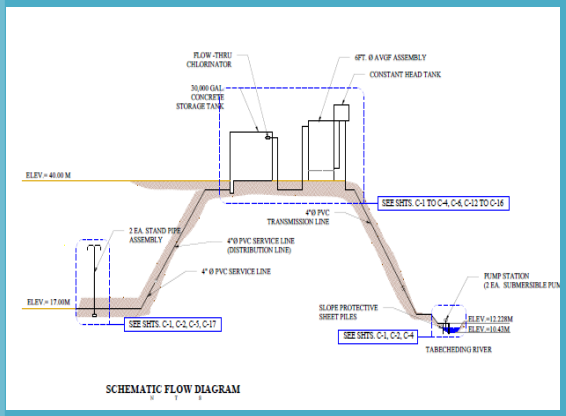
2019

RENI Water Storage Project
Environmental Assessment

Water Storage Tank will be on hill top of Tabecheding



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1 Executive Summary of Project

The RENI Water Storage Project is a government effort to augment resilience of those living in Palau to shocks and uncertainties as result of droughts. Palau has had numerous drought occurrences necessitating declaration of State of Emergency due to shortage of water dating back to 2015.The climate change predictions through 2100 for Palau indicate extreme temperatures and high occurrences pattern of El Niño/La Niña.

Readiness for El Niño Project is about community working to secure food and water resources ahead of droughts. Palau Government chose to focus on enhancing water security through the RENI Water Storage Project. The goal of the proposed project is to build Palau's resilience to droughts by strengthened water securities with construction of a public water supply system (PWSS). This proposed PWSS, to be built in Tabecheding of Ngerdubech Hamlet, Ngatpang State, will consists of a 30,000 gallons storage tank with automatic filter and a chlorinator with stand pipes situated near compact road and delivery trucks for ease of accessibility in time of need. The outcome of this project is a Public Water Supply System that will provide public water with quality fit for human consumption, and regularly serves an average of twenty-five (25) individuals daily at least sixty (60) days out of the year.

The project encompasses clearing of vegetation; installation of a temporary Geo-textile fabric for erosion control measures; excavation of trench to lay out water lines; concrete platform for water filter with backwash treatment; concrete platform for two stand pipes; concrete tank with security fence; layout of electrical wiring; access road with concrete entrance and gravel to water intake pump station and pumps' installation for extraction of water from Tabecheding River. One or two water delivery trucks will be procured to enable water delivery services throughout Palau.

The SPC-RENI team and the Palau-RENI Steering Committee carried out feasibility study of Tabecheding River in Ngatpang State and Ngerderar River in Aimeliik by reviewing the results of the hydrological assessment and the preliminary costing for the water security measures to determine the location for this proposed project. It was decided to focus on the Tabecheding water storage system only, in view of the following results: stream flow data exists for the Tabecheding River (for an 11-year period). The mean low flow for the Tabecheding River, allowing for 80% retention in the river system, permits the extraction of 87,425 gallons (397,440 liters), which is sufficient for the proposed water storage system.

The Pacific Community (SPC) provides financial support and will work with the Palau National Emergency Committee (NEC) - RENI Project Steering Committee Members, represented by National Emergency Management Office (NEMO) and Capital Improvement Program (CIP) to

design, construct, build the public water supply system to be turned over upon completion to Palau Public Utility Corporation (PPUC) for long term operation and maintenance.

People who were interviewed showed full support for the proposed project and anticipate its completion to utilize the public water supply system. Majority of those interviewed were not aware of the proposed project but did not have any environmental or social concerns. One person recommended avoiding excavation of hillsides for construction of water tank and another indicated lack of interest for use of the system should there be user's fee.

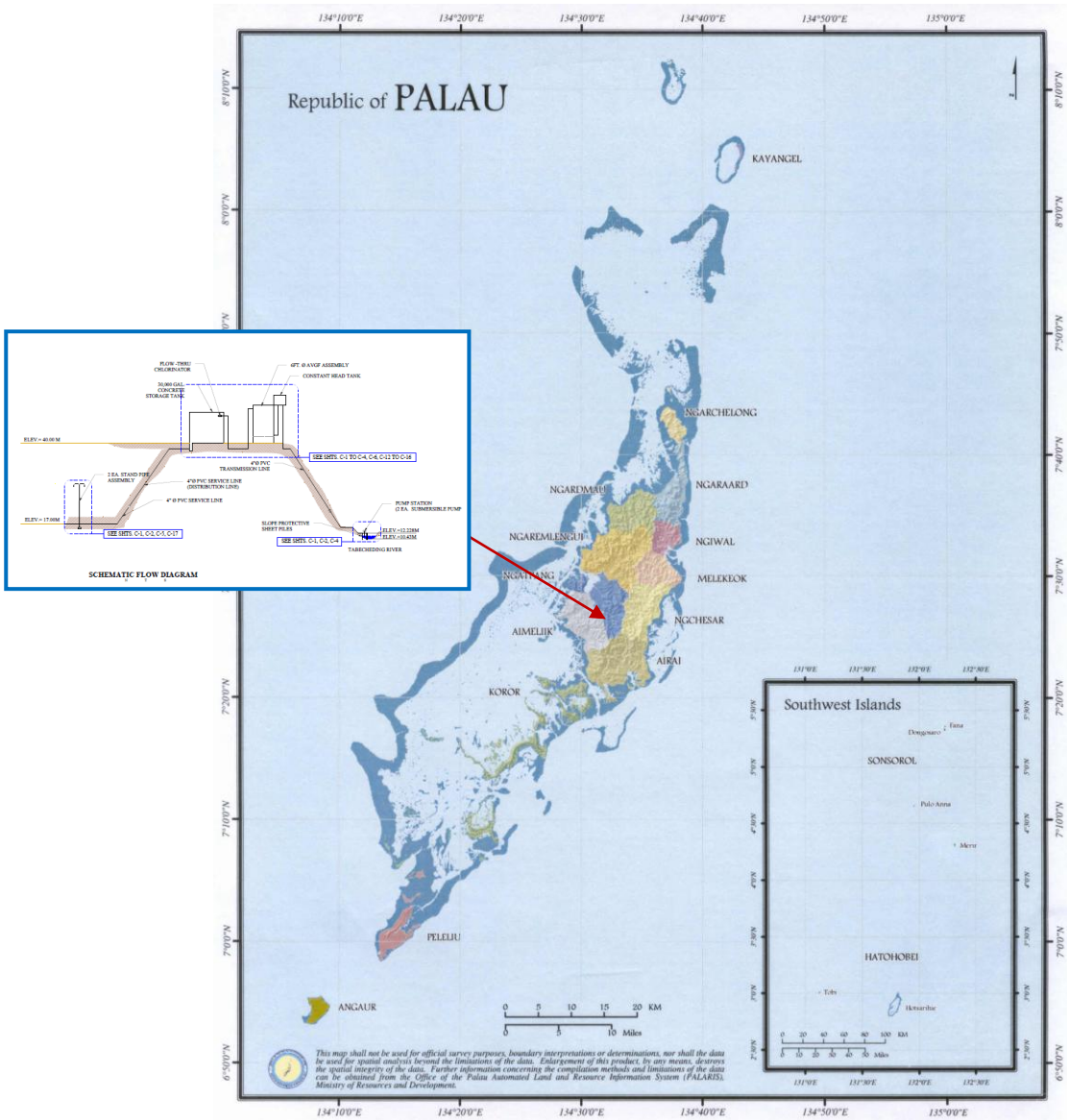
During the course of the project, the project manager will have oversight of the Contractor who will design and implement the ESCP, inspect, maintain and modify erosion and sediment control facilities throughout all phases of the project. Major erosion and sediment control facilities to be installed are the silt fence, silt curtain, ditch, and the permanent ground covers. A treatment facility will be installed to treat backwash water from AVGF system prior to discharge to existing waterways.

Implementation of a state master development plan, with due consideration of stream ecosystems protection consistent with national goals, is a recommended approach for long-term protection of the integrity of Tabecheding River, which sustains one of major ecologically sensitive habitat, Ngermeduu Conservation Area.

The proposed RENI Water Storage Project will not have significant impacts on the environment. As proposed, it will have minimal impact on secondary vegetations that will be removed, a temporary erosion of soil and a long-term reduction of river flow through uptake of about twenty percent of stream water volume. The remaining eighty percent water volume of the river is adequate to sustain ecological function of the river.

The recommended action is to proceeds with the proposed project development plans for the RENI Water Storage Project. This project will fulfill the objective of the Palau National Emergency Committee (NEC) RENI Steering Committee together with SPC-RENI Team in enhancing the resiliency of those living in Palau to shocks and insecurities resulting from droughts. The project will meet the national objective of addressing impacts of Climate Change by ensuring readiness for future El Nino events in Palau and meet the existing daily needs of water for those communities outside of piped water service area in Airai State, Aimeliik State and Ngerdubech Hamlet of Ngatpang State.

Fig. 1: Palau Map with Site Plan Diagram



2 Introduction

2.1 Identification of Applicant

The Pacific Community (SPC) and Palau NEC- RENI Steering Committee are the Project Proponents. The NEC-RENI Steering Committee Membership consists of the following agencies: National Weather Service, National Emergency Management Office (NEMO), Bureau of Budget and Planning, Division of Property and Supply, National Public Information Office, Bureau of Public Works (BPW), Environmental Quality Protection Board (EQPB), Bureau of Foreign Affairs, Palau Red Cross, Palau Public Utilities Corporation (PPUC) and Palau Chamber of Commerce.

NEMO Office will coordinate implementation of the project in collaboration with BPW and PPUC. The applicant has leased a portion of the Ngiraremiang Family Land, Lot No. 017 L 05, known as "Rolel a Dukl", in Ngerdubech Hamlet of Ngatpang State for the project (Appendix A – Government of Palau Land Use Right). The total area to be disturbed for construction of the project is 4,858 square meters.

Bureau of Public Works will be responsible for project design and construction oversight. PPUC will be responsible for operation, monitoring and maintenance of this Tabecheding Public Water Supply System when the project is completed and handed over by Pacific Community to Palau Government (Appendix E- PPUC Assurance Letter for Operation).

2.2 Identification of Assessment Preparers

The KAMPOR Analytical is a consulting service entity founded in 2015 by Ongerung Kambes Kesolei. The Team, Kambes in partnership with Portia Franz, have more than 30 years combined experience working for the Palau EQPB. Kambes has an Associate Degree in Science and worked as EQPB Lab Technician, PICRC Chief Aquarist, Ngardmau State PAN Coordinator, and Consultant for ADB KASP and an Editor for Tia Belau Newspaper. Portia has a Masters degree in science and worked as an Administrator for the Office of Health Preparedness, Policy and Research at Ministry of Health, EQPB Executive Officer, Palau Community College Cooperative Research & Extension Researcher/Extension Specialist and EQPB Laboratory Supervisor.

As a team, Kambes and Portia have provided consultancy services on several government, civil society, and private business projects in Palau in areas of environment, development, social, media/communication, health and water monitoring.

Mr. Naito Soaladaob, a Palau vegetation expert who is a retired government worker, provided the expertise on vegetation survey for this project. Mr. Soaladaob spent most of his career with Division of Entomology, retired in 1997 and is currently working as a vegetation specialist at the Belau National Museum.

Ms. Heather Ketebengang, a Palau bird expert, provided the bird assessment for this project. Ms. Ketebengang has a B.A. in Interdisciplinary Studies on Environmental Studies and Minor in Geography. She currently works at Palau Conservation Society as the Program Coordinator. She has years of experience in bird survey and monitoring in Palau with several publications such as "State of Palau's Birds 2010 and Noteworthy bird observations from the Caroline and Marshall Islands 1988 - 2009".

The Palau Environmental Quality Protection Board Laboratory, as the only certified Laboratory in Palau, collected and analyzed the water samples from Tabecheding River.

2.3 Organizations Consulted

This environmental assessment was developed in consultation with the Palau Environmental Quality Protection Board (EQPB), Bureau of Public Works (BPW), Capital Improvement Project Office (CIP), Historical Preservation Office (HPO), National Emergency Management Office (NEMO) and Ngatpang State Office. The residents that live along the Compact Road from Airai to Ngtpang area, who are not connected to piped public water supply, were interviewed.

A Scoping Meeting was held on October 15, 2018 between KAMPOR Analytical Team as the EA Consultant and the Palau Environmental Quality Protection Board representatives namely, Executive Officer Roxanne Y. Blesam, Laboratory Supervisor Metiek Kimie Ngirchechol, Assistant Executive Officer Mike Blesam and Engineer Soledad R. Lozaro.

The purpose of the scoping meeting with EQPB is to ensure all issues concerning the project will be addressed in the Environmental Assessment. The following are issues raised by EQPB to be evaluated and made part of the EA:

1. General basic requirements outlined in the Earthmoving Application and Environmental Assessment Checklists.
    a. Project Designs, including detail designs, for dam/weir if applicable, wet well and piping.
    b. Design for access road, if any
    c. Project Site/Location
    d. Land use right
    e. State Permit
    f. HPO clearance
    g. UXO Clearance

2. Water Filter design, pipes, valves and other construction materials specifications (consult PPUC for standardization of materials).
3. Treatment of Rejected/backwash water.
4. Security Fence for the facilities.
5. Effect of water abstractions upstream and downstream of intake on ecosystem.
6. Endemic species of flora and fauna.
7. Name and contact of SPC agent in Palau, potentially NEMO as recipient of the grant.
8. Water Disinfection Treatment for drinking water.
9. Chlorination for disinfection of water and operator's qualification.
10. Consult with PPUC, BPW and NEMO pertaining to the ownership, operation and maintenance of the system.
11. Cheaper and simpler filter treatment alternatives.
12. This facility will be considered public water supply system.

The EQPB will potentially have additional comments when detail designs are made available and the final quality and designated use of water product is concurred. EQPB emphasized the need to submit timely all relevant information to enable permit consideration by March 2019.

2.4 EA Process Documentation

Table 1: EA activity summarized with timeline of work performed by KAMPOR Analytical.

Activity	*Date*
Execution of EA Service Contract with Pacific Community (SPC)	October 15, 2018
Scoping meeting with Palau EQPB	October 15, 2018
Initial meeting with SPC (Proponent) in Palau	October 21, 2018
Initial visit of project site	December 1, 2018
Assessment visits of Project Site	December 1, 3 & 12, 2018. Jan. 7, 2019.
Follow-up meeting with project proponents, CIP and RENI Project Coordinator at NEMO, to discuss development plans	January 14, 2019
Interview of representative community members in Airai, Aimeliik and Ngatpang States.	December 2018 to January 2019
Meeting of Proponent and EA Preparer to complete development plans and ESCP.	January 14, 2019
Meeting with SPC Team to discuss status of designs, treatment plans and land use right causing delays of EA Report and Permit Application	February 17, 2019
Meeting with SPC and CIP to incorporate pending designs for treatment facilities and ESCP	February 18, 2019
Meeting with RENI Coordinator and EA Preparer to discuss pending documents, EA and EQPB application requirements	April 10, 2019

3 Assessment Methodology

Various Methodologies were used to assess range of environmental and technical issues as part of the EA. Techniques used include literature reviews, interviews of residents along Airai, Ameliik and Tabecheding areas as resource users/community members, environmental baseline surveys, monitoring and testing. The compilation of an inventory of environmental resources was carried out through baseline monitoring and resource documentation.

3.1 Literature Review

EQPB Guide to Environmental Assessment (Aug. 2000) and the Amendments to EQPB Earthmoving Regulations (July 2015) served as guidance in preparing this assessment to ensure that a comprehensive review of the environmental impacts of the proposed project is undertaken.

Pacific Community's (SPC) Summary of preliminary feasibility assessment for drought response storage in Bebeldabo-Tabecheding River and Ngerderar River, August 2018 (based on a desk study using available data) and the Pacific Community (SPC) and Government of Palau's Palau

Final Draft for Project Design Document: Securing water resource ahead of drought in Palau, October 2018.

3.2 Interview of Community

KAMPOR Team conducted interview of community members along the Compact Road between the Siokumins area in Airai through Imul, Aimeliik all the way to Ngimis in Ngatpang. The homes are not connected to any piped public water supplies. The residents in these areas where interviewed regarding the awareness of the project, negative concerns on potential degradation of environment, the resources that would be lost as a result of proposed development plan and the social impacts to be realized through the proposed water storage development.

3.3 Maps

Palau Automated Land and Resources Information System (PALARIS) developed Palau maps delineating Historical Sites, soil types, Ngatpang Protected Areas, vegetation, streams, and land contours for the area to be impacted due to proposed project.

3.4 Vegetation Survey

The terrestrial flora at the project site was recorded during a walk through survey on December 1, 2018. Mr. Naito Soaladaob, a vegetation expert, conducted a walk through survey to identify vegetations on the path of pipe-layout at the water intake pump station all the way to the top of the hill where storage tank will be constructed. Observations were documented with local names, endemicity, use and scientific names cites on known flora and fauna within the impacted areas. Tables 2 (a)(b)(c) provide lists of living vegetations and those that have been cleared (cut down).

3.5 Water Test

The Palau EQPB Water Quality Laboratory collected and analyzed the water samples utilizing approved Standard Laboratory Methods for Total Coliform Bacteria, E.coli, Turbidity, pH, Temperature, Dissolved Oxygen, Salinity, Conductivity and Total Suspended Solids.

Grab water samples were collected from Tabecheding River on December 12, 2018 at three different locations. Water Sample 1 was taken about 100 feet upstream from water intake pump station site, Water Sample 2 was taken at the water intake pump station, just below the "Japanese Sakseng Bridge", and Water Sample 3 was taken about 100 feet downstream from water intake site (Table 3: EQPB Water Standards Comparison & Appendix B – EQPB Water Quality Lab Test Results).

3.6 Bird Survey

Ms. Heather Ketebengang, bird expert, conducted a survey of birds utilizing the National Bird Monitoring Protocol developed by the Belau National Museum and approved by EQPB. The Bird

survey was carried out on December 3, 2018 at two locations, one at northern end of the site near the Old Japanese Bridge where water intake pump station is located and the other at southern end on the hill top where water storage tank will be constructed (Appendix C – Tabecheding River Bird Survey).

4 Project Description

The Readiness for EL Nino (RENI) Water Storage Project or RENI Water Storage Project encompasses infrastructures to facilitate access to new surface water as a source of a Public Water Supply System that will be treated to meet EQPB's requirements as potable water. A grant agreement between Palau Government and Pacific Community (SPC) will enable financial support from European Development Funds to complete the construction of the project. This proposed project will construct a Public Water Supply System that will provide to the public water fit for human consumption and will regularly serves an average of twenty-five (25) individuals daily at least sixty (60) days out of the year.

The RENI Water Storage Project includes the following facilities:

a. Concrete drive way with 12 feet (3.7 m) wide and 300 feet (91 m) long access road covered with base course to the water intake site following the alignment of old Japanese road east of Compact Road just before the Tabecheding River Bridge. Water Storage Tank area will be accessed utilizing existing road south of the project area.
b. Electrical panel and wiring following the alignment of the access road from the area of stand pipes to the water intake Pump station Site.
c. Sheet piles and concrete platform for submersible pumps as part of water intake Pump Station Facility.
d. Trench (3 ft. D X 2 ft. W) to lay underground 4 inch (102 mm) wide PVC pipes connecting raw water from intake culvert Pump Station to AVGF Filter System and the treated water line from concrete water tank to stand pipes.
e. Concrete slab for two stand pipes.
f. Concrete Water Storage Tank (30,000 gallons capacity) with Chlorinator.
g. Chain-link Fence surrounding the Water Storage Tank.
h. Reinforced concrete base and installation of AVGF Filtration System with backwash water treatment.
i. Water Tankers (2,113 gallons Capacity trucks); 2 each depending on availability of funds.

4.1 Purpose and need for action

The Palau Government, as an emergency supplier charged to mitigate water shortage during drought events, has identified and approved the RENI Water Storage Project to build a public

water supply using Tabecheding River as a water source. This proposed project is consistent with national policies and strategies notably the Palau's 2020 National Master Development Plan, the 2016 National Disaster and Risk Management Framework, the 2015 Climate Change Policy and the National Emergency Committees (NEC) Drought Action Plan. The NEC's Drought Action Plan seeks to access new surface water source and update rolling stock to make certain water is secured for Palau, particularly for most populous states of Koror and Airai.

The purpose of this RENI Water Storage Project is to fulfill the objective of the Palau National Emergency Committee (NEC) - RENI Steering Committee together with SPC-RENI Team in providing water security measures in form of water storage, in order to enhance the resilience of those living in Palau to shocks and insecurities of fresh water resulting from droughts.

The Palau NEC is partnering with European Union (EU) –North Pacific Readiness on this El Nino (RENI) Project implemented by the Pacific Community (SPC) to enable communities in Palau working together to secure food and water resources ahead of drought. The implementation of this structural measure; the RENI Water Storage Project, will help strengthen sustainable, multisectoral, multi-stakeholder approach to water security readiness for future El Nino events.

The Pacific Community, in 2018, evaluated two rivers, the Tabecheding in Ngerdubech hamlet of Ngatpang Sate and the Ngerderar in Aimeliik State, and determined the Tabecheding Rivers as most feasible water source for this RENI Water Storage Project.

The RENI-Water Storage Project will help meet the water security for the people of Palau during future water shortage due to droughts by constructing this new Tabecheding Public Water Supply System. This will provide direct benefits to the residence of Airai, Aimeliik and Ngatpang States, who lives along the Compact Road without access to piped potable public water services for many years. This project will also aid to enhance the resilience to drought for the rest of Palau's population, as water trucks will be procured to facilitate distribution of water during drought events. Water standpipes will be accessible all the time.

About thirty-seven (37) homes, workers housing and farm facilities along sides of Compact Road are not connected to potable piped public water services between Airai and Ngatpang States. Five (5) homes in Ngerulubel, Airai State, nineteen (19) homes and one (1) farm in Imul, Aimeliik, ten (10) homes, one (1) workers housing and one (1) farm from Tabecheding to Ngimis in Ngerdubech Hamlet of Ngatpang State. These households need constant source of water for domestic use and have expressed immediate use of the water supply system.

There is direct benefit of this RENI Water Storage Project to the surrounding communities. It's anticipated that increasing development growth in Airai and Koror will need additional water supply thus extending the use of this water system.

The 2015 Census show estimated population of Airai as 2,455, Aimeliik as 334 and Ngatpang as 282. It is anticipated that the residents of these three states will have direct benefit as immediate users of this new water supply system. Residents of Koror and the rest of Babeldaob will have indirect benefit with water delivery trucks distributing water during future drought events.

Fig. 2: Map of Project Site showing Water Line.

4.2 Total area to be disturbed

The estimated area to be disturbed due to proposed facilities for RENI-Water Storage Project is approximately 4,858 square meters. Construction corridor of about 15 feet wide will be required for installation of water pipes and electrical wiring.

Proponents propose to clear vegetations to enable 15 feet (4.6 m) corridor for construction of an access road, trench to lay out water pipes, and install a 30,000 gallons concrete water tank with platform for water filter, chlorinator, fence, Stand pipes and pumps (Fig. 3: -Site Map Showing Project Layout).

4.3 Site Location and Development Plan for all facilities to be constructed

The RENI Water Storage Project is situated within a private property along side of Tabecheding River in Ngatpang State. The landowner, Ngiraremiang Family, has executed a fifty years Land Use Right t to the Government of Palau for use as the project site (Appendix A- Government of

Palau Land Use Right and Fig. 3 - Site Map). The site will be cleared for the construction of the following facilities (Fig. 4: Site Development Plan):

a. Access road off Compact Road is combined concrete entrance and gravel to water intake site about 300 feet (91 meters) east of Tabecheding River Bridge. Existing dirt road will be utilized to access the area for water tank, filter, disinfection and fence facilities on hill top.
b. Platform using h-beam metal sheet piles and concrete as casing for submersible pumps as part of water intake facility.
c. Trench, 2.5 ft. deep (.8 m) X 2 ft. (.7 m) wide, to enable underground pipes layout connecting raw water intake to AVGF system and the treated water from concrete water storage tank to stand pipes. Total of 2,005 feet (611 meters) length of water pipes.
d. Electrical panel casing for water pumps with wiring from water intake site to electric pole along side of Compact Road.
e. Two standpipes along east side of Compact Road, just before the Tabecheing Bridge.
f. A 30,000 gallons capacity concrete water storage tank with Tablet Chlorinator on top of the hill.
g. An Automatic Valveless Gravity Filter System with backwash water treatment and drainage to existing waterways.
h. Chain link fence surrounding the water tank & filter.
i. Tankers as water delivery trucks (2 each depending on availability of funds).

Fig. 3: Site Map showing RENI project layout (red box)

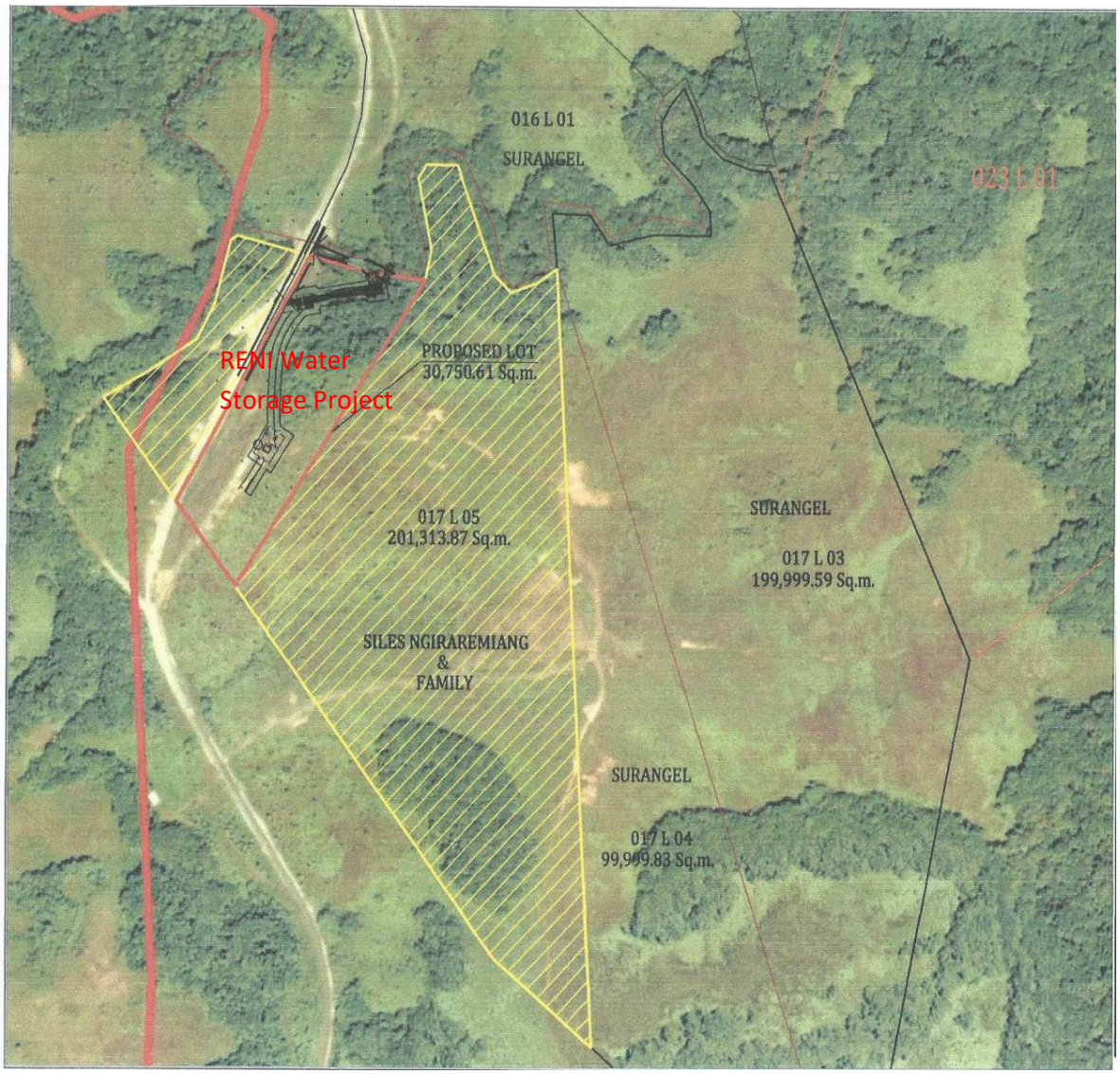


Fig. 4: Site Development Plan

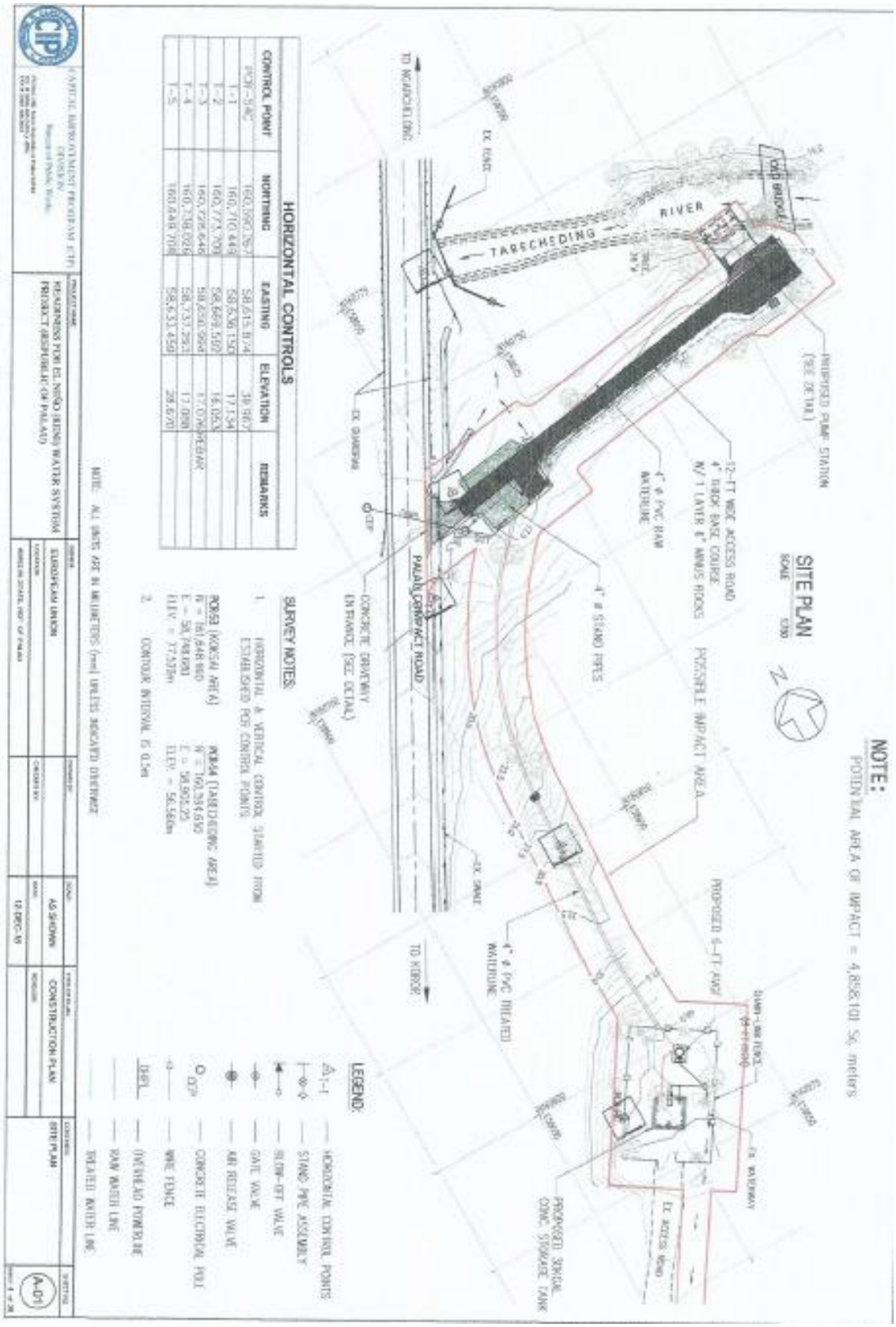


Photo Plate 1: Photo of Sites for all facilities.

Tabecheding River Water Intake pump station area.

Alignment of pipe layout to & from storage tank

Water Storage Tank, Chlorinator, AVGF & fence area

Alignment of wiring &raw water pipe layout from intake pump toward stand pipes area

Entrance to Water Stand Pipes Area adjacent to compact road

4.4 Project Phases

Proponents will utilize services of CIP, Palau NEC- RENI Steering Committee Member, to design the project and oversee its construction to completion. Needed construction services, equipments and supplies will be outsourced to successful bidders. The estimated duration of the project to its completion is about twelve months.

4.4.1 Pre-Construction

Prior to commencing earthwork activities, the winning contractor under guidance from CIP Office, will develop appropriate Project Work Schedule, ESCP & Treatment Facility design plan for filter back wash water. The Contractor will also follow set conditions for all pertinent national and state permits.

Before the commencement of earthwork activities, an EQPB approved Erosion and Sediment Control Plan (ESCP) will be put in place, including silt curtain for pump installation and silt fence for land based earthmoving activities.

The winning Contractor will also be responsible for routine monitoring, maintenance and repair of temporary erosion control measures for the entire project period and necessary removal upon project completion.

4.4.2 Construction

Placement of information signs for safety of the public and workers should be posted at the site prior to the start of the project.

Reusable wastes should be segregated and recycled. All non-reusable solid wastes from construction activities should be disposed at Ngatpang Sanitary Landfill using trucks.

Portable restroom should be made available for workers during construction phase.

4.4.3 Operation

The Water Storage Tank Facilities will be operated by PPUC to service water to needy community members in Ngatpang, Aimeliik, Airai and other states.

The 30,000 gallons tank can serve about 500 people per day.

Pre-cautionary actions should be taken when heavy equipments, water trucks and individual users of standing pipes enter into the main Compact Road. A traffic sign should be erected to caution the speeding commuters passing the project site, particularly in the morning and evening.

The work area should be maintained clean and free of debris. Routine maintenance of Compact Road drainage ditch along the western side of the project site should be implemented.

4.4.4 Abandonment

Abandoning the project is not anticipated as the project has secured funding to complete the entire development plan. CIP has committed to designing and overseeing the construction of the project, the PPUC has committed to operate and maintain the water system with the RENI-NEC Steering committee ensuring project completion to fulfill a National Emergency Plan.

The Proponents will take all necessary actions, under the guidance of EQPB, for the necessary restoration of the site should the project be abandoned.

4.5 Project Work Schedule

The RENI Water Storage Project is envisioned to commence in May 2019 and end in June 2020. Project Work Phase Schedule will be developed and submitted by Bureau of Public Works/Contractor.

4.6 Project Cost

The total cost of the project is estimated to be about $500,000.

5 Environmental Setting Prior to Project

5.1 Physical

5.1.1 Land Use

The project site is situated along the eastern side of the Compact Road at the junction of Tabecheding River in Ngerdubech, Ngatpang State. The area is previously disturbed as it was used during Japanese Administration for a bridge, road and police station. Also during early 2000 it was degraded when Compact Road was under construction as evident by excavation and remnants of stockpiled asphalts. There exists an old Japanese “Sakseng Hashi” bridge across the Tabecheding River just upstream of the water intake location that connects to an old Japanese road that runs west toward Compact Road and then southeast to the hilltop where storage tank will be built.

The connecting pipes will be laid 2 feet underground along the old Japanese Road starting near the old bridge to the side of Compact Road continuing up to the hilltop.

Photo Plate 2: Existing use of area surrounding raw water intake site	
View of site for raw water intake facility just below the old Japanese Bridge.	View of river upstream of intake toward East from old Japanese Bridge ("Sakseng Hashi")
Down stream view of river with intake on bottom left	View of rope across to north of intake site used for recreational swimming activity
N.East view of abandoned EQPB rain and water automated monitoring facility at upper left.	East side of "Sakseng Hashi"an old Japanese bridge.

Photo Plate 3: View of old Japanese road where electrical wiring & intakes raw water pipes will be laid out	
View of old Japanese road situated south of intake site where underground pipes will be laid out.	NE view of old Japanese road and Japanese bridge
17 feet wide Old Japanese road within the forested area	River view of old bridge toward East; intake to right below the old bridge.

5.1.2 Farms

The project site is situated between two active farms. Amos Mesubed Green House Farm is about 400 meters toward the south and Surangel's Farm is located about 70 meters northwest across the Tabecheding Bridge. The rest of surrounding areas are inhabited forest and savanna.

These farms lie down stream of the water intake pumps and will not affect the quality of source water.

Fig. 5: Map of Tabecheding River with two farms situated north and south of the project site.

5.1.3 Weather Conditions during assessment

Weather conditions during the field assessments were mostly clear with sunshine and no rain. National Weather Service Station recorded weather conditions on days for field assessments as follow:

Date	Rain (inches)	Wind Direction
12/1/18	0.2	East to Northeast
12/3/18	0.32	East
12/12/18	0.46	Northeast
1/7/19	0	Northeast

5.1.4 Soil

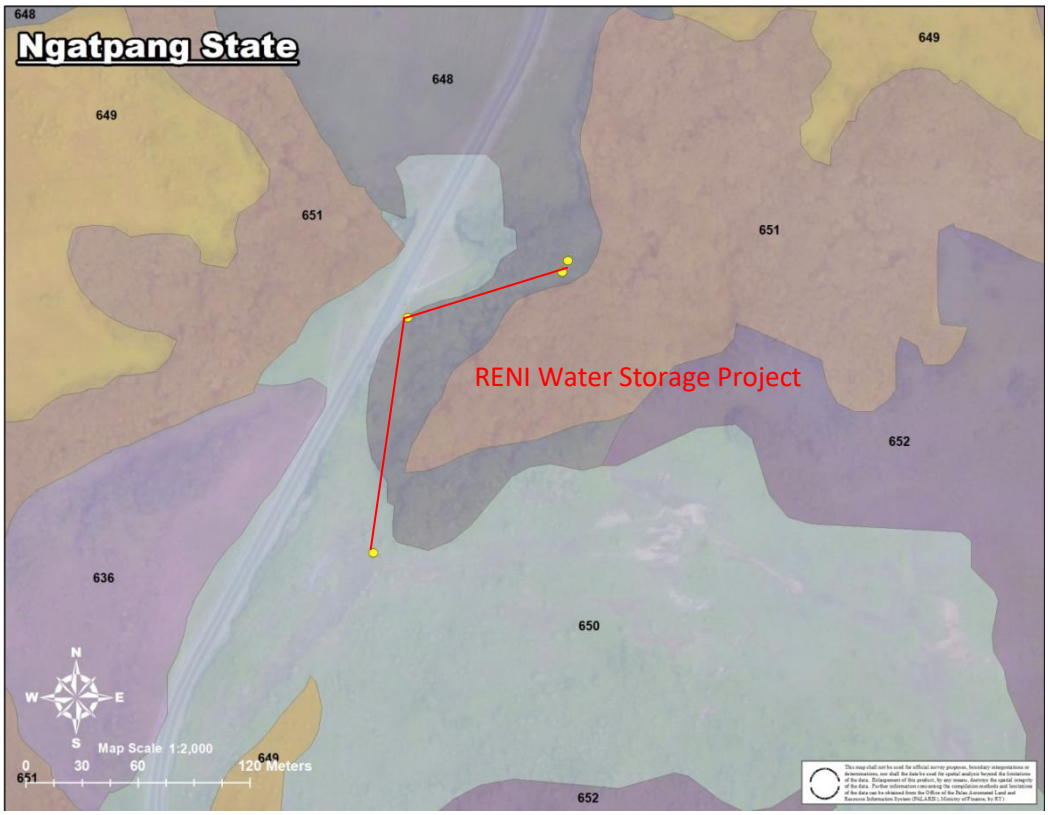
The USDA Soil Survey Map of Palau describes the project site consisting of two types of soil, Aquic Dystrudepts Map Series, Unit 650 & 652, characterized as silty clay with high runoff

hydrological properties. The project site is combined forest and grassland areas fully vegetated with no sign of accelerated erosion.

The soil features of Aquic Dystrudepts Unit 650 are interbedded and silty clay with high slippage and very high runoff; somewhat poorly drained with elevation of 1 to 81 meters and slope of 6-12 percent. The surface covered with 15 percent angular gravel fragments. This soil type has very deep limiting permeability and low available water capacity.

The soil features of Aquic Dystrudepts Unit 652 are interbedded and silty clay with high slippage and very high runoff; somewhat poorly drained with elevation of 6 to 71 meters and slope of 12-30 percent. The surface covered by rock fragment is ten (10) percent angular gravel and 5 percent surrounded gravel. This soil type has very deep limiting permeability and low available water capacity.

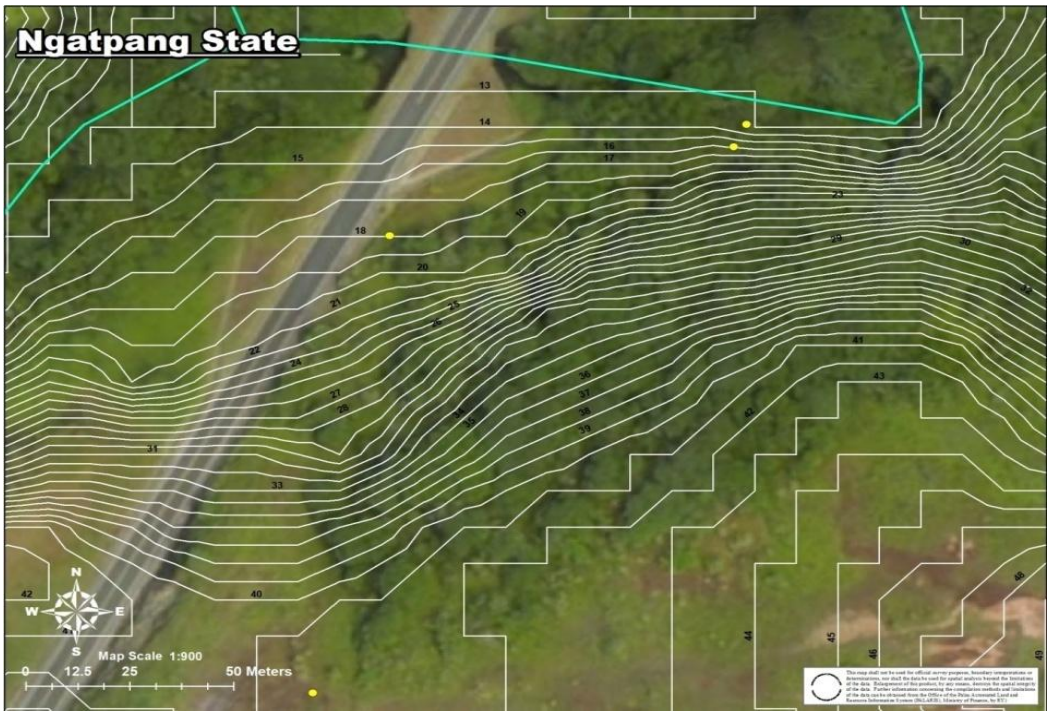
Fig. 6: PALARIS Soil Map, Tabecheding, Ngatpang State.



The proposed water storage tank facilities will be constructed on the highest elevation around 42 meters on top of the hill to as low as 13 meters at the river bank for water pumps.

The Tabecheding River depth at the raw water intake site was measured at 1.27 meters deep with substrate consisting of rock. The middle of river was around 2.5 meters deep with basalt rock bottom while toward the opposite riverbank was 2.9 meters deep with soft earthen substrate.

Fig. 7: PALARIS Contour Map of project area (yellow dots) in Tabecheding, Ngatpang State.



5.1.5 Air

The project site has good ambient air quality. The only potential air degradations are emissions from vehicles on the Compact Road to the west and the dust from farming activities to the northwest of the project site.

5.1.6 Water use

5.1.6.1 Tabecheding River

Tabecheding River has a watershed of 7.2 square miles, an average discharge of 49.8 cubic feet per second and recorded maximum flow of 99.6 cubic feet per second. Tabecheding River, along with Ngermeskang River and Ngatpang River, are the three major rivers that drain into the Ngermeduu Bay. Tabecheding River plays an extensive biological function supporting swamp forest, mangrove, and estuary ecosystems within the Ngermeduu Conservation Area situated northwest of the project site.

There is a utility metal box standing on the river banks some 200 feet to northeast of the water intake site. This utility box is part of the remains of hydrological equipments for rain gauge & river monitoring program carried out by EQPB some years ago.

The Tabecheding River would be classified as "Class 1 Water" in accordance with the EQPB Classification of Fresh Water usage as the source of drinking water supply.

5.1.6.2 Waterfall Downstream

The only notable use of the river at the time of the site assessment was the waterfall site and the bridge. Tabecheding Waterfall lies downstream of the Compact Road Bridge and easily accessible.

It is one of the three tourist waterfall attraction sites in Palau.

Tabecheding Waterfall

5.1.6.3 River ecosystem

A small tributary runs south to north along the west side of the Compact Road and feeds into the Tabecheding River below the Compact Road Bridge. This tributary may potentially receive run offs from proposed National Solid Waste Landfill in Aimeliik State, however it will not affect the quality of the source water intake which is some 300 feet upstream.

The river flow rate was measured using the Float Method. The width of the river at the vicinity of raw water intake pump station is 30.83 feet with average depth of 7.34 feet. The estimated average water velocity measured at this site is about 22 feet per minute.

5.1.6.3.1 Water Extraction

The SPC RENI team and the Palau RENI Steering Committee evaluated water extraction from Tabecheding River in August 2018. Results of the hydrological assessment and the preliminary costing for the water security measure for Tabecheding River and Ngerderar Rivers were examined. The decision was to focus on the Tabecheding water storage system only, in view of the following results: Streamflow data exists for the Tabecheding River (for an 11-year period) while there are no comparable data for the Ngerderar River. The mean low flow for the Tabecheding River, allowing for 80% retention in the river system, enables for the extraction of 87,425 gallons (397,440 liters), which is sufficient for the proposed water storage system (Figures for the Ngerderar River were significantly lower). The result of review also indicated that Ngerderar Watershed is part of the Protected Area Network and may require more stringent safeguards to maintain the integrity of ecosystem.

Additionally, the Pacific Community Geoscience, Energy and Maritime Division, Summary of Preliminary feasibility assessment for drought response storages Babeldaob-Tabecheding River and Ngerderar River of 2018 provided the following hydrological results:

Table 3: Minimum flow estimates Babeldaob catchments

Station no.	Drainage area km²	Data Source	Period of record	Minimum flow discharge m³/s
16890900 Tabecheding (below falls)	15.7	Der Brug, 1984	1971-1982 (23-24 March 1973)	0.023 0.031#
		SOPAC, 2012	1989 -2005	0.052
		De Bruijn et al, 2016	1970 - 1994, 1997-1999, 2000-2003,2004-2005	0.030*
Ngerdarar river	4.46	De Bruijn et al, 2016 (after ADP 2008)		0.011*
Kmekumer 16891310	4.1	SOPAC, 2012	1990 -2005	0.035 0.048#
		De Bruijn et al, 2016	1978 - 1991, 1992-1993, 1997-1998, 1999-2000 2000-2001 2002-2003, 2004-2005	0.0096*
Ngardok South Fork 16891400	6.32	Der Brug, 1984	1971-1982 (9 March 1973)	0.016 0.018#
		SOPAC, 2012	NA	0.028
		De Bruijn et al, 2016	1971 - 1991, 1991-1992	0.018*
Diongradid 16890600	11.5	Der Brug, 1984	1970-1982 (24,25,31 March; 1 April 1973; 28,29 April 1977)	0.076 0.071#
		SOPAC, 2012	NA	0.118
Edeng River 16891300	11.0	Der Brug, 1984	1972-1982 (23-24 March 1973)	0.045 0.045#
		De Bruijn et al, 2016	1969 - 1982,	0.028*

*Calculated minimum discharges with a return period of 25 years (T25); #minimum discharge with 20 year return period.

Table 4 Summary of minimum flow and rainfall ranking for 3 month rainfall index

Catchment	Minimum daily flow and period m³/sec	Ranking of 3 month rainfall ranking relative to minimum flow period
Tabecheding	0.023 (March 1973)	7th ranked (Jan 1973 – Oct 1973)
Ngerdarar	0.011 (similar sized catchments indicate similar flow)	NA

Table 5. Maximum volume available from low-flow under two pumping scenarios for Tabecheding and Ngerderar Rivers assuming abstraction at 20% of low-flow conditions

Catchment	Maximum allowable flow rate for low-flow conditions (L/s) (20% of minimum measured flow)	Maximum volume abstracted in 8 hour pumping (L)	Maximum volume abstracted in 24 hour pumping (L)	Number of hours required to fill a 200,000L storage tank (20% of minimum measured flow)
Tabecheding	4.6	132,480	397,440	12.1
Ngerderar	2.2	63,360	190,080	25.3

5.1.6.3.2 Water Quality

The physical parameters such as turbidity, total suspended solids, temperature, dissolved oxygen; salinity, conductivity and velocity of the river were recorded on December 12, 2018 for the Tabecheding River, the source water. Total coliform bacteria and E.coli were also tested at three different sites, including the area for raw water intake pump station.

According to Classification of Fresh Water Uses, EQPB Regulations 2401-11-06 A(1) (2), Class 1 Water is to be protected for use as drinking water supply, food processing, the support and propagation of aquatic life, and compatible recreation. The quality of this Class 1 Water should remain at natural state as possible with minimal pollution from any source. Waste discharge into this Class 1 Water is prohibited.

Two of three grab samples collected for water quality analysis indicated coliform bacteria counts within the standard level. The third sample had 330/100 ml E.coli that is above the standard of 230/100 ml for this class of water used as surface water source for public system.

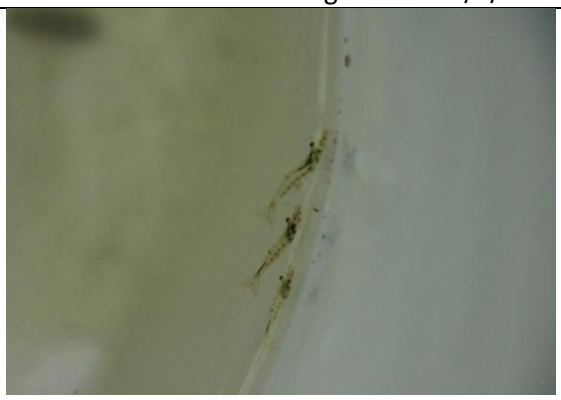
Table 3: EQPB Water Quality Standard Comparison

Parameter	**Class 1 Water Standard***	**Sample 1 100 feet upstream from intake**	**Sample2 Water Intake Site**	**Sample3 100 feet downstream from intake**
(A) total or fecal coliform bacteria	The median count shall not exceed 70/100 ml for any consecutive samples nor shall any single sample exceed 230/100 ml	> 2400/100 ml Total Coliform Bacteria & 210/100 ml E.coli.	> 2400/100 ml Total Coliform Bacteria & 330/100 ml E.coli.	> 2400/100 ml Total Coliform Bacteria & 160/100 ml E.coli.
Temperature	Shall not vary by more than 1.5 degree Fahrenheit from the natural conditions in marine and freshwater	25.5 ^{o} C	25.5 ^{o} C	25.5 ^{o} C
Turbidity	(C) Turbidity (NTU) shall Not be greater than 5% above natural conditions	4.0 NTU	4.1 NTU	4.3 NTU
pH	(B) pH variation shall not be greater than 0.2 pH units from natural	7.4	7.3	7.4

Dissolved oxygen	(A) Dissolved oxygen concentrations shall not vary by more than 25% from natural conditions. (B)(1) Except for concentrations attributed to natural causes dissolved oxygen concentration shall not be less than the greater of 6.0 mg/l, 75% saturation	5.5 mg/L	5.3 mg/L	5.5 mg/L
Salinity (ppt)	No change in channel, basin geometry or water influx shall be made which would cause permanent changes in isohaline patterns of more than 10% from natural conditions or change in salinity outside the rage of 29-15 ppt or which would otherwise adversely affects the indigenous biota and natural sedimentary patterns.	0 ppt	0 ppt	0 ppt
Total Suspended Solids			5 mg/L	
Conductivity		69.9 µS/cm	70.1 µS/cm	69.8 µS/cm

5.1.6.3.3 Aquatic Organisms

The species of native plants and animals recorded during the 1991 Ngermeduu Bay surveys found the following freshwater life: freshwater decapods crustaceans, freshwater fishes, amphipods and gastropods. During site assessment on 1/7/19, the only macrofauna observed in the streambank along the vicinity of raw water intake pump station site were water striders and freshwater shrimps. These are common inhabitants of the Tabecheding River. The attempt to catch river fish with baited fish line was unsuccessful, not a single bite and no fish caught within fifteen minutes time.

Photo Plate 4: Aquatic organisms observed at intake site in Tabecheding River on 1/7/19.	
	
water strider (4 each in one scoop)	Baby Fresh water shrimps (10 each in one scoop)

5.2 Biological

The preliminary assessment of the site was conducted on December 1, 2018. Other site assessments took place on December 3 &12, 2018 and January 7, 2019. The assessment team walked around the periphery of the proposed project site noting key features of the area and observed flora and fauna.

5.2.1 Plants

PALARIS Vegetation Map indicates the project site to be about 75% forested and the rest is savanna grassland area. On December 1, 2018, the area was observed to be cleared of vegetation along the path of pipe layout for raw water from the intake pump station site all the way up to the top of the hill. The cleared forested area, averaged about 17 feet wide and 200 feet long, consists mostly of secondary vegetations and follows the old footprint of the old Japanese Road connecting the “Sakseng Hashi” Bridge.

Vegetation plots representing contour of environmental gradient along the proposed project footprint were surveyed to capture the information about the flora and fauna distributions. The total area surveyed for vegetation ranged from 6 - 17 feet wide and 600 feet long.

The forest area contains various vegetations with major species such *Tonget, Chersachel & Chebouch* dominating the bank of Tabecheding River. The savanna area, along the western to southern part of the project site, has an extensive community of *Itouch, kilkuld* and *Bakelild as* common weeds. A “rubber tree”, an introduced tree from Japan is common on the hill top. This type of tree is found wild only in this particular area of Palau. During Compact Road construction, Daewoo built an old access road that passes about 50 feet southeast of the water storage tank and used the area for stockpiles of road asphalt materials.

Palau has approximately 200 endemic plant species including 60 species of orchids. The vegetation assessment of the project site identified about 62 species of plants and seven (7) of which were endemic to Palau.

(Above) T1 -*Itouch, Kilkuld*, and *Bakelild* are the main weeds in the area of water dispense pipes all the way to the hill top.

(Below) *Ersachel, Tonget & Ebouch* are dominating trees on river side.

(Above) T3-Japanese Paper Bark is the prominent tree.
(Below) *Dilngau* is prominent grass on hill top where water storage tank, AVGF and Chlorinator will be installed with chain-link fence.

Photo Plate 5: Vegetation Transects.	
 T1- Trees dominating the river banks	 T1 – Raw water pipes layout & access road, from intake pump station to stand pipes near compact road, that has been cleared of vegetations
 T2 - Trees near stand pipes water dispensers area that will be removed	 T2- View of hill side toward south for pipes layout
 T3-East view on top of the hill south of the project site, for concrete storage tank, filter & fence.	 T-3 West view of hilltop area for water storage tank, AVGF and chlorinator will be constructed.

Photo Plate 6: Cleared vegetations along the old Japanese road from bridge to Compact Road for pipe layout (T1)

Cleared old Japanese road from the "Sakseng Bridge" toward southwest where compact road is situated.

Ertochet (Endemic)

Bedel

Ebouch

Kerdeu

Kesiamel

Tonget

Table 2(a): Vegetation survey from Intake pump station to area designated for water standpipes, Transect 1 (T1).

No.	Palauan Name	Scientific Name	Endemicity	Description / Use
1.	Bkau	*Parinari corymbosa*	Endemic	Fruits eaten by pigeon, fruit dove & bats
2.	Kerdeu (cut)	*Ixora casei*		Use to build traps for fish & chicken
3.	Chersachel	*Horsfeldia palauensis*	Endemic	Fruits edible & taste like taro & coconut
4.	Tonget	*Semecarpus venenosus*		Poisonous tree
5.	Cheluu	*Cyathea lunulata*		Tree fern
6.	Buklbeluu			Epiphytes, Bird's nest fern
7.	Toilalech	*Epipremnum carolinense*		
8.	Chebouch	*Heterospathe elata*	Endemic	
9.	Kesiamel	*Osmoxylon oliveri*		
10.	Chuchab	*Colona scabra*		
11.	Bedel	*Macaranga carolinensis*		Young leaves treat stomach aches & diarrhea
12.	Kilkuld	*Thelypteris unita*		
13.	Kelel a Charm	*Campnosperma brevipetiolata*	Endemic	
14.	Meliik	*Nepenthes mirabilis*		
15.	Koteb (vine)			
16.	Emeirasech (vine)			
17.	Chertochet	*Pandanus ameriikensis*	Endemic	
18.	Belloi (vine)	*Dioscorea bulbifera*		Edible seed
19.	Chebechab (vine)	*Phymatosorus scolopendria*		Monarch fern
20.	Chemeridech	*Cerbera manghas*		The seed is called Kamduangel
21.	Lius	*Cocos nucifera*		
22.	Chelangel	*Pouteria obovata*		
23.	Cheues	*Rhus taitensis*		
24.	Chosm	*Premna obtusifolia*		
25.	Iuetekill (vine)	*Lophopyxis maingaya*		
26.	Orredakl	*Dracaena multiflora*		
27.	Fern	*Unidentified*		
28.	Neneng (weed)	*Mimosa pudica*		Also called "mechiuaiu"
29.	Kelelakaming (weed)			
30.	Kloreuikl			
31.	Bakkellild	*Sceleria laevis*		
32.	Bedel	*Macaranga carolinensis*		
33.	Kelel a charm	*Campnosperma brevipetiolata*		
34.	Cheues	*Rhus taitensis*		
35.	Chertochet	*Pandanus ameriikensis*		
35.	Ongor ra ked	*Pandanus tectorius*		
37.	Matakui	*Melastoma malabathricum*		
38.	Kilkuld	*Thelypteris unita*		
39.	Meliik	*Nepenthes mirabilis*		End of cleared area next to compact road & beginning up hill

Table 2 (b): Vegetation Survey from stand pipes area up the hill toward water storage tank, Transect 2 (T2)

No.	Palauan Name	Scientific Name	Endemicity	Description/Use
1.	Kelel a charm	*Campnosperma brevipetiolata*	Endemic	
2.	Cheues	*Rhus taitensis*		
3.	Las	*Pterocarpus indicus*		Valuable hardwood
4.	Orchid (attached to kelel a charm)			Epiphytes
5.	Kloreuikl (fern)			
6.	Kebeas	*Merremia peltata*		
7.	Ngolm	*Glochidion ramiflorum*		Standing, young tree
8.	Beokl	*Vitex cofassus*		Standing, young tree
9.	Kelel a charm	*Campnosperma brevipetiolata*		
10.	Bedel	*Macaranga carolinensis*		
11.	Itouch	*Dicranopteris linearis var. ferruginea*		Dominated weeds include Itouch, kilkuld, bakelild
12.	Olecheul a beab	*Lypodium cernum*		
13.	Orchid on Ngolm			
14.	Bebechelut			Medecine (chew young leaf and drink water
15.	Orchid on Bebechelut tree			
16.	Cheskiik	*Decaspermum parviflorum*		Use for first birth bath
17.	Chelsau	*Trichospermwn ledermannii*		
18.	Chemudelach	*Hedyotis fruticulosa*		Medicine; common in savanna (ked)
19.	Chertochet	*Pandanus aimeriikensis*	Endemic	
20.	Ksid	*Fragrae ksid*	Endemic	

Table 2(c): Vegetation Survey from top of the hill at southern part of project site, Transect 3 (T3).

No.	Palauan Name	Scientific Name	Endemicity	Description/Use
1.	Chertochet	*Pandanus aimeriikensis*	Endemic	
2.	Paperbark	*Melaleuca quinquenervia*		Dominant tree on hill
3.	Ongor ra ked	*Pandanus tectorius*		Dominant tree in the area for water tank
4.	Matakui	*Melastoma malabathricum*		
5.	Koteb			
6.	Techellel a chull	*Cassytha filiformis*		
7.	Ksid	*Fagraea ksid*	Endemic	Strong wood for post & bridges
8.	Chemudelach	*Hedyotis fruticulosa*		
9.	Cheues			
10.	Ngolm	*Glochidion ramiflorum.*		
11.	Olcheiul a beab	*Lypodium cernum*		
12.	Chelsau	*Trichosperma ledermannii*		
13.	Kilkuld	*Thelypteris unita*		
14.	Dilngau /Mases			Prominent weed at top of hill
15.	Eleiatel			
16.	Lisel a beab (ground orchid)	*Spathoglottis sp.*		
17.	Botang (grass with yellow flower)			
18.	Louchebeluu (grass)	*Stachytarpheta jamaicensis*		

Fig. 8: PALARIS Map of vegetation showing forest covering two third of the project site.

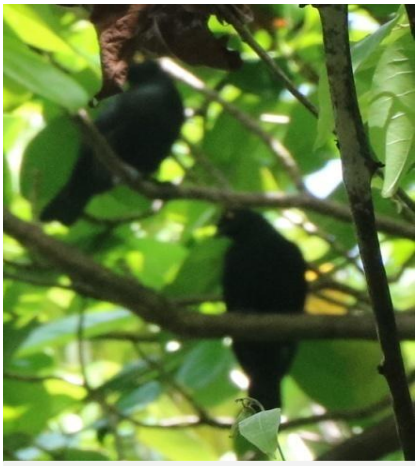
5.2.2 Birds

Palau is known to have about 16 species of birds and 2 species of bats.

There were total of seventeen (17) birds of eleven (11) different species recorded at two bird survey sites on December 3, 2018. A stationary counts of observed or heard birds carried out in the morning of December 3, 2018, around 6:21 to 7:00 a.m., indicated *Palau Fruit Dove, Palau Brush Warbler (endemic), Micronesian Starling, Palau Fantail (endemic), Palau Flycatcher (endemic), Mircronesian Myzomela, Black Noddy and Micronesian Kingfisher (Erosech) at Survey Site 1. In addition to those birds counted at Survey Site 1, three other bird species, Dusky White-eye, Chestnut Munia and White Tern* where heard on the second Survey Site, a savanna grassy area up the hill of Tabecheidng River. This result of bird survey using the National Bird Monitoring Protocol developed by Belau National Museum is presented as Appendix C.

No threatened or endangered bird species was either seen or heard during these surveys.

Erosech



Kiuid -Mironesian Starling (Aplonis opaca orii)

5.2.3 Reptiles

Palau is a home to 12 species of amphibians, reptiles, freshwater fish and the endangered Palau Megapode. Frogs, lizard and green tree snake, "*Nguus*", were observed at the site near old Japanese bridge.

"Nguis" seen at the old Japanese bridge

"*Elaich*", lizard, observed at old bridge

5.2.4 Endangered species

The Ministry of Natural Resources, Environment and Tourism and the Ministry of Justice are the national regulatory agencies charged with the protection of the endangered and protected species under the Endangered Species Act. No endangered or protected species of fauna or flora, as specified in the Endangered Species Act (1975), were observed within the project site during the assessments.

5.3 Socio-cultural and economic

5.3.1 Interview of Community

KAMPOR Analytical Team interviewed total of twelve (12) households not connected to any public water supply system and are situated between Siokumins, Airai State and Ngimis area in Ngerdubech, Ngatpang State. Gender distribution of those who were interviewed was equally spread with women making up forty-two percent (42%), men were forty-two percent (42%) and business facilities making up the remaining sixteen percent (16%). Those who were interviewed reside along the Compact Road from Ngimis through Tabecheding in Ngerdubech, Ngatpang State, all the way through Imul, Aimeliik State to Siokumins in Ngeruluobel, Airai State. Majority of those interviewed were not aware of the proposed project, had no environmental concerns and gave full support for it. They all endorsed the project and are anticipating completion to access the treated water.

Table 4: Result of community interview conducted by Kampor Analytical (December 2018 to January 2019).

No.	Gender/age/status	Remark
1	Male, 59 yrs old, resides in Ngaimis, retired.	Not aware of the project but fully support the water storage facility and will utilize the water.
2	Male, 62 yrs. old, resides in Imul, retired government worker	Fully support the project; uses about 2,000 gallons per week and will definitely use the water storage tank.
3	Male, 51 yrs. old, resides in Imul, private professional.	Not aware of the project but fully support it and will utilize the water storage tank.
4	Female, over 50 yrs., government worker, reside in Tabecheding area northwest of project site	Not aware of the water storage and have no environmental concerns. Family has three water tanks with combine capacity of 2,800 gallons for her household use. Support the water storage project and will use it. Currently use delivery trucks to supply water.
5	Female, over 40 yrs. Resides in Imul, work for state government.	Aware of the project and concern about the ecological impact on the river posed by water extraction. Currently has over 3,000 gallons tank capacity at her home and will not access the RENI water storage tank if there is cost associated with delivery of the water.
6	Male, over 60 yrs. Resides in Koksai, retired government worker and a farmer.	Not aware of the project. Will utilize the water system. The only environmental concern is to avoid excavating hill side to install the concrete storage tank.
7	Company workers housing in Koksai.	Have heard about the project. The four workers residing in the work housing will use the water during emergency and drought. No environmental concerns.
8	Female, 49 yrs., resides in Siokumins Ngeruluobel Hamlet, Airai State, unemployed.	Not aware of the proposed water project and fully support the project. She has only about 100 gallons water tanks for household use and will utilize the proposed water supply system. No other concerns

9	Female, 59 yrs. Resides in Ngerchemel, Ngeruluobel Hamlet, Airai State. Government worker.	Not aware of the water project. Currently using a dug up well for household while awaiting piped water connection for many years now. Will use the proposed water supply.
10	Female, over 60 yrs. Resides in Ngaimis, Ngatpang State. Retired government worker.	Not aware of the project and fully support it. Household of 8 people are utilizing untreated spring water for general use. Getting drinking water from Koror piped water. Will use the proposed water supply. No environmental concern.
11	Male, over 65 yrs. Resides in Sechersoi in Imul, Aimeliik State.	Not aware of the project. Support government effort to construct treated pipe water to the area. Has been waiting for government piped water connected to K/APWSS for many years. Will use the water if piped or delivered to his home. No environmental concerns.
12	Male, over 60 yrs, owns a green house farm south of project site	Not aware of the project and will not use it as he gets needed water directly out of the adjacent stream. No environmental concerns.

5.3.2 Road Facilities

A Compact Road, completed in 2006, runs southwest to north along the western side of the Project Site. A bridge connects the road crossing the Tabecheding River. There is a concrete culvert ditch that runs up the hill from north down toward the southwest along the roadside terminating into the grassy area before reaching the river.

On the southern side of the bridge, a road concrete ditch runs along the side of the project area draining into the Tabecheding River. The ditch discharges road runoffs into the river some 300 feet below the raw water intake pump station and will have no effect on the quality of source water.

Concrete road culvert that drains into river and bordering north-west of water standpipes area

A ten (10) minute count of vehicles passing by the project site was carried out on the morning of December 3, 2018 from 6:55 a.m. to 7:05 a.m. A total of 33 cars were counted with 21 cars heading southwest toward Aimeliik and 12 cars heading north toward Ngatpang. Vehicles heading in southwestern direction were at higher speed as compared to the ones going north.

The Compact Road is curved toward southwestern part of the project site and hilly on the northern part crossing the bridge. The declining road elevation cause motorists to accelerate as they pass by the project site.

5.3.3 Historical and Cultural Sites

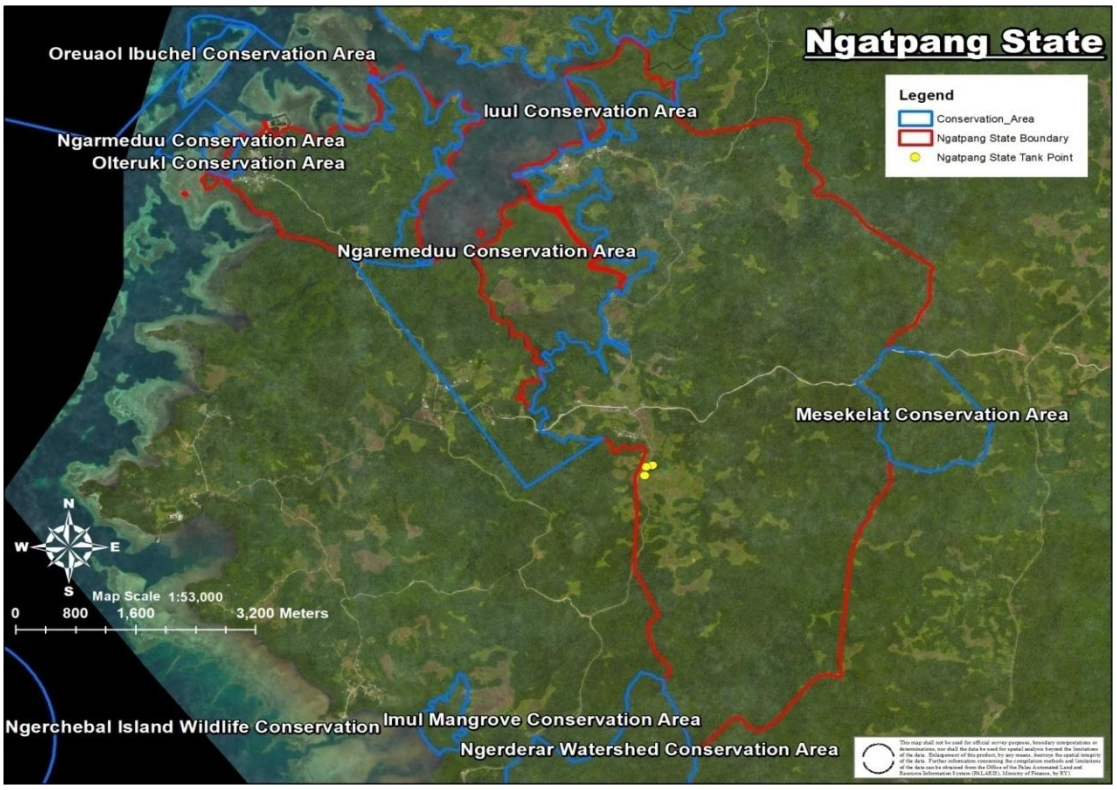
The Historical Map obtained from Palau Automated Land and Resource Information System (PALARIS) shows no historical or culturally sensitive areas within the project site. However, part of the Water Storage Tank Project will be situated within an area designated as Historical Remains Administration, an area for an old Japanese Police Station.

Fig. 9: Historical Sites Map by PALARIS.

5.3.4 Ngatpang State's Protected Areas Network

The proposed project site is situated far south and away from any of Ngatpang State's Protected Area Networks. The closest conservation area is Ngermeduu Conservation Area that is about 500 meters northwest of the project site.

Fig. 10: Map of Ngatpang State Protected Conservation Areas, by PALARIS; yellow points for project site.



6 Alternatives Including the Proposed Action

6.1 Environmental Consequences of Alternative 1: No Action

With an alternative of no action the National Emergency Plan to provide secured water sources ahead of drought will not be fulfilled. The existing community need for dependable potable water will not be met. However, the ecological habitats and ecosystems will remain intact and will continue to flourish.

6.2 Environmental Consequences of Alternative 2: Development Plan reduction or equally suitable plan

The design of the projects was modified to re-align all the water pipes along the pre-disturbed old Japanese road so as not to disturbed an intact forest area. This modification enabled the layout of both raw and treated water pipes in the same trench from the area of stand pipe to water storage tank facilities reducing the degradation of ecosystem's footprints.

Two alternatives for affordable filter systems; the Automatic Valveless Gravity Filter (AVGF) and Ecological Purification System (EPS), were discussed between the Pacific Community and the RENI-Steering Committee Members, particularly the Bureau of Public Works. Even though the AVGF system was significantly more expensive, the Palau Public Utility Corporation (PPUC)

selected it to be consistent with existing use of filtration systems (Appendix D- AVG Filter Design). The existing knowledge and skills of PPUC personnel to operate and maintain AVGF system was also factored into the selection of proposed water filter system. The Palau Public Utilities Corporation will take responsibility for the maintenance of the public water system once Pacific Community (SPC) hands it over to Palau Government (Appendix E – PPUC Assurance Letter).

Fig. 11: Modified design plan eliminating destruction of forest area.

Above: Initial proposed design for 200 meters raw water pipe (red) form water intake concrete culvert in the Tabecheding River through the forest area to the AVGF filter & storage tank on top of the hill.

Below: Modified design with raw water intake pipe layout following the alignment of old Japanese road thus eliminating disturbance of the forest area.

6.3 Environmental Consequences of Alternative 3: Alternate development site

Ngerderar River in Imul, Aimeliik State, was assessed a potential second site for this proposed RENI Water Storage Project. Result of the hydrological study revealed Ngerderar River inadequate to produce the water demand during droughts while maintaining an ecological function of the river. Additionally, this river is part of Ngerderar Watershed Conservation Area to south of Aimeliik State. This conservation area is said to be home diverse species of birds including a concentration protected bird species of Micronesian Pigeon.

Ngerderar River, Aimeliik State PAN Site

6.4 Environmental Consequences of Proposed Action

To proceeds with the proposed project development plans will result in a completed Water Storage Tank Project to fulfill the objective of the Palau National Emergency Committee (NEC) RENI Steering Committee together with SPC-RENI Team in enhancing the resilience of those living in Palau to shocks and insecurities resulting from droughts. The implementation of this RENI Water Storage Tank Project will help strengthen water security readiness for future El Nino events in Palau and meet the existing daily water needs for those communities outside of piped water service area in Airai, Aimeliik, and Ngatpang States.

The proposed Water Storage Facilities plan is the preferred action. The proposed action will have minimal impact on secondary vegetations that will be removed, a temporary erosion of soil and a long-term reduction of river flow through uptake of about twenty percent of stream water volume.

The concrete structure on top of the hill, along with AVG Filter unit and the stand pipes will have aesthetic impact of the area but the benefit of having access to safe water far outweigh the undisturbed integrity of the site.

7 Impact Assessment

7.1 Magnitude of the project

Since the entire project is situated within a pre-disturbed area, the primary impacts will be loss of functional forest as habitat for birds and animals, soil enrichment and root systems that are effective in trapping sediments preventing spread to stream. The cleared forest and savanna areas will temporarily lose their functions but the ecological impacts will revert back over time to sustain recovered fauna and flora.

7.2 Erosion and Sedimentation

Soils within the project site are conducive to high erodible properties. Cleared and excavated areas for piping layout and construction of facilities will be susceptible for erosion and sediment-laden runoffs into the adjoining river. Disturbance of riverbanks for placement of concrete chamber and submergible pumps will impact river banks and increase suspended solids in the water. The removal of vegetation will increase soil erosion and sedimentation overload into the stream, which will eventually impact the waterfall and the Ngermeduu Conservation Area downstream. Silt tainted runoffs will occur from earth moving, filling and compacting activities and during operational phase from various activities such as unpaved surfaces movements of trucks and heavy equipment operation within and traffic in and out of the facility.

The impact of riverbank protection structure during installation of concrete culvert can increase suspended solids within the river. Although this impact is short term, construction activities should be designed and implemented to minimize generation of suspended solids.

The concrete culvert in the river can increase turbulence and scour from reflected water current causing accelerated erosion of riverbanks. An improved design by incorporating rubble toe protection or riprap revetment extending down in a sloping angle will help dissipate the current velocity and provide habitat for aquatic organisms.

7.3 Air Quality and Noise

It is anticipated that increases operation of heavy equipments and trucks will contribute to temporary deterioration of air quality during construction period. Once the construction phase is completed, the ambient air quality will resume to its good quality. There will be minimal contribution of noise during the operation phase from delivery trucks and individual transports of water from the dispensers.

7.4 Clearing of vegetation

The physical alteration by clearing of vegetations will be the primary cause of habitat destruction within the project area. The loss of contiguous habitat and the changes of landscape are minimal enabling natural functions of the area to recover in short period of time.

The project area had received cumulative impacts from the construction of old Japanese bridge and road along with more recent construction of Compact Road. The removal of current secondary growth vegetations will affect the functions of both physical and biological components of the environment as water runoff purification, wildlife refuge and native species diversity.

7.5 River water quality and aquatic organisms

It is anticipated that work to place the sheet piles and pre-cast concrete as casing submergible pumps will cause increase of suspended solids. These activities will have minimal affects on physical parameters, such as temperature. The suspended solids will increase the turbidity of water, which will have effect on the quality of water during construction.

The placement of the pump casing will take away the habitat for aquatic organism and potentially change the water flow dynamics of the stream.

7.6 Public Infrastructure

The anticipated connection to the PPUC Electrical services for water pumps should be within the allowable usage consumption. There is an accessible electric pole at the project site.

Construction of concrete drive way to access stand pipe may obstruct a discharge flow of existing road concrete swale.

Slow moving vehicles in and out of the water dispenser area into the compact road may pose potential hazard for vehicular commuters.

7.7 Solid Waste

Generation of solid wastes from construction activities, operation of water treatment and repair of machineries is anticipated. Ngatpang Solid Waste Landfills is situated way north of project site toward Ngchesar State.

7.8 Socio-cultural and Economic

The proposed project is anticipated to have a positive direct impact to the Ngatpang and Aimeliik residents as the project will build their communities' resilience to droughts by strengthened water securities with supply of treated water that is readily accessible. This project will address challenges anticipated with Palau's climate change predictions of extreme temperatures and high occurrences pattern of El Niño/La Niña.

The Ngiraremiang Family, as the owner of the private property, realized the benefits of the proposed water project in supplying water to the people in times of droughts, and had executed Land Use Right to the Government of Republic of Palau to use portion of their land for the proposed water storage project.

The land use pattern in the proposed site will change as the result of water storage tank, filter and standpipes facilities. The water pipes have been redesigned and relocated to reduce impact the forest area.

The majority of men and women of Ngeruluobel, Airai State, Ngerdubech hamlet of Ngatpang State, and Imul, Aimeliik State that were interviewed during field assessment, were not aware of the water storage project but expressed full support for it. The proposed RENI Water Storage Project has positive impact for those interviewed and will meet water demand for residents of Airai, Ngatpang, and Aimeliik States who are not connected to public water supply system.

8 Proposed Mitigation for Preferred Action

8.1 Erosion and Sedimentation

Prior to any earthwork, Proponents must design and install erosion and sediment control facilities, in accordance to EQPB approved ESCP, to contain sediments. Conduct routine inspection and maintenance of ESCP facilities with prompt implementation of corrective actions as necessary. Remove silt fence and dispose properly upon completion of earthwork activity and install permanent ground cover such as mulch or vegetations.

Install washbasin facility within the project site to clean dirt off the truck's tires before entering Compact Road.

Clean up any soil spillage on the public road.

Minimize areas to be cleared of vegetation, maintain natural landscape and re-plant lost vegetation.

Ensure the 15 feet construction corridor, along with other bare areas, are re-vegetated and all ditches and slopes are stable. Mimic natural process for landscaping and promote use of native species for ground cover.

Maintain adequate buffer area to protect the river from soil and other contaminants runoffs.

Ensure uninterrupted flow and function of the existing road concrete swale.

Install and maintain a treatment facility for the backwash water and runoffs from standpipe prior to discharge back to the existing waterway.

8.2 Operation of Public Water Supply System

The outcome of the RENI- Water Storage Project is a new public water supply system defined by Palau EQPB Public Water Supply System Regulations 2401-51- 03 MM (3) as a "Non-Transient Non-Community Water System. This new Tabecheding Public Water Supply System will not have piped water service connection to homes but will regularly serves at least 25 of same persons over six months per year.

A complete permit application with notice of intent to build a Public Water Supply System with final design drawings and specifications for all facilities, developed with acceptable engineering practices, along with pertinent support documents should be submitted to EQPB.

Upon completion of the system, treated water pipes and tank should be treated prior to system activation following EQPB disinfection guidelines. Hyper chlorinated disinfection water must be treated to lower than 0.2 ppm before discharge to any waterways.

Palau Public Utility Corporation (PPUC) commits to operate and maintain the system. Water Operators should have minimum skills sets and certificates to run residual chlorine and other tests required by EQPB to ensure water is safe for human consumption. PPUC, as an operator, must ensure adequate disinfection contact time prior to disbursement of the treated water. PPUC, as the supplier of water, must also conduct standard quality tests on monthly basis to ensure the water is safe for human consumption and meet the required level for Total Coliform Bacteria (absent), Chlorine residual (>0.2 ppm) and Turbidity (<1NTU).

Sanitary Surveys should be carried out every five years to evaluate the adequacy of surface water source, equipment, operation, facilities and maintenance to ensure continuous production of potable water, in addition to establishing basis for reduced monitoring frequency.

Any major water system maintenance, change of operator, facility repair or alteration must get prior approval from EQPB. Water Operator should keep all records of water quality tests and system repair and maintenance.

PPUC must notify the people served by this system whenever the system fails to meet any of the water quality standards.

8.3 River & Watershed Management Initiatives

Implementation of a state master development plan, with due consideration of stream ecosystems protection consistent with national goals, is a recommended approach for protection of the integrity of Tabecheding River, which is ecologically sensitive habitat. National, State Governments and landowners must work together to protect the Tabecheding watershed to ensure a “Class 1” water quality is maintained for the source water.

Ideally, maintain the raw water intake above any point source discharges.

Minimize fragmentation of habitat and promote connectivity of natural areas.

Work with the state government to proactively include community input in determination of usages of water resources.

Best practices for extraction of water should be maintained to ensure water intake is within the 20 percent volume of the river natural output so as not to threaten the river's ecological integrity or negatively affect downstream Tabecheding Waterfall and Ngermeduu Bay.

8.4 Control Measure for Air and Noise

The direction of the wind should be monitored during the application of chlorine for water disinfection. The chlorine fumes are heavier than air and will potentially decent downhill to the road. The application for disinfection should make certain that westerly wind do not carry chlorine dusts /fumes downhill to commuters on the compact road.

Use of water for dust control measure should be made part of operation procedures during construction activities.

Carry out proper maintenance of all machineries in accordance to manufacture guidelines to minimize smoke and dust emitted from operating machineries.

8.5 Waste Management

The handling of solid waste management during construction and operation phases should be consistent with recycling principle of reuse, reduce and recycle. Install recycling bins and segregate wastes.

Wash water from the AVGF system backwashing should be treated prior to discharge into existing water ways that will eventually drain into Tabecheding River.

Treated water pipes and tank should be disinfected prior to system activation. Disinfection flash out water should be treated to less than 1 ppm chlorine residual prior to discharge into water ways.

Conduct routine clean up of solid wastes in the areas surrounding the project site. Solid wastes will be disposed properly at permitted land fill such as Ngatpang Solidwaste Landfill.

Establish and adopt a Road clean-up Program for the community.

Maintenance of equipments should be handled at a designated area and in accordance to manuals to avoid spillage.

Provide temporary portable toilet facilities for workers.

8.6 Climate Change

This RENI Water Storage Tank Project is the preventive response action for climate change effects on temperatures to provide people of Palau water security during droughts. This Palau RENI Water Storage Project is consistent with the intents of the 2016 National Disaster and Risk

Management Framework and the 2015 Climate Change Policy for Climate and Disaster Resilient Low Emissions Development.

8.7 Socio-cultural and Economic

Post public notices prior to start of construction activities.

Maintain public safety by use of road signage or workman directing traffic as necessary when entering the main road.

For public safety, install appropriate road signage to warn off commuters to watch for slow moving vehicles in and out of the water pipes area.

Maintain a safe water quality at all time.

Provide regular access to water dispensers and reasonable costs for water delivery services.

Provide employment opportunity and product incentives to resource owners and local community members.

Maintain the functions of the existing road concrete swale and drainage ditch. Implement routine clean up of accumulated solid waste and dirt.

Ensure safety and protection of water storage facilities.

There are signs of recreational use at the raw water intake site, as indicated by a hanging rope for swinging. Notices must be posted to help inform public on the use of river water as source of public water supply system.

National and state government must adopt policies to protect the use of the Tabecheding River as a surface water source for Tabecheding Public Water Supply System.

9 Impact Summary and Conclusion

The RENI Water Storage Project will be situated in an area that is pre-disturbed. The negative impacts are mostly temporary and the extraction of raw water from river will be monitored to ensure adequate volume of water remains to support aquatic ecosystem. Financial and technical resources are available to complete the proposed project. The CIP will provide construction oversight and PPUC has committed to operate and maintain this water supply system safely.

The recommended action is to proceeds with the proposed project development of a RENI Water Storage Project. This project will fulfill the objective of the Palau National Emergency Committee (NEC) RENI Steering Committee together with SPC-RENI Team in enhancing the resilience of those living in Palau to shocks and insecurities resulting from droughts. The project will meet the

national objective of addressing impacts of Climate Change ensuring security readiness for future El Nino events in Palau and meet the existing daily needs of water for those communities outside of piped water service area in Airai, Aimeliik and Ngatpang States.

Table 5: Summary of Environmental Impacts and Mitigation Measures

Identified Impact	Type		Duration		Level		Mitigation Measure	Responsible
	-	+	Short Term	Long Term	Direct	In Direct		
Pre-Construction								
Design Plans		X		X		X	Incorporate measures to ensure use of AWWA drinking water standard utilities and equipments, continuous safe quality of water, safety of users and treatment of discharges & runoffs	Proponent/ Designer
Secure Permits		X		X		X	EQPB, HPO, UXO, Ngatpang State	Proponents/ Project Manager
Installation of silt fence	X		X		X		Follow EQPB approved ESCP	Project Manager and workers
Construction								
Inspection of silt fence/curtain		X	X			X	Ensure sediment containment	Project Manger/ Workers
Installation of backwash water treatment facility	X			X	X		Containment/treatment of backwash water prior to release off site.	Project Manager/ Workers
Installation of drainage ditch	X			X	X		Ensure conveyance of treated backwash and operation effluents	Workers
Install permanent ground cover		X		X		X	Use local vegetations for ground cover	Workers
Operation								
Monitor water intake level	X			X	X		Maintain record to ensure less than 20% water intake volume from the river	System Owner/Operator (PPUC)

Disinfect treated water lines	X			X	X		Treated water pipes must follow EQPB disinfection standards prior to system activation; proper treatment and release of super-chlorinated water	System Owner/Operator
Water Disinfection Treatment				X	X		Ensure adequate chlorine contact time and residue	System Operator
Solid Waste	X			X		X	Implement segregation; reuse, reduce, recycle; install recycling bins	Project Manger/ Workers
Water Quality Monitoring				X	X		Implement routine monitoring tests following EQPB guidelines	System Operator
Job opportunities	X			X		X	Employ locals; provide training; increase tax revenue; support Ngatpang's work force	Proponents/ Project manager
AVGF back Wash water Discharge	X			X	X		Ensure treatment of back wash water prior to discharge into waterways	Water System Operator
Utility Fees		X		X		X	Water Users fee should remain within the affordable price/cost of living for customers	System Owner/Operator (PPUC)
Watershed Protection Initiative				X		X	Work with all stakeholders to ensure protection of Tabecheding River as a source of public water supply system	Proponents
Abandonment								
Not applicable							Guidance from EQPB as needed.	Proponents

10 Accountability Statement of EA Preparer

ACCOUNTABILITY STATEMENT

The objectives of this Environmental Assessment (EA) were met through collection of information and assessment of the project in accordance with the dictates of reasonable and sound professional judgment adhering to the rules set forth in the Palau Environmental Quality Protection Board (EQPB) guidelines and regulations. New data/information which would make the enclosed EA inaccurate will be forwarded to the attention of the EQPB.

We certify that all the information contained in the enclosed EA is true, accurate and complete to the best of our knowledge.

In witness whereof, we hereby set out hands this 16th day of _____, 2017.

Ongerung Kambes Kesolei Print	Signature	EA Preparer/Marine Assessor Specialization
Portia K. Franz Print	Signature	EA Preparer/Project Lead Specialization

SUBSCRIBED AND SWORN to before me this 16th day of June, 2017 in Koror, Republic of Palau.

Effecia Kazuma
Clerk II
Palau Supreme Court

Clerk of Courts, Supreme Court of the Republic of Palau

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