

資料-9 Initial Environmental
Examination (IEE)



Palau Public Utilities Corporation

Water and Wastewater Operations

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October 17, 2014

Ms. ROXANNE SIAL BLESAM SENGEBAU

Executive Director

Palau Environmental Quality Protection Board (EQPB)

Republic of Palau

SUBJECT : Water Supply System Improvement Project

Dear Ms. Sengebau,

We would like to inform you that the Japan International Cooperation Agency (JICA) as part of their commitment in providing technical assistance to strengthen further the friendly relations existing between the Government of Japan and Palau, PPUC being held responsible to implement the above proposed project, we are seeking your assistance to provide the JICA Survey Team any necessary requirements for the survey.

Part of their survey this report is prepared by PPUC to conduct an Initial Environmental Examination (IEE) for the proposed project under the laws and regulations of Palau together with JICA guidelines for Environmental and Social Considerations, but due to time constraints and a further detailed study/ies shall be conducted later on (*if deemed to be necessary*) shall be executed.

JICA survey team will require some information and approval if necessary for this report to the Government of Palau and Japan regarding the issues on environmental of the proposed project.

With this, we are seeking your assistance and approval regarding our request for the immediate facilitation of the request.

Your usual cooperation and understanding regarding the matter will be highly appreciated.

Sincerely yours,

Mr. KIONE ISECHAL

Acting CEO/Gm

CC:

Mr. Fujii Katsumi, Chief Consultants/Water Supply Planning of JICA Survey Team

Dave Dengokl, Acting WWO Manager

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**JICA PREPARATORY SURVEY
FOR
WATER SUPPLY SYSTEM IMPROVEMENT PROJECT
IN THE REPUBLIC OF PALAU
INITIAL ENVIRONMENTAL EXAMINATION
(IEE)**



OCTOBER 2014

**Palau Public Utilities Corporation
(PPUC)**

FOREWORD

In response to the request from the Government of the Republic of Palau, the Government of Japan decided to conduct a Preparatory Survey on the Water Supply System Improvement Project and entrusted the survey to the Japan International Cooperation Agency (JICA).

JICA dispatched to Palau the Preparatory Survey Team, which is headed by Ms. Eriko Tamura, Director, Water Resources Management Division I, Water Resources and Disaster Management Group, Global Environment Department, JICA, and the 1st field survey was carried out in Palau from June 2014 to August 2014. The 2nd Survey is implemented in Palau from September 2014 up to November 2014.

Presently, The Survey Team held discussions with the officials concerned of Palau. In the series of discussions and field surveys, both sides confirmed to proceed with their initial study regarding the improvement of the water supply system. The Survey Team will proceed to further work and prepare the Preparatory Survey Report as part of their commitment and report shall be discuss later on to the Government of Japan for approval and execution of the Project.

This IEE report has been prepared in accordance with the requirements of the Japan International Cooperation Agency (JICA), Guidelines for environmental and social considerations series 2010 and it conforms to the environmental assessment requirements defined in Palau's EQPB Environmental Impact Statement (EIS) Regulations (1996) and related guidelines.

INITIAL ENVIRONMENTAL EXAMINATION (IEE)

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Abbreviations

ADB: Asian Development Bank
BPW: Bureau of Public Works
BWSP: Babeldaob Water Supply Project
CC: Construction Contractor
CIP: Capital Improvement Projects
DOE: Design Office Engineering
DSC: Design and Supervision Consultant
EA: Executing Agency
EA: Environmental Assessment
EIA: Environmental Impact Assessment
EIS: Environmental Impact Statement
EMP: Environmental Monitoring Plan
EQPB: Environmental Quality Protection Board
ES/C: Environmental Specialist/Consultant
GOP: Government of Palau
IA: Implementation Agency
IEE: Initial Environmental Examination
JICA: Japan International Cooperation Agency
MAS: meters above sea level
MOFA: Ministry of Foreign Affairs
MPIIC: Ministry of Public Infrastructure, Industries, and Commerce
OECD: Organization for Economic Cooperation and Development
PIU: Project Implementation Unit
PMU: Project Management Unit
PPUC: Palau Public Utilities Corporation
PPTA: Project Preparation Technical Assistance
RA: Responsible Agency
ROP: Republic of Palau
RPPL: Republic of Palau Public Law
UFW: Unaccounted for water
WHO: World Health Organization
Dia: diameter, Ft: feet
Gpm: gallons per minute, In: inch
Lpm: liters per minute, m : meter
m/sec: meters per second, mg/L: milligram per liter

Initial Environmental Examination

I. Introduction

This section provides a basic summary of the Initial Environmental Examination (IEE) of the Project.

Improvements in water supply planning, infrastructure, operations and maintenance under this Project will bring benefits to the environment of Koror and Airai. This is to improve the access to safe water in the state through the rehabilitation and improvement of the water supply system.

The Initial Environmental Examination (IEE) report describes the existing environment, presents the potential environmental impacts and mitigation and enhancement measures for the project. The IEE has been prepared in accordance with the requirements of the Japan International Cooperation Agency (JICA), Guidelines for environmental and social considerations series 2010 and it conforms to the environmental assessment requirements defined in Palau's EQPB Environmental Impact Statement (EIS) Regulations (1996) and related guidelines as outlined below.

A. General

The purpose of this Initial Environmental Examination (IEE) is to provide a preliminary environmental assessment on the rehabilitation works for water supply component in Koror and Airai States and to improve the access to safe water in the State through the rehabilitation and improvement of the water supply system.

The objective of the project is to improve the security of water supply, in the face of occasional drought, for the communities of Koror and the State of Airai on the south end of Babeldaob Island. Improvements in water supply facilities, infrastructure, operations and maintenance under this Project will bring benefits to the people of Palau.

In addition the Project considers savings to be achieved by reduction of Unaccounted For Water (UFW) and the potential for extending the Koror-Airai system to the nearby State of Aimeliik.

This project is classified under the Japan International Cooperation Agency (JICA) Environmental Guidelines (2010) for Environmental and Social Considerations which refers to "projects judged to have some minor adverse environmental impacts, but of lesser degree and/or significance than those for projects". An IEE is required to determine whether or not significant potential environmental impacts exist which warrant a more comprehensive EIA. If an EIA is not needed, the IEE is regarded as the final environmental assessment report for the project.

This IEE has been prepared in accordance with the JICA guidelines to meet the JICA requirements for the Draft Final Report for the project and conforms to environmental assessment requirements defined in Palau's Environmental Quality Protection Board (EQPB) *Regulations* (1996 and 2013) and other related guidelines. This report provides screening of

various design alternatives at the Draft Final stage in project preparation. A previous IEE report, prepared at the interim stage of project preparation..

This IEE is based upon analysis of the potential impacts of the proposed project works following research and inspection of the project area in general, and component sites in particular by the project environmental survey team members during visits in June-July 2014, and in September-October 2014. During these visits the specialists had discussions with various Palau government institutions like the Ministry of Public Infrastructure, Industries, and Commerce (MPIIC), Bureau of Public Works (BPW), Palau Environmental Quality Protection Board (EQPB) and Airai and Koror State representatives to obtain information relating to the physical and ecological resources. The results of the social survey and institutional framework evaluations by other team members were also incorporated into this assessment.

Field investigation work involved the survey of three old groundwater boreholes followed by the drilling of new boreholes and a nearby observation borehole and reviewed pump testing data of these installations. In addition, sampling and analysis of surface water from the reservoir and river water at the pump station was carried out.

This IEE has been prepared by the environmental survey team from PPUC in association with JICA which comprised the following personnel:

- Mr. Dave Dengokl : Acting Manager for Operations, PPUC-WWO
- Mr. Neph A. Macasaet : Civil Engineer for Operations, PPUC-WWO
- Mr. Richard Basiya : Civil Engineer for Operations, PPUC-WWO
- Mr. Kagawa Shigeyoshi - Environmental Specialist, JICA Survey Team
- Mr. Shimoosako and Mr. Nakamura - Groundwater Specialist who provided the geotechnical and water resources aspects of the environmental assessment and prepared the Draft Final IEE report.
- Mr. Fujii Katsumi - Chief Consultants of JICA Survey Team who provided overall direction and coordination of the project and reviewed the IEE reports.
- Guidance on Palau reporting requirements was provided by an Environmental Specialist within the EQPB, Ms. Lynna Thomas, Compliance Specialist

B. Definitions

- "Environmental and social considerations" means considering environmental impacts including air, water, soil, ecosystem, flora, and fauna, as well as social impacts including involuntary resettlement, respect for the human rights of indigenous people, and so on.
- "Project proponents etc." stands for host countries and host country governments, including local governments, borrowers, and project proponents.
- "Cooperation projects" include the following: (1) Loan aid, (2) Grant aid (excluding projects executed through international organizations), (3) Preliminary studies of grant aid undertaken by the Ministry of Foreign Affairs (MOFA), (4) Technical cooperation for development planning, and (5) Technical cooperation projects, undertaken by JICA.
- "Projects" are undertakings that project proponents etc. conduct and that JICA supports.
- "Environmental and social considerations studies" include baseline surveys, predicting and evaluating the adverse impacts and likely impacts that projects may have on the

environment and on local society, and mitigation measures to avoid and minimize these.

- “Environmental impact assessment” includes evaluating the environmental and social impacts that projects are to have, analyzing alternative plans, and preparing adequate mitigation measures and monitoring plans in accordance with the laws or guidelines of host countries.
- A “strategic environmental assessment” is an assessment that is implemented at the policy, planning, and program levels, but not a project-level EIA.
- “Support for environmental and social considerations” means offering project proponents etc. assistance by conducting environmental and social considerations studies, analyzing countermeasures, accumulating knowledge and experience, developing human resources, and so on.
- An “examination of environmental and social considerations” is a confirmation of the measures taken by project proponents etc. to meet the requirements of the guidelines in view of the project’s characteristic features and the inherent nature of the affected countries and/or area.
- “Screening” means deciding whether proposed projects are likely to have impacts that need to be assessed by conducting environmental and social considerations studies according to project description and site description. JICA conducts screening by classifying proposed projects into four categories: A, B, C, and FI.
- “Scoping” means choosing alternatives for analysis, a range of significant and potentially significant impacts, and study methods.
- “Local stakeholders” means affected individuals or groups (including illegal dwellers) and local NGOs. “Stakeholders” are individuals or groups who have views about cooperation projects, including local stakeholders.
- The “Advisory Committee for Environmental and Social Considerations” is a third-party council that consists of external experts and provides advice regarding JICA’s support for and examination of the environmental and social considerations of cooperation projects.
- “Follow-up activities” range from the confirmation that project proponents etc. reflect the conclusions of environmental and social considerations studies in Technical Cooperation for Development Planning, to the implementation of plans.
- “Terms of Reference” (TOR) are a set of administrative, procedural, and technical requirements.
- An “Environmental Impact Assessment (EIA) level study” is a study that includes the analysis of alternative plans, the prediction and assessment of environmental impacts, and the preparation of mitigation measures and monitoring plans based on detailed field surveys.
- An “Initial Environmental Examination (IEE) level study” is a study that includes an analysis of alternative plans, a prediction and assessment of environmental impacts, and a preparation of mitigation measures and monitoring plans based on easily available information including existing data and simple field surveys.
- An “agreement document” details an agreement between JICA and project proponents etc. to implement cooperation projects; these documents include Loan Agreements (L/A) for Loan aid, Grant Agreements (G/A) for grant aid, and others.
- A “preparatory survey” is a survey that prepares JICA cooperation programs and also identifies and prepares individual projects by confirming relevance, effectiveness, efficiency, etc.
- A “JICA cooperation program” is a strategic framework for assisting developing countries in achieving their specific mid- to long-term development objectives

(including cooperation objectives and appropriate cooperation scenarios that will help to achieve them).

- “Project formation” is a type of preparatory survey that identifies and prepares a project to be supported by Loan aid, grant aid, or technical cooperation projects; it also confirms the relevance, effectiveness, efficiency, etc. of the project.
- “Detailed design study” is a study that decides the detailed plan of a project such as project objective, confirmation of feasibility, scale of input and activities, and it is conducted after the approval of the project by MOFA. 22. “Detailed design study” is a study that decides the detailed plan of a project such as project objective, confirmation of feasibility, scale of input and activities, and it is conducted after the approval of the project by MOFA including local stakeholders.

C. Identification of the Applicant, Agencies and Organizations

This paragraph is included in accordance with Palau Government regulations. The Project Applicant is the Government of the Republic of Palau. The Responsible Agency is the Ministry of Public Infrastructure, Industries, and Commerce (MPIIC). The Implementing Agency (IA) is the Palau Public Utilities Corporation (PPUC). The environmental monitoring agency is the EQPB, Environmental Quality Protection Board

Some project activities may be undertaken by state governments aimed at improving small-scale independent water supply systems in which case the Bureau of Public Works acts as a sponsor for state agencies undertaking those activities.

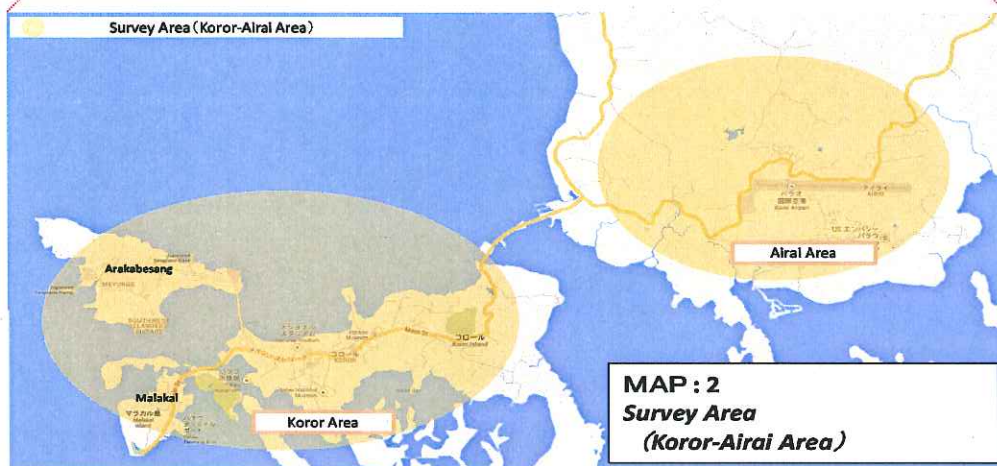
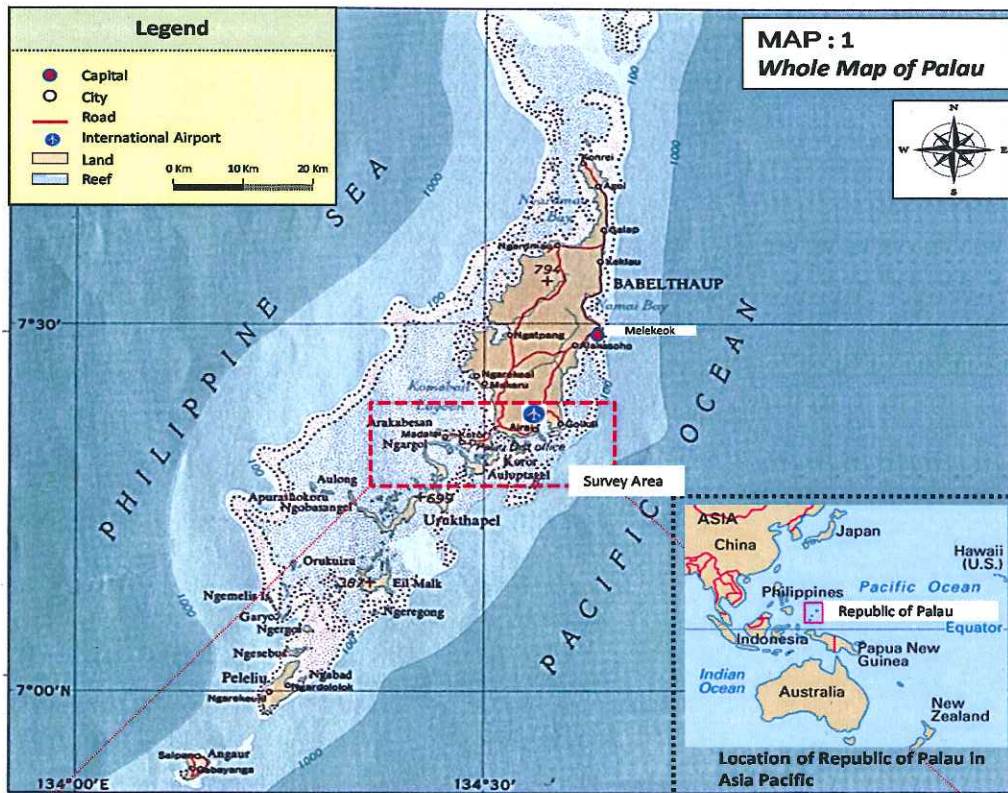
A list of agencies and organizations consulted is contained in Table 1.

Table 1: List of Agencies and Organizations Consulted

1.	<i>National Policy on Population and Sustainable Development Project :- Ms. Jean Williams, Environmental Specialist</i>
2.	<i>Bureau of Public Works, Water Supply & Sanitation Division Head of State System Maintenance Unit: Capital Improvement Program: Senior Project Manager, Mr. Benjamin R. Asuncion</i>
3.	<i>State of Ngermetengel, Water Supply Operations System operators</i>
4.	<i>Bureau of Public Works Techur Rengulbai, Director</i>
5.	<i>Palau Public Utility Corporation Board – Chairman, Mr.Fritz Koshiba – CEO, General Manager, Mr.Kione J. Isechal</i>
6	<i>Airai State Government Governor: Ms. Vicky N. Kanai</i>

D. Project Area

The project area encompasses the south end of Babeldaob Island, comprising the States of Airai and Aimeliik, as well as the Islands of Koror, Malakal and Ngerekebesang within the State of Koror that are connected to the centralized water supply system. The project area and the general location and alignment of the water infrastructure facilities are shown in Figure 1&2.



E. Environmental Policy, Legal and Administrative Framework

1. National Environmental Framework

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, and 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.

2. Environmental Impact Statement Regulation (Chapter 2401-61)

The EIS, same as EIA, 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 JICA environmental safeguard policy. 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 Environmental Impact Statement (EIS) must be completed.

The project is considered by the PPTA, such as this JICA survey 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.

3. Marine and Freshwater Quality Regulations (Chapter 2401-11)

The Marine and Freshwater Quality Regulations provide the criteria and quality standards for classification of both surface water and groundwater. The purpose of the Marine and Freshwater Quality regulations is:

- (i) To identify the uses for which the various waters of the Republic of Palau shall be maintained and protected
- (ii) To specify the water quality standards required to maintain the designated uses, and
- (iii) To 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 Regulations require 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 the IEE.

4. 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.

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

5. Toilet Facilities and Wastewater Disposal System Regulations (Chapter 2401-13)

The Project will not include any works related regarding the above.

6. Air Pollution Control Regulations (Chapter 2401-71)

The most relevant section of the Air Pollution Control Regulations to sanitation planning is the prohibition on odours, which forbids the emission of odours causing a nuisance and/or negative impact to public health.

7. Solid Waste Management

With regard to the Project, local solid waste management legislation requires that sludge and bio-solids from water treatment plants be disposed of at the M-Dock solid waste landfill, and/or Airai State solid waste landfill under the regulations of EQPB.

8. 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.

II. Description of the Project

A. Need for the Project: Economic and Social Characteristics

The need for the Project is dictated by a perceived need for capacity expansion, increase system coverage and reduction of risk associated with shortages in water supply that may occur during periods of drought. Despite the perception of a shortfall in capacity, investigations have shown that the present water supply source for Koror and Airai States is sufficient to meet all future demand scenarios up to Year-2020 (the Project planning horizon). However, reliability of supply is only one in 10 years, i.e. the supply can be expected to fall short of demand one year in 10, due to drought conditions that typically last a period of two to three months. For small-scale water supply systems owned by state governments on Babeldaob Island the situation is similar, with few exceptions; yet here reliability is more affected by the unreliability of aging equipment and lack of maintenance budgets. Many components of the

water supply systems have reached the limit of their useful lives, having been in place some 20 – 25 years with only emergency repairs made to accommodate equipment failures; hence there is a need for rehabilitation of some systems but without any immediate need to increase availability of supply.

The water resources survey report states that the Koror-Airai system reliability “is generally unsatisfactory for urban consumers, and the dependence of the Palauan economy on tourism is another factor to consider. Improving reliability of the water supply system yield so that shortages occur no more frequently than 1 in 25 years is regarded as acceptable.” Hence, targets framed in terms of economic and social acceptability aim at achieving greater reliability by augmenting supply to the Koror-Airai system and by rehabilitating small-scale systems operated by State governments.

The perceived shortage of water is due to exceptionally high per capita consumption. The Koror – Airai waters supply system includes some 3,600 customer connections of which around 3,000 are located in Koror and the balance in Airai. Household connections in Airai are not metered; each household connection pays a flat monthly rate of \$5.00 for water. Average production of water metered at the treatment plant is 3.8 million gallons per day (MGD) and some 16,870 equivalent people live, work and/or visit and are temporarily resident in the service area. This consumer group is made up of the residents of Koror and Airai, the foreign workers that are present but not counted in the overall census, and tourists that visit Palau an average of 4.6 days per visit and reside at hotels and resorts that are connected to the distribution system. The overall per capita consumption of around 225 gal/day is three to five times higher, and in some instances ten times higher, than consumption rates at other island nations in the Pacific and urban areas in the USA and Australia. Furthermore it is not clear where this quantity of water is being consumed. While only some 58% of water being produced at the Airai Water Treatment Plant is billed to customers, there is no obvious source of unaccounted for water through pipe leakage or losses through un-metered connections. The conclusion reached in the survey is that the unaccounted for water is the result of legal and illegal un-metered consumption, leakage from the pipe network and possibly under reading of existing service meters.

B. Project Alternatives

The investment program described in the ADB Technical Assistance Report (2007) envisioned an additional raw water source located in Aimeliik State comprising surface flows discharging from the Tabecheding River toward the western side of Babeldaob Island, an additional water treatment plant located near the source of supply, and a bulk supply main installed along the recently constructed Compact Road supplying the Koror-Airai system, an additional 1 Mg/d. However this system is unable to produce the required quantity of water when it is most needed due to the effect drought conditions have on the surface raw water source. Such a project does, however, accomplish other objectives to extend service into Aimeliik State and to assist development along the Compact Road, which is a goal of the ROP. It is, however, costly.

An alternative is to reduce necessary production and hence increase the reliability of present sources. The Community Action and Participation Program (CAPP) is being proposed as a part of the Water Supply Sector Development Plan to be implemented under the loan project. The key objectives of this program will heighten community awareness of water conservation which, along with other measures, will assist to bring per capita water use down by at least 20% and make the present sources of supply more sustainable over the project planning horizon.

Infrastructure improvements are proposed to the management of water and to introduce incentives for conservation at the user level. In-line metering is poor and it is not possible to isolate and identify system losses when they occur; hence the Project plans to install a series of in-line meters so that consumption by sub-groups among users defined by geographical area can be determined and enable line losses to be isolated. Some of the transmission mains are old and, in all likelihood, contribute to unaccounted-for losses; these mains will be replaced. Finally, some 19% of connections are un-metered (23% of residential connections) leading to an excessive level of consumption as the cost of water is ignored; installing meters on all connections is a goal of the Project. Once unaccounted-for losses are brought under control and usage falls by 20%, the current sources of supply are capable of meeting consumption projections through the project-planning horizon, except for prolonged drought periods. Improving reliability of supply during periods of drought may be achieved by increasing reservoir storage or tapping a groundwater source. The IEE prepared at the JICA survey stage of project reporting considered the environmental impacts of these alternatives and related infrastructure improvements. The dam site considered preferable from the standpoint of access and capacity is referred to as the Edeng I site. The reservoir would need to cover some 8-11 ha, which is currently occupied by well-established secondary forest. The potential loss of biodiversity and the need to clear the reservoir area of vegetation prior to filling, in order to establish, protect and maintain water quality in the reservoir, are significant environmental considerations with high financial and economic costs. Therefore, this project of JICA is considered the improvement of water supply facilities excluding water resources development.

Groundwater was previously used to supplement the Koror–Airai water supply system in the mid-late 1980's when at least 6 boreholes were constructed and several of these were pumped for periods during the drought periods in 1988 and 1997/98. It was not used sustainably and abundant, now.

C. Project Proposal: Technical and Environmental Characteristics

The proposed Project has eleven components refer to Table-4:

1. Improvement on Water Supply Facilities

1-1. Water Resources and Intake Facilities

The capacity of water resources is enough for 4M G/day (15,140m³/d) of water supply. On the other hand, alternative water sources should be examined carefully, monitoring the water demand/ NRW reduction and observing the frequency of draughts. The borehole construction of Airai well field is an good option for the additional water resource development. Moreover, the survey team recommends dredging the existing Ngerimel Dam to increase the storage capacity due to minimize the operation cost for energy by gravity.

Pumping equipment and emergency generator for Ngerikiil Intake Pump Station are old and deteriorated. It is recommended for PPUC to replace and repaired it as usual maintenance works.

Table 2 Water Demand Projection from 2013 to 2020

Category	2013	2014	2015	2016	2017	2018	2019	2020
Population	14,126	14,050	13,975	13,900	13,826	13,754	13,682	13,610
Foreign Visitors per day	1,151	1,233	1,319	1,413	1,512	1,619	1,733	1,856
Equivalent population	15,277	15,283	15,294	15,313	15,338	15,373	15,415	15,466
Domestic Consumption								
Unit consumption (G/capita/d)	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0
Domestic consumption (MG/d)	0.96	0.96	0.95	0.95	0.94	0.94	0.93	0.93
Non-Domestic Consumption (Gov)								
Consumption (G/capita/d)	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
Annual increase ratio		0%	0%	0%	0%	0%	0%	0%
Non-Domestic Consumption (Com)								
Flat rate consumption (MG/d)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Annual increase ratio		3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%
Metered consumption (MG/d)	0.85	0.88	0.91	0.94	0.97	1	1.03	1.07
Annual increase ratio		3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%
Total Commercial consumption (MG/d)	0.86	0.89	0.92	0.95	0.98	1.01	1.04	1.08
Grand Total for Consumption (MG/d)	1.91	1.94	1.96	1.99	2.01	2.04	2.06	2.10
NRW								
NRW (MG/d)	1.78	1.79	1.81	1.70	1.64	1.42	1.21	0.99
NRW ratio %	48%	48%	48%	46%	45%	41%	37%	32%
Production (MG/d)	3.69	3.73	3.77	3.69	3.65	3.46	3.27	3.09
Reference								
Production (G/capita/d)	261	265	270	265	264	252	239	227
Production (G/equivalent population/d)	242	244	247	241	238	225	212	200

Source: JICA Survey Team

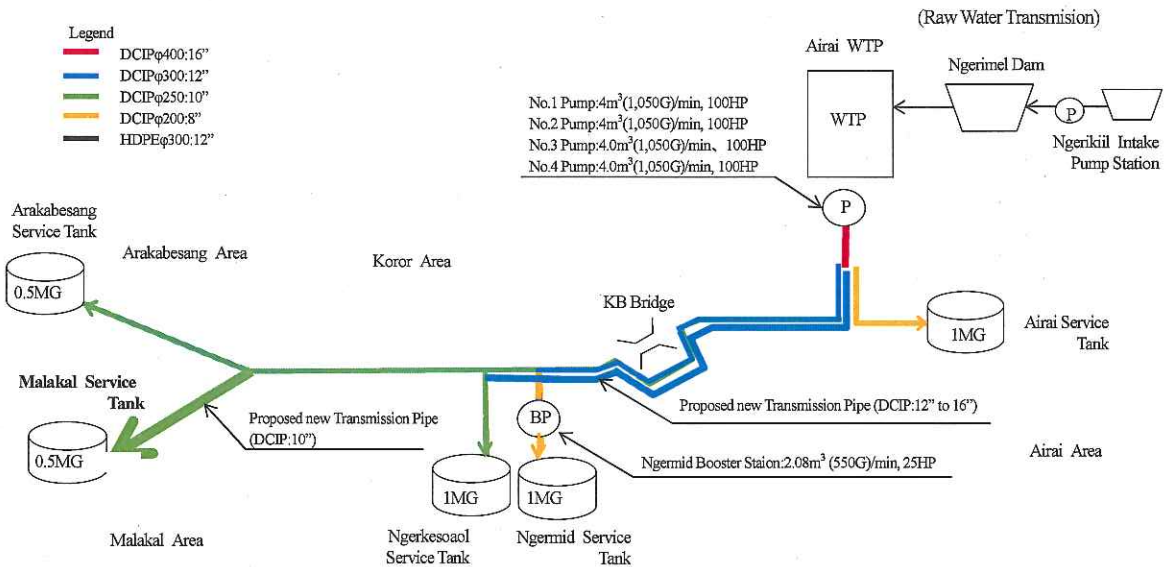
1-2. Koror - Airai Water Treatment Plant (KAWTP)

The production capacity of Koror - Airai Water Treatment Plant (KAWTP) is 4MG/day (15,140m³/d). Although some facilities, such as chemical injection devices and filters, are old and deteriorated, KAWTP secures the water quality at 2 - 3 NTU in turbidity. Accordingly, it is not urgently required for improvement and rehabilitation, but the rehabilitation should be undertaken in a middle term. The survey team recommends the following rehabilitation and/or improvement:

- Establishment Water Quality Management System (toward Water Safety Plan recommended by World Health Organization)
- Rehabilitation of Chemical Injection System
- Rehabilitation of Sand Filter
- Rehabilitation of Clear Water Well.
- Replacement of Raw Water Pumps and Installation of Flow Meters
- Improvement of Operation Procedures

1-3. Water Transmission

The current water production reaches 4MG/d (15,140m³/d). The existing water transmission main was, however, designed for 2.1MG/d (7,949m³/d). The current water flow exceeds the assured level, by design without improvement of existing pipeline is provided, much high capacity of transmission pumps are necessary. Therefore, the survey team recommends laying additional pipeline for transmission up to Ngerkesewal Service Tank as shown in **Figure -3**. It is an urgent component to secure the stable water supply.



Source: JICA Survey Team

Figure -3 Improvement for Koror and Airai Water Transmission Pipeline

2- Water Distribution Zones

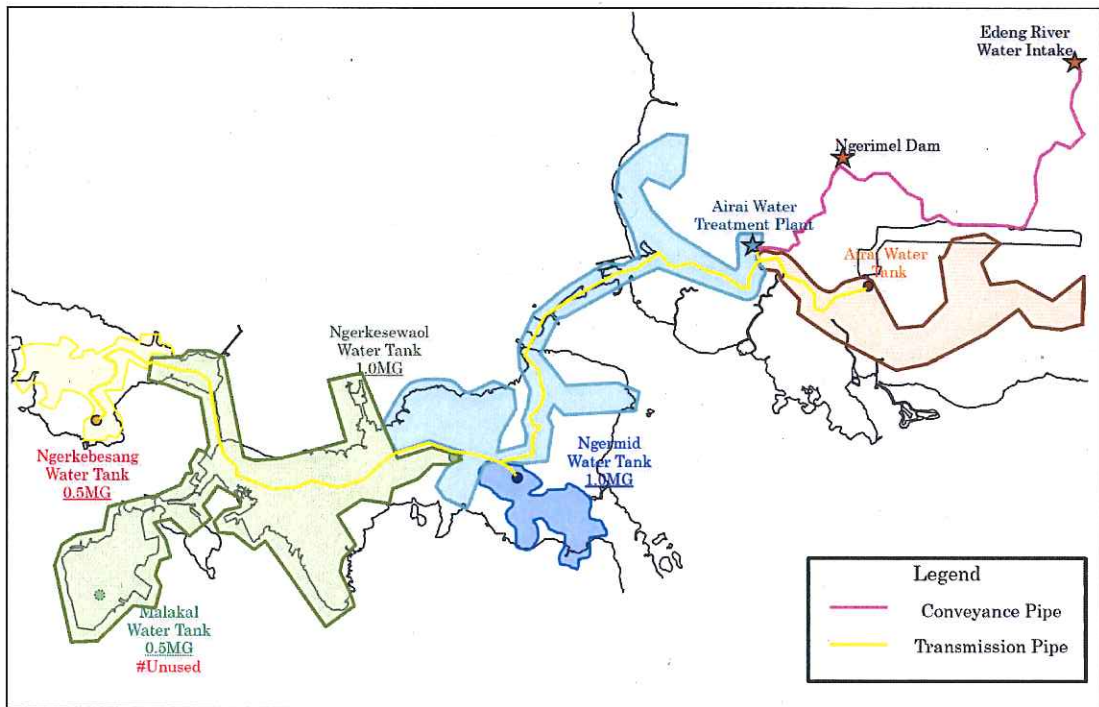
Current water distribution system is comprised of five (5) water distribution zones, namely Airai, Ngermid, Ngerkesewaol, Arakabesang and direct distribution zone from KAWTP. Currently, water in Malakal zone is distributed through Ngerkesewaol Service Tank. Except for direct distribution zone from KAWTP, water is distributed by gravity. The amount of water is enough. However, there are some low pressure areas, such as Ngerbeched area, in Ngerkesewaol distribution zone and the water is not supplied to Malakal at the time of the accident for water transmission and/or distribution such as leakage. The current water distribution zones are shown in Figure - 4

To eliminate low water pressure areas and to ensure stability of the water supply of Malakal area, it is urgently required to separate the Malakal area from Ngerkesewaol water distribution zone and re-arrange the distribution covering areas of each zone as shown in Figure-5. For this purpose, renewal of Malakal Service Tank and an exclusive transmission main are necessary. Along the mentioned rehabilitation, district flow meters should be installed at service tanks for distribution flow management.

3- Replacement of Major Distribution Lines

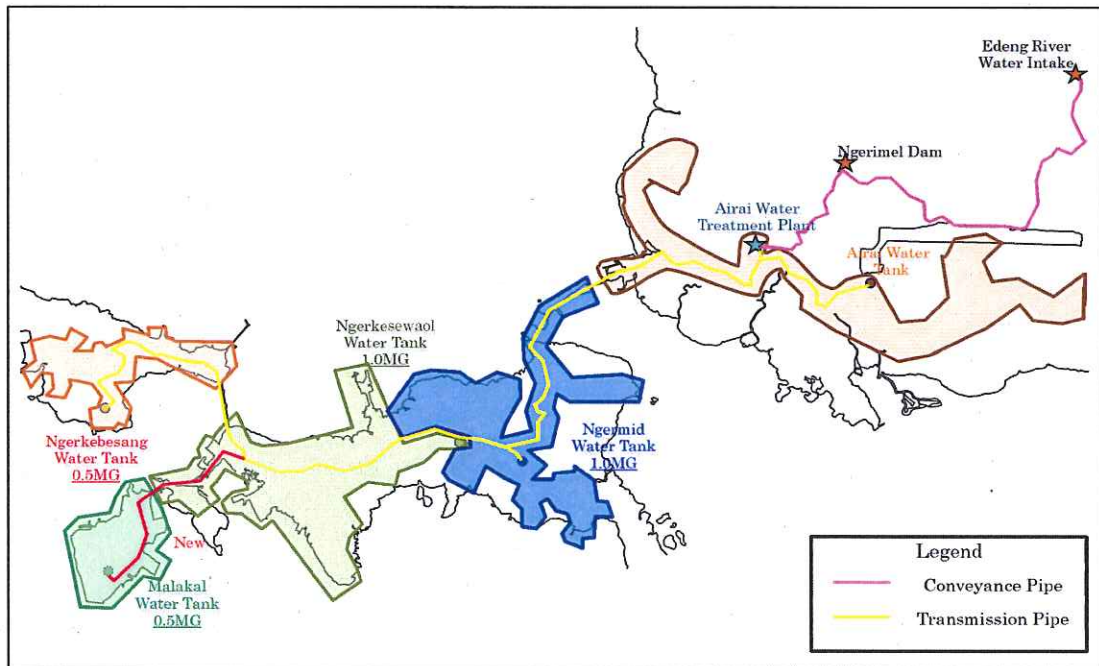
The Reduction of water leakage is strongly required for PPUC to improve the business efficiency. The replacement of larger diameter AC pipes should be commenced immediately. Since it is difficult to replace all the pipelines at once, the improvement works should be scheduled in short and/or medium terms. The works should also include the replacement of lateral connection pipes.

As the urgent parts to be replaced, the survey team recommends the routes as shown in Figure - 6. Total length of the urgent routes is around 8.1 miles (13km).



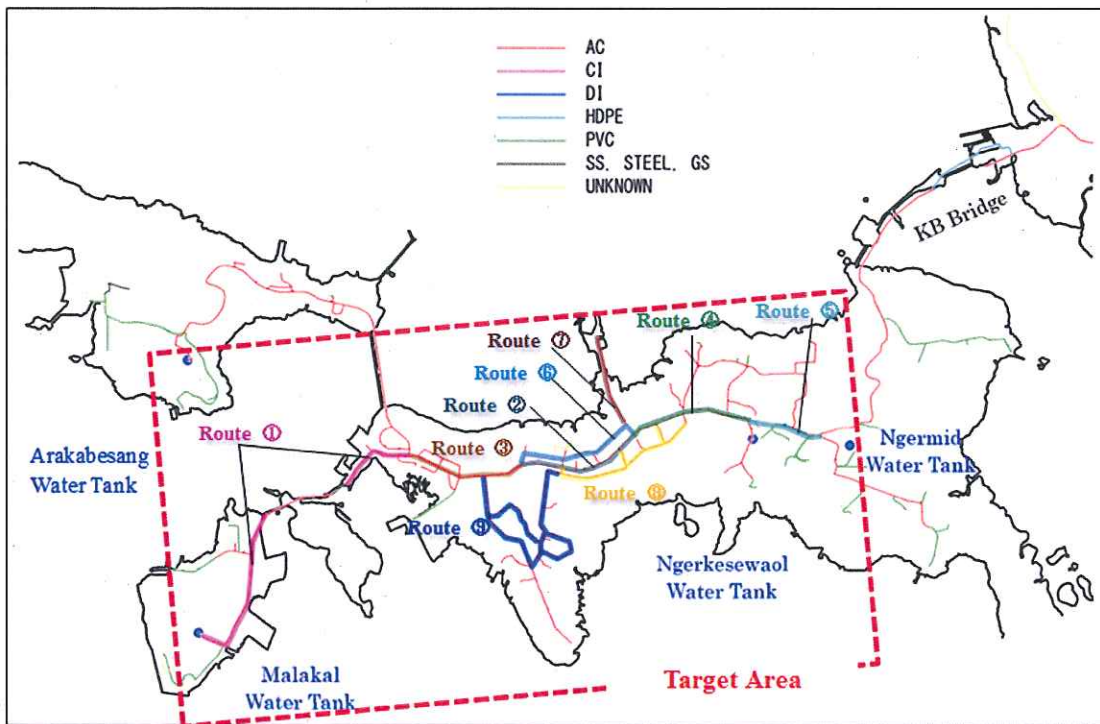
Source: JICA Survey Team, based on PPUC information

Figure -4 Current Water Distribution Zones



Source: JICA Survey Team, based on PPUC information

Figure -5 Proposed Water Distribution Zones



Source: JICA Survey Team

Figure -6 Recommended Route for Urgent Replacement for Old Distribution Pipes

4. Soft Approach

The following items are recommended as soft component approaches for the capacity development:

- Management for Water Flow and Pressure
- Leak Detection
- Improvement of Water Quality Monitoring System
- Establishment of Sustainable Management Section

5. Priority for Urgent Action Plans

Based on the previously mentioned recommendations, the survey team recommends action plans summarized as shown in **Table -4**.

Table -4 Priority for Urgent and Short and/or Medium Terms Action Plans

Priority	Plan	Note
Urgent Action Plans		
Priority-1	Meter Installation in Koror - Airai	Meter is the basic tool for management of water distribution. PPUC has been conducting this action since April 2014. It should be completed promptly.
Priority-2	Strengthening Transmission Main (additional transmission main)	The capacity of the existing transmission main has been insufficient. It is placed in a risky condition for the sudden stoppage of water transmission. This action should be conducted as soon as possible.
Priority-3	Modification of Distribution Zones (Re-arrangement of zones)	There are low pressure areas and a direct distribution zone where the flow / pressure control is difficult. Since such troubles appear on the network, this should be conducted as a higher component.
	Establishment of Malakal Zone and Transmission Main to Malakal Tank	Establishment of Malakal Distribution Zone is indispensable for the re-arrangement / modification of distribution zones for Koror - Airai. It should be a part of the action for modification of distribution zones.
	Management for Water Flow and Pressure (Soft Approach)	Along with the facilities construction / re-arrangement, management system should be established for management of water distribution and NRW, including data management for consumptions.
	Leak Detection (Soft Approach)	Staff members and equipment for leak detection are not enough for NRW management of the existing distribution networks. It is recommended to promote leak detection skills along with the improvement of water distribution management.
Priority-4	Replacement of Major Distribution Lines	To promote efficiency for water supply, the reduction of NRW / leakage is prioritized actions. As the first step, the major pipelines (8.1mi or 13km) are recommended to be replaced.
Short / Medium Terms Action Plans (5 - 10 years)		
Priority-5	Small Scale Water Supply Systems in Babeldaob	Since the issues are related to water quality, this is one of urgent actions. It is, however, not placed in urgent actions due to investment efficiency of the action. It is recommended commencing the action soon and complete within short term.
Priority-6	Painting the Existing Tanks	This action is not so difficult and costly. As one of periodical maintenances, it should be conducted promptly.
Priority-7	Rehabilitation of Koror - Airai Water Treatment Plant (KAWTP)	Including necessary land acquisition, a plan for rehabilitation should be formulated within a few years. After then, the rehabilitation works should be undertaken in short term.
	Improvement of Water Quality Monitoring System (Soft Approach)	Water quality monitoring system should be established, considering water safety plan. It includes skill trainings, equipment provision and formulation of a permanent team.
Priority-8	Improvement of Ngerikiil Intake Pump Station	As the exiting pumps and auxiliary equipment are deteriorated. A risk for sudden stoppage will be increased according to ages. It is recommended to conduct this action earlier in short term.
Priority-9	Improvement of Ngerimel Dam	As priority for water resources development is less, it should be managed within medium term. It is, however, recommended to be undertaken before development of Airai well field.
Priority-10	Establishment of Airai Well Field	It is less prioritized than the Improvement of Ngerimel Dam. Study for this component should be undertaken along with monitoring the NRW reduction.
	Establishment of Well Management Section (Soft Approach)	Once well field developed, a management section is necessary. Along with the facilities construction, PPUC should formulate a permanent team with enough technical trainings and equipment.
Priority-11	Replacement of Remained AC Pipelines (Continue after the project mentioned in the priority-3)	The major AC pipes are planned to be replaced within 6 years (8 years if adding preparation period). It should be managed within short / medium terms.

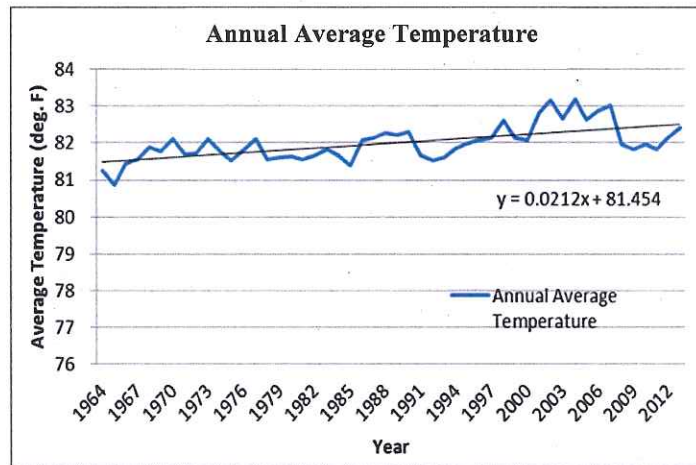
III. Description of the Environment

A. Physical Resources

1. Climate

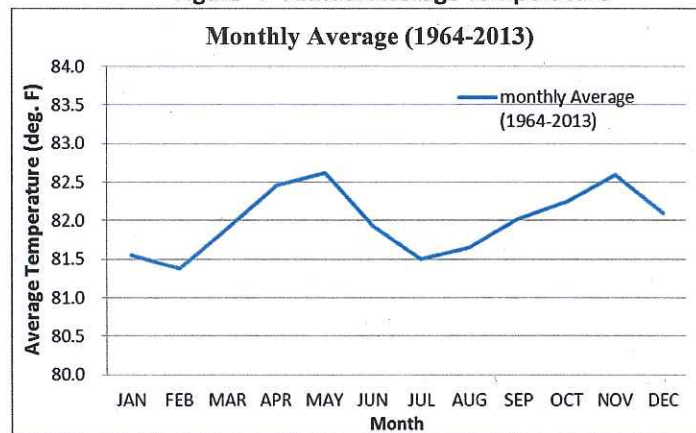
Palau has a tropical monsoon climate characterized by seasonal variation in precipitation, moderately warm temperatures, and high humidity. Two seasons are generally recognized as a rainy season from May to December and a dry season from January to April.

The average daily temperature is 82.0°F (27.8°C). The fluctuation of the temperature by season is relatively small (1.2°F or 0.7°C). The annual average temperature has increased at a rate of 0.21 °F (0.11°C) per decade since 1964 as shown in **Figure -7 and -8**.



Source: NOAA's National Climatic Data Center (NCDC)

Figure -7 Annual Average Temperature

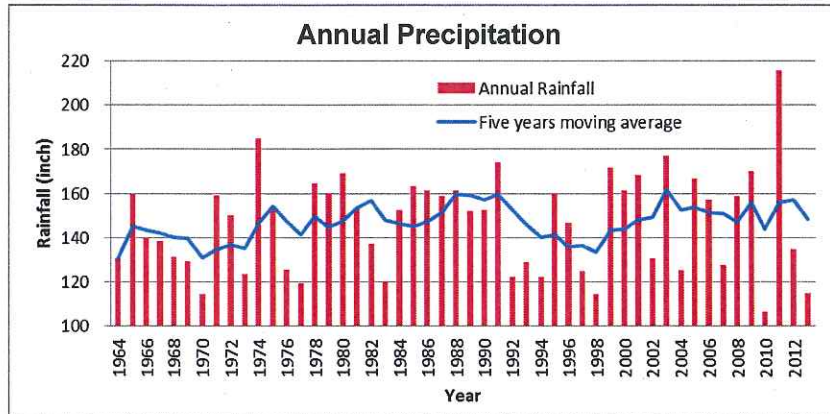


Source: NOAA's National Climatic Data Center (NCDC)

Figure -8 Monthly Average Temperature

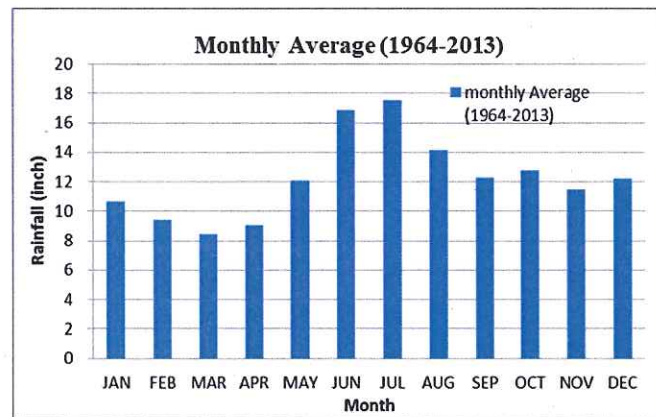
Precipitation is heavy throughout the year, and the annual average is 147 inches (3,734 mm). More than about 8 inches (200 mm) precipitation is recorded every month. The maximum precipitation

is recorded in July, the least in March as in **Figure-9** and **-10**.



Source: NOAA's National Climatic Data Center (NCDC)

Figure -9 Annual Average precipitation



Source: NOAA's National Climatic Data Center (NCDC)

Figure -10 Monthly Average precipitation

2. Geology, Soils and Topography

2-1. General Geology

The geology of the Palau Archipelago is quite variable and complex and a simplified the general geological conditions within the survey area are described below.

The geology of Palau consists of mainly volcanic rocks and coral limestone as shown in **Table -5**. Volcanic rocks are classified into basalt, andesite and dacite, which erupted on the bottom of the sea. Subsequently the volcanic rocks were lifted up above the sea to form the basement of the islands.

On the other hand, the coral limestone was originally deposited covering the volcanic rocks on the bottom of the sea. Subsequently the limestone was lifted up above the sea to form the small islands that are currently called as Rock Islands. Rock Islands show characteristic Karst topography with several sinkholes.

Table -5 Geology of Palau

Age	Formation		Lithology	
Holocene	Palau coral limestone	Alluvium beach deposit	Limestone	Sand, silt, clay
Pleistocene		Terrace gravels		Sand and gravel
Pliocene		Airai Clay		Shale and shaley siltstone and pebble conglomerate
Oligocene	Ngeremlengui		Andesitic and dacitic volcanic breccia with tuff, flow conglomerate	
Eocene	Aimeliik Formation		Basaltic andesite volcanic breccia, tuff breccia and tuff	
	Babledaob Formation		Basalt and basaltic andesite flow a and flow breccia's	

Source: "History and Geology of Palau Islands" (1990)

Coastal terraces were well developed in the survey area. There are five main types of island landforms within the Palau Archipelago; volcanic, high limestone low platform and atoll or reef islands. Some islands have a combination of landform.

There are 5 coastal plains recognized in Babeldaob Island as summarized in [Table -6](#).

Table -6 Classification of Coastal Terrace Plain

Plain classification	Altitude	Condition of the Terrace plain
1 st plain	240m above sea level	Peneplain
2 nd plain	100m above sea level	Erosional plain
3 rd plain	40m above sea level	Deposited plain
4 th plain	20m above sea level	Deposited plain
5 th plain	2m above sea level	Current alluvial plain

Source: "Topography, Geology, and coral reef of Palau Islands" (1935)

2-2. Hydrogeology

There are relatively many areas with flat plains and gentle slopes in Babeldaob, Koror, Arakabesang and Malakal islands, where people can reside. Basaltic tuff breccia is distributed in those islands.

On the other hand, steep slopes face the sea directly in the other islands called as Rock Islands, where people cannot reside. Coral limestone is distributed in those islands. The characteristics of the aquifer in the survey area are shown in [Table -7](#). Airai area of Babeldaob Island is proposed as a candidate for groundwater development of this survey considering both aquifer potential and accumulation of the existing data for groundwater development.

Table -7 Hydrogeological Aquifer Conditions

Hydrogeology	Distribution area	Aquifer characteristics
Andesitic tuff breccia	Babeldaob Koror, Arakabesang, Malakal	Aquifer consists of weathered parts of tuff breccia. It seems that sea water intrudes into aquifer, though the toe of the interface between fresh and salt water has not yet reached the inland area. Groundwater development is more suitable for larger islands.
Limestone	Rock Islands	Limestone is originated from the coral reef with extreme high permeability. Groundwater is distributed as fresh water lens beneath the entire islands. It is expected that sea water will easily intrude into boreholes by pumping. Rock Islands show too steep slopes to set borehole drilling machines within islands. Therefore, groundwater development is not possible in the Rock islands.

Source: "History and Geology of Palau Islands" (1990) but arranged by JICA Survey Team

Groundwater was initially evaluated under ADB in July-August 2008 by 24 hour pumping of three existing boreholes to gain a preliminary estimate of their yield. The results of this initial work were encouraging as those boreholes tested were indicated to have a short-term yield of 25 -60 gpm. These boreholes are each over 20 years old and new boreholes drilled to greater depth and of larger diameter could be expected to have a significantly sustainable yield; up to 100 gpm.

A more comprehensive pump test program was planned to be carried out during February-April 2009, however due to the limited local availability of drilling equipment and operating expertise the additional work was limited to the construction of new boreholes and one nearby monitoring installation. In addition a PVC standpipe was installed in one the older boreholes to enable the monitoring of the response to pumping up to 200m away from the new borehole.

The results of the groundwater evaluation by ADB report are considered to indicate that a viable source of supplementary supply of up to 1 MGD is likely to be available from a wellfield, comprising 10 to 15 boreholes, located along the shallow valley of the Ikoranges watercourse between the Ngerikiil Pump station and the Ngerimel Reservoir. These boreholes would be connected via a new water pipeline to the existing Airai water treatment plant.

3. Surface Water

The survey area is blessed with ample surface water resources from generous rainfall distributed relatively evenly over the year. The rainfall runoff determined at four gauging stations on Babeldaob by USGS (1984) indicates about 70% of rainfall discharges to the ocean, amounting to some 275 billion gallons of water annually. The uniformity of rainfall and basin characteristics is shown by an excellent correlation between mean annual rainfall and streamflow measured at gauging stations.

The surface water resource of the Ngerikiil River is of special relevance. The Ngerikiil watershed covers over 2,850 ha and the river is fed by three main tributaries: the Edeng, the Kmekumel and the Ikoranges watercourses.

The EQPB carried out a water monitoring study (EQPB 2000) of the Ngerikiil River involving water sampling and analysis from 5 locations at monthly intervals over the period from October 1999 to June 2000.

These results indicate the water in Ngerikiil River during this monitoring period was highly variable

in turbidity, total suspended solids, fecal coliforms and pH, whereas temperature and dissolve oxygen (DO) were quite consistent. The fecal coliform results indicate a level of pollution with pathogenic organisms, which, together with the periodically high turbidity levels, confirms the need for treatment of this water prior to entry to the water supply system. The DO levels indicate a high ability to support aquatic biota. Nitrate was only detected at the most downstream location, most likely reflecting a low level of contamination from farm fertilizer.

Coastal Waters

Palau has a coastline of over 1,500 km (SOPAC 2007) and a reef area that encompasses nearly all of the islands and supports a diverse and highly prized shallow reef ecosystem. Human influences on water temperatures, seawater chemistry (toxic substances and nutrients), the spread of diseases, removal of species, and food web alterations are presently changing reef ecology. The 2001 International Panel on Climate Change (IPCC) predicts a rise of between 0.2 and 0.9m in sea level by year 2100.

Hydrogeology and Groundwater Resources

The unweathered parent volcanic bedrock underlying the islands involved in this project is most unlikely to contain significant aquifers. This is because the fresh rock is very dense, has low porosity and typically very few discontinuities (joints, fractures or defects) to store and transmit groundwater. However the zone of weathered material, overlying the fresh rock commonly has a greater primary porosity and significantly more discontinuities and therefore, has the potential to contain aquifers.

The overburden soil covering the sideslope and higher elevation areas, which is derived from complete decomposition of the volcanic rock, is typically clayey resulting in relatively high surface runoff and consequently minor infiltration. However in the lower elevation areas which occur along the coastal fringe and within the valley floor areas the surface soils comprise alluvial or colluvial soils which may contain sandy, more permeable layers or zones which may form localized aquifers and/or they may provide conduits to recharge potential aquifers within the underlying weathered bedrock.

Limestone formations are generally highly permeable, have high storage capability and commonly provide high yield aquifers. However there are only limited limestone zones within the project area on Koror and Malakal Islands.

During the mid 1980's a groundwater study was carried out in the area between the surface water collection points on the Ngerimel and Ngrikil River systems in Airai. This study was commissioned following a significant 'dry' period during 1983 as part of an evaluation of proposed water supply for various Palau rural water systems mostly on Babeldaub and Koror. (Nance 1986) This study involved the drilling a series of exploration bores, some of which were converted to wells and subsequent pump testing was carried out. The wells varied in pumping capacity from 25 to 85 gpm.

A Comprehensive Groundwater Protection Strategy report prepared in 1996 (WinzlerKelly 1996) referred to the previous investigation work and concluded that "this groundwater development showed significant potential for future success and could supply an additional 0.48Mgpd (20 hr/day) of very high quality water" and "preliminary results also demonstrate that a substantially greater groundwater supply could be developed through further well development." However a recommendation is made that further pumping tests are required to determine a safe yield.

B. Biological Resources

1. Habitats

Terrestrial habitat in Palau includes upland (volcanic, both primary and secondary), mangrove, swamp, high limestone (including the Rock Island forests), low limestone and atoll (strand) forests. Savannas and grasslands are also prevalent on Babeldaob and parts of Koror and are covered by a mixture of bare soil, ferns, grasses, and shrubs. Freshwater habitats are found in lakes (natural and manmade), streams, and rivers. Estuarine, brackish water habitats are found at the mouths of rivers and in embayments along shorelines. Coral reef habitats are found offshore. (Holm et. al. 2008). Approximately 70% of Palau's forest consists of upland forest, distributed throughout Babeldaob and Koror. Mangroves comprise 15% of Palau's forests and cover 80% of Babeldaob's coastline, mostly the west coast, parts of Koror and vicinity, and the island of Peleliu.

Agroforest is often found along coasts and near villages, consisting of a mixture of native and introduced species. Upland and limestone forests are important for much of Palau's vertebrate biodiversity. All of Palau's endemic birds use forests during some or all of their lives. Deforested lands often become savannas, especially if the areas are subject to repeated burning. Streams and rivers support rich riparian habitats that are essential to many of Palau's species. Erosion and sedimentation, in some areas, have inevitably made their way to the coral reefs, which can potentially impact the tourism industry. Palau's network of protected areas covers over 40% of near-shore marine areas and 18% of terrestrial habitats. There are 36 protected areas, which have been established for a variety of different reasons. Whether the existing network fully protects the whole range of Palau's biodiversity is unknown. (Holm et.al., 2008)

2. Floristic Diversity

Palau upland forest is the most diverse vegetative community in Micronesia. (SOPAC 2007) One survey recorded over 342 plant species of which 243 were native, 60 species were endemic to Palau and another 31 were introduced. A total of 36 important forest areas or individual rare trees were identified primarily in upland forests. Palau has approximately 203 species of endemic plants and 50 additional species that are candidate endemics. Of these, about 72 are endemic to Babeldaob Island. (Costion 2006) Another source estimates that a total of 165 of the total number of endemic plant species, or 82%, are recorded from Babeldaob. (Holm 2004)

Some agroforest or plantation areas are found close to villages, which support a variety of tropical trees and crops, including bananas, papaya, tapioca, dryland taro and sweet potato vines. Medicinal plants are found in a variety of terrestrial ecosystems and weaving materials are gathered from the forest. Timber harvest involves small-scale operations that cut trees for housing supports, furniture and carved storyboards. (Holm et.al., 2008)

C. Human and Economic Development

Population and Socio-Economic Conditions Related to Water Supply and Sewerage Plans

1. Population

1-1. Trend of Population from 1990 to 2012

According to the Bureau of Budget & Planning, Ministry of Finance, the population of Palau is decreasing from 2005 and Koror from 2000 as shown in [Table -8](#) and [Figure -11](#).

Effective measures have not been taken against the population decrease. It is, therefore, forecast that the population decrease will continue for a several next years.

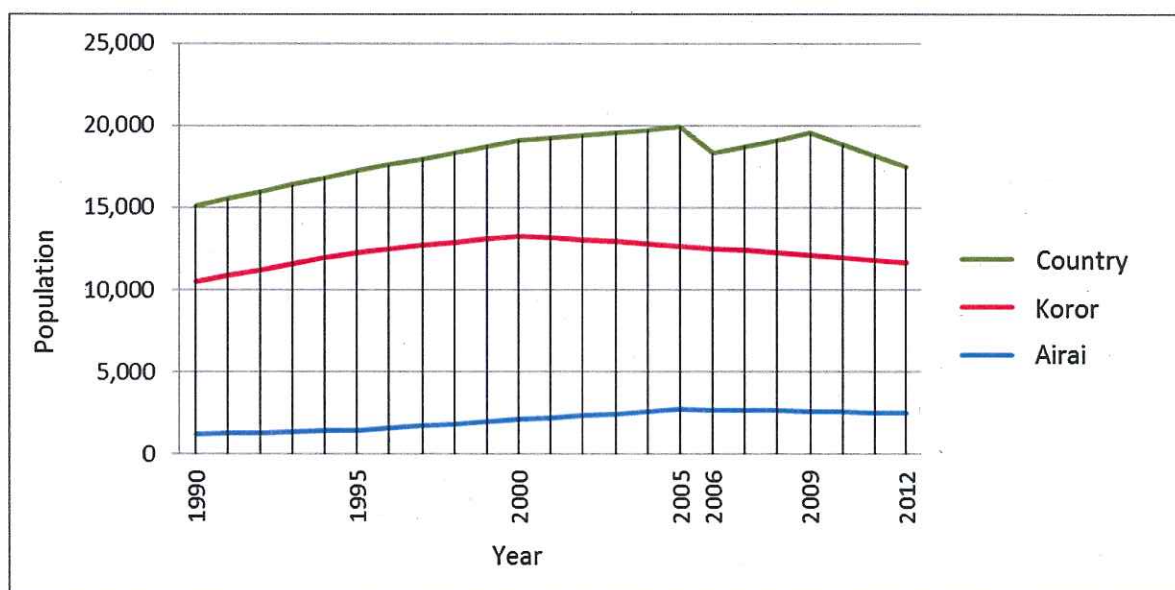
Table -8 Trend of Population from 1990 to 2012

Area	1990	1995	2000	2005	2006	2009	2012	Increase Ratio
Population: Whole Country	15,122	17,225	19,129	19,907	18,324	19,535	17,501	-1.7%
Population: Koror	10,501	12,299	13,303	12,676	N/A	N/A	11,665	-1.1%
Population: Airai	1,234	1,481	2,104	2,723	N/A	N/A	2,537	-1.0%

"Increase Ratio" is shown between 2005 and 2012.

Population's per State are not available in Statistical Yearbook 2013 such as 2006 and 2009.

Data Source: Statistical Yearbook 2013 and 2005 Census Monograph



Source: JICA Survey Team, based on Statistical Yearbook 2013 and 2005 Census Monograph

Figure -11 Tendency of Population from 1990 to 2012

1-2. Population Forecast for Koror and Airai

GoP has not officially authorized forecasts of the future population. The forecast will be conducted by the next census which GoP is planning to conduct in 2015. Therefore, the future population is estimated as follows:

1) High Scenario

The survey team assumed, as the high scenario, that the population will remain unchanged until 2020. It was assumed that effective solutions will be taken by GoP in the near future against the population decrease. The population forecast is shown in Table -9.

Table -9 Population Forecast (High Scenario)

Area	2012	2013	2014	2015	2016	2017	2018	2019	2020
Population: Koror	11,665	11,665	11,665	11,665	11,665	11,665	11,665	11,665	11,665
Population: Airai	2,537	2,537	2,537	2,537	2,537	2,537	2,537	2,537	2,537
Total	14,202	14,202	14,202	14,202	14,202	14,202	14,202	14,202	14,202

Data Source: JICA Survey Team, based on Statistical Yearbook 2013

2) Low Scenario

The low scenario was calculated by the population increase ratio between 2005 and 2012, which shows the decreasing tendency. It was assumed that no solution is taken by GoP for the population decrease. Utilizing the population increase ratio of -1.1% and -1.0% for Koror and Airai, respectively. The population is estimated as shown in Table -10.

Table -10 Population Forecast (Low Scenario)

Area	2012	2013	2014	2015	2016	2017	2018	2019	2020
Population: Koror	11,665	11,537	11,410	11,284	11,160	11,037	10,916	10,796	10,677
Population: Airai	2,537	2,512	2,487	2,462	2,437	2,413	2,389	2,365	2,341
Total	14,202	14,049	13,897	13,746	13,597	13,450	13,305	13,161	13,018

Data Source: JICA Survey Team, based on Statistical Yearbook 2013

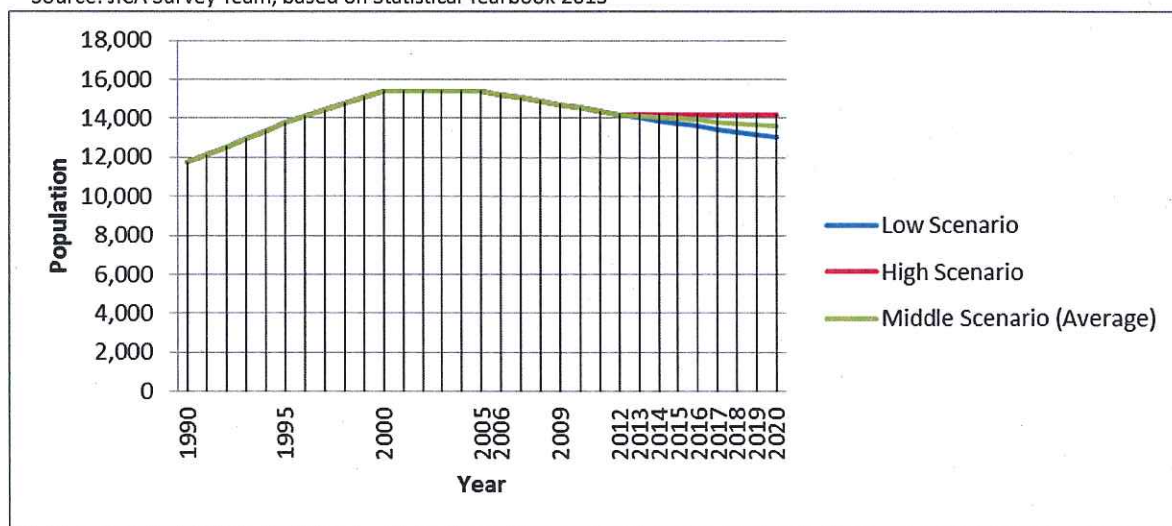
3) Preliminary Result of Planned Population

The above two estimations shows the high and low scenarios of the population growth. However, assuming some countermeasures are taken by GoP against the population decrease, the Team selected the average value of the two scenarios as the population forecast to be used in the Project design.

Table-11 Population Forecast (Middle Scenario: Planned Population)

Area	2012	2013	2014	2015	2016	2017	2018	2019	2020
Population: Koror	11,665	11,601	11,538	11,475	11,413	11,351	11,291	11,231	11,171
Population: Airai	2,537	2,525	2,512	2,500	2,487	2,475	2,463	2,451	2,439
Total	14,202	14,126	14,050	13,975	13,900	13,826	13,754	13,682	13,610

Source: JICA Survey Team, based on Statistical Yearbook 2013



Source: JICA Survey Team, based on Statistical Yearbook 2013 and 2005 Census Monograph

Figure-12 Comparison of Population Forecast

1-3. Number of Foreign Visitors

(1) Increasing Trend of Foreign Visitors

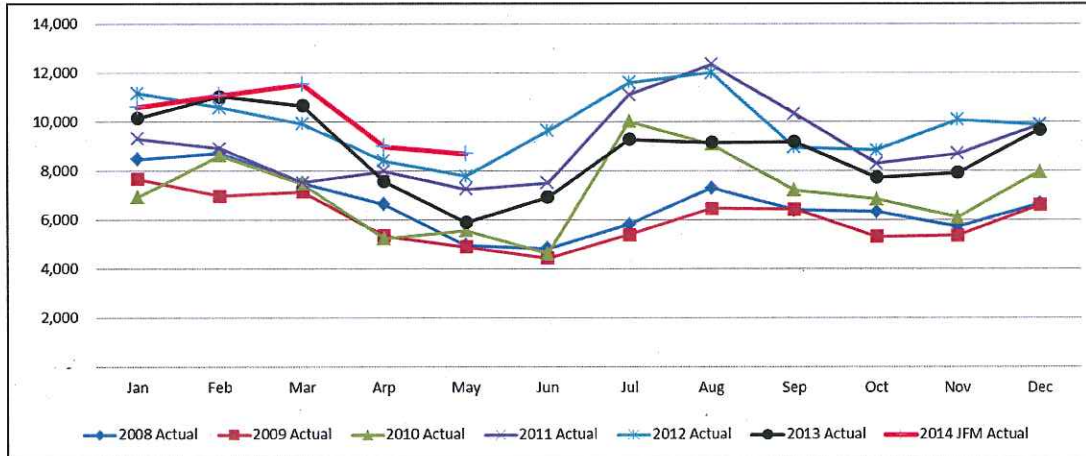
Palau receives more than 100 thousand of foreign visitors per year against its population which is less than 20 thousand. An international airport for Palau is located in Airai. Koror is a main area for business and tourism of foreign visitors, and 93% of rooms for accommodation facilities, such as hotels, are concentrated in Koror. Therefore, the number of foreign visitors is indispensable to estimate socio-economic activities as well as water demand for Koror - Airai water supply system.

The Palau Visitors Authority (PVA) reported an increasing trend of the foreign visitors as shown in Table -12 and Figure -13. In general, the 1st and 2nd peaks are recorded in July - August and January - February. The 2011 – 2013 data shows that visitors in the peak season are 1.27 times of the average number of visitors.

Table -12 Trend of Foreign Visitors

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2008	8,467	8,726	7,500	6,623	4,945	4,817	5,801	7,281	6,389	6,327	5,719	6,664	79,259
2009	7,656	6,964	7,148	5,329	4,878	4,428	5,385	6,456	6,411	5,300	5,345	6,587	71,887
2010	6,909	8,630	7,463	5,233	5,568	4,610	10,008	9,078	7,203	6,833	6,096	7,962	85,593
2011	9,308	8,905	7,515	7,979	7,240	7,489	11,091	12,335	10,327	8,286	8,693	9,889	109,057
2012	11,161	10,577	9,909	8,402	7,770	9,627	11,591	12,002	8,949	8,829	10,075	9,862	118,754
2013	10,141	11,030	10,657	7,558	5,879	6,909	9,264	9,140	9,173	7,722	7,909	9,679	105,061
2014	10,597	11,073	11,528	8,975	8,691								50,864

Data Source: Palau Visitor Authority



Source: Palau Visitors Authority

Figure -13 Trend of Foreign Visitors

Although GoP has no officially authorized forecasts of foreign visitors, PVA has its own estimate of visitors for the coming two years (for 2014 and 2015). The PVA estimate shows an increasing trend of the number of foreign visitors.

Table-13 Forecast of Foreign Visitors (PVA)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2014	10,597	11,073	11,528	8,975	8,691	8,007	11,058	10,501	9,541	8,118	9,080	10,123	117,292
2015	11,407	11,861	11,895	9,255	7,520	9,348	12,759	12,106	10,674	9,090	10,301	11,318	132,616

Data Source: Palau Visitors Authority (but adjusted by the Team for 2014)

(2) Forecast of Foreign Visitors

Number of foreign visitors is a significant parameter to estimate the socio-economic scale of Koror - Airai. The increasing number of foreign visitors should be considered in the water demand forecast. According to PVA, average period of stays of the foreign visitors is approximately 4 days per person. 118,754 persons, which are 2012 visitors and the highest record of foreign visitors, are converted into approximately 1,301 persons per day. It is more than 10% of the population of Koror. The number of foreign visitors is forecasted at 169,351 in 2020 as shown in Table -13 and Figure -13. The Team took the following into account in the forecasting:

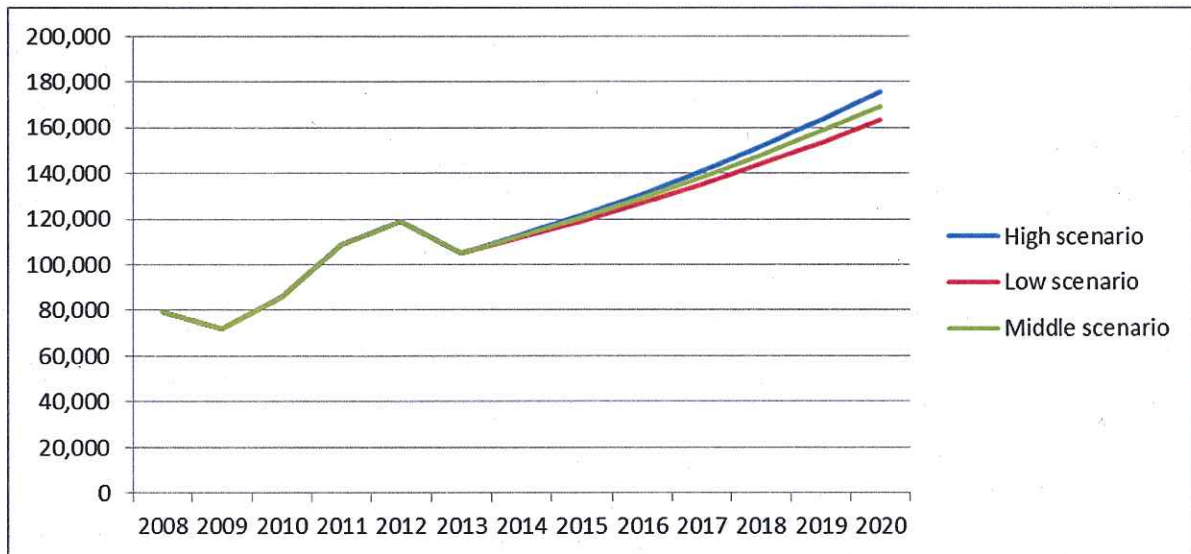
- 1) Since the Japan's Grant Aid is extended for urgent issues, the Team forecasts the water demand until 2020. In order to forecast the number of foreign visitors for the coming 5 - 6 years, a short-term history of trend for around 5 years is appropriate. The sharp increase for 3 years between 2010 and 2013 and the moderate one for 5 years between 2008 and 2013 on the number of foreign visitors should be taken into consideration.
- 2) Increase ratio for the 3 years between 2010 and 2013, which is 7.6% per year, is applied for estimation of high scenario.
- 3) Increase ratio for the 5 years between 2008 and 2013, which is 6.5% per year, is applied for estimation of low scenario.
- 4) The averages of the above figures (middle scenario) are preliminary applied for the Project as the forecast of foreign visitors.

Assuming the average staying period of foreign visitors at 4 days, 169,351 persons per year are converted to 1,856 persons per day.

Table-14 Forecast of Foreign Visitors for the Project

Category	2008	2009	2010	2011	2012	2013	2014
High scenario	79,259	71,887	85,593	109,057	118,754	105,061	113,046
Low scenario	79,259	71,887	85,593	109,057	118,754	105,061	111,890
Middle scenario	79,259	71,887	85,593	109,057	118,754	105,061	112,468
Category	2015	2016	2017	2018	2019	2020	
High scenario	121,637	130,881	140,828	151,531	163,047	175,439	
Low scenario	119,163	126,909	135,158	143,943	153,299	163,263	
Middle scenario	120,400	128,895	137,993	147,737	158,173	169,351	

Data Source: Palau Visitors Authority until 2013



Source: JICA Survey Team, based on Palau Visitors Authority Data until 2013

Figure -14 Forecast of Foreign Visitors

2. Economic Development

Non-Domestic Consumption depends on socio-economical activities and scale. Table 2.1-8 shows the recent trend of Gross Domestic Product (GDP) by industry. The total scale of GDP is in increasing trend for the recent five years. It is clear that "transportation and storage" and "accommodation and food service" industries, which reflect the scale of foreign visitors, are increasing, and they contribute to the GDP development as shown in Table-15. They also account for 26% of total GDP.

The "public administration" is in flat trend for the five years.

The mentioned GDP trend should be reflected in the demand forecast.

Table -15 GDP by Industry

Industry	Constant Prices of FY2005, in US\$ millions						
	FY07	FY08	FY09	FY10	FY11	FY12	FY13 ¹
Agriculture and forestry	2.6	2.7	2.5	2.4	2.3	2.3	2.2
Fishing	7.5	7.0	5.7	5.4	5.4	5.5	5.5
Mining and quarrying	1.5	1.5	1.1	0.8	0.8	0.9	0.6
Manufacturing	1.4	1.6	1.4	1.3	1.5	1.7	1.9
Electricity, gas, steam and air conditioning supply	0.7	0.7	0.8	0.9	0.9	0.8	0.8
Water supply, sewerage, waste management and remediation activities	1.2	1.2	1.2	1.1	1.0	1.0	1.1
Construction	20.8	14.9	9.6	10.5	11.4	10.2	7.5
Wholesale and retail trade, repair of motor vehicles and motorcycles	26.7	26.8	21.8	23.1	24.4	26.0	28.5
Transportation and storage	8.5	8.3	7.7	8.5	10.1	11.4	10.8
Accommodation and food service activities	26.6	24.7	22.4	25.6	29.4	35.3	35.1
Information and communication	6.8	7.5	7.2	6.8	6.9	7.6	7.7
Financial Intermediation	9.0	7.9	7.7	7.7	8.3	9.5	9.5
Real estate activities	16.4	16.9	16.7	16.1	16.5	16.0	16.3
Professional, scientific and technical activities	2.4	2.0	1.7	2.0	1.7	1.5	1.6
Administrative and support service activities	2.3	2.0	1.7	2.0	2.2	2.4	2.5
Public Administration	29.0	28.8	28.5	28.4	27.6	27.5	27.9
Education	9.2	9.0	8.9	8.9	8.7	8.4	8.0
Human health and social work activities	6.0	5.9	5.6	5.9	6.0	6.1	6.6
Arts, entertainment and recreation	1.6	1.4	1.4	1.6	1.9	2.2	1.9
Other service activities	2.2	1.8	1.7	1.7	1.8	1.9	1.8
Private Households With Employed Persons	3.9	3.6	3.4	3.3	3.0	2.6	2.3
less intermediate FISIM	-2.6	-2.5	-2.6	-2.8	-2.8	-2.7	-2.7
GDP at basic prices	183.7	173.9	158.2	160.9	168.9	178.0	177.3
Taxes on products	23.6	22.0	18.8	19.8	21.4	23.1	23.1
less subsidies	-0.4	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
GDP at purchasers prices	206.9	195.4	174.4	180.2	189.8	200.6	199.9

Source: 2013 Statistical Yearbook, Bureau of Budget & Planning, Ministry of Finance

Table -16 Increase / Decrease of GDP

Category	2009	2010	2011	2012	2013
Total GDP (Million USD)	156.2	160.9	168.9	178.0	177.3
Increase from previous year		4.7	8.0	9.1	-0.7
Activities related to Foreign Visitors					
Accommodation & food service	22.4	25.6	29.4	35.3	35.1
Transport and storage	7.7	8.5	10.1	11.4	10.8
Sub-Total	30.1	34.1	39.5	46.7	45.9
Increase from previous year		4.0	5.4	7.2	-0.8
Public Administration	28.5	28.4	27.6	27.5	27.9
Increase from previous year		-0.1	-0.8	-0.1	0.4

Source: 2013 Statistical Yearbook, Bureau of Budget & Planning, Ministry of Finance

Palau has a significant history of foreign occupation and administration (Otto 1998). Spain sent missionaries in the late 19th century, Germany then developed copra and mining operations, and later Japan used the islands first as a source for marine products and later as a strategic military base during World War II.

The Japanese administration had a great impact on Palau's land management systems, as new land tenure systems were created, dryland farming was encouraged and supported, commercial mining operations were opened, and roads, buildings and settlements were built. The population during the peak of the Japanese administration consisted of 30,000 Japanese, Okinawans and Koreans and only 5,000 Palauans. In 1944, American forces bombed Japanese military and commercial sites in Palau. Peleliu was completely deforested as a result of the heavy bombing, and locations in southern Babeldaob, especially in Airai and Aimeliik, received considerable damage as well. After the war, Palau fell under the administration of the United States as part of the United Nations Trust Territory of the Pacific Islands. On October 1, 1994 the new nation of Palau was born. Under the Compact of Free Association, Palau receives trust funds plus fifteen years of budgetary support to decline at five year intervals over the fifteen years. (Otto 1998, p.16) Palau granted the US control of security and defense for 50 years, and exclusive access to limited land areas.

Per capita income in 2004 was \$6,870. The Palauan economy has been dominated by the public sector for many decades, and public administration is currently estimated to account for 26–27% of GDP. (JICA 2005) The national economy in Palau is dependent on foreign aid. The largest and fastest growing industry in the country is tourism, which rose to 66,000 visitors in 1997 before declining to 54,000 in 2001. However tourism is diversifying with increased arrivals from Korea and Europe to balance the traditional arrivals from Japan and Taiwan. The Palauan economy is narrow and the services sector accounts for 83% of GDP. Agriculture, forestry, and fishing activity are low—the sector is estimated to represent only 4% of GDP. Although the agriculture and fisheries sector makes only a small contribution to GDP, it provides the main livelihood for about 20% of Palau's population, which lives far from Koror. In addition to the cash economy in Palau, there is a strong subsistence economy. Fish, crops and other food items are collected or grown for subsistence.

JICA (2005) reports that most of the employment growth is among foreign workers, which in the years 1994—2003 grew at an average of 9.3% per year as compared to 1.6% per year for Palauans. In 1994, there were almost two Palauans working in the formal economy for every foreign worker; however by 2001, there were as many foreign workers as Palauans in the formal economy.

2-1 Population

Arrival of humans is thought to have occurred between 3000 and 5000 years ago. The Palauan population through history has been estimated to range from 25,000-50,000 to just 4,000 people. The population of Palau was 19,200 in 2000, with an additional 6,500 Palauans living abroad. The latest population estimate (2005) was 20,303. Average annual population growth was 2.4% (1990–1999), which slowed to 1.9% (2000–2003). The median age increased from 25.6 years (1990) to 30.8 years (2000), while the dependency ratio decreased from 57.0 (1990) to 51.0 (1995) to 41.4 (2000). (JICA 2005). Seventy-three percent of the population is ethnic Palauan and the remaining 27% comprises primarily people from the Philippines, Japan, China, United States and other Micronesian Islands. Some 24% of

the Palau population is younger than 24 years, with 70% between the age of 14 and 65, and 6% older than 65. The urban population is estimated at 78% of the total.

2-2 Urban Infrastructure

Ground transportation was limited until recently with the majority of paved roads centered in Koror and Airai. The recent completion of the 85 km long Compact Road more than doubled the nation's transportation network and made all 10 Babeldaob states accessible by car. Transportation to outlying islands is still by boat and access to the islands outside the main archipelago is severely limited by sea and weather conditions. (Holm et.al. 2008)

Government monopolies operate communication and electricity services, and supply water and sewerage services to Koror and its surroundings. The communications and electricity services are controlled by independent boards that set their own prices, and the stevedoring operation also enjoys price setting privileges. Water, sanitation and waste disposal services are supplied by government ministries which control price levels. (JICA 2005)

D. Culture and Quality of Life Values

Anthropological research has been carried out in Palau for the Trust Territory government by McKnight and previously by Endo, followed by Kramer, under the auspices of the Japanese and German administrations. Present work in historic preservation is conceived and directed by Palauans. Local people set priorities based on an indigenous understanding of what is valued and what has the potential to make the greatest contribution to preserving Palau's traditional culture. The Historic Preservation Office (HPO) of the ROP currently leads that effort. The ethnography/oral history section of the HPO arranges regular sessions of the Society of Historians whose members are appointed in consultation with the president of the Republic and the state government. An Historian is appointed from each state. Members meet to discuss traditions long held within the community to ensure that younger people are exposed to traditional ideas. The survey and inventory section of the HPO assists in the preservation of important cultural sites. When a development project submits an application for historic clearance it is often the case that the survey section must inspect the site, and may assist the survey section in determining land ownership and use. (Holyoak 2001)

While Palau is subject to extensive acculturative forces, there is ample evidence that culture change in Palau is not monolithic. In contemporary Palau, the people are aware of the importance of their Palauan identity and of the role that their traditions play in creating and maintaining that identity. As development proceeds here, so does the consciousness of its potential effects on lifeways and values. (Holyoak 2001)

IV. Screening of Potential Impacts and Mitigation Measures

Environmental Checklist: 14. Water Supply (1)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations(Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) No. (b) No. (c) No. (d) No.	(a) IEE report have been prepared and submitted EQPB, and then the project is very important for safe drinking water supply and environmental impacts is minimized and the urgent benefits to residents, therefore IEE is approved and enough considerations as same as EIA approval. (b), (c), and (d) is same as on the above (a).
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) Yes (b) Yes	(a) PPUC is responsible to explain the potential impacts together with benefits and important infrastructures of public water supply system improvement for the residents. Koror-Airai. PPUC is explained the Local stakeholders through JICA survey and the project implementation stages. (b) There is no serious comment from the stakeholders.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Yes	(a) We have examined the alternative plans, especially the location of Malakal water service tank.
2 Pollution Control	(1) Air Quality	(a) Is there a possibility that chlorine from chlorine storage facilities and chlorine injection facilities will cause air pollution? Are any mitigating measures taken? (b) Do chlorine concentrations within the working environments comply with the country's occupational health and safety standards?	(a) No. (b) Yes	(a) There is no air pollution because the project is not include any chlorine nor chlorine facilities. (b) Under the working environment we consider carefully the country's occupational health and safety standards.
	(2) Water Quality	(a) Do pollutants, such as SS, BOD, COD contained in effluents discharged by the facility operations comply with the country's effluent standards?	(a) No.	(a) Under the project there is not include pollutants such as SS, BOD, COD.
	(3) Wastes	(a) Are wastes, such as sludge generated by the facility operations properly treated and disposed in accordance with the country's regulations?	(a) Yes	(a) Yes, the waste such as sludge is properly treated and disposed in accordance with the country's regulations.
	(4) Noise and Vibration	(a) Do noise and vibrations generated from the facilities, such as pumping stations comply with the country's standards?	(a) No.	(a) There is no country's standards for noise such as pumping station.
	(5) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	(a) No.	(a) This project is not pumping groundwater, therefore there are no problems of land subsidence.
3 Natural Environment	(1) Protected Areas	(a) Is the project site or discharge area located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) No.	(a) There is no possibility that the project will affect the protected areas because water treatment plant and water tank is far away from the city and the protected areas.

Environmental Checklist: 14. Water Supply (2)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
3 Natural Environment	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site or discharge area encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	(a) No. (b) No. (c) Yes (d) No.	(a) There is no sign of use of the proposed site by fauna, but Koror State explained the illegal farming shall be removed under responsibility of State without any conflicts. (b) The protected site designated by the international treaties and conventions does not exist. (c) If we can find impact we do the protection, but the impact is limited at the site and no significant impact on the ecosystem. (d) The intake amount of water is increased this project and limited small.
	(3) Hydrology	(a) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect surface water and groundwater flows?	(a) No.	(a) The project is not use the amount of surface water.
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Is the compensation going to be paid prior to the resettlement? (e) Is the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a) No. (b) No. (c) No. (d) No. (e) No. (f) No. (g) No. (h) No. (i) No. (j) No.	There is not any involuntary resettlement included in this project such as: (a), (b), (c), (d), (e), (f), (g), (h), (i), and (j).

Environmental Checklist: 14. Water Supply (3)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
4 Social Environment	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (b) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect the existing water uses and water area uses?	(a) Yes (b) No	(a) The project will contribute to improve the living conditions of inhabitants. (b) Surface water is only water source for this project, and the amount of water does not increase the volume based on the future demand projection.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) No	(a) There is no site of the local archeological, historical, cultural, and religious heritage in this project area.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) No	(a) There is no landscape resources and special view point in the project site. The new site of Malakal water tank is avoided this type of problem in this project and discussed Koror State and local stakeholders.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) No (b) No	(a) & (b) There is no ethnic minorities and indigenous peoples in the project area.
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a) Yes (b) Yes (c) Yes (d) Yes	(a) All project activities will be implemented in accordance with laws of Palau and ordinances associated with the working conditions. (b) Sufficient protection measures are considered in the design of water pipelines and water supply facilities. (c) The all necessary intangible measures will be carried out by the contractor and consultants upon completion of the project facilities. (d) All project activities will be implemented in accordance with relevant Palau labor laws and security guards in the project.
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? (d) If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?	(a) Yes (b) Yes (c) Yes (d) Yes	This project is not expected the any impacts such as (a), (b), (c), & (d). If we find impacts under the construction we will be carefully considered, and monitoring programs will be prepared in consideration of available equipment, site conditions, capacity and budget which could be allocated for environmental monitoring.

Environmental Checklist: 14. Water Supply (4)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations(Reasons, Mitigation Measures)
5 Others	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) Yes (b) Yes (c) Yes (d) Yes	(a),(b),(c)&(d) All impacts will be considered seriously, and monitoring programs are prepared in consideration of available equipment, site conditions, and PPUC capacity and budget which could be allocated for environmental monitoring.
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Dam and River Projects checklist should also be checked.	(a) No.	(a) Not Applicable.
	Note on Using Environmental Checklist	(a) If necessary, the impacts to <u>transboundary</u> or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as <u>transboundary</u> waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) No.	(a) The scale of the project is small and will not cause global impacts.

1) Regarding the term "Country's Standards" mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made.

In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience)

2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which the project is located.

V. Institutional Requirements and Environmental Monitoring Plan

A. MONITORING FORM (Construction Phase)

-If environmental reviews indicate the need of monitoring by JICA, JICA undertakes monitoring for necessary items that are decided by environmental reviews. JICA undertakes monitoring based on regular reports including measured data submitted by the project proponent. When necessary, the project proponent should refer to the following monitoring form for submitting reports.

-When monitoring plans including monitoring items, frequencies and methods are decided, project phase or project life cycle such as construction phase should be considered.

1. Responses/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
Submission of Construction items before start of work to Airai State, BPW and EQPB to get comments, guidance and approval	(expecting Nov-Dec., 2015)

2. Mitigation Measures

- Air Quality (Emission Gas / Ambient Air Quality)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Dust	-			Visual check		Once a week
Complaints from residents and stakeholders	-			Acceptance of complaints		Any time during the work

- Water Quality (Effluent/Wastewater/Ambient Water Quality)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Turbid water	-	Acceptable turbid	High turbid	Visual check		Project site and its surrounding area

- Waste

Monitoring Item	Monitoring Results during Report Period
Solid waste materials	Visual check daily, once a week, and report to monthly progress report

- Noise / Vibration

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Noise level	-			Appropriateness		Once a week at site
Vibration level	-			Complaints from residents and stakeholders		Any time during the work at project site and its surrounding area

- Odor

Monitoring Item	Monitoring Results during Report Period
Complaints from residents and stakeholders	Any time during the work at project site and its surrounding area

3. Natural Environment

- Ecosystem

Monitoring Item	Monitoring Results during Report Period
Survey results of IEE and complaints from residents and stakeholders: At this time, there is not serious ecosystem problem in the project area.	Any time during the work at project site and its surrounding area

- Geology/ Topography

Monitoring Item	Monitoring Results during Report Period
Survey results of IEE and complaints from residents and stakeholders: At this time, there is not serious problem of geology/ topography in the project area.	Any time during the work at project site and its surrounding area

4. Social Environment

- Resettlement

Monitoring Item	Monitoring Results during Report Period
Ownership and responsibility, complaints from residents and stakeholders	Any time during the work at project site and its surrounding area

- Living / Livelihood

Monitoring Item	Monitoring Results during Report Period
Complaints from residents and stakeholders	Any time during the work at project site and its surrounding area

- Land Ownership

Monitoring Item	Monitoring Results during Report Period
At the Malakal Water Service Tank area, the project is required the land for workshop and replacement of the Water Service Tank. The land belongs to Koror State, but famers are illegally cultivated the land. Therefore, the land use for the project was discussed with PPUC and Koror State and stakeholders.	Koror State is normally accepted to use land for the project based on the PPUC request due to public benefits. Koror State accepted to explain the famers without any conflicts.

- Existing Infrastructure and Social Services

Monitoring Item	Monitoring Results during Report Period
Condition of traffic control and traffic safety measures such as workers, equipment, temporary light, traffic jam due to water pipe instaration along the road.	Any time during the work at project site and its surrounding area

- Occupation Health, Safety and Labor Environment

Monitoring Item	Monitoring Results during Report Period
Occurrence of accident (cases/month)	Before, during and after the construction works
Record of safety meeting and training programs (memorandum or minutes)	Before, during and after the construction works

B. MONITORING FORM (Operation Phase)

-If environmental reviews indicate the need of monitoring by JICA, JICA undertakes monitoring for necessary items that are decided by environmental reviews. JICA undertakes monitoring based on regular reports including measured data submitted by the project proponent. When necessary, the project proponent should refer to the following monitoring form for submitting reports.

-When monitoring plans including monitoring items, frequencies and methods are decided, project phase or project life cycle such as operation phase should be considered.

1. Natural Environment

- Landscape (visual Amenity)

Monitoring Item	Monitoring Results during Report Period	Remarks (Period & Frequency)
Condition of vegetation surrounding Malakal Water Service Tank and Airai Water Treatment Plant (records by photographs before, during and after the construction works)	Record by photographs	Once a month until 6 th month

2. Social Environment

- Occupation Health, Safety and Labour Environment

Monitoring Item	Monitoring Results during Report Period	Remarks (Period & Frequency)
Record of Health, Safety Environment training programs (memorandum or minutes) at Malakal Water Service Tank and Airai Water Treatment Plant	Record by monthly progress report	Once a month until 12 th month

- Accident

Monitoring Item	Monitoring Results during Report Period	Remarks (Period & Frequency)
Record of Health, Safety Environment training programs (memorandum or minutes) at Malakal Water Service Tank and Airai Water Treatment Plant	Record by monthly progress report	Once a month until 12 th month

VI. Recommendations

A. Recommended Approach to Environmental Management

Planning and Design: The selection of groundwater to provide the supplementary source to cover drought periods has overcome the need for, and the adverse environmental impacts of, additional surface water storage.

Construction: Construction impacts are mitigated through application of the Earthmoving Regulations, environmental clauses for incorporation into construction contract tender documents, and mitigation measures described in the IEE. These include means for controlling the production of noise and dust in the vicinity of construction, preventing spillage of oil and fuel from construction equipment, and managing occupational health and safety issues for construction workers in some particular work areas.

Operations: Impacts during operations are limited to the possibility of over-pumping of the groundwater aquifer during drought periods and a program of water level monitoring is recommended to ensure that this does not occur.

VII. Conclusions

Technical analyses conducted during the JICA survey determined that supply is not a constraining factor; however high per capita consumption is a key issue. Within a 2020 design horizon, achieving reasonable conservation targets that bring per capita consumption in line with other countries would not necessitate an increase in supply. However reliability in the face of occasional drought seems to justify additional sources, for which various alternatives were considered. These alternatives have varying levels of environmental impact.

The alternatives comprising an additional surface water resource involve construction of a dam and reservoir and this poses the most severe environmental impact and greatest overall and environmental cost. This is the least desirable alternative and has now been eliminated from

further consideration.

The other alternative of utilizing the groundwater resource, in the vicinity of the two existing surface water sources, causes only minor or moderate potential impacts, principally related to construction, for which well-established environmental management techniques and existing local regulations provide sufficient means for mitigating impacts. The rehabilitation of some of the existing pipelines, and minor additional equipment for pump stations and the treatment works will provide a significant improvement to the reliability of these facilities and the extension of the pipeline network will provide the water supply to additional consumers. The provision of new or recalibrated water meters to all consumers will enable greatly improved management of the unaccounted for water' situation.

The Community Action and Consultation program will aim to educate the consumers regarding the 'value' of the water supply and a significant reduction in the per-capita consumption is expected to be achieved.

Under this project definition, overall capacity is not increased, though reliability is improved both by provision of added supply and equipment replacement. Extension of the system is possible into areas of low population density where sanitation and waste management are best handled at the household level and governed by the existing septic tank ordinance.

No irreplaceable resources are threatened by the proposed Project. Any land acquisition will be minimal and no resettlement will be needed. A poverty and social assessment assures the benefits of the Project are distributed among all members of the community, that there is involvement of women during execution of the Project, and project interventions assist in the livelihoods of women.

The Project is being prepared in conformance with the JICA social and environmental safeguard policies. The Project does not require preparation of any more comprehensive Environmental Impact Assessment than this IEE.

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