacity shortfall hence the requirements for future ongoing sewer upgrade and rehabilitation program, and (ii) optimum system configuration especially the location and number of pump stations to minimise energy requirements.

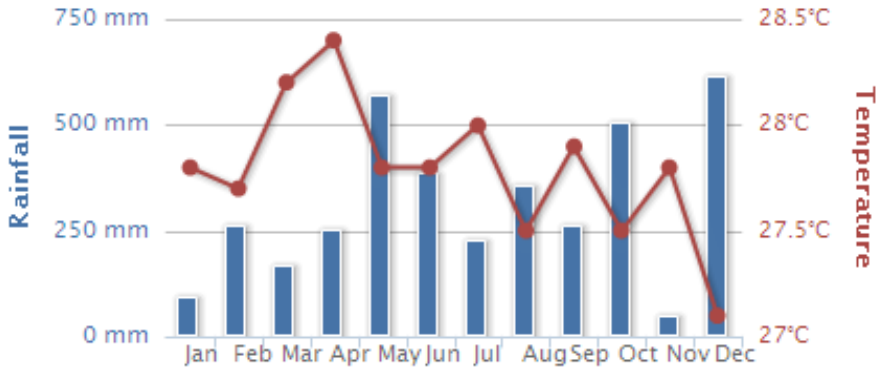
IV. DESCRIPTION OF ENVIRONMENT

A. Physical Environment

1. Climate

58. Palau has a tropical monsoon climate characterized by seasonal variation in rainfall, moderately warm temperatures, and high humidity. Two seasons are generally recognized as a rainy season from May to December and a dry season. Average annual rainfall is high, in the order of 3,760 mm, and occurs relatively uniformly throughout the year. The monthly average temperature range is 24°C to 32°C with March and April the warmest months.

Figure 5: Average Monthly Rainfall and Temperature for Palau (1990-2009)



Source: World Bank, 2012.

59. The northeastern trade winds prevail with a mean wind speed of 9.65 kph. Palau lies to the south of the Northern Pacific typhoon belt. Over the past 60 years, Palau has been impacted by only 5 major typhoons,[2] the most recent was Typhoon Utor in 2001. Typhoon Utor recorded winds up to 120 km/h, causing damage to infrastructure, however, the damage was mainly due to landslides caused by excessive rain. Other notable typhoons impacting Palau over the years include Gelda in September 1959 with 140-knot winds, Louise in November 1964 with 100-knot winds, Opal in December 1964 with 140-knot winds; and Mike in November 1990 with 135 knot winds[3]. With regard to the project, typhoons have the potential to impact on sewerage infrastructure as a result of (i) high winds impacting above ground structures, (ii) associated storm surges inundating pump stations, and (iii) associated flooding infiltrating into the sewerage system.

60. **Climate Change.** It is recognized by the International Panel on Climate Change (IPCC) that developing countries particularly small island developing states such as Palau are particularly vulnerable to climate change[4]. Climate change and variability is expected to increase the risk of higher sea level, more frequent storm surges, and extreme weather events in many other parts of the world including Palau[5]. The Pacific Climate Change Science Program report for Palau[6] notes that as a result of climate change: (i) temperature will continue to rise in Palau, expected to

[2] SOPAC, 2007, National Integrated Water Resource Management Diagnostic Report, Miscellaneous Report 642.
[3] NOAA, 2005, National Weather Service reported in NCRS.
[4] IPCC, 2007, AR4.
[5] IPCC, 2001, Climate Change Impact, Adaptation and Vulnerability.
[6] International Climate Change Adaptation Initiative, 2011, Report on Current and Future Climate of Palau.

increase in the range of 0.4 –1.0°C by 2030; (ii) rainfall patterns will change, with rainfall during the wet season projected to increase over the course of the 21st century consistent with expected intensification of the west Pacific monsoon and the intertropical convergence zone. Projections for dry season rainfall also suggest a general increase; (iii) less frequent but more intense typhoons; and (iv) sea level will continue to rise, projected to rise by 4–15 cm by 2030 under a high emission scenario. Planning for the potential impacts of climate variability will help to mitigate against potential impacts which may include (i) sea water inundation resulting in failure of near shore sanitation infrastructure, and (ii) increased risk of contamination of near shore freshwater and marine waters. Planning considerations include: (i) planning new infrastructure greater than 2 m above the current high tide level, (ii) provision for protective flood levies around existing above ground infrastructure less than 2 meters above the current hide tide level, and (iii) ensuring new infrastructure is designed to withstand extreme weather events.

61. The vulnerability of fragile ecosystems such as coral reefs, mangrove forest and coastal zones as well as rare or endangered species is further increased by climate variability, droughts, water pollution, soil erosion, poor land management and land degradation, and unsustainable development.

2. Geology and Geomorphology

62. The geology of Koror and Airai comprise two broad formations: volcanic, and high limestone islands (ancient uplifted reefs).The majority of Koror (including Malakal Island where the existing sewerage treatment plant is located) and Airai are comprised of weathered andesitic and basaltic breccia generally overlain by more than 1 m of residual clayey soil[7]. The breccia commonly appears course grained, composed of angular broken rock fragments welded together in a fine grained matrix. The upper 30 m is commonly partially weathered, with un-weathered bedrock at depth. Geological and geotechnical conditions should be taken into consideration in the master planning of any new subsurface sanitation infrastructure works.

63. Koror and Airai also consists of limited areas of high limestone ridges, and more than 300 high limestone islands, known as the “rock islands”, the full extent of which range from south of Babeldaob, through the Koror area, and southwest to Peleliu. The rock islands are largely uninhabited and are outside the scope of this sanitation master plan.

64. Both Koror and Airai State are enclosed by barrier reef and/or fringing reef. The barrier reef is well developed on the west side where it averages 2.5 kilometers in width and is approximately 105 kilometers in length.

65. Iwayama (Nikko) Bay located on the south side of Koror Island includes raised barrier reef formations (high limestone ridges) which encompass Iwayama Bay. The presences of barrier and fringing reefs, and raised barrier reefs around Iwayama Bay have implications for marine water flows which must be considered when assessing the site location of any new sewage treatment effluent discharge point.

3. Soils

66. A thick well developed soil profile is common throughout much of Koror and Airai, as a result of intense weathering of volcanic geology exposed to high humidity and high rainfall. Soils are commonly clay rich, range from well drained to poorly drained, and are susceptible to

[7] Geolab-Hawaii, 1998, Geotechnical Report.

landslides on steeper slopes, especially if vegetation is removed. Removing vegetation decreases the amount of water that can be drawn out of the soils. Therefore, the soils may become saturated more readily. This saturation adds weight to the slope and may destabilize it. Other major management concerns are low soil strength, slope, soil degradation, and the hazard of erosion.

67. The dominant soil formation in Koror is known as the Aimeliik-Palau soil unit, characterised as well draining, occurring on hilltops and terraces. These soils are susceptible to landslides if vegetation is removed.

68. The dominant soil formation in the most populated areas of Airai is the Tabecheding-Ngatpang-Dystrudepts soil unit, found on marine terraces on low hills, and characterised as silty clays, poorly drained, shallow saturation zone, and low structural strength. These soils are generally poorly suited to the siting of septic tanks, due to their limited capacity to percolate or adsorb waste from septic systems, resulting in a tendency to pond water. This has been observed at some sites in Airai.

69. Figure 6 presents a summary of the soil types within the Koror and Airai area, with a brief description provided in Table 6.

Figure 6: Soils Map of Koror Airai Area

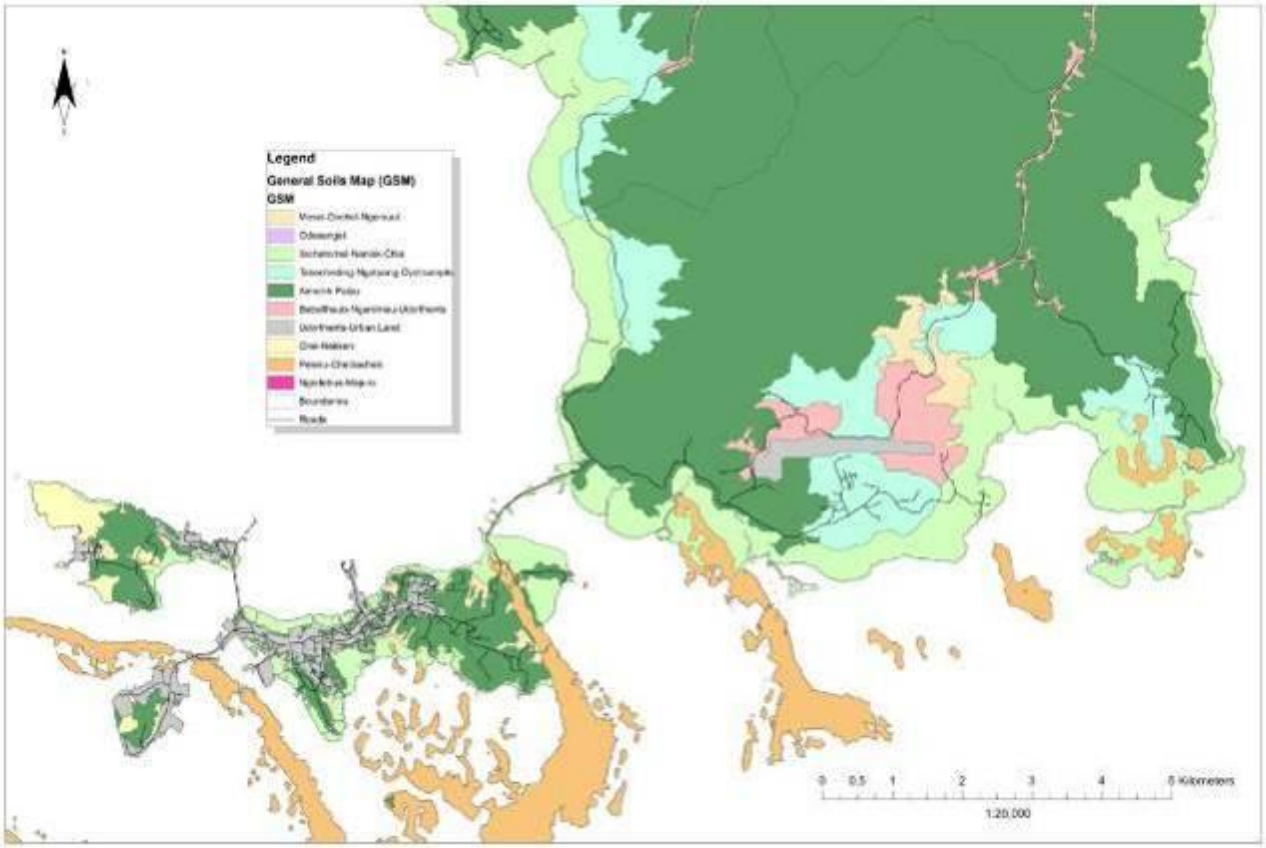


Table 6: Koror and Airai Soil Types

Soil Unit	Description
Aimeliik-Palau	The dominant soil type within Koror and Airai, these soils are located on volcanic uplands, are very well drained and occur on hilltops and terraces. These soils are susceptible to landslides if vegetation is removed.
Illachetomel-Naniak-Chia	Found in the intertidal zone of mangrove swamps adjacent to volcanic or karst islands. These soils have a high water table, are susceptible to subsidence, and have poor engineering properties. They are poorly suited to onsite waste disposal systems because of the hazard of seawater contamination, flooding, and wetness. Effluent may be washed into the lagoon with daily outflow of tidal waters and thus contaminate the adjacent lagoon and create a hazard to the health of swimmers and consumers of the sea life taken from these areas.
Mesai-Dechel-Ngersuul	These soils are found on bottom lands and are very deep and poorly drained. These are areas of swamps and floodplains on valley floors of volcanic islands. These soils support wetland taro (Crytosperma and Colocasia) production, also swamp forest plant communities and wildlife habitat. The soils have a high water table and are susceptible to subsidence, and have poor engineering properties. The poor soil characteristics means they are not well suited to the siting of septic tank absorption fields due to the tendency for flooding.
Tabecheding-Ngatpang-Dystrudepts	Found in Airai on marine terraces on low hills. These silty clays are poorly drained soils, and are limited mainly by low strength, slope, and wetness. The soils have poor charaacteristics for the the siting of septic tank absorption fields due to the tendency for ponding as the depth to the saturation zone (water table) is shallow (< 1m).
Babeldaob-Ngardmau-Udorthents	These soils located within Airai are found on hillsides, ridges, and terraces. They are very well drained. Major management concerns are low soil strength, very low soil fertility, slope, soil degradation, and the hazard of erosion. The soils are somewhat limited to the siting of septic tank absorption fields due excessive slope and slow percolation rates.
Udorthents-Urban Land	This soil unit, located mainly in Koror, and also the airport in Airai, represents built areas with human transported material, such as clays or coral fill, over in-situ material. Areas where clayey material is the dominant fill material are poorly suited to septic tank absorption fields, and to the construction of roads. The main limitations affecting these uses are low soil strength and restricted permeability.

4. Surface Waters

70. Babeldaob Island, which includes Airai State, has ample surface water resources as a result of high rainfall, distributed relatively evenly over the year. While Babeldaob includes significant surface water resources and surface water ecologies, including the Ngerdorch River with a drainage of about 46 sq km, Lake Ngardok spanning up to 730 metres long and 180 widest part, and the Ngrikill watershed providing the drinking water source for Koror and Airai[8], the

[8] The drinking water supply for Koror and Airai is sourced from the Ngrikill (Edeng) River and the Ngerimel Reservoir. The Ngrikill River and Ngerimel Reservoir are located outside the area of potential impact of the Project.

surface water bodies within the Project area are limited to streams, ponds and man-made irrigation patches. These streams are small and often dry-up during the dry season.

71. Focusing on surface waters likely to be impacted by the project, the proposed Kesebelau/Ked sewerage treatment plant will discharge to the stream flowing east from the area.[9] This stream drains a catchment area of approximately 133 hectares discharging to the Airai Bay. As part of this IEE, the stream was inspected on 4 April 2012 at which time the creek was flowing at a low level (approximately 200 L/sec), however, scouring in the creek banks suggested significantly higher flow volumes occur.

72. The surface water quality within the Kesebelau/Ked Project area is variable and has been reported to show impacts of agricultural runoff, sedimentation and leakage from non performing septic tanks[10]. However, limited water quality data is available to confirm this. Water sampling and analysis of the stream was conducted by the PPTA consultants on 4 April 2012 to provide an initial indication and baseline for water quality within the stream. Samples were collected from three locations: (i) initially at the proposed location of the sewerage treatment plant discharge (KED1), (ii) approximately 300 m downstream of the proposed discharge point (KED2), and (iii) at the stream crossing prior to discharge to the bay (KED3). Samples were analysed by the EQPB laboratory for Enterococci and turbidity. The results are presented in Table 7 and show elevated Enterococci concentrations above the Class 2 water standard of 60/100 ml in each sample.

Table 7: Stream Water Quality

Sample No	Enterococci MPN/100 ml	Turbidity NTU
KED1	280	7.2
KED2	2,200	8.0
KED3	910	46.5

73. Turbidity showed a significant increase in the downstream sample, which is likely to be influenced by the quarrying activities occurring within the watershed. Additional monitoring to establish baseline water quality is recommended in the EMP.

5. Marine Waters

74. Coastal marine waters around Koror and Airai are influenced by a complex interaction of tidal flows, variable depth and island geomorphology. Areas of low tidal flow and hence low pollution diffusion potential are shown in Figure 10. Tidal exchange within Iwayama (Nikko) Bay is limited by the surrounding raised coral islands, and diffusion potential is very low. The enclosed nature of the lagoon and relatively restricted exchange and flushing with the open ocean make the area an undesirable location for sewage disposal.

[9] Note, the stream flowing east from the Kesebelau/Ked area is not known to have a specific name
[10] SOPAC, 2007, National Integrated Water Resource Management Diagnostic Report, Palau

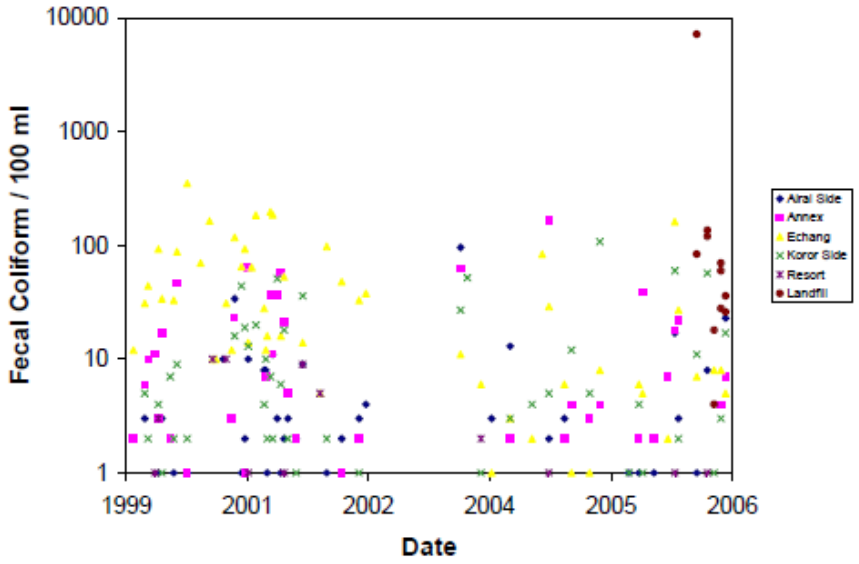
Figure 7: Areas of low marine tidal flux and poor diffusion potential

75. Coastal marine water quality has been an ongoing concern in Koror for several decades. Prior to the operation of Koror's current sewage treatment system in 1976, untreated sewage discharged directly to coastal waters. Hardy (1972)[11] assessed the Iwayama (Nikko) Bay lagoon area off south-central Koror and the western lagoon adjacent to the bay (off Ngerbeched Hamlet), and stated "a considerable portion of the water in the shallow reef areas in the west lagoon is highly polluted and greatly exceeds the water quality guidelines for limits on faecal coliform", and further "the enclosed nature of the lagoon and relatively restricted exchange and flushing with the open ocean make the area an undesirable location for sewage disposal."

76. Water quality has improved since the introduction of the Koror sewage treatment plant, however exceedances of the Class AA marine water quality standards for microbiological parameters still occur. The EQPB conducts monthly[12] marine water quality testing in coastal waters around the Koror area. Based on this data, Figure 8 shows a summary of coastal marine water quality from 1999 to 2006 at six sites. While some exceedances for Fecal coliform (230/100ml) are shown, generally test results are within the Class AA marine water quality standards.

[11] Hardy, 1972, Tidal Circulation and Sewerage Pollution in a Tropical Marine Lagoon.
[12] Although scheduled for monthly sampling the data are quite sporadic and large gaps in the data records exist.

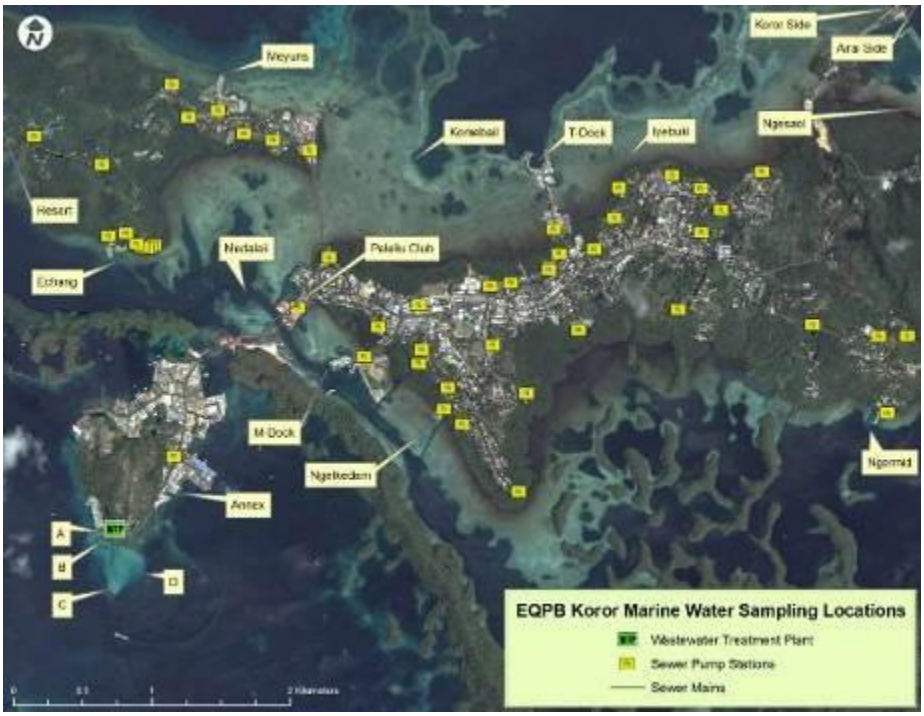
Figure 8: Marine water fecal coliform concentrations within the Koror-Arai area 1999 - 2000



Source: EQPB, unpublished data.

77. Since 2008, the EQPB has expanded its coastal marine water quality monitoring program to include 16 sample locations (Figure 9). Monthly water quality data for these sites from January 2008 to March 2011 is included in Appendix A, and reports 26 exceedances of the Class AA marine water quality standard for Enterococci fecal bacteria (60/100ml) out of a total of 542 samples tested.

Figure 9: Marine water quality EQPB monthly monitoring locations



78. The 2008–2011 marine water quality data show frequent exceedances for the Class AA Enterococci standard (60 MPN/100ml) at Station C location as summarised in Table 8. Station C is located approximately 30 meters from the point of discharge of the current sewerage treatment plant outfall. Sample results at adjacent Stations A, B and D (see Figure 12) do not show exceedance of the Class AA Enterococci standard (60 MPN/100ml), suggesting the area of exceedance is localized.

Table 8: EQPB Water Quality at Station C exceeding Enterococci standards, 2008-2011

Sample Date	Station C
	Enterococci (MPN/100ml)
Class AA Standard	60
30-Oct-08	500
26-Jan-09	309
27-May-09	109
27-Sep-09	84
17-Dec-09	231
16-Feb-10	290
18-Mar-10	1515
17-May-10	359
15-Jun-10	220
23-Sep-10	820
28-Dec-10	813
20-Jan-11	1450

Source: EQPB, 2012.

79. Coastal marine water temperature in the area is monitored regularly in keeping with the threat posed by the El Nino Southern Oscillation phenomenon, in which increases above a threshold of about 30^{o}C lead to coral bleaching. Data from 2000 show that water temperatures were generally within the range associated with healthy coral reefs and there was not any large scale bleaching along the Palauan reef tract during the year, however coral bleaching during the drought period in 1998 was particularly severe. Water temperature typically decreases with the occurrence of westerly monsoon winds and cloudy conditions.

B. Ecological Environment

80. The ecology of Palau is rich with diversity, with the highest number of flora and fauna species in the islands of Micronesia, including a high rate (25 per cent) of species endemic to Palau. The ecological environment of Palau has been extensively studied, particularly the marine ecology which boasts coral diversity comparable to the Philippines, Indonesia, and Australia. The following section draws on past studies to summarise the ecological environment of the Project area.

1. Terrestrial Flora

81. Approximately 80% of Palau is covered in native forest. With more than 1,200 species of plants, Palau's forests are the most species-diverse in Micronesia. The primary vegetation zones within the Project area can be divided into three broad categories (i) upland forest (both primary and secondary), (ii) mangrove swamp, and (iii) grassland Savanna. Additional, vegetation categories within Palau include (i) high limestone forest and (ii) low limestone and atoll (strand) forests. It is important to note that grassland Savanna has been established as a result of human activity including clearing, mining and wildfire. Also small areas of wetland irrigated crops and other vegetation are interspersed in riparian zones, along streams within the project area. Table 9

summarises the areas broad vegetation categories for the whole of Palau, based on vegetation maps derived from 1976 aerial photography.

Table 9: Major Vegetation Zones in Palau

Forest Type	Hectares	Percent of natural forest cover
Upland (volcanic) forest	21,891	70
Mangroves	4,708	15
Swamp forest	1,680	5
Limestone forest	1,232	4
Rock Island forest	1,116	4
Casuarina forest	451	1
Atoll, plantation, palm forest	182	<1
Total Forest Cover	***31,259***	***100***
Agroforest	1,109	-

Source: National Biodiversity Strategy and Action Plan, ROP, 2007.

82. **Upland Forests.** Upland forests of Palau are the most species diverse in the Project area, and include a number of species endemic to Palau.[13] Common species found include Campnosperma *brevipetiolata, Maranthes corymbosa, Alphitonia carolinensis, Rhus taitensis, Elaeocarpus joga, Serianthes kanehirae, Semecarpus venenosus, Calophyllum inophyllum, Gmelina palawensis, and Pterocarpus indicus*. Species commonly found in the understory of Palau's upland forests include palms such as *Pinanga insignis*, and plants such as *Pandanus aimiriikensis, Ixora casei, Eugenia reinwardtiana, Osmoxylon oliveri, Manilkara udoido, Symplocos racemosa, and Cyathea lunulata.*

83. **Mangrove.** Mangrove forest is common along the coastline of Koror and in south and eastern Airai, established as a strip 50–300 meters wide along in the tidal zones. The mangroves of Palau are a particularly species-rich mangrove type. Typical species include *Rhizophora mucronata, Rhizophora apiculata*, and *Sonneratia alba*. Mangroves filter terrestrial runoff and help sustain coral reef and fish habitat by trapping sediment. The project will not involve clearing of any mangrove forests.

84. **Grassland Savana.** The grassland or savanna areas within the Project area support mixed grasses, herbs, ferns and low growing shrubs with scattered tall shrubs and trees, with the dominant species including grasses *Ischaemum spp*. and *Miscanthus floridulus*, low growing fern *Gleichenia linearis*, and scattered trees and shrubs such as *Pandanus spp., Eurya japonica, Wikstroemia elliptica*, and *Melastoma malabathricum* (Kitalong and Holm 2004).

85. Figures 10 and 11 illustrate the distribution of vegetation zones within the Airai and Koror Project areas, respectively.

[13] Cole, et. al. 1987, Vegetation Survey of Palau.

Figure 10: Airai Vegetation Zones

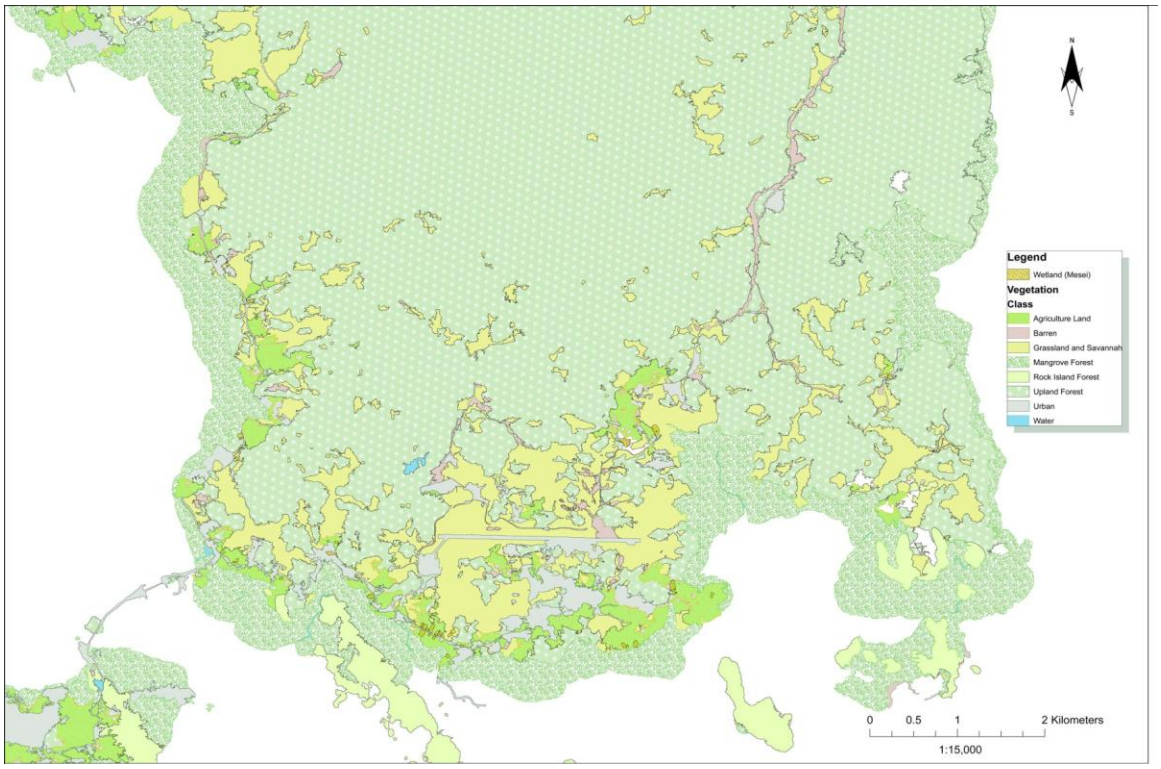
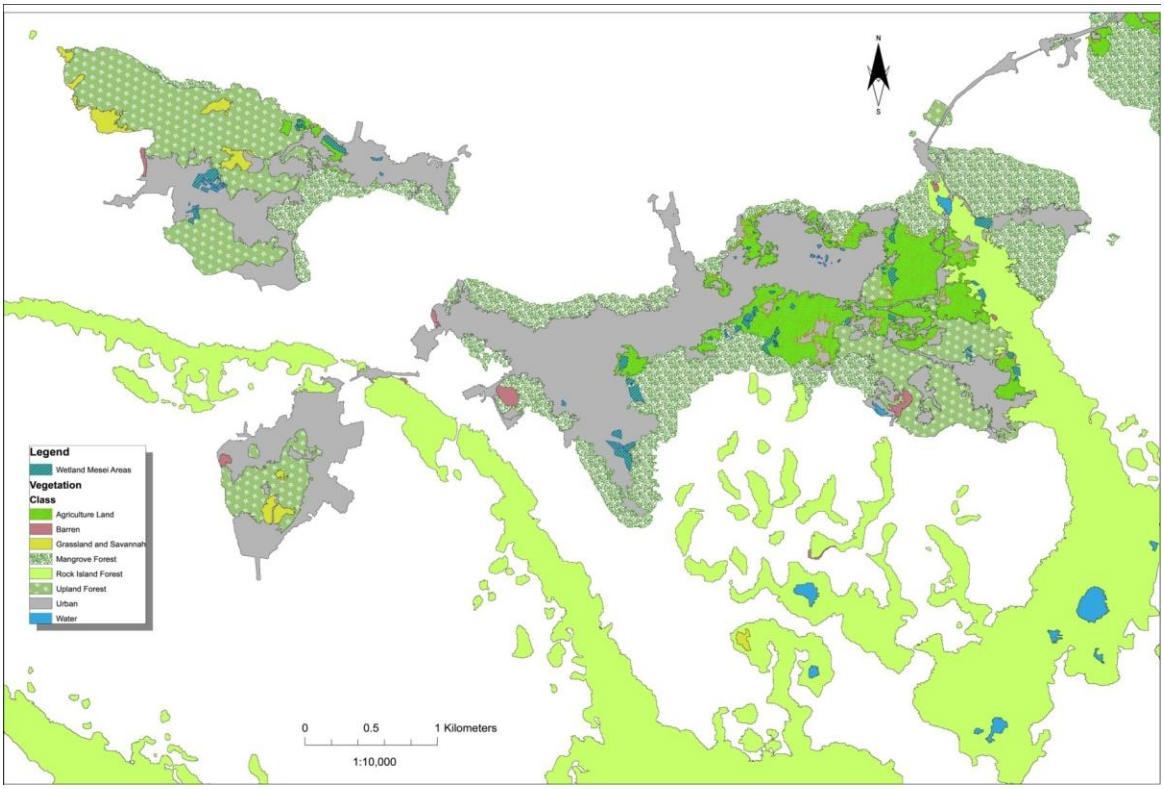


Figure 11: Koror Vegetation Zones



2. Terrestrial Fauna

86. As with flora, Palau hosts a diverse range of terrestrial fauna, with over 140 bird species i, of which 43 permanently inhabit Babeldaob, 47 species of fish, saltwater crocodiles (endangered), and over 5,000 recorded species of insects. The native mammals are made up of two bat species, both of which are endemic sub-species. A species of fruit bat - Palau Flying-fox (Pteropus pilosus) - is now known to be extinct, this species was endemic to Palau. Table 10 provides a summary of Palau's terrestrial fauna.

Table 10: Terrestrial Fauna

Species	Approx Total	Endemic	Introduced	Endangered
Insects	5,000	1,500	Unknown	Unknown
Birds	141	9-12	4	1
Freshwater Fish	47	4	5	Unknown
Terrestrial snails	77	32	2	Unknown
Freshwater mollusk	15	Unknown	Unknown	Unknown
Amphibians and Reptiles	46	12	3-5	5
- Frogs	2	1	1	Unknown
- Lizards	30	9	2	Unknown
- Snakes (incl 2 sea snakes)	7	2	-	Unknown
- Turtles (incl 4 sea turtles)	6	-	2	4
- Crocodiles	1	1	-	1
Bats	2	2	-	-

Source: Palau National Biodiversity Strategic Action Plan, 2007.

3. Marine Flora

87. Palau has a coastline of over 1,500 km and a reef area that encompasses nearly all of the islands and supports a diverse and highly prized shallow reef ecosystem. The Koror and Airai areas share similar near shore marine habitats, due to their shared geomorphology, the lagoon fringing reefs of both islands are underlain with basaltic rock and typically have an inshore mangrove zone. Where established, the mangrove zone may vary in distance from 100 m to over 500 m starting from the shoreline and extending out on to the fringing flats. These fringing shallow flats are generally 500–1,000 m wide and are seldom less than 100 m wide.

88. Also similar between Koror and Airai are the occurrence of sea grasses in a zone found seaward of the mangroves onto the fringing reef. Typically these areas are mixed with isolated colonies of corals and other benthic invertebrates. The most common species of sea grasses found in this zone are Enhalis acoroides and Thalassia hemprichi. Farther seaward on the fringing reef flats, the habitat zone transitions to mainly corals and coralline algae. The corals that dominate the fringing reefs are typically the Porites, Montipora, and Acorpora genera, though many other genera of corals are present.

89. Figures 12 and 13 show a mapping of the various marine habitat zones found in the lagoon fringing reefs of the Airai and Koror areas (Battista, T.A., et al. 2007. Shallow-water Benthic Habitats of the Republic of Palau).

Figure 12: Airai Marine Habitat Zones

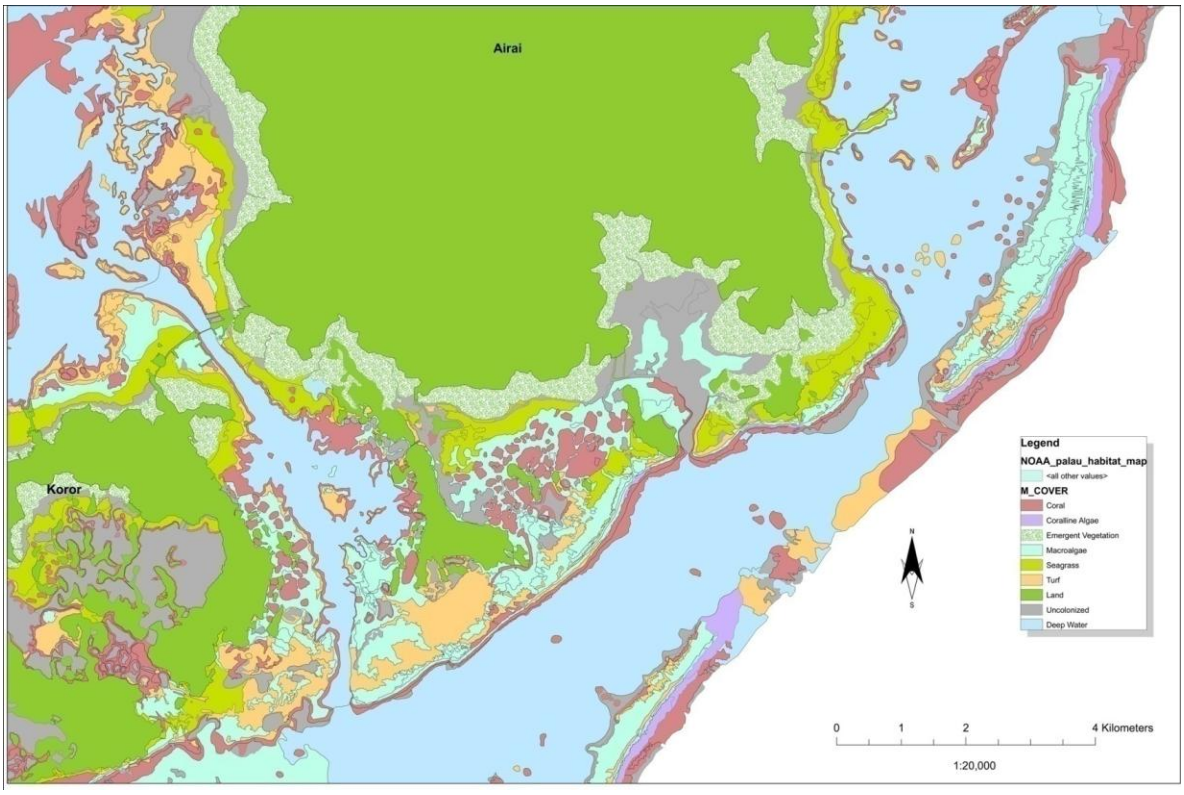
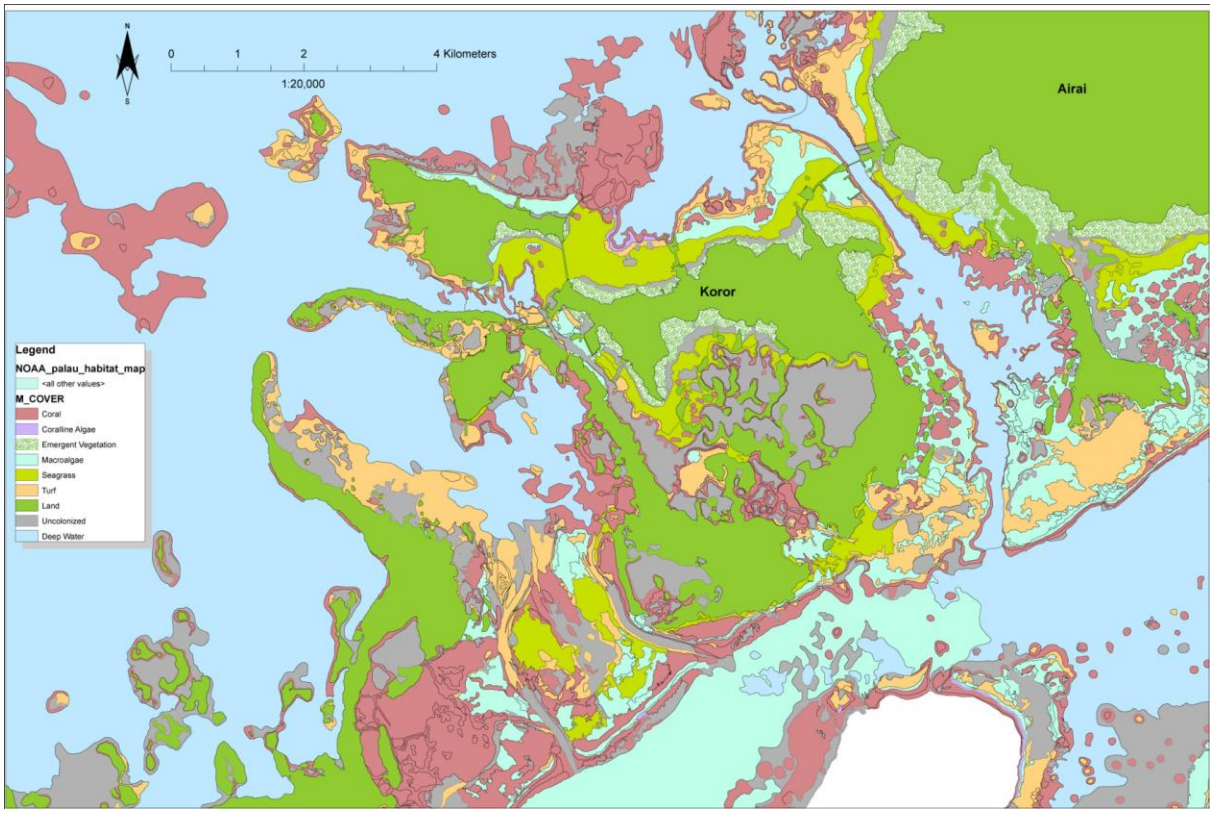
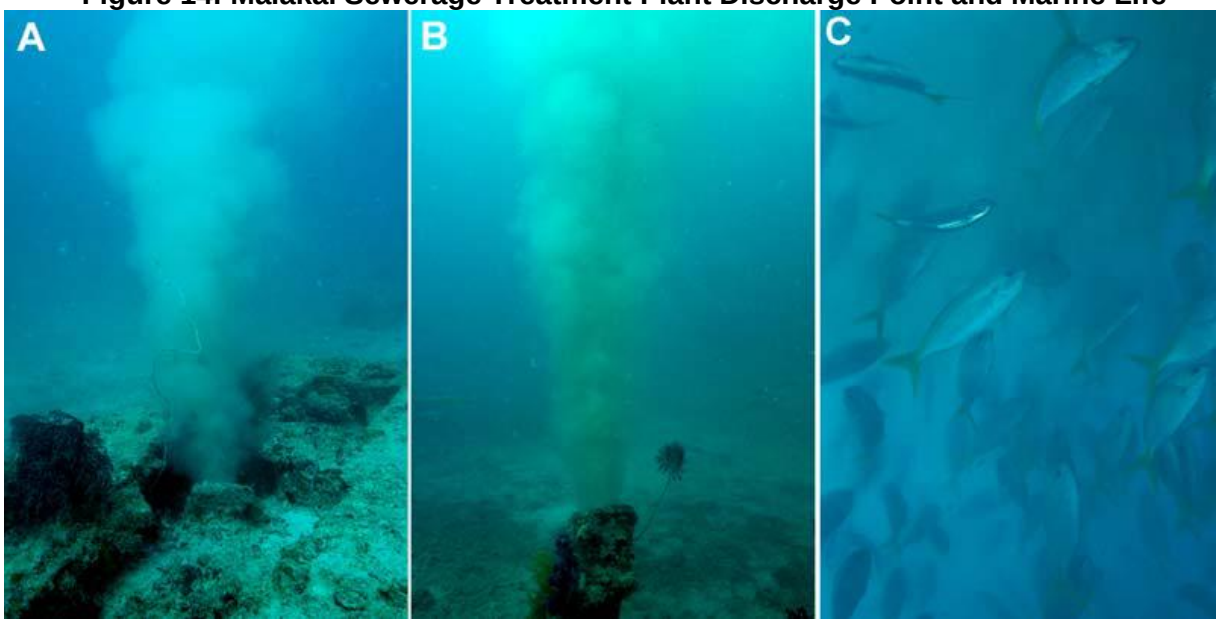


Figure 13: Koror Marine Habitat Zones



90. **Malakal Sewerage Treatment Discharge Point:** Several studies have assessed the marine habitat in the vicinity of the sewer outfall; others have calculated long residence times for effluent discharged within the Malakal Harbor. They have not determined any major impacts to the marine communities in Koror. Figure 14 shows the Malakal outfall pipe's two diffusers at approximately 15–16 m (A and B), as well as particulate plankton feeding fishes (C), in this case *Caesio cuning*, hovering above the discharge and immediately ingesting any particulates emerging.

Figure 14: Malakal Sewerage Treatment Plant Discharge Point and Marine Life



91. Birkeland, et al. (1976) surveyed the coral reef community at the Malakal Island sewer outfall and found it rich and diverse. Nutrient levels were also found to be very low. Twenty four years later, Birkeland (2000) reported that coral reef survey of this same area in 1993 and 1999 showed high living coral cover, but reduced species diversity.

92. Hamner et al. (1997) stated that there is no evidence, in coral reef areas studied in Malakal Harbor, of damage to reefs from high levels of nutrients (possibly due to the discharge of sewage effluent in the harbor). Though they calculated a mean residence time for water in Malakal Harbor of several weeks, their findings indicate the effluent was diluted sufficiently to have no effect on nearby coral reefs.

4. Marine Fauna

93. Palau's marine fauna includes 7 of the 9 species of giant clams, and all 7 species are identified on the International Union for Conservation of Nature and Natural Resources (IUCN) Red List. Two species of giant clam are endangered and four species are near threatened.

94. Fish species are abundant, and the fishing industry provides significant input to the Palau economy. Over the past 20 years, total inshore fishery production averaged 1,800 tons, or an estimated 1 ton/km2 of reef. Approximately 20% of this catch is sold at the local markets, 14% is exported, and 66% is for direct consumption.

C. Air quality

95. Only minor ambient air quality impacts presumably occur from sources such as boilers, the incinerator at the National hospital (and possibly the Airai waste incinerator), asphalt and concrete batch plants, petroleum fuel storage tanks, two quarries, and aircraft activity. With a small population and lack of major economic activity, one would expect the air quality on Palau, and especially Babeldaob, to be almost pristine (Final EIS for Construction of the Palau Compact Road, 1998).

D. Noise Levels

96. The project area, Koror and Airai States, has a mix of urban and rural settings. Traffic consists of private and commercial cars and trucks; taxis and busses. Noise levels are generally low from commercial activities in the area, such as markets, auto repair shops, and port activities. Somewhat frequent construction works in the urban Koror area may raise noise impacts to the "nuisance" level.

E. Traffic

97. The number of passenger vehicles in Palau has risen substantially, mostly due to imported used vehicles from Japan. Traffic congestion is encountered along the main street in Koror during week days from about 0700 to 0830, and again in the afternoon from about 1630 to 1800, reflecting trips made to work and school. Airai has limited traffic and only encounters delay when the main road might be obstructed.

F. Public Health

98. Currently, 47 pump stations service the Koror sewer system, and by design most are situated at low elevations and around the periphery of the islands comprising Koror State. Numerous overflows of untreated sewage from failing pump stations have been reported by the EQPB since the commencement of the sewer system operations. Typically, these discharges flow to low-lying wetland areas, some cultivated for taro production (Cyrtosperma sp. and Colocasia sp.), or directly into near shore marine waters. No studies have assessed the impacts of these discharges on freshwater wetland or shoreline mangrove habitats. Severe negative impacts, such as a die off of mangrove vegetation, fish kills (anoxia) from oxygen depleted near shore waters, and large algae blooms are not evident.

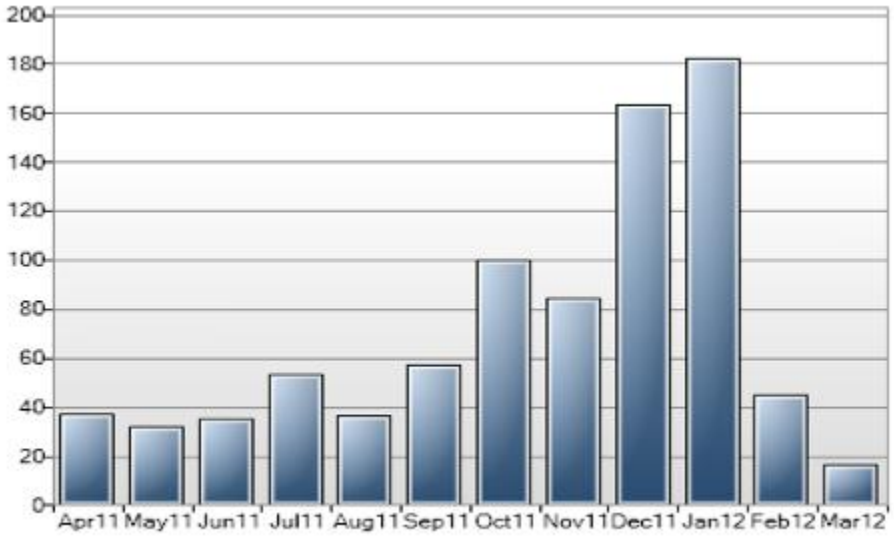
99. Matson (1995) addressed local concerns of potential public health risks that might be associated with effluent from the sewage treatment plant (STP). Water samples taken directly from the effluent discharge showed high levels of fecal bacteria (Enterococci). However, other than the occurrence of high densities of fecal bacteria in and near the discharge plume, no evidence of fecal bacteria was found on the surfaces of fish and shellfish sampled in adjacent areas. The study concluded that a health hazard does not appear to exist.

100. The EQPB has issued public advisories following test results that exceed biological standards. The "Prohibited Water Use Advisory" states "High levels of Enterococci bacteria is a health hazard and could cause illnesses, therefore, immediately, a "Prohibited Water Use Advisory" for water related activities such as swimming, fishing and seafood gathering is in effect for the marine waters near this area until further notice". The public advisories typically follow serious sewer overflows reported by the Bureau of Public Works to the EQPB, such as overflows from the large pump station "SPS1", in the vicinity of the Long Island public park. The EQPB

samples waters during the overflows or shortly after, and may issue a public advisory if fecal bacteria exceed standards.

101. The incidence of pump station overflows was exacerbated from November 2011 to January 2012, when a fire at the main electrical power station in Aimeliik State destroyed generators at the plant. The Koror area was subject to a rotating schedule of hours for electrical power, and those pump stations without backup generation, overflowed continually during off-power periods. The EQPB Water Quality Laboratory was also affected by the power outages and was not able to perform testing during this critical period of sewer overflows (M.K. Ngirchechol, EQPB Water Quality Laboratory Supervisor, pers. comm.). The number of gastroenteritis (inflammation of the stomach and intestines) cases also rose significantly during this period of significant sewer overflows.

Figure 15: Gastroenteritis cases Koror April 2011 to March 2012



Source: Health Information System, Ministry of Health, ROP.

G. Social Environment

1. Socioeconomic Environment

102. Palau has a population of approximately 20,000 people (4,707 households). Its main population center is Koror, a much smaller island and the main urban center, is connected to Airai by a bridge. Koror and Airai are two of the 16 states in Palau and host 80% of the country's total population. Koror and Melekeok are the only urban centers with a sewerage system and treatment works while all other population centers, including Aira,i utilize septic tanks and pit latrines.

103. From the 2005 Census, Koror (population 12,676) and Airai (population 2,723) have a combined population of 15,399 people representing 80% of the country's population. Of the country's total country's population, there were 10,699 males and 9,208 females (54% males and 46% females). The national average household size is 3.86 people. Urban and rural household sizes are similar at 3.94 and 3.63 people, respectively.

104. Based on the result of the 2005 Census, Palau had about 706 female-headed households (15% of total households) with Koror having 469, and Airai having 68 female-headed households.

105. In terms of ethnicity, 70% of the country's population are Palauan's while 22% are of Asian origins and 8% are from Micronesia, United States and other countries.

106. From a more recent 2010 Airai State Census, Airai has 2,287 people (576 households). There are 93 female-headed households in Airai. Five hundred four households have landline connections, 433 households own their houses, and 37 households rent while the rest live in company housing.

107. Paid employment, in government and private sector, is the most common income source for both Koror and Airai populations with a few engaged in informal trade such as selling prepared food packages and bulk food crops in the local markets and some engaging in fishing and agriculture. The median household income for Palau in 2000 was USD 13,421. In 2005, labor force participation (16 years old and above) in Palau was at 69.1% with male participation rate at 76.9% and 72.4% for females.

108. Land is still relatively abundant throughout Palau at 290 people per sq km in 2005, a moderate increase from 280 per sq km in 2000 Census. Reflecting the traditional land management system where land was mostly communal, in Airai State 60% of land is public land and 40% privately owned (est.); in Koror State, it is more of an even split, 55% public land and 45% privately owned (est.).

109. The infant mortality rate for Palau has dropped 69 per cent from 1990 to 2000 (from 36.8 down to 7.2 per 1,000 live births). In recent years, virtually all child deaths occur from first weeks of life and occur from congenital anomalies. In terms of maternal mortality ratio or maternal deaths per 100,000 live births, no death was recorded from 1995 to 2007. However, pregnancies classified as high risk are increasing due to maternal obesity and increasing prevalence of obesity even among young women. There is only one national hospital (Belau National Hospital) and two private medical clinics and one private dental clinic in Koror. In Airai, commonly people go to the Airai Dispensary Clinic (1 nurse and 1 admin assistant) for medical treatment and would be referred to the National Hospital if required.

110. In terms of access to sanitation services, the Koror sewerage system services approximately 2,431 residential customers and 578 commercial and government customers. This is considered inadequate with hotels having to store sewerage until off-peak times.

111. From the 2008 Palau MDG Report, 99.9 per cent of households in Palau have access to basic sewerage treatment facilities (sewer connection or septic tanks). However, the sewer treatment system in Koror is currently in poor condition suffering from frequent overflows or shutdown.

2. Poverty

112. As in most Pacific countries, cash or material poverty is a sensitive and often controversial topic. This stems from strong cultural beliefs and practices of 'caring and sharing' for those vulnerable and where no one gets hungry. Acknowledging the presence of poverty challenges the traditional foundation of the society and strength of its culture.

113. An estimated 24.9% of population (18.4% households) or almost one-in-four of the population and one-in-five households, is under the basic needs poverty line (BNPL)14. BNPL includes essential foods and non-foods expenditure within a household. It therefore suggests that about 3,737 people in urban Palau and 1,202[15] people in the rural areas were unable to afford a basic minimum standard of living.

114. Commonly in the Pacific, including Palau, people express their condition as 'being in hardship' rather than in poverty. Causes identified for their hardship include (i) low income, (ii) limited access to basic social services such as sanitation facilities and (iii) limited access to opportunities for gainful income. In particular, increasing monetization of the Palau economy affects the ability of low-income individuals and families to afford daily needs and perform increasingly monetized traditional obligations.

115. According to the Vulnerable Population Study these populations are broadly characterized as: (a) persons who have special needs due to physical or social characteristics; and (b) persons (or households) experiencing economic hardship.[16] Vulnerability is defined as the inability of individuals or households to easily withstand economic shocks such as death of a breadwinner or loss of employment.

116. Vulnerability is very high in Palau due to high consumption patterns, low levels of savings, and high levels of indebtedness.

117. People identified by service providers to belong to a category with special needs include: (i) persons with disabilities and other special health care needs; (ii) adolescents; (iii) women and children who are victims of abuse or in the case of children and dependent elderly, neglect; (iv) certain other categories of women who are under stress; and (v) certain categories of elderly.

3. Cultural Heritage

118. Palau has a rich cultural heritage, including five sites (two are being proposed under both cultural and natural categories) proposed for World Heritage Site status. The Bureau of Arts and Culture, Historic Preservation Office is responsible for administration and protection of sites of cultural significance in Palau. The PPTA consultants are awaiting a response from the Bureau of Arts and Culture, Historic Preservation Office to confirm no sites of cultural significance are known to exist within the project area.

[14] Analysis of the 2006 Household Income and Expenditure Survey, UNDP 2008.
[15] 2008 Palau Millennium Development Goals Report.
[16] MTDS Vulnerable Population Study, Government of Palau and ADB, July 2009.

V. ANALYSIS OF ALTERNATIVES

A. No Project Alternative

119. Compared to the with-project scenario, the without-project scenario would see continued inefficient and ineffective sanitation management, including frequent sewerage pump station overflows, odour nuisance, and ongoing impacts to marine water quality. There would be continued risk of negative impact on the tourism industry as a result of overflows, odours, impact to water quality and risk of intestinal disease outbreak. The existing sewerage system would limit future development. Health impacts and impact to marine environment would continue.

B. Discussion of Alternative Solutions

1. Koror Alternatives

120. Consideration and analysis were given to three design scenarios for assessing the driving factors within the Project timeframe: (i) centralized collection, upgrading and consolidating existing centralised collection and treatment system, (ii) coastal carrier, modifying the existing system to create a coastal collection and transport system, and (iii) decentralized treatment, modify the existing system to create a decentralised collection and disposal system. Each design scenario was evaluated against several criteria including potential environmental impact and benefit. The following summarises each option with regard to environmental considerations. A details description of each option is provided in the Sanitation Master Plan (ADB, 2012).

i) **Centralized Collection, Treatment, and Disposal.** Upgrade the existing centralised collection, treatment and disposal system, without reconfiguring the existing network, to provide a better level of service in terms of improved sewage transport capacity and performance, and effluent quality.

ii) **Coastal Carrier, Centralised Treatment and Disposal.** Upgrade the existing centralised collection system by reconfiguring the existing network to drain areas served by small pump stations to a coastal carrier system for transport to a new central treatment and disposal facility on Malakal Island. The aim of these upgrade works is to provide a better level of service in terms of improved sewage transport capacity and performance, and effluent quality.

iii) **Decentralised Collection, Treatment and Disposal.** Upgrade the existing centralised collection system by reconfiguring the existing network to drain areas served by small pump stations to a number of separate discrete collection, treatment and disposal facilities. The aim of these upgrade works is to provide a better level of service in terms of improved sewage transport capacity and performance, and effluent quality.

121. The centralized collection, treatment and disposal option was evaluated to be the preferred option, based on minimal disturbance to the existing environment, cost effectiveness, and ability to address critical system issues in a relatively short implementation period (2013–2015).

2. Airai Alternative Approaches

122. Three alternatives were considered during the Airai project design stage, including (i) onsite system improvements, (ii) common effluent system, and (iii) conventional sewerage.

i) **Onsite System Improvements.** Upgrade the existing onsite system to provide a better level of service in terms of effluent quality and/or disposal. The following options were considered: (i) install a more sophisticated treatment unit than septic tank, (ii) improve the absorption trenches or use in ground irrigation, and (iii) provision of regular septic tank pump-out to reduce volume going to absorption trenches.

ii) **Common effluent system.** Bypass the individual effluent absorption areas and collect / convey the septic tank effluent in a gravity sewer network to a secondary treatment facility. The secondary treatment can either be a package plant or a constructed wetland area.

iii) **Conventional sewerage.** Decommission existing septic tank systems and replace with a normal (conventional) sewerage system including gravity sewer network, pumping station if needed, treatment plant, and discharge to nearby stream.

123. The conventional sewerage system option was evaluated to be the preferred option, based on cost effectiveness, ability to provide high quality effluent, and ability to address critical system issues in a relatively short implementation period (2013–2015).

VI. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

124. The potential environmental benefits and impacts of the proposed activities have been assessed in line with ADB's SPS, including assessment of the possible benefits and impacts with regard to (i) biodiversity conservation and sustainable natural resource management; (ii) pollution prevention and abatement; and (iii) health and safety, and physical cultural resources.

A. Incremental Environmental and Social Benefits

125. **Improved coastal marine water quality.** The project will result in improvements in the sewage treatment effluent discharge quality. Expected effluent discharge quality improvements are detailed in Table 11 for key parameters, showing that there will be a significant reduction in E Coli concentrations. Currently, the existing BOD_5 and SS discharge standards are rarely met so an improved system should enable these parameters to be achieved.

Table 11: Improvement Koror Sewerage Effluent Discharge Quality

Parameter	Existing plant (mg/L)	New plant (mg/L)
BOD5	30	30
SS	30	30
TN	Not specified	10
TP	Not specified	10
E Coli	5500-245000 MPN/100 ml	200 MPN /100ml

126. As a result of achieving effluent discharge quality improvements, the project is expected to result in improved coastal marine water quality. The current coast marine water quality is defined in Section IV.A. 5, and shows exceedance in the Class AA standards for microbiological pollution indicators in 26 samples between 2008 and 2011 around Koror. In particular, 12 exceedances are reported for Station C (see Figure 12) located approximately 30 meters from the point of discharge of the current sewage treatment plant outfall. The project improvements to the treatment process are expected to result in no further exceedances at Station C.

127. PPTA Sanitation Masterplan Report (ADB, 2012), presents calculations of the estimated dilution available at a distance 300 m distance from the outfall diffuser at Koror STP.

Table 12: Estimated marine water quality 300 m from effluent discharge point

Parameter	Estimated marine water quality 300 m from effluent discharge point
BOD5	0.007 mg/L
SS	0.007 mg/L
TN	0.007 mg/L
TP	0.007 mg/L
E Coli	less than 1 organism/100 ml

128. Ongoing monthly water quality monitoring conducted by the EQPB at 26 locations around Koror will be used to quantify the improvement in water quality.

129. **Improved surface water quality.** The project is likely to result in improved surface water quality, particularly in the stream draining Kesebalau and Ked areas (defined in Section IV.A. 4). The decommissioning of septic tanks and replacement with a centralised sewer system, will result in improvement in effluent discharge water quality, as summarized in Table 13.

Table 13: Improvement in Airai Sewerage Effluent Discharge Quality

Parameter	Influent concentration (from household)	Typical Effluent Quality (from Septic Tank)	Typical Effluent Quality (from Treatment Plant)
BOD	250 mg/L	175 mg/L	<30
SS	300	120	<30
TN	300	120	<10
TP	300	120	<10
E Coli	Not specified	Not specified	<200 MPN /100ml

130. As a result of decreased discharge of nutrients, BOD, SS and E Coli, water quality in the stream draining Kesebalau and Ked area is expected to improve. Ongoing stream surface water monitoring is recommended in the EMP (Appendix A) to quantify these ambient water quality improvement against baseline monitoring presented in Section IV.A. 4.

131. **Reduce odor nuisance.** Improved residence times in the sewers as a result of the Project is likely to result in reduced odor nuisance due to an improvement in conditions where hydrogen sulphide may form. In addition, removing the initial pond from the current sewerage treatment plant, improving the sewerage treatment process with new technology, and reducing the occurrences of overflows also contributes to improved odour control.

132. **Reduced risk of public health impacts.** By reducing the conditions for sewage gas generation by decreasing residence times, the project will reduce the risk of exposure to high concentrations of toxic and corrosive chemicals accumulating in confined spaces. As a result of the reduction in likelihood of public exposure to untreated sewage by decreasing overflow events, the project will reduce the risk of gastrointestinal infections such as diarrhoea, cholera and dysentery. These health impacts are commonly related to ingestion of water contaminated with human faeces.[17] The occurrence of treated cases of diarrhoea should be monitored to quantify this benefit.

133. **Reduce risk of injury.** The project will include improved access control to wells, high voltage switchboards, pump stations and other related infrastructure which is currently easily accessible to the public. These improvements in access control will reduce the risk of injury associated with these potentially hazardous areas.

134. **Associated and cumulative benefits**. Improved marine and surface water quality, will bring associated social and public health benefits, including reduction in the number of “No Swim” days, reduced risk exposure to elevated coliform concentrations from recreational marine water user, and reduced risk of contamination of food crops. Improved water quality and reduced odors will reduce the potential risk of negative impacts to the Palau tourism industry. An improved sewerage system will provide additional capacity for future development of hotels and other similar development which are currently limited in some areas due to insufficient sewerage capacity.

[17] WHO, 2012, http://www.who.int/water_sanitation_health/diseases/diarrhoea/en/

B. Potential Adverse Impact and Mitigation Measures during Construction Phase

135. The Project construction phase has the potential to result in adverse environmental impacts. The construction phase, which will occur over a 2 year period expected to commence in 2013, and will involve construction of the infrastructure described in Section III. The proposed construction works have the potential to cause adverse environmental impacts to soil, water, air, flora, and fauna. The following paragraphs identify potential environmental impacts.

136. **Increased sediment runoff.** Earth works associated with the project have the potential to result in increased sediment runoff entering the coastal marine environment and surface water bodies. Earthworks will be associated with the construction of the two sewerage treatment plants, the main drainage sewer, and decommissioning of some existing infrastructure. Sedimentation and subsequent nutrient input has been listed as a key threat to coral reef ecosystems, coastal marine water quality and associated flora and fauna in Palau.[18] The effects of run-off impacting the physical and biological aspects of the coral reef ecosystems are well documented, and are the most studied impact on coral reefs. Negative impacts are largely caused by physically covering of coral reefs and contamination from organic matter and other potential contaminants within the sediment. Sedimentation can also have a negative impact on surface water bodies. To mitigate against these potential issues, the following measures will be adopted: (i) avoid and/or minimise the requirement for disturbance of surface soils in the design phase where ever possible; (ii) retain and re-establish topsoil. Top soil should be retained in a bunded area and covered during the course of the exaction works. Following excavation, topsoil should be re-applied and vegetation re-established. Hydroseeding may be applied to assist the re-vegetation process; (ii) use of sediment retention berms and sandbags around excavations to restrict the release of sediment from the construction site, and (iii) construction of temporary diversion berms using sand bags, to redirect upslope overland flow during heavy rainfall events around the construction area.

137. **Impacts to flora including mangroves.** Clearing planting sites may cause permanent or temporal disturbances to original vegetation. While no known protected flora species have been identified on the Project sites, disturbance of original vegetation should be minimised. Mitigation measures outlined in the EMP include: (i) prohibition of burning vegetation and residual bushes and grasses when clearing planting sites, (ii) only cutting flora which are a direct obstacle to project infrastructure works, and (iii) a strict policy of no disturbance to mangrove forest areas. The construction works under the project will not occur in areas of mangrove forests.

138. **Directional drilling.** The directional drilling works associated with the main drain replacement will disrupt traffic along the main road of Koror. The drilling works are not expected to cause any subsidence or vibration impacts. To mitigate against traffic impacts, a traffic management plan will be developed, including appropriate signage, traffic flow management, excavation work hours. The plan will be implemented by the contractor and overseen by PWSC.

139. **Generation of solid wastes and disposal.** Construction works will result in the general waste and construction solid waste. Management of waste should include minimisation, reuse, recycling through the use of multi-compartment collection bins, composting of solid waste where appropriate, regular collection, and disposal to M-Dock Landfill. Koror State Solid Waste Management Department will be responsible for the general waste collection. M-Dock landfill has existing recycling and composting facilities which will be used by the project. However, it is noted

[18] ADB. 2008. Review of the Impacts of Public Infrastructure and Identification of the Opportunities and Constraints the Environment offers Development, Palau, TA 4929- PAL, prepared by PINZ.

that the amounts of general waste for recycling and composting generated by the Project will not be significant.

140. **Disposal of spoil.** Spoil will be generated from the horizontal drilling associated with the main sewer trunk installation. Spoil will either be reused as fill or provided to M-Dock Landfill for use of landfill coverage. M-Dock landfill is centrally located within Koror and has confirmed they require inert fill for coverage. The provision of inert fill to M-Dock landfill will be undertaken in consultation with the Koror State Solid Waste Department.

141. **Septic tank and sewerage treatment plant decommissioning.** Following the installation of the new sewage treatment plant infrastructure, the Malakal sewage treatment plant and the Kesebalau/Ked area septic tanks will be decommissioned. The details of the decommissioning process have not been confirmed and must be clearly defined in the detailed design phase including the development of a decommission plan. Septic tanks are the property of individual landowners and it will be their choice if the tanks are decommissioned. Decommissioning of septic tanks will only include emptying of sludge. Removal of the tanks if required will be the responsibility of the individual landowner. Soil and sludge potentially contaminated with sewerage, should be tested before excavation and disposed of to a suitable facility.

142. **Impacts to air quality.** Fugitive dust generated by excavation and emissions from vehicles have the potential to impact local air quality for short periods. Potential sources of dust generation from construction include (i) dust from land preparation, (ii) dust from excavation, loading, transporting, and unloading, and (iii) dust generated by the movement of vehicles and heavy machinery on unpaved or poor quality roads. . Mitigation measures for dust not mentioned above for soil erosion, include vehicles delivering materials to the sites must be covered, spraying water on active roads and excavation sites reduce dust, and re-vegetating construction sites at completion of works.

143. **Noise impacts.** Heavy machinery operation has the potential to result in noise impacts. Noise volume of construction machinery is generally between 80 ~ 110 dB, while vehicle (trucks) noise intensity is generally about 90 dB, and general traffic about 60 dB. As the majority of the construction works will be within the commercial and urban parts of Koror or close to residential dwellings it will be important to reduce noise impacts where possible. To mitigate against this, Project equipment and machinery must comply with commonly accepted standards, selecting low-noise technology and equipment, use of vibration dampers for equipment components with large vibration, and maintain equipment in good repair. When vehicles pass through Koror commercial centre, speed should be controlled to no more than 35km/h and use of horn should not be permitted. Construction works should be restricted outside the hours 09:00 and 18:00, or as agreed based on consultation with the community and EQPB.

144. These potential impacts are likely to be localized and will occur over a relatively short period of time. With strict adoption and enforcement of mitigation measures, the majority of these impacts can be avoided (see EMP, Appendix A).

C. General mitigation measures

145. In the preparation of the IEE and Feasibility design, the following mitigation measures have been and will be undertaken:

i) All the project sites have been selected as far as practicable to avoid or minimize potential adverse impacts on the environment and surrounding communities.
ii) The facilities have been located and designed to avoid resettlement impacts.
iii) Adequate technical design and scheduling of construction activities for the components will provide for safety, sanitation, and environmental protection in compliance with government regulations and international practices.
iv) All components will pass through the EQPB EIS process under the Environment Protection Act. The EIS report will be prepared by the executing agency, and reviewed and approved by the EQPB board.
v) Appropriate environmental mitigation and monitoring measures are included in the environmental management plan (EMP). The proposed environmental mitigation measures will form part of the design documents for the Project, and will be included in the contracts for procurement of goods and services. All contractors and subcontractors will be required to comply with the EMP.
vi) The environmental monitoring program has also been incorporated into the overall Project design to ensure that environmental impacts are closely monitored and the construction and operating activities are closely supervised against the approved EMP.

D. Biodiversity Conservation and Sustainable Natural Resource Management

1. Critical Habitats and Legally Protected Areas

146. Neither important historical and cultural sites nor rare and endangered species have been identified within the effluent discharge points proposed under the Project. However, the marine habitat surrounding the project area is of high ecological value. Appropriate measures have been established to ensure potential impact to the marine environmental is mitigated. Construction areas will not be located in forests and grassland of ecological significance, natural reserves, or scenic areas. All the project sites have been carefully selected to avoid or minimize potential adverse impacts on the environment and surrounding communities. The project will promote the management and use of renewable natural resources. The project will not introduce any alien species that are not yet established in the region of the project, or promote species that are known to be invasive in the given environments.

E. Land Acquisition and Resettlement

147. There will be no resettlement associated with the project.

F. Cumulative Impacts

148. No cumulative impacts have been identified during the environmental assessment. The implementation of this project will mainly bring benefits in terms of improved water quality and public health. The construction impacts are localized and can be mitigated to acceptable levels.

G. Cultural Relics and Physical Culture Resources

149. No physical cultural resources were identified during the project preparation, and it is considered unlikely that important physical cultural resources will be found in the project areas. In case such resources are found, all construction work will be put to a halt and consultations will be held with the local authorities and project staff on how to proceed. Such events and the subsequent decisions and actions will be reported in the environmental progress reports. In any

case, the provincial governments confirmed that the project will not remove any physical cultural resources unless the following conditions are met: (i) no alternatives to removal are available; (ii) the overall benefits of the project substantially outweigh the anticipated cultural heritage loss from removal; (iii) any removal is conducted in accordance with relevant provisions of national regulations; and (iv) local laws, regulations, and protected area management plans and national obligations under international laws are applied and employ the best available techniques.

H. Potential Adverse Impact and Mitigation Measures during Operation Phase

150. While the improvements to the Koror and Airai sanitation system are expected to bring environmental benefits, there is the potential for adverse impacts during the operation phase, including potential impacts related to (i) point source effluent discharge to the marine environment, and (ii) point source effluent discharge to a freshwater environment, in particular the stream draining the Kesebelau/Ked area.

151. **Point source effluent discharge to the marine environment.** There is a potential for impacts to the marine environment related to point source effluent discharge from the new sewage treatment plant if discharge limits are exceeded. Considering past studies do not show negative impact on the marine environment from the existing discharge which is likely to have exceeded current standards, and the new sewerage treatment plant will use the existing outfall pipe, the likelihood of negative impact is low. The recommended limits are considered protective of the marine environment. To manage and mitigate against potential impacts associated with point source effluent discharge from the new sewage treatment plant, the following should be followed: (i) strict adherence to the effluent discharge limits reported in regular monitoring of effluent quality and regular oversight from EQPB to ensure compliance, (ii) development and implementation of appropriate sewage treatment plant operations and maintenance plans, including appropriate staff training, and (iii) development and implementation of emergency response plansand appropriate staff training.

152. **Potential impacts on freshwater environment of the stream draining the Kesebelau/Ked area.** There is a potential for impacts to the freshwater environment downstream from the new centralised sewage treatment plant. The baseline water quality within the stream is poor, with elevated Enterococci concentrations ranging up to 2,200 MPN/100ml (refer Table 7). The new centralised sewage treatment plant is expected to improve water quality in the stream. However, there is the potential for ongoing impacts or new impacts related to centralised point source discharge into the stream, including increased discharge of untreated sewage if the new system fails. To mitigate against these potential impacts, the following measures recommended are similar to those above and include: (i) strict adherence to the effluent discharge limits reported in regular monitoring of effluent quality and regular oversight from EQPB to ensure compliance, (ii) development and implementation of appropriate sewage treatment plant operations and maintenance plans, including appropriate staff training, and (iii) development and implementation of emergency response plans and appropriate staff training.

VII. INFORMATION DISCLOSURE AND PUBLIC CONSULTATIONS

A. Legislative Framework for Public Consultation

153. Public participation and consultation in the evaluation of project design, planning and implementation is an important part of environmental impact assessment; it can directly reflect the public's perceptions on environmental quality in the project's area of influence. Relevant provisions in the local EQPB EIS regulation require public consultation through public disclosure, provision for submission of written comments, design review and EQPB approval. The ADB's environmental guidelines also have detailed and strict requirements on public participation and consultation. The public consultation processes for this project therefore follow both the Palau requirements and the ADB requirements (most recently amended in the ADB Safeguards Policy Statement of 2009).

B. Public Consultation Activities

154. Project preparation included (i) information dissemination, (ii) questionnaires and response, (iii) stakeholder consultation, and (iv) information disclosure. A list of the names of persons who participated in the public consultation process is attached as Appendix B.

1. Public Consultation

155. As part of the project preparation phase, three rounds of public consultation were undertaken following the procedures outlined above. The first round of public consultation was undertaken in December 2011 and included information dissemination through the local newspaper and public notice on the Ministry of Public Infrastructure, Industry and Commerce website. Subsequent public consultation was held in March 2012 and May 2012.

2. Stakeholder Consultations during the IEE

156. The PPTA team held the publically advertised consultation workshops with Project stakeholders on 13 December, 2011, 8 March 2012, 2 April 2012, and 22 May 2012. Following the ADB environmental assessment guidelines, the PPTA team ensured that people from areas where potential impacts might occur were consulted, as well as appropriate representatives to cover a range of age, gender, poverty, and ethnic categories. The stakeholder groups included: (i) Palau Water and Sewer Corporation (PWSC); (ii) Bureau of Public Health Services, Division of Environmental Health; (iii) EQPB; (v) Koror State; (vi) Airai State; (vii) business owners along project sites; (viii) hotel owners; (ix) tour operators; (x) environmental non-government organizations; (xi) traditional leaders/chiefs; (xii) women's groups; (xiii) landowners; and (xiv) affected households.

157. The objectives of the consultations were to gather information on public concerns about the project before finalizing the IEE. Concise project descriptions about the components were prepared and distributed to the public before or at the time of the consultation. The results of the consultations were used to modify the IEE and the project designs. The stakeholder consultations and disclosure exercises comprised:

i) Dissemination of Project information to local residents;
ii) Public consultation meetings with groups directly affected by the proposed project; and
iii) Distribution of public consultation questionnaires.

158. The affected people from with the project area were mainly concerned about the funding and implementation of the project, capacity of the implementing agency to operate and maintain the new system, decision making processes for the future planning relating to sanitation, potential impacts to the marine and freshwater stream environment, and a strong expectation for a reduction in the occurrence of pump station overflows and mitigation of the public health risk.

159. The majority of participants indicated that if the measures and policies recommended in the design, IEE, and EMP were carried out during construction and operation, they would be satisfied.

160. **Consultation Results.** The consultations revealed that stakeholders were generally supportive of the project. The expected benefits included: (i) improved marine water quality and reduction in restrictions on swimming, (ii) improved tourism perception of Palau due to improved environmental quality, (iii) reduced occurrence of pump station overflows, (iv) reduced odours, (v) improved future planning for sewerage works, and (vi) better prospects for socioeconomic development.

161. The primary anticipated negative impacts included: (i) poor operation and maintenance of the facility resulting in poor performance and ongoing environmental impacts, and (ii) potential impacts to the freshwater creek environment. The stakeholder consultation also reinforced the current issues associated with the existing system, which included common concerns including (i) chronic overflowing of raw sewage to houses, yards and mangroves; (ii) absence of data to link incidence of diseases with sewer overflows; (iii) weak planning, monitoring and reporting, and enforcement to address overflows; (iv) weak communication on sanitation problems by responsible agencies and measures being undertaken to address them; (v) funding; (vi) non-compliance by property and business owners on regulations; and (vii) perceived inaction and lack of information by government agencies to address sanitation problems. The result from consultation process are summarised in Table 14.

Table 14: Stakeholder consultation finding

Stakeholder	Identified Benefits	Issues Forward	Proposed Actions
1. National Government			
1.1Division of Environmental Health (DEH)	Improved sanitation will minimize water borne and vector diseases.	No established data on linkages of gastrointestinal diseases and incidences of sewer overflows.	New epidemiologist on staff at Bureau of Public Health will be tasked to establishing data on linkages
1.2 Bureau of Public Health Services		Without work safety equipment for sewerage employees	
1.3 Environmental Quality Protection Board (EQPB)	Help maintain quality of lagoon undergoing a World Heritage site application	Existing overlap and gaps in regulatory enforcement, monitoring, &reporting between agencies	
1.4 Food Production & Employment Palau Community Action Agency (PCAA)	Protect quality of women's "mesei" taro patches from sewer overflow and contributing to enhanced food security	"Mesei" inundation with sewer discharge is also coming from areas currently on septic tanks and not hooked up to the system	Women's group in Koror must engage PCAA to assist with identifying affected "mesei" areas and to do overall inventory
1.5 Senator, OEK Vice Chair	Improve public health and reduce daily	Communicate to major stakeholders critical problems	Approval of funding for project if ADB loan has to be secured

Infrastructure Committee and Member Steering Committee	hardships	and bottle necks of the system and show how they can be fixed	from OEK
2. State Governments			
2.1 Airai State	Safeguard quality of water supply source of Koror and Airai; Meet demand for residential and commercial development stemming from Koror; Improve health & environmental quality now affected by current poor septic tank and seepage area design	Airai stage of development critical to have sewer infrastructure and should have same priority as Koror State	Include Kesebelau Hamlet in Phase I; provide public land for treatment plant location
2.2 Airai State Government: Planning Commission; State Public Land Authority / Traditional Chiefs	Improvement of current sanitation system; expansion of service key development in new state master plan and land use plan	Unless funding for Kesebelau treatment plant is included in Phase I at national level, Airai State cannot afford on its own	There is willingness to pay for service
2.3 Building & Zoning Office, Koror State	Streamline assessment process of system capacity for additional hookups	Lack of adherence to zoning law by some property owners and government officials; plans on paper only	
2.4 Koror State Planning Commission	Increased sewer infrastructure capacity to accommodate proposed hotel and residential developments in Koror	Current sewer system capacity constraints are a deterrent to growth and development	Enable re-zoning of Malakal area to resort rather than industrial area
3. Private Sector			
3.1 Palau Pacific Resort	Increased quality and attractiveness of hamlet area for residents and guests; removed risk of health peril from recreational use of water caused by overflowing drainage into bay area near PPR	Prolonged daily exposure of sewer overflow onto road and bay since early March 2012 but unclear when problem can be fixed even with PPR donating resources to assist, i.e., pump truck and employee; unclear on charges or 'impact fee' billing cycle.	PPR is now exploring building self-sufficiency with own sewer system. Open to consider a PPP arrangement, i.e., land for a treatment plant, also can look at an initial mentoring or training process for O&M with transition to PWSC.
4. NGOs			
4.1 Island SEAS	Sustained community health and environmental quality	Unclear direction of how to move forward with project implementation and who can continue to communicate with stakeholders and community	NGOs can partner with community raising awareness and education efforts
4.2 Environmental Consortium Group	Provide guidelines, principles, criteria such as site selection for treatment plants and discharge locations that can be used for sanitation planning in Babeldaob states and elsewhere	Conflict between infrastructure developments and old sewer system unable to meet current needs	Ensure sustained information to public. If they know something is being done, recent public stirrings for reduced sewer rates will quite down.
4.3 Chamber of Commerce/National Women's Leader	Stop chronic overflows therefore addressing series health threat for her	Inability by government agencies to address problem due to: (i) lack of proper	Need for national sanitation building standards to be followed by new and existing

	young children	building standards in the country including for toilets, (ii) serious weakness and disinterest in law enforcement and (iii) low capacity by responsible employees on handling domestic liquid waste including sanitation.	homeowners, greater awareness by government agencies on handling domestic liquid waste, and real enforcement of land use zoning plan.
5. Affected Households			
5.1 Household Hamlet PS #12	Remove direct exposure to public health hazard; better quality of life free from chronic outflows, foul smell, standing sewer water in yard	Lack of response and inaction from relevant government agencies	
5.2 Households PS #A7 site visit	Improved quality of life from having to endure foul smell, overflow runoff into the street, people's yards and "mesei", relief from increased costs of cleaning and disinfectant products	Problematic long delay of response time from Public Works to calls made and continued inaction on any fixes and maintenance, i.e., pump broken; overflow well without cover	If aware of what government is doing to fix system then will not support current demand protest for lower sewer rate
5.3 Resident – Iyebukel hamlet 04/18/2012 PS 2B visit	His house is next to PS 2. Overflow covers his yard and neighbors.	Receptive to proposed project overflow pipe design and installation of telemetry system; no concern with construction activities, willing to bear disruption to have problem fixed; receptive to the idea that excavation will have metal or wood covers to allow his car still to cross from road to his garage during construction	
5.4 Female (informal settler next to Malakal treatment pond) Malakal site visit 04/18/2012	Has about 50 plots of taro, cassava, and banana crops. Some is sent to market, and some is given away to family and neighbors. Its mostly a farm hobby, and not a main source of income.	Land is owned by Koror State given to National government for agreed infrastructure use (sewer sedimentation pond). Koror State knows of informal settler use of land for small farms.	
5.5 Female Resident – Ngerbeched Hamlet; Member "NgaraKerisebsub" traditional women's group 04/19/2012 interview	Not personally affected with sewer outflow but it is happening around them.	Her mother's two-story house, her sister lives there and now occupies the second floor abandoning the first floor due to chronic sewer back flows; overflows always occur after heavy rainfall.	Construction work for project, outside work for men, women should do administrative work inside only. Thinks there should be public toilets at Meyuns Skozio, Icebox Malakal Park, and update the one at Renrak, K-B bridge.

3. Information Disclosure

162. Environmental information on the project was and will be disclosed. This IEE will be made available for review by interested stakeholders at the EQPB upon submission.

VIII. GRIEVANCE REDRESS MECHANISM

163. In order to settle unforeseen issues effectively, an effective and transparent channel for lodging complaints and grievances has been established. The grievance redress mechanism is detailed in the EMP in Appendix A.

IX. ENVIRONMENTAL MANAGEMENT PLAN

164. The objective of establishing an EMP is not only to stipulate appropriate mitigation measures, but also to require establishment of institutions or mechanisms to monitor and ensure compliance with environmental regulations and implementation of the required mitigation measures. Such institutions and mechanisms will seek to ensure continuously improving environmental protection activities during preconstruction, construction, and operation in order to prevent, reduce, or mitigate adverse impacts. The EMP draws on the IEE report and on the Project discussions and agreements with the relevant government agencies.

165. The EMP for the project is presented in Appendix A. The EMP will be reviewed and updated at the end of the detailed design in order to be consistent with the final detailed design.

A. Mitigation Measures

166. The EMP contains measures to mitigate the potential environmental impacts. The responsibilities for implementing and supervising these measures are also assigned to different agencies. Details of the mitigation measures can be found in Appendix A.

B. Organizational Structure for Environmental Management

167. The Project Management Office (PMO) within the Palau Water and Sewerage Commission will be responsible for setting up the environmental management system, consisting of inspection, monitoring, reporting, and initiating corrective actions or measures. In the design stage, the PMO will pass the EMP to the design consultants for incorporating mitigation measures into the detailed designs. The EMP will be updated at the end of the detailed design, and finally be passed to the construction contractors. To ensure that contractors will comply with EMP provisions, the PMO will prepare and provide the following specification clauses for incorporation into the bidding procedures: (i) a list of environmental management requirements to be budgeted by the bidders in their proposals; (ii) environmental clauses for contractual terms and conditions, and (iii) the full IEE report for compliance. The PMO and contractors will each nominate dedicated, trained, and qualified environment specialists to undertake environmental management activities and ensure effective EMP implementation. The PMO will set up an environmental management unit (EMU). An independent environmental monitor contracted by the PMO will be responsible for inspection, monitoring, and evaluating implementation of mitigation measures.

168. Environmental training will be essential for the PMO and contractors to implement the EMP. The PMO will be responsible for organizing training programs, which will cover (i) environmental laws, regulation and policies; (ii) implementing mitigation measures; (iii) environmental technologies and procurement; (iv) operating and maintaining environmental facility; (v) environmental monitoring, supervision; and (vi) documentation and reporting.

C. Inspection, Monitoring, and Reporting

169. The PMO will nominate at least one qualified full-time environmental management staff member to undertake environmental management and monitoring activities. The PMO will further recruit an environmental management consultant to assist itself in carrying out internal environmental monitoring and inspections, and conducting necessary training. The PMO, with assistance from an environmental management consultant, will submit to ADB quarterly project progress reports and semi-annual environmental monitoring reports on the progress of the EMP, information on project implementation, the environmental performance of the contractors, and environmental compliance. In addition, within 3 months of physical completion of the project, the PMO will submit to ADB a project completion report (PCR) that describes the achievements in relation to the project's expected impact, outcome, and outputs including environmental terms.

170. The EQPB will conduct compliance monitoring as part of their standard ongoing monitoring program. The EQPB will conduct regular and random environmental monitoring activities before, during, and after construction, as well as in the event of emergencies. The compliance monitoring reports will include: (i) project background, (ii) construction and operation activities, (iii) environmental conditions, (iv) measurement or sampling taken during auditing and their locations, (v) analytical results, (vi) interpretation and implication of the monitoring results, (vii) determination of the compliance status with regard to applicable regulations and standards, and (viii) recommendations for improvement. These reports will be submitted to the PMO who will forward it to project stakeholders.

171. The independent environmental monitoring (IEM) will be conducted to ensure that contractors appropriately implement mitigation measures, and will be commissioned by the contractors. The contractors will submit independent environmental monitoring reports on a semi annual basis to the PMO which will be forwarded to the EQPB. The reports will emphasize: (i) progress made in implementing the EMP, (ii) implementation of mitigation measures, (iii) environmental compliance, (iv) institutional strengthening and training, (v) public consultations, and (vi) problems occurred and corrective actions taken. IEM will also assist the PMO, including the EQPB, to prepare quarterly project progress reports, semi-annual environmental monitoring reports, and a PCR.

172. Results of the all reports mentioned above will be used for assessing: (i) the extent and severity of the environmental impacts against the predicted impacts, (ii) performance or effectiveness of the environmental protection measures or compliance with pertinent rules and regulations, (iii) trends in impacts, (iv) overall effectiveness of the project EMP, and (v) the need for taking additional mitigation measures.

D. Mechanism for Feedback and Adjustment

173. The EMP and grievance redress mechanism will be refined during the detailed design phase of the project when more details will become available. The updated documents will be submitted to ADB.

174. Based on the inspection and monitoring reports, the EQPB will decide whether: (i) further mitigation measures are required as corrective action, or (ii) improvement is required to environmental management practices. If it is found during the monitoring and inspection exercise that there has been substantial deviation from the EMP or any changes made to any of the construction and operation activities, which may cause substantial adverse environmental impacts or an significant increase in the number of affected people, the PMO should consult with

the Ministry of Public Infrastructure, Industry and Commerce (MPIIC) and the ADB immediately and form an environmental impact assessment (EIA) team to conduct additional environmental assessment and, if necessary, further public consultation. The revised EIA reports will be submitted to environmental authorities and to ADB for review and approval.

E. Environmental Management and Monitoring Capacity

175. The PWSC was recently established as part of the Palau Water Supply and Sanitation Sector Development Program. As a newly formed corporation, the capacity of the PWSC is limited and without experience with environmental management or monitoring. It is recommended the PWSC employ at least 2 full time staff dedicated to environmental management and monitoring of the sanitation infrastructure works.

176. The EQPB is responsible for administering and enforcing the Marine and Freshwater Quality Regulations, EIS Regulation, Earthworks Regulation, Air Quality Regulation and Toilet Facilities and Wastewater Disposal System Regulation. The EQPB is under resourced to regulate the increasing development around Palau.

177. The EQPB undertake monthly monitoring of marine water quality, including Enterococci concentrations at 16 locations around Koror. The EQPB conduct inspections in response to environmental complaints, including pump station overflows, and issue infringement notices under the Environmental Protection Act.

178. The EQPB laboratory is US EPA accredited to undertake the following analysis bacterial (Enterococci) and turbidity analysis only. The EQBP noted that they expect to become accredited to test for nutrients by 2013.

179. Improved capacity development and increased authority have been identified in past reports[19] as an important need to support improved environmental protection. It is important that the EQPB's capacity to monitor and enforce these regulations keeps pace with improvements in sanitation infrastructure.

180. It is recommended that one dedicated staff be supported by the project implementation loan within EQBP to oversee this project.

X. CONCLUSION AND RECOMMENDATION

1. Project Benefits

181. The project is expected to provide environmental benefits such as improved coastal marine water quality, improved freshwater quality, reduce odour nuisance, reduce public health risk from exposure to untreated sewerage, and increased public safety. Associated and cumulative benefits included increased tourism potential, improved planning and management of future sanitation infrastructure, and improved development planning.

182. The project also will help develop the capacity of the PWSC to manage and monitor environmental performance of the sanitation system.

[19] ADB. 2007. TA 6204-REG- Mainstreaming Environmental Considerations in Economic and Development Planning Processes in Selected Pacific Developing Member Countries. Country Environmental Analysis.

2. Environmental Safeguard Assurances

183. An EMP with a detailed environmental monitoring program and institutional strengthening and training program was developed as part of this IEE. The EMP stipulates appropriate mitigation measures that needed to be implemented through the duration of the project cycle and establishes mechanisms to monitor and ensure compliance with environmental regulations and implementation of the proposed mitigation measures. It seeks to ensure continuously improving environmental protection activities. This mechanism is carefully designed to fit into Palau's existing management system for environmental management.

184. The main project environmental risk relates to the low institutional capacity of the PWSC, including their lack of environmental management staff, and the under resourced EQPB to enforce regulations. The following measures are proposed to mitigate these risks: (i) specific assurances to implement the mitigation measures in the EMP; (ii) capacity building for PWSC, including staffing and training; (iii) appointment of project implementation and monitoring consultants/companies, including EMS and IEM; (iv) clear definition of roles and responsibilities for EMP implementation, performance monitoring, and mechanisms for feedback and adjustment; (v) role of EQPB and PWSC in environmental inspection and supervision; and (v) project reviews and monitoring by ADB.

185. Assurances and covenants related to the environmental aspects of the project are required as follows:

i) MOF shall cause the PWSC to construct, maintain, and operate the Project facilities including those which are fully funded from counterpart funds in strict conformity to (i) all applicable national, provincial and local government environmental laws, regulations and procedures; (ii) ADB's Safeguard Policy Statement (2009); and (iii) the environmental mitigation and monitoring measures set out in the Aggregate IEE and EMP for the project.

ii) MOF through the PWSC shall ensure that (a) requirements for mitigation implementation are incorporated into all civil works contracts; and (b) environmental performance of the contractors and subprojects is reported and evaluated as part of quarterly project progress reports, semi-annual environmental monitoring reports, and a project completion report.

iii) MOF through the PWSC shall ensure that the capacity-building program described in the EMP is provided to the contractors properly and on time.

iv) MOF through the PWSC will report to ADB the project progress on environmental issues through quarterly project progress reports and semi-annual environmental monitoring reports

v) MOF through the PWSC shall enable ADB's representatives to conduct due diligence reviews during project implementation for works under the Project including those which are fully funded from counterpart funds, to the extent required to mitigate overall project impacts.

3. Overall Conclusion

186. The project will generate socioeconomic benefits by promoting improved sanitation in Koror and Airai. The overall findings of the IEE are that negative impacts on water, air, and acoustic environment are expected, particularly during construction. In general these impacts will be temporary and localized. The required mitigation measures are prescribed conceptually in the IEE. These measures will be updated into the detailed EMP during the design stage and

continuously refined during construction. The EMP will be implemented by the PWSC and contractors; monitored and supervised by professional environmental management agencies the EQPB environmental monitoring stations, and regularly reported PMO, EQPB, and ADB.

187. Adverse environmental impacts of the project will mainly be construction impacts, which are expected to be minimal and adequate mitigation measures will be implemented. Adverse environmental impacts associated with the project will be prevented, eliminated, or minimized to an acceptable level if the EMP required under the IEE is effectively implemented, particularly through the mechanism for the continuous refinement and effective implementation of the environmental mitigation measures.

Appendix A:

Environmental Management Plan

CONTENTS

ENVIRONMENTAL MANAGEMENT PLAN

A. Objectives

1. The objective of establishing an environmental management plan (EMP) is to stipulate appropriate mitigation measures for implementation during the Palau Sanitation Sector Development Loan, and recommend establishment of institutions or mechanisms to monitor and ensure compliance with environmental regulations and implementation of the proposed mitigation measures. Such institutions and mechanisms will also seek to ensure continuous improvement of environmental protection activities during project preparation, construction, and operation in order to prevent, reduce, or eliminate adverse impacts.

2. The EMP includes: (i) objectives, (ii) summary of impacts and mitigation measures, (iii) environmental monitoring and inspection, (iv) public consultations, (v) responsibilities and authorities for implementation, (vi) institutional strengthening and training, (vii) reporting and supervision, (viii) work plan, (ix) cost estimates, and (x) mechanisms for feedback and adjustment. The EMP will be reviewed and updated at the end of the detailed design to ensure it is consistent with the final detailed design.

B. Summary of Potential Impacts and Mitigation Measures

3. Potential environmental issues and impacts during the pre-construction, construction and operation phases, as identified by the Initial Environmental Examination (IEE), as well as corresponding mitigation measures designed to minimize the impacts are summarized in Table A2.1. The mitigation measures must be incorporated into the tendering documents (where appropriate), construction contracts and operational management plans, and be undertaken by contractors, the Palau Water and Sewerage Corporation (PWSC) in which the Project Management Office (PMO) is established, the Ministry of Public Infrastructure, Industry and Commerce (MPIIC) and Ministry of Finance (MoF) as identified in Table A2.1. The effectiveness of these measures will be evaluated based on the results of the environmental monitoring to determine whether they should be continued or improvements should be made. Improvements need to be confirmed through stipulated environmental management procedures.

Table A2.1: Summary of Potential Impacts and Mitigation Measures

Impact Factor/ Stage	Potential Impacts and/or Issues	Mitigation Measures	Project Implementing Organisation	Supervising Agency
A. Pre-Construction				
1. IEE and Feasibility Study Stage	Site selections	• The recommended STP site and discharge point selected from various alternatives so as to minimize adverse impacts on the environment and land	PPTA Consultants, PWSC, Government of Palau	EQPB, ADB

Impact Factor/ Stage	Potential Impacts and/or Issues	Mitigation Measures	Project Implementing Organisation	Supervising Agency
		resources.		
	Engineering and technological alternatives	• Engineering and technological alternatives were evaluated based on pre-defined environmental and economic criteria.	PPTA Consultants, PWSC	PWSC, EQPB, ADB
	Public consultations	• Several rounds of wide public consultations have been conducted on environmental issues, poverty, and resettlement during feasibility studies, and IEE and EMP preparations. Additional consultations may be undertaken when the EQPB prepares an EIS.	PPTA consultants, PWSC	PWSC, EQPB, ADB
2. Design Stage	Updating EMP	• Mitigation measures defined in the EMP will be reviewed, updated and incorporated into the detailed design to minimize adverse environmental impacts.	PWSC, Contractors	PWSC, EQPB
3. Bidding and Construction Preparation	Bidding documents and contractors' qualifications	• Environmental section and provisions will be included in the bidding documents. • Environmental clauses for contractors in reference to the EMP and monitoring plan will be included in the construction and supply contracts. • The local EIA report to be prepared by EQPB, the IEE report, and EMP will be included in the contract documents	PWSC, Contractors	PWSC, EQPB
	Environmental	• Contractors will be required to	Contractors	PWSC,

Impact Factor/ Stage	Potential Impacts and/or Issues	Mitigation Measures	Project Implementing Organisation	Supervising Agency
	operation and supervision manual	prepare an environmental operation and supervision manual, for approval by the Implementing Agency.		EQPB
	Complaint and information office or appointed person	• Establish a complaint and information office or appoint a responsible person before starting construction. • Ensure that staff at the office is well trained to handle conflicts with residents from environmental impacts.	Contractors	PWSC, EQPB
	Environmental protection training	• Environmental specialists and/or officials from PWSC will be invited to provide training on implementation and supervision of environmental mitigation measures to relevant persons, especially construction engineers and managers.	PWSC, EMC	PWSC, EQPB
	Engagement of EMC	• Prior to start of construction, a national environmental management consultant (EMC) will be engaged.	PWSC	PWSC, EQPB
	Engagement of IEMs	• Prior to start of construction, Independent Environmental Monitors (IEMs) will be engaged.	PWSC	PWSC, EQPB
B. Construction Phase				
1. Soil Erosion	Excavation	• Avoid and/or minimise the requirement for disturbance of surface soils in the design phase where ever possible, • Construction of diversion terraces with adequate	Contractors	MPIIC, PWSC, EQPB

Impact Factor/ Stage	Potential Impacts and/or Issues	Mitigation Measures	Project Implementing Organisation	Supervising Agency
		capacity upgrade of construction sites, to redirect runoff around the construction area		
	Transport and disposal of soils	• Excavated soil will be used as refill on site where possible. • Settling ponds will be built in construction sites. Soils in settling ponds will be cleared for use as refill materials.	Contractors	PWSC, EQPB
	Construction vehicles	• Tires of construction vehicles will be cleaned regularly of soils.	Contractors	PWSC, EQPB
	Exposed surfaces	• As soon as refill and land leveling has been completed, exposed areas will be sealed with concrete/asphalt or re-vegetated	Contractors	PWSC, EQPB
2. Water Quality	Wastewater from construction sites	• Portable sanitary systems will be used on site. Wastewater will be collected, transported off site and disposed of to the domestic sewerage system. • Unauthorized dumping of wastewater will be prohibited.	Contractors	PWSC, EQPB
3. Air Quality	Dust from construction sites	• Materials storage sites must be covered or sprayed with water.	Contractors	PWSC, EQPB
	Dust from construction roads	• All roads and pavements used by vehicles of the contractors or suppliers will be kept clean and clear of	Contractors	PWSC, EQPB

Impact Factor/ Stage	Potential Impacts and/or Issues	Mitigation Measures	Project Implementing Organisation	Supervising Agency
		all dust, mud, or extraneous materials dropped by their construction vehicles. Such cleaning must be completed on a regular basis.		
	Emissions from vehicles and equipment	• Equipment and machinery emissions must be well maintained without visible emissions. • A regular inspection system will be initiated.	Contractors	PWSC, EQPB
4. Noise	Noise from equipment and vehicles	• Equipment and machinery emissions must be well maintained without visible emissions. • Works will be restricted to hours between 9:00am and 6:00pm, or as otherwise agreed by stakeholder consultation.	Contractors	PWSC, EQPB
	Community complaints about noise	• Interviews with residents living adjacent to construction sites will be conducted on a weekly basis to identify community complaints about noise, and seek suggestions from community members to reduce noise annoyance. • Community suggestions will be used to adjust work hours of noise-generating machinery.	Contractors	PWSC, EQPB
5. Solid Wastes	Domestic waste from construction	• Multi-compartment collection bins will be provided to facilitate reuse,	Contractors	PWSC, EQPB

Impact Factor/ Stage	Potential Impacts and/or Issues	Mitigation Measures	Project Implementing Organisation	Supervising Agency
	sites	recycling and composting of solid waste. • Wastes will be stored away from water bodies and will be regularly collected by the waste collection service and hauled to the M- Dock landfill.		PWSC, EQPB
	Decommission waste management	• Best management decommission plan reviewed and approved.	Contractors	
7. Social and Cultural Considerations	Resettlement	• No resettlement will be required under the proposed project design.	IAs	PWSC, EQPB
	Traffic disruption	• Development and implementation of traffic management plan • Use of appropriate signage • Controlled traffic flow management	Contractors	PWSC, EQPB
	Cultural heritage	• Cultural heritage sites will be preserved where identified. In accordance with the Bureau of Arts and Culture requirements, no person shall destroy, damage, deface, conceal, or otherwise interfere with a relic. • If an important site is unearthed, work should be stopped immediately and the matter promptly referred to the HPO for evaluation and decision on appropriate actions.	Contractors, IAs	PWSC, EQPB Bureau of Arts and Culture and Historical Preservation Office

Impact Factor/ Stage	Potential Impacts and/or Issues	Mitigation Measures	Project Implementing Organisation	Supervising Agency
C. Due Diligence of Ongoing Activities				
1. Due Diligence	Non-compliance with EMP and EIA requirements during construction works	• Undertake due diligence reviews of EIA documents and field inspections of ongoing works.	Independent consultant	PWSC, EQPB
D. Operation Phase				
1. Malakal STP Effluent discharge	Exceedance of discharge standards (see Table A2.3) and potential impact on marine water quality	• Strict adherence to the effluent discharge limits reported in regular monitoring of effluent quality and regular oversight from EQPB to ensure compliance, • Development and implementation of appropriate sewage treatment plant operations and maintenance plans, including appropriate staff training, • Development and implementation of emergency response plans, which may include onsite storage capacity in the event of plant failure due to power outage or similar, and include appropriate staff training.	Contractor	PWSC, EQPB
2. Kesebalau/Ked STP effluent discharge	Exceedance of discharge standards (see Table A2.3) and impact on stream water quality	• Strict adherence to the effluent discharge limits reported in regular monitoring of effluent quality and regular oversight from EQPB to ensure compliance • Development and implementation of	IAs	PWSC, EQPB

Impact Factor/ Stage	Potential Impacts and/or Issues	Mitigation Measures	Project Implementing Organisation	Supervising Agency
		appropriate sewerage treatment plant operations and maintenance plans, including appropriate staff training • Development and implementation of emergency response plans, which may include onsite storage capacity in event of plant failure due to power outage or similar, and include appropriate staff training		

ADB = Asian Development Bank, EMC = environmental management consultant, EMP = environmental management plan, IEM = independent environmental monitor, m = meter, OEE = onsite environmental engineer, IA = implementing agency, IEE = Initial Environmental Examination, MPIIC = Ministry of Infrastructure, Industry and Commerce, PMO = project management office, PPTA = project preparatory technical assistance, PWSC = Palau Water and Sewerage Corporation.

C. Environmental Monitoring and Inspection

4. An environmental monitoring program is presented in Table A2.2. This program considers the scope of monitoring, environmental media, monitoring parameters, time and frequency, implementing and supervising agencies. The monitoring will follow the methodology provided in the national standard methods for monitoring pollutants. Other associated standards are national environmental quality standards and pollutant discharge/emission standards.

5. **Internal Monitoring and Inspection.** The PMO will nominate at least one qualified full-time environmental management staff member to undertake environmental management and monitoring activities. The PMO will further engage a national environmental management consultant (EMC) to assist them and the contractors in carrying out monitoring and inspection, reporting to ADB through quarterly project progress reports, semi-annual environmental monitoring reports, and a Project completion report, and conducting necessary training. The PMO and contractors, with assistance from the EMC, will conduct internal monitoring and inspection on the progress of the EMP, information on Project implementation, the environmental performance of the contractors, and environmental compliance, considering reports submitted by contractors, environmental monitoring stations (EMSs), and independent environmental monitors (IEMs).

6. **Environmental Acceptance Monitoring and Audit.** Within 3 months of the Project completion, or no later than 1 year with permission from the responsible environmental authorities, environmental acceptance monitoring and audit reports will be (i) prepared by a qualified environmental specialist, (ii) reviewed for approval by the EQPB, and (iii) finally reported to the Asian Development Bank (ADB) through a Project completion report.

7. **Independent Environmental Monitoring.** A local environmental monitoring company will be engaged by PWSC to undertake independent environmental monitoring (IEM). IEM specialist(s) will include an environmental safeguard specialist. The independent environmental monitoring will be conducted to ensure that contractors appropriately implement mitigation measures. The results of the environmental monitoring will form part Project reporting. . The IEM specialist(s) will assist PWSC and PMO in reporting to the ADB the Project progress on environmental issues through quarterly project progress reports, semi-annual environmental monitoring reports, and a project completion report.

8. Results of the all monitoring mentioned above will be used to evaluate: (i) the extent and severity of environmental impacts compared with the predicted impacts, (ii) performance of the environmental protection measures or compliance with related rules and regulations, (iii) trends of impacts, and (iv) overall effectiveness of the EMP. Effectiveness of mitigation measures and monitoring plans will be evaluated through a feedback reporting system. Modification of measures required by the EMP will be performed, if necessary. The PMO and PWSC will play critical roles in this feedback and adjustment mechanism as shown in Figure A1.

9. The cost estimates for the environmental monitoring program are shown in Table A2.8. Before implementing the monitoring plan, responsible agencies will provide more accurate estimates of the costs and present a further detailed breakdown of the cost estimates. During project implementation, the costs will be adjusted based on actual requirements.

Table A2.2: Environmental Monitoring Program

Item	Parameters	Location	Time and Frequency	Implementing Agency	Supervising Agency
A. Internal Monitoring and Inspection					
1. Progress on EMP 2. Project Implementation 3. Environmental Performance of Contractors 4. Environmental Compliance Monitoring	Follow parameters set for compliance monitoring and inspection, environmental acceptance monitoring and audit, independent environmental monitoring	All sites	Quarterly	PWSC	EQPB

Item	Parameters	Location	Time and Frequency	Implementing Agency	Supervising Agency
B. Project Monitoring					
1. Erosion control	Visual inspection for erosion and sedimentation	1 monitoring location at each construction site	Inspect at beginning of construction and quarterly thereafter	EMSs	PWSC, EQPB
	Water quality testing suspended solid where located within 100 m of water body.	1 monitoring location at each construction site	Weekly during construction phase	EMSs	PWSC, EQPB
2. Noise and dust generation	Sound testing Visual inspection for erosion	Around all construction sites	Daily checking of sound and dust levels.	Contractor	PWSC/EQPB
3. Effluent discharge monitoring during commissioning and operation	Water quality testing prior to discharge as per table A2.3	Water sample collected following treatment process, prior to discharge point	Weekly	PWSC	EQPB
4. Ambient marine water quality	Ongoing ambient marine water quality testing for Enterococci	16 marine water sample locations currently undertaken by EQPB	Monthly	EQPB	EQPB
5. Ambient stream water quality	Ambient stream water quality testing for Enterococci	Three locations in stream draining the Kesebalau / Ked area. Upstream of STP, 100 m downstream from STP discharge, and at the intersection of the bridge	Monthly	EQPB	EQPB

Item	Parameters	Location	Time and Frequency	Implementing Agency	Supervising Agency
		downstream.			
D. Independent Environmental Monitoring					
1. Mitigation Measures by Contractors	Mitigation measures to be implemented by contractors (listed in Table A2.1)	All sites	Semi-annually	IEMs	PWSC, EQPB

BOD = biochemical oxygen demand, COD = chemical oxygen demand, dB(A) = A-weighted decibel, EMC = environmental management company/consultant, EMP = environmental management plan, , , IEM = independent environmental monitor, IA = implementing agency, L_{eq} = equivalent continuous noise level, m = meter, NH_3-N = ammonia nitrogen, pH = measure of acidity and alkalinity, PM_{10} = particulate matter smaller than 10 micrometers, TN = total nitrogen, TP = total phosphor, TSP = total suspended particulates, TSS = total suspended solids,

Source(s): Domestic EIAs, and consultations with PMO, PWSC, EQPB, and other Government of Palau Ministries.

Table A2.3: Proposed discharge limits* for key parameter

Parameter	Discharge limit (mg/L)
Biological Oxygen Demand (BOD_5)	<30
Suspended Solids (SS)	<30
Total Nitrogen (TN)	<10
Total Phosphate (TP)	<10
Enterococci	<200 MPN/100ml

* Monthly average, not to be exceeded by individual tests in 90% of samples.

D. Public Consultation

1. Public Consultation during Project Preparation

10. Various public consultations were conducted in the course of the Project preparation and the preparation of this IEE. During the Project preparation, the stakeholder governments Ministries and agencies were consulted to assist in site and technology selections. During IEE preparation, public consultations with various groups of stakeholders were also conducted. The main focus of the public consultations was to assess the environmental impacts of the proposed subprojects on nearby residents and identify mitigation measures. These activities were carried out in accordance with ADB *Safeguard Policy Statement* (2009). A Grievance redress mechanism has been also discussed with people who might be affected during Project preparation, through several rounds of public consultations with various stake holders groups.

2. Future Public Consultation Plan

11. Future plans for public involvement during the design, construction, and operation phases were developed during the Project preparation. These plans include public participation in (i) monitoring impacts and mitigation measures during the construction and operation stages, (ii) evaluating environmental and economic benefits and social impacts, and (iii) interviewing the public after the Project is completed. They include several types of consultations, e.g., site visits, workshops, investigation of specific issues, interviews, and public hearings (Table A2.4).

12. Public participation plans are part of the Project implementation and management plan. The PWSC and Ministry of Public Infrastructure, Industry and Commerce (MPIIC), as the Implementing Agency (IA) is responsible for public participation during Project implementation. The PWSC/MPIIC will also establish an environmental management unity (EMU) for supervising implementation, continuing public consultation, monitoring progress, and responding to grievances. The staff will be well trained to handle crisis situations or conflicts with residents due to distress from environmental impacts. Costs for public participation activities during Project construction are included in the Project funding. Costs for public participation activities during operation will be covered by the PWSC. In addition, the established feedback mechanisms (Figure A1) will ensure timely feedback and measures to address any concerns raised by the project affected communities.

Table A2.4: Public Consultation Program

Organizer	Approach / Times	Subjects	Participants
1. Project Preparation			
PPTA Consultants	• IEE public opinion surveys • Socioeconomic and Affected Person (AP) surveys • Public consultation meeting and questionnaire • Site visits: multiple times	Priority, design, environmental benefits and impacts, social benefits and impacts, mitigation measures, attitudes toward the Project, and suggestions	Government stakeholders, community, NGOs, business representatives
2. Construction			
PMO, EMC, IEM	• Public consultation and site visits: monthly	Adjusting mitigation measures if necessary, construction impacts, comments and suggestions	Government stakeholders, community, NGOs, business representatives
	• Public information session: at least quarterly during construction and first year of operation	Adjusting mitigation measures if necessary, construction impacts, comments and suggestions	Government stakeholders, community, NGOs, business representatives
3. Test Operation			
PMO, EMC, IEM	• Questionnaire survey: at least	Comments and	Government

Organizer	Approach / Times	Subjects	Participants
	once during test operation (eg when testing STP operations, or new sewer) • Site visits: multiple, depending on results of project completion environmental audit	suggestions on operational impacts, public suggestions on corrective actions	stakeholders, community, NGOs, business representatives
4. Operation			
PMO, EMC, IEM	• Site visits: once every 6 months by IEMs and PMO	Sewerage system operational performance, informal interviews with local residents	Government stakeholders, community, NGOs, business representatives
	• Specialist workshop or press conference: as needed based on public consultation and workshop	Expert comments and suggestions on corrective measures	Government stakeholders, community, NGOs, business representatives

AP = affected person, EIA = environmental impact assessment, EMC = environmental management consultant, IEM = independent environmental monitor, IA = implementing agency, PMO = project management office.

E. Responsibilities and Authorities for Implementation

13. The Ministry of Finance is the executing agency (EA). The Project will be implemented by the Palau Water and Sanitation Corporation (PWSC) with assistance from the Ministry of Public Infrastructure, Industry and Commerce, the implementing agency (IA). The project will be guided by a Project Steering Committee which includes Minister of Finance, the Governor of Airai State, the Governor of Koror State, the Minister for Natural Resources, Environment and Tourism, Director of Capital Infrastructure Projects, and the Executive Officer of EQPB.

14. The PMO will be located in the Palau Water and Sanitation Corporation. Delegated by the EA, the PMO will have overall responsibility for supervising the implementation of mitigation measures and reporting to ADB. The PMO will also be responsible for replying to petitions and/or complaints from affected persons, if such petitions and/or complains are appealed to the PMO.

15. The PMO and contractors will each nominate dedicated, trained, and qualified environment specialists to undertake environmental management activities and ensure effective EMP implementation. Project management consultants engaged by the PMO including EMC will assist the PMO in preparing quarterly project progress reports and carrying out training programs. Table A2.5 shows the environmental responsibilities in different phases of the project.

16. The PMO will be largely responsible for environmental management and implementation of mitigation measures. The PMO will ensure that the EMP is carried out. The PMO will also engage consultants to help with environmental management at the preparation, design,

construction, and operation phases. The PMO will be responsible for arranging environmental monitoring reviews and responding to any adverse impacts beyond those foreseen in the IEE. The PMO will also address requests for mitigation measures from the EQPB and ADB. If affected persons appeal petitions and/or complains to the PMO, the PMO will reply within 30 days, based on consultations with the IEM and other relevant institutes and/or agencies as necessary.

17. Construction contractors will be responsible for implementing mitigation measures during construction, while the PMO will be responsible for implementing such measures during the operation.

18. In accordance with the EMP, the PMO will set up an environmental management unit (EMU) that will generally require two employees. The EMU will be responsible for: (i) implementing the EMP and developing further implementation details; (ii) supervising contractors' implementation of mitigation measures during construction; (iii) implementing training programs for contractors; (iv) incorporating environmental management, monitoring, and mitigation measures into construction and operation management plans; (v) developing and implementing internal routine environmental monitoring; (vi) reporting performance of the EMP to the PMO and the EQPB; and (vii) replying to petitions and/or complaints appealed from affected persons, if such petitions and/or complains are appealed to the IA.

Table A2.5: Environmental Responsibility Matrix

Phase	Agencies	Environmental Responsibilities
Preparation	PPTA consultant	Review and select alternatives (technological, design, location, etc.)
	MPIIC/PWSC	
		Prepare IEE and EMPs for project, including public consultations
		Prepare EMP for EQPB approval, including public consultations
		Coordinate and supervise IEE and public consultations
		Review and endorse IEE, including the EMP, for posting at ADB website
Detailed Design	PMO, Design consultant	Update the EMPs in cooperation with environmental consultants, and incorporate mitigation measures in engineering detail designs and contracts
		Review and approve environmental measures
Tendering and Contracting	PMO, procurement consultant	Incorporate EMP clauses in bidding documents and contracts
Construction		Ensure implementation of mitigation measures, and public consultations
	Contractors	Implement mitigation measures
	PMO	Advise and supervise implementation of mitigation measures
	EMC contracted by PMO	Conduct internal monitoring and inspection, and public consultations
	IEMs	Conduct independent monitoring (including public consultations), and prepare periodic monitoring reports to IAs
Test Operation	PMO	Conduct Project completion environmental audit, including sampling and lab tests, and prepare Project completion environmental audit report
	EQPB	Review and approve Project completion environmental audit report, and order corrective actions if necessary
	EMC, IEM	Assist PMO in conducting environmental audit and preparing progress reports
Operation	PMO	Ensure proper operation of facilities according to design standards, and implementation of mitigation measures and public consultations
	EMC	Conduct internal environmental monitoring and inspection, supervise implementation of the EMP, and conduct public consultations
	IEMs	Conduct independent monitoring (including public consultations), and prepare periodic monitoring reports to IAs
Grievance Redress Mechanism	Contractors, project managers	Resolves a concern arising from affected persons during construction directly with the affected persons
	Local committees	If petitions and/or complains are submitted to local committees from

Phase	Agencies	Environmental Responsibilities
		affected persons, reply to the affected persons within 2 weeks.
	Governments offices	If petitions and/or complains are submitted to government offices from affected persons, reply to the affected persons within 2 weeks.
	PMO	If petitions and/or complains are submitted to PMO from affected persons, reply to the affected persons within 30 days
	EA	Deal with petitions and/or complains, if such petitions and/or complains are appealed

EIA = environmental impact assessment, EMC = environmental management consultant, EMP = environmental management plan, , IA = implementing agency, IEE = initial environmental examination, IEM = independent environmental monitor, level, IA = project implementing agency, PMO = provincial project management office, PPTA = project preparatory technical assistance.

F. Institutional Strengthening and Training

19. The Palau Water and Sewerage Corporation (PWSC) was recently established as part of the Palau Water Supply and Sanitation Sector Development Program. As a newly formed corporation, the capacity of the WSC is limited and without experience with environmental management or monitoring. It is recommended the PWSC employ at least 2 full time staff dedicated to environmental management and monitoring of the sanitation infrastructure works.

20. The EQPB is responsible for administering and enforcing the Marine and Freshwater Quality Regulations, EIS Regulation, Earthworks Regulation, Air Quality Regulation and Toilet Facilities and Wastewater Disposal System Regulation. The EQPB is under resourced to regulate the increasing development around Palau.

21. The EQPB undertake monthly monitoring of marine water quality, including Enterococci concentrations at 16 locations around Koror. The EQPB conduct inspections in response to environmental complaints, including pump station overflows, and issue infringement notices under the Environmental Protection Act.

22. The EQPB laboratory is US EPA accredited to undertake the following: bacterial (Enterococci) and turbidity analysis only. The EQBP noted that expect to become accredited to test for nutrients by 2013.

23. Improved capacity development and increased authority have been identified in past reports[20] as an important need to support improved environmental protection. It is important that the EQPB's capacity to monitor and enforce these regulations keeps pace with improvements in sanitation infrastructure.

[20] ADB. 2007. TA 6204-REG: Mainstreaming Environmental Considerations in Economic and Development Planning Processes in Selected Pacific Developing Member Countries, Republic of Palau, Country Environmental Analysis.

24. It is recommended that one dedicated staff be supported by the project implementation loan within EQBP to oversee this project. It is necessary to strengthen the capacity of the PSWC and EQPB. The proposed training is shown in Table A2.6.

Table A2.6: Institutional Strengthening and Training

Activities	Target Agencies/ Attendees	Contents	Timing
Strengthening			
Institutional Strengthening	PSWC/PMO	• Defining institutional arrangements for environmental management, monitoring, and supervision • Defining positions and responsibilities • Appointing and recruiting personnel	During project preparation
	EMC	• Recruiting and contracting EMC for internal environmental management consultancy and monitoring	Prior to project implementation
	IEMs	• Recruiting and contracting IEMs to conduct independent environmental monitoring	Prior to Project implementation
Environmental Management Clauses and Protocols	PSWC/PMO, procurement agency, EMC	• Developing environmental management clauses and incorporating them into construction and operational contracts • Developing/refining environmental monitoring protocols • Developing environmental emergency response procedures	During project preparation
Training			
Environmental Laws, Regulations and Policies	PSWC/PMO, contractors	• Environmental laws and regulations • Environmental policies and plans • Basic environmental management • Environmental emergency response	Prior to project implementation
EMP Implementation	PSWC/PMO, contractors	• Responsibility and duties for Project construction, management and environmental protection • Tasks of environmental protection in the project construction • Key environmental protection contents in project construction • EMP improvement and corrective actions	Prior to and during project implementation
Environmental	PSWC/PMO,	• Monitoring and inspection methods, data	Prior to and during

Activities	Target Agencies/ Attendees	Contents	Timing
Monitoring, Inspection and Reporting	EQPB, contractors	collection and processing, interpretation of data, reporting system • Environmental reporting requirements	project implementation

EMC = environmental management consultant, EMP = environmental management plan, IA = implementing agency, IEM = independent environmental monitor, PPMO = provincial project management office,
Source(s): Domestic EIAs, and consultations with PMO, and IAs.

G. Reporting and Supervision

25**.** **Monthly Construction Reports.** During the construction period, contractors will submit monthly construction reports to the PWSC. The reports will summarize: (i) environmental issues during construction; (ii) mitigation measures taken, if any; and (iii) consequences of the impacts on the environment and/or surrounding communities.

26. The contractors will be trained to take immediate actions to remedy unexpected adverse impacts or ineffective or inefficient mitigation measures, as required by the EMP. The PWSC will also respond to these reports in order to ensure that the contractors have taken appropriate and timely action. Additional measures may be taken, if needed, to ensure that all issues raised by the reports are appropriately addressed.

27. The reported environmental issues, mitigation measures, and the impacts will be reported to the PWSC quarterly and EQPB semi-annually. The EQPB may request that further environmental mitigation actions be taken, as they deem necessary, and may determine further mitigation measures for different stages, if necessary.

28. **Compliance Monitoring Reports.** The EQPB will conduct compliance monitoring as part of their standard ongoing monitoring program. The EQPB will conduct regular and random environmental monitoring activities before, during, and after construction, as well as in the event of emergencies. The compliance monitoring reports will include: (i) project background, (ii) construction and operation activities, (iii) environmental conditions, (iv) measurement or sampling taken during auditing and their locations, (v) analytical results, (vi) interpretation and implication of the monitoring results, (vii) determination of the compliance status with regard to applicable regulations and standards, and (viii) recommendations for improvement. These reports will be submitted PMO which will forward to project stakeholders.

29. **Independent Environmental Monitoring Reports.** IEMs will submit independent environmental monitoring reports on a semi annual basis to IAs which will forward to the PMO and EQPB. The reports will emphasize: (i) progress made in implementing the EMP, (ii) implementation of mitigation measures, (iii) environmental compliance, (iv) institutional strengthening and training, (v) public consultations, and (vi) problems occurred and corrective actions taken.

30. **Quarterly Project Progress Reports and Project Completion Report.** Based on the monthly construction reports, compliance monitoring reports, environmental acceptance monitoring and audit reports, and independent environmental monitoring reports submitted to the PMO, the PMO, with assistance from the EMC, will report to ADB on a quarterly basis the progress of the EMP, information on project implementation, and the environmental performance of the contractors, through quarterly project progress reports. In addition, within 3 months of physical completion of the project, the PMO will submit to ADB a project completion report that describes the achievements in relation to the project's expected impact, outcome, and outputs including environmental terms. ADB may request that further environmental mitigation actions be taken, as they deem necessary, and may determine further mitigation measures for different stages, if necessary.

31. The environmental reporting plan is presented in Table A2.7.

Table A2.7: Environmental Reporting Plan

Reports	From	To	Frequency
Construction reports	Contractors	PSWC/PMO	Monthly
Compliance monitoring reports	EQPB	PSWC/PMO	As per the ROP regulation
Independent environmental monitoring reports	IEMs	PSWC/PMO	Semi-annual
Quarterly Project Progress Reports and Project Completion Report	PMO, EMC	ADB	Quarterly and within 3 months of physical completion of the Project

ADB = Asian Development Bank, EMC = environmental management consultant, , IEM = independent environmental monitor, IA = implementing agency, PMO = Project management office .

Source(s): Domestic EIAs, and consultations with PMO, and IAs.

H. Work Plan

32. Before construction the PSWC/PMO will develop detailed responsibilities and requirements for contractors and will provide detailed cost estimates of mitigation measures and environmental monitoring in the construction, contracts. The PSWC/PMO will also detail the responsibilities of their environmental management offices and prepare their work schedules.

33. Before operation, the PSWC/PMO will develop detailed work plans for environmental management and monitoring during operation based on the EMP. These work plans will be submitted to EQPB and the MPIIC to help them to supervise implementation.

I. Cost Estimates for Environmental Management

34. The PSWC/PMO will develop detailed plans for procurement of equipment and materials, and civil works for implementing mitigation measures and monitoring plans. Environmental considerations will be incorporated into the bidding documents and contracts to ensure environmentally responsive procurement.

35. Cost estimates for mitigation measures, environmental monitoring, and environmental administration are summarized in Table A2.8. Before implementing a monitoring plan, responsible agencies will present a more detailed breakdown of the estimated budget. During Project implementation, the budgets will be adjusted based on actual requirements. Contractors will bear the costs for all mitigation measures during construction, which will be included in the bidding documents and contracts. The IAs will bear costs related to mitigation measures during operation. Costs related to environmental supervision during construction and operation will be borne by the IAs. Costs for capacity building will be borne by the Project as a whole. During the operation phase, the training costs will be included in the operation and maintenance budget.

Table A2.7: Cost Estimates for EMP

	Estimated Costs ($)
Construction Phase	
Erosion control measures	5,000
Environmental monitoring	10,000
Operational Phase	
Effluent Quality Monitoring	5,000 (annual)
Ambient water quality monitoring	5,000 (annual)
Training	5,000 (annual)

J. Mechanism for Feedback and Adjustment

36. Based on environmental reports, EQPB will decide whether: (i) further mitigation measures are required as corrective action, or (ii) some improvement is required to environmental management practices. If it is found during inspection that there has been substantial deviation from the EMP or any changes made to the project which may cause substantial adverse environmental impacts or increase the number of affected people, then PMO should consult with the EQPB and ADB immediately and form an environmental assessment team to conduct additional environmental assessment and, if necessary, further public consultation. The revised EIA reports including EMPs should be submitted to the environmental authorities for approval, and finally report to ADB. The revised EMPs will be passed to the contractor(s) and IAs for implementation.

K. Grievance Redress Mechanism

37. Public participation, consultation and information disclosure undertaken as part of the IEE process have discussed and addressed major community concerns. Continued public

participation and consultation has been emphasised as a key component of successful Project implementation. As a result of this public participation and safeguard assessment during the initial stages of the project, major issues of grievance are not expected. However, unforeseen issues may occur. In order to settle such issues effectively, an effective and transparent channel for lodging complaints and grievances has been established, in parallel with the mechanism developed under the resettlement planning process (refer to subproject resettlement plans).

38. In the event of a grievance issue, the basic stages established for redress are:

(i) Stage 1: If a concern arises during construction, the affected person tries to resolve the issue of concern directly with the contractor and the project manager. If successful, no further follow-up is required.

(ii) Stage 2: If not successful, the affected person can submit an oral or written petition/complaint to the local level committee. For an oral complaint, the village committee must make written records properly. The village committee must give a clear reply within 2 weeks. The IEM will assist the village committee in replying to the affected person.

(iii) Stage 3: If the affected person is not satisfied with the reply in Stage 2, he/she can appeal to the local government after receiving the reply in Stage 1 and the township government must give a clear reply within 2 weeks. The IEM will assist the government in replying to the affected person.

(iv) Stage 4: If the affected person is still not satisfied with the reply of State government, he can appeal to the PSWC. The PSWC, through the PMO, must report to the ADB project officer as soon as the complaint is recorded, by submitting relevant documents. The IA PSWC through the EMU established in the PSWC, must prepare a clear reply in consultation with the EQPB and IEM, and give it to the affected person within 30 days.

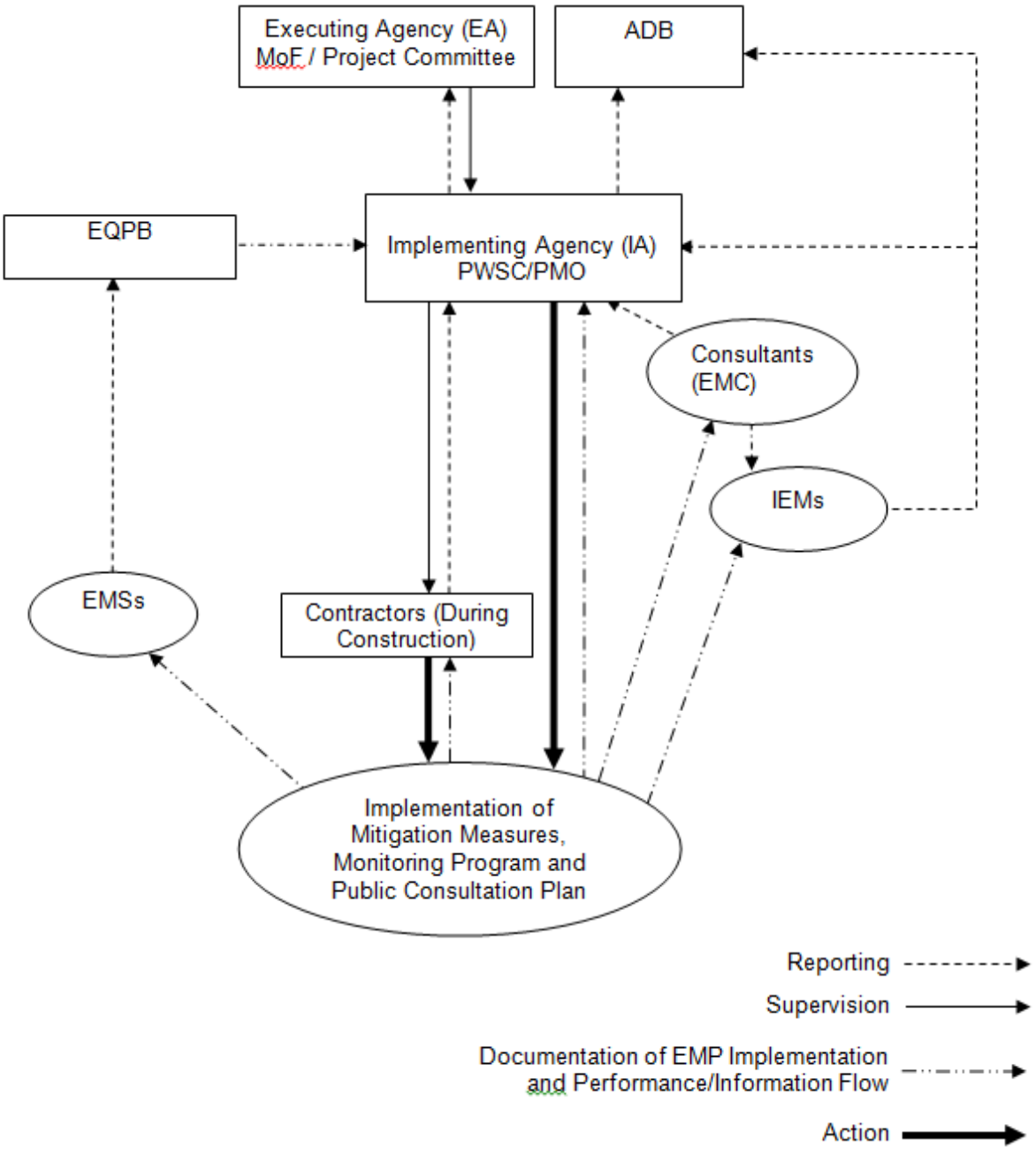
(v) Stage 5: If the affected person is still not satisfied with the reply of the PSWC, he/she can appeal to the MoF after receiving the reply of Stage 4. The MoF must report to ADB as soon as the complaint is recorded by submitting relevant documents, and prepare a clear reply in consultation with ADB. The MoF must give the reply to the affected person within 30 days. ADB project team will assess the situation, contact the affected people and government project counterparts and design and implement the course of actions. Stages (ii)-(v) will be further refined during the detailed design stage.

39. In addition to the established project specific channel above, ADB's overall accountability mechanism (2003) applies[21]. The mechanism provides opportunities for people 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 two separate, but related, functions: (i) consultation, led by ADB's special project facilitator, to assist people adversely affected by ADB-assisted projects in

[21] The accountability mechanism replaced ADB's Inspection Function (1995).

finding solutions to their problems; and (ii) providing a process through which those affected by projects can file requests for compliance review by ADB's Compliance Review Panel.

Figure A1: Mechanism for Feedback and Adjustment



ADB = Asian Development Bank, EMC = environmental management consultant, EMS = Environmental Monitoring Station, EQPB = Environmental Quality Protection Bureau, IA = implementing agency, IEM = independent environmental monitor, PMO = provincial project management office.