Initial Environmental Examination

Project Number: 53284-002
October 2020

Federated States of Micronesia: Chuuk Water Supply and Sanitation Project

Prepared by the Chuuk Public Utility Corporation for the Asian Development Bank.

ABBREVIATIONS

ADB	Asian Development Bank
ADWF	Average Dry Weather Flow
BCD	Bid and contract documents
BOD	Biochemical oxygen demand
BOQ	Bill of quantities (in the contract)
CCP	Communications and consultation plan (of the Project)
CEMP	Construction environmental management plan (of the contractor)
COD	Chemical oxygen demand
CSS	Country safeguard system
EA	Environmental assessment
EPA	Chuuk State Environmental Protection Agency
EP	Equivalent Population
EMP	Environmental management plan
ESO	Environmental safeguards officer (in the PMU)
FSM	Federated States of Micronesia
Gpd	US Gallons per day
GRM	Grievance Redress Mechanism
GWI	Groundwater infiltration
HDPE	High Density Polyethylene
HSP	Health and Safety Plan (part of the CEMP)
HMI	Human machine interface
I and I	Inflow and Infiltration
IA	Impact assessment
IEE	Initial environmental examination
IES	International environment specialist
ML/d	Million liters per day
NTU	Nephelometric turbidity units
PACI	Poly aluminum chloride
PCCS	Pacific Climate Change Science Program
PER	Public Environment Report (under the CSS)
PMU	Project Management Unit
PDWF	Peak Dry Weather Flow
PWWF	Peak Wet Weather Flow
RRF	River Regulated Flow
SPS	Safeguard Policy Statement 2009 (of ADB)
STP	Sewerage Treatment Plant
TOR	Terms of Reference
TSS	Total suspended solids
UWSSSP	Urban water supply & sanitation sector project
USD	United States Dollar
WHO	World Health Organization
WERI	Water and Environmental Research Institute for the Western Pacific, University Guam
WTP	Water Treatment Plant

NOTES

(i) The fiscal year (FY) of the Government of the Federated States of Micronesia and its agencies ends on 30 September. “FY” before a calendar year denotes the year in which the fiscal year ends, e.g., FY2019 ended on 30 September 2019.

(ii) In this report, "$" refers to United States dollars.

CONTENTS

FIGURES

TABLES

EXECUTIVE SUMMARY

The Project. The Asian Development Bank (ADB) and FSM Government (the Government) have established the Chuuk Urban Water Supply and Sanitation Project (CWSSP). The Project aims to improve access to safe water and improved sanitation in urban and peri-urban areas by secure and safe urban water supplies; effective, efficient and safe urban services; and the financial and technical sustainability of CPUC, the state-owned enterprise responsible for the management and development of urban water resources and sewerage services in Chuuk.

Safeguard Policies. This IEE was conducted in accordance with ADB's Safeguard Policy Statement 2009 (SPS), and the requirements of the Chuuk Environmental Act (1994), Environment Regulations (2008) and Environmental Impact Assessment Guidelines (2010). The Project is deemed Category B for environment per ADB's environmental screening because physical impacts are involved, with site specific, manageable impacts related to the construction phase and can be readily mitigated and/or managed. This proposed project, is screened as a Category B project under ADB's social safeguards policy as it requires a resettlement plan that addresses involuntary resettlement impacts which are not deemed significant.

Outcomes. The IEE found no significant negative social or environmental impacts or risks that could not be mitigated. It was determined that a full environmental impact assessment was not warranted. Since the detailed assessment has been completed, the IEE will serve as the Project's final social and environmental assessment.

Anticipated impacts. Scoping and assessment of the project has identified social and environmental considerations for the Project's pre-construction, construction, and operational phases.

(i) **Pre-construction considerations** include compensation, climate change vulnerability; integration of the IEE and EMP and development consent conditions in the bid and contract documents; grievance redress and management; disruption of utilities and services; identification of materials sources, materials extraction and application for building materials permits and land access arrangements. Actions necessary to address pre-construction considerations will be included in tender documents and construction contracts.

(ii) **The construction phase** impacts are site access and clearance including potential disruption of utilities (power and communication cables); soil erosion and sedimentation control; haulage and stockpiling of construction materials; oil and hazardous materials management; dust control and on-site air pollution; solid waste management; construction noise and vibration; traffic management; community and occupational health and safety; potential damage to archaeological and cultural assets. Contractors will be required to prepare construction environmental and social management plans (CEMPs) based on the ESMP included as part of the environmental assessment and reflecting their construction approach and methodology to ensure appropriate environmental management during the construction period.

(iii) **Operational considerations** of the water supply and sanitation projects include health hazards due to unplanned delivery of poor water quality and health and safety risks of reservoir operation and maintenance. Operational impacts will be addressed by incorporating the necessary measures, such as a water safety plan, in the design and use of appropriate operational procedures and by ensuring effective mitigation and monitoring plan for each subproject. The operational environmental issues will be addressed at design stage to ensure the long-term management and mitigation; these will include:

(a) Curtailment of water abstraction from the Wichen River to ensure a minimum level of river flow
(b) Inclusion of sludge drying facilities at the WTP and implementation of a sludge management/handling plan by CPUC
(c) Implementation of a chemical management/handling plan by CPUC
(d) Implement a well monitoring program to be able to track aquifer performance
(e) Community liaison on best practice for pit latrine and septic tank management by CPUC

Contractors Environmental Obligations. Based on the Project's EMP, contractors will be required to prepare their construction EMP (CEMP) to ensure appropriate environmental management during the construction period. In responding to the Project's EMP, the CEMP is to be site and activity specific reflecting the contractor's construction methodology and approach and include all sub-plans (health and safety plan, traffic management plan, erosion and sediment control plan, waste management plan, hazardous substances management plan) as required.

Climate change adaptation. The Project will address the critical need for climate change resilience, given Chuuk State vulnerability to the effects of droughts and flooding.

Institutional arrangements and capacity building. The Ministry of Finance and Treasury is the executing agency and the Chuuk Public Utility Corporation (CPUC) is the implementing agency for this Project. CPUC's Project Management Unit (PMU), will supervise the construction contractors and ensure that CEMPs are properly implemented and monitored. The PMU will designate a safeguards/community liaison officer.[1]

Consultation and participation. CPUC conducted consultations during project preparation and will continue to do so during the construction phase.

Grievance redress mechanism. The Project will use the CPUC grievance redress mechanism (GRM). This procedure meets the requirements of CPUC infrastructure projects and the ADB SPS.

Conclusion and recommendations. The findings of the IEE are that, no further environmental or social assessment is required. The recommendations are:

(i) specific mitigation and/or design specifications of the subproject EMP's (Wichen River WTP, water supply and sanitation pipelines and associated infrastructure and construction of septic tanks/pit latrines) will be included in the design process and integrated into the bid document along with any conditions of the development consent(s).
(ii) It will be a requirement of the contract that the contractor(s) will submit a CEMP for CPUC approval prior to any physical works commencing.
(iii) The construction contract will also require the contractor to respond to the Project's GRM in their CEMP.
(iv) Improved and strengthened operation stage monitoring of health and safety is required to reduce risks to the public and CPUC personnel.
(v) CPUC will continue the process of public consultation and information disclosure during detailed pre-construction, construction and operation phases as guided by the Project's CCP.

[1] Exact designation will be confirmed by PMU in due course.

I. INTRODUCTION

A. Project Background and Rationale

1. In Chuuk State, access to public water supplies and sanitation services is limited. The 2010 National Census reported that 7% of households obtained drinking water from the public water supply systems. Other sources of household drinking water were rainwater tanks (69%), wells (8%), springs and streams (11%), and bottled water and other sources (4%).[2] Rainwater harvesting is not secure due to the seasonal rainfall patterns and more frequent and severe dry periods as a result of climate change.

2. The Chuuk Public Utility Corporation (CPUC) operates the public water supply on Weno Island, serving 378 residential customers (around 19% of total households) and 101 commercial and government customers. CPUC produces 2,500 cubic meters of water per day (m^3/day) of which 95% is sourced from deep wells. CPUC has identified a new potential surface water source from the Wichen River which could expand the water supply, reduce reliance on groundwater and rainwater harvesting, and lower pumping costs.

3. The Weno sewerage network, the only centralized sewer system in Chuuk is located on the north and northwestern side of Weno Island and was commissioned in 1973. The sewerage network is operated by CPUC with 384 residential households and 106 commercial and government customers. Sewage is treated at the Weno wastewater treatment plant (WWTP) which is located next to the Weno airport. The WWTP has a capacity of 750,000 gallons/day. Treated sewage is discharged into Chuuk Lagoon 600 meters from the Wastewater Treatment plant via an ocean outfall.

4. The sewerage network and the sewage pumping stations are dilapidated and requires rehabilitation. CPUC has made continuous improvements of the Weno sewerage pipes since 2011. However, further investment is still required to expand the sewer pipe service and rehabilitate the pump stations. Beyond the sewerage network service area, septic tanks and pit toilets are widely used, particularly among poor communities. Septic tank and pit toilets discharge sewage randomly into shallow aquifers and contaminate Weno's groundwater sources. Consequently, diarrhea, particularly among infants is endemic for households using shallow wells for drinking water.

5. CPUC is mandated under the Chuuk Public Utility Corporation Act of 1996 to deliver electricity, water supply, and sewerage services to the people in Chuuk State. CPUC's performance has improved significantly after the institutional reforms began in 2010 financed by the Asian Development Bank (ADB) and the United States Department of Interior. [3] CPUC fully recovered its operation and maintenance, depreciation, and debt servicing cost in fiscal year 2019 with revenue generated from utility service tariff collection.

6. However, further institutional reforms of the governance and tariff frameworks are required to address deficiencies identified during the ongoing CPUC institutional review and to minimize the reliance on cross-subsidies from electricity sales to finance CPUC water supply and sewerage operations.[4]

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[2] Government of the Federated States of Micronesia. 2011. *Summary Analysis of Key Indicators from the FSM 2010 Census of Population and Housing*. Palikir. More recent data is unavailable.

[3] ADB. 2004. *Omnibus Infrastructure Development Project*. Manila. The CPUC reforms commenced in 2010.

[4] The CPUC institutional review is being delivered under ADB's TA 9425-REG. ADB. 2017. *Capacity Building and Sector Reform for Renewable Energy Investments in the Pacific*. Manila.

7. Nonrevenue water (NRW) in Weno water supply network during 2019 averaged 65%. In March 2019, a survey by CPUC of the water connections in Weno showed the number of unrecorded (or illegal) connections is greater than connections recorded by CPUC. Such unrecorded connections reduce the water supply revenue and significantly increase the CPUC's NRW. CPUC plans to reduce the NRW and increase revenue by: (i) optimizing its water supply operations and recording all connections, and (ii) strengthening its water leak detection capacity to minimize physical water losses.

8. Women play an important role in promoting good health and sanitation practices in FSM households and children learn important lessons on hygiene from their mothers. As primary caregivers, productivity of women may be adversely affected by loss from productive activities such as paid employment, to care for sick family members affected by water-borne diseases. Public hygiene awareness and education activities targeted at women will improve children's health and behavior such as handwashing. Access to sanitation facilities will ease the burden of women on tasks related to sanitation, health, and hygiene and will likewise reduce medical costs on waterborne and other infectious diseases.

9. The Government of FSM has requested ADB assistance to improve water supply and sanitation on Weno Island. The project will improve project will improve water supply and sanitation service on Weno Island, the largest urban center in Chuuk State (Chuuk). The project will also contribute to reducing the transmission of the coronavirus disease (COVID-19) and other hygiene-related and waterborne diseases through increased access to safe water and improved sanitation service. A project readiness financing grant, also requested by the Government, was approved in 2019 to prepare the project and facilitate a smooth transition to project implementation.[5]

10. ADB's engagement in the water and sanitation sector in Chuuk adds value by (i) bringing in extensive experience in water and sanitation infrastructure investments and associated technical assistance in Pacific developing member countries including FSM, and (ii) providing best practices for water utility institutional strengthening and capacity building. Previous ADB assistance for development water supply and sanitation services in FSM include the Water Supply and Sanitation Project,[6] the Omnibus Infrastructure Development Project (footnote 5), and the Weno Water Supply Well Remediation Project.[7] The project design will reflect lessons from previous relevant ADB and development partner sector operations in FSM and other Pacific developing member countries.[8]

11. The project will contribute to goal 6 of the Sustainable Development Goals to ensure access to water and sanitation for all. It aligns with the ADB's Strategy 2030 operational priorities to: (i) address remaining poverty and reducing inequalities (OP1); (ii) accelerating progress in gender equality (OP2); (iii) tackle climate change, building climate and disaster resilience, and enhance environmental sustainability (OP3); (iv) make cities more livable (OP4); and (v) strengthen governance and institutional capacity (OP6). The project is included in ADB's country operations business plan 2020–2022[9] and will have the following three outputs.

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5 ADB. 2019. *Project Readiness Financing Report. Federated States of Micronesia: Preparing the Chuuk Water Supply and Sanitation Project*. Manila.

6 ADB. 1996. *Water Supply and Sanitation Project*. Manila.

7 ADB. 2008. *Weno Water Supply Well Remediation Project*. Manila.

8 Key lessons include (i) extensive community participation and awareness programs during project design and implementation are essential to build the community knowledge and ownership required to secure improved utilities, and (ii) prioritized investment should be more focused to avoid dilution of resources.

9 ADB. 2019. *Country Operations Business Plan: 11 Small Pacific Island Countries, 2020–2022*. Manila.

B. Outputs and Targets

12. **Output 1**. Continuous and safe water supplies provided. Output 1 will (i) install new water supply connections to increase the number of households with legal access to the CPUC water supply network to 1,000 households or more; (ii) construct 10 kilometers of new water mains to replace dilapidated water mains and expand the water supply networks to cover more households; (iii) develop a new surface water intake on Wichen River with an associated 1,000 m3/day water treatment plant; (iv) recommission deep wells and development of new deep wells in the Wichap-Epinup area to supply the southern area of Weno; (v) improve water supply network efficiency including connection of deep wells to centralized water reservoirs and construction of a booster station (at Sapuk); and (vi) reduce NRW to 30% or less by installing and replacing customer meters with prepaid water meters, installation of real-time network monitoring equipment, and repair or replacement of leaking water mains.

13. **Output 2.** Effective, efficient and safe sanitation provided. Output 2 will: (i) install new sewer connections, free of charge, to increase the number of households with legal access to the CPUC sewer system 750 households or more (ii) develop and implement a wastewater inflow and infiltration management program; (iii) construct 2.8 kilometers of sewage pipes to expand and rehabilitate the pipe system; and (iv) rehabilitate 2 sewage pumping stations and 11 sewage grinder stations. Output 2 will also facilitate the regular desludging of onsite sanitation facilities by: (i) mandating septic tank construction and operations standards; (ii) developing a cost recovery framework for desludging of onsite sanitation facilities; and (iii) facilitating private sector participation in desludging operations. CPUC will strengthen its septic tank desludging operations and treat the septic tank sludge at the Weno wastewater treatment plant

14. **Output 3.** Chuuk Public Utility Corporation made financially and technically sustainable. Output 3 will assist CPUC to further strengthen its technical and financial sustainability through water supply and sewerage system operator training programs and asset management training programs. Output 3 will also assist CPUC to implement a new tariff framework by 31 December 2023 to enable CPUC to recover water supply and sewer operation and maintenance costs. The will have the following outcome: efficiency, climate change and disaster resiliency, and sustainability of safe water and sanitation improved in Chuuk State.[10] The project is aligned with the following impacts: (i) sustainable development of social and economic infrastructure promoted through the provision and utilization of cost-effective, safe, reliable, and sustainable infrastructure and (ii) Chuuk State infrastructure needs towards a sustainable development are met and maintained.

15. The Project will be implemented by CPUC. CPUC is establishing a project management unit (PMU) which will include a safeguard specialist.

16. This initial environmental examination (IEE) is the assessment of the components that have been defined during project preparation for the Weno water source improvement, upgrades to the WTP and improved sanitation in urban and peri-urban areas.

17. This IEE has been prepared in accordance with the requirements of the country safeguards system (CSS), WB's Safeguard Policies (WBSP) and the ADB's Safeguard Policy Statement 2009 (SPS). The Project has been screened as Category B for environment due to the significance of its environmental impacts and risks which are largely site-specific, mainly related to the construction phase and many of which can be readily managed or

[10] The preliminary design and monitoring framework is in Appendix 1 of the RRP.

mitigated through implementation of the measures identified in the environmental management plan (EMP).

18. This IEE provides an assessment of the social and environmental impacts and risks associated with the Weno projects including the Wichen River Water Treatment Plant, well development, borehole consolidation, pipeline construction, increased sewer connections pipeline construction and the incorporation of pit latrines or septic tanks to improve sanitation in urban and peri-urban areas.

19. It is based on preliminary engineering design, field visits to the proposed areas; review of available information; and discussions with government agencies and communities in the relevant locations.

II. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

20. The environmental safeguards requirements of the Project will be implemented to comply with Chuuk Sate's laws and regulations and the SPS.

A. Country Safeguards System

21. **Environmental Laws and Regulations.** The Environment Act (1998) provides the legal basis for environmental protection and management. It provides the foundation of the Chuuk' environmental impacts assessment (EIA) system, under the jurisdiction of the Environment Protection Agency.

22. This project is a prescribed development under the second schedule of the Environment Act 1998. As a result, CPUC is required to produce an EIA and management plans for the project. EIA's are undertaken for activities that are likely to have impact on the environment and are subjected to decision of the national authority, the Environment Protection Agency. The EIA will be approved by the Director EPA who will then issue a development consent for the project to proceed.

23. An Environmental Impact Assessment (EIA) assesses the social and environmental impacts associated with the project and identifies mitigation measures to minimize and avoid the impacts, including restitution for any damage to by those effects through replacement, restoration and compensation.

24. EPA furthermore confirmed during consultation, that the level of assessment conducted and reported as IEE for a category B project (according to ADB's SPS) is equivalent to an EIA of the Chuuk's Environment Act of 1998.

25. The IEE concludes that majority of the environmental impacts are minor and marginal, all of which can be satisfactorily managed and mitigated.

26. Environmental standards for the Chuuk are still being developed. However, EPA generally advises project proponents to follow internationally recognized standards such as those of the World Health Organization (WHO) and US EPA standards.

B. Other Relevant Laws

27. The Environmental Health Act (1980) provides for the management and control of public health in the Chuuk. It defines local authority responsibilities in relation to the construction, operation, and management of sewerage systems, including sewage disposal works. It also provides penalties for the willful pollution of a water supply source.

28. The Earthworks Regulations (2008) regulates the mining and extraction of aggregate or gravels from rivers. It requires that building material permits (BMP) be applied for prior to any extraction of construction or building materials. The application for BMP may require a PER and will require preparation of an extraction plan.

29. The USA - OSHA (Occupational Safety & Health Association) protects the health, safety and welfare of people at work. This protection covers the employee and employer as well as self-employed people.

30. International conventions. Chuuk is a signatory to a number of international agreements (treaties and conventions) with environmental and conservation implications as well as for the protection, promotion and safeguarding of cultural heritage and traditional knowledge.

C. ADB Safeguard Policy

31. Any investment funded or administered by ADB must comply with the requirements of the SPS. The SPS promotes the sustainability of project outcomes by protecting the environment and people from potential adverse impacts. The SPS comprises three safeguards—environment, involuntary resettlement, and indigenous peoples—which aim to avoid adverse impacts on the environment and people and if it is not possible to avoid then to minimize, mitigate, and/or compensate for adverse impacts; and to help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

32. In accordance with the SPS, screening and categorization of a project (including its subprojects and/or components) is undertaken to reflect the significance of potential project impacts or risks; to identify the level of assessment and institutional resources required for the safeguard measures; and determine disclosure requirements. Consequently, the SPS categorizes potential projects or activities into categories of impact (A, B, C or FI) to determine the level of environmental assessment required.

33. This section of the CWSSP has been deemed category B for environment based on the low significance of its potential environmental impacts and risks. This proposed project, includes resettlement impacts that are deemed also not significant, and is screened as a Category B project for social impacts. An IEE is the appropriate level of assessment for a category B project.

III. PROJECT DESCRIPTION

A. Project Objectives

34. The project objective is to target increased access in Chuuk State to efficient, uninterrupted, and sustainable water supply and sewerage services that are resilient to climate change and disasters. The FSM government has proposed the Chuuk Water Supply and Sanitation Project (CWSSP). The project will improve CPUC's utility operation and customer management, expand CPUC's water supply services, reduce NRW, and increase revenue from water supply and sewerage services. CPUC's sewage system on Weno will also be expanded and rehabilitated.

35. The project will have three outputs:
- (i) increase in the number of registered households with access to uninterrupted, safe, and climate and disaster resilient water supplies;
- (ii) provision of effective, efficient, and safe sanitation services to the residents of Chuuk; and
- (iii) continued strengthening of CPUC's financial, technical, and operational sustainability.

36. In Chuuk State, access to public water supplies is limited. Only 8% of households obtain drinking water from the public water supply systems which are provided by the Chuuk Public Utility Corporation (CPUC). The majority households rely on rainwater tanks (69%) as the source of drinking water. Other household water sources include wells and springs (19%), and bottled water and streams (5%). Rainwater harvesting is not secure due to the seasonal rainfall patterns and more frequent and severe dry periods as a result of climate change. The CPUC water production is 2,900 cubic meters per day in which 95% is from deep wells and 5% from the Pou River.

37. CPUC filters the water abstracted from the Pou River and chlorinates all the water produced. The Pou River headworks and treatment plant constructed in 1982 are dilapidated and require rehabilitation. CPUC has identified another potential surface water source in the Wichen River, which would expand its water supply, reduce the reliance on groundwater, and substantially cut pumping costs. However, the development of the new water source requires adequate funding.

38. In Chuuk State, public sanitation service is also limited. The Weno sewerage system commissioned in 1973 serves about 400 households in the northern and western side of Weno Island. Parts of the sewerage network and the sewage pumping stations are dilapidated and requires rehabilitation. CPUC has made continuous improvements of the Weno sewerage system since 2015 together with the Weno road upgrading program. However, substantial investment is required to expand coverage of the sewer network and to rehabilitate the dilapidated parts of the sewer system.

39. Beyond the island's sewerage network area, septic tanks and pit toilets are widely used, particularly among poor communities. Septic tank and pit toilets discharge effluent directly into the shallow aquifers that underlie the island, becoming a major contributor to groundwater contamination and individual household wells. Consequently, diarrhea, particularly among infants is endemic.

40. CPUC is mandated under the Chuuk Public Utility Corporation Act of 2006 to deliver electricity, water supply, and sewerage services to the people in Chuuk State. CPUC's

performance has been improved significantly after the institutional reforms began in 2010 financed by the Asian Development Bank (ADB)5 and the United States Department of Interior. CPUC fully recovered its operation and maintenance, depreciation, and debt servicing cost in fiscal year 2019 with revenue generated from utility service tariffs. However, further institutional reforms of CPUC's framework for water supply and sewerage tariffs are still needed as CPUC's water supply and sewerage services are relatively underperforming and are dependent on cross-subsidies from CPUC electricity sales.

41. CPUC's noted underperformance on water supply and sewerage services is largely due to the high rate of nonrevenue water (NRW) in CPUC's water operations. CPUC delivers water services to 480 households in Weno. However, in early 2019, a detailed CPUC survey in one of the water supply zones in Weno indicated that the actual number of households connected to the CPUC water supply system was substantially higher than the CPUC records showed. This large number of undocumented consumers to the CPUC water supply network explains the high NRW in CPUC's water operations, estimated over 50%, and substantially reduces its water supply revenue.

42. CPUC recognizes that reduction of NRW is essential to enable it to collect water supply and sewerage revenue, which will then allow CPUC to expand its water supply and sewerage customer base. To reduce NRW, CPUC plans to: (i) strengthen both its demand management capacity to optimize its water supply network operations and eliminate undocumented connections; and (ii) strengthen its water leak detection capacity to identify physical losses from the pipe network.

B. Site Information

1. Weno Water System

43. CPUC have good records of the Weno water supply network. These were mapped onto a GIS system (ArcGIS) in 2016. The system has not been used in the last two years but CPUC are planning to reactivate the license and train staff to use the GIS.

44. The water supply network covers all villages in Weno. Figure 1 shows the extent of the CPUC water network. Villages in the north (Sapuk) and south (Wichap and Epinup) have never been properly served due to lack of water to fill the network. Water storage reservoirs in Wichap, Peniesene and Sapuk have also never been utilized as CPUC has not been able to fill them from the production sources.

C. Water Source Improvement Projects

1. Weno - Wichen WTP

a. Wichen River – Water Availability

45. The largest surface water source on Weno is the Wichen river that discharges to the sea in Peniesne village on the northern coast of Weno. The river drains two adjacent catchments from high level with an estimated catchment area of 0.6 square miles. The potential for using the Wichen river as a long- term water source for Weno through the construction of an impounding

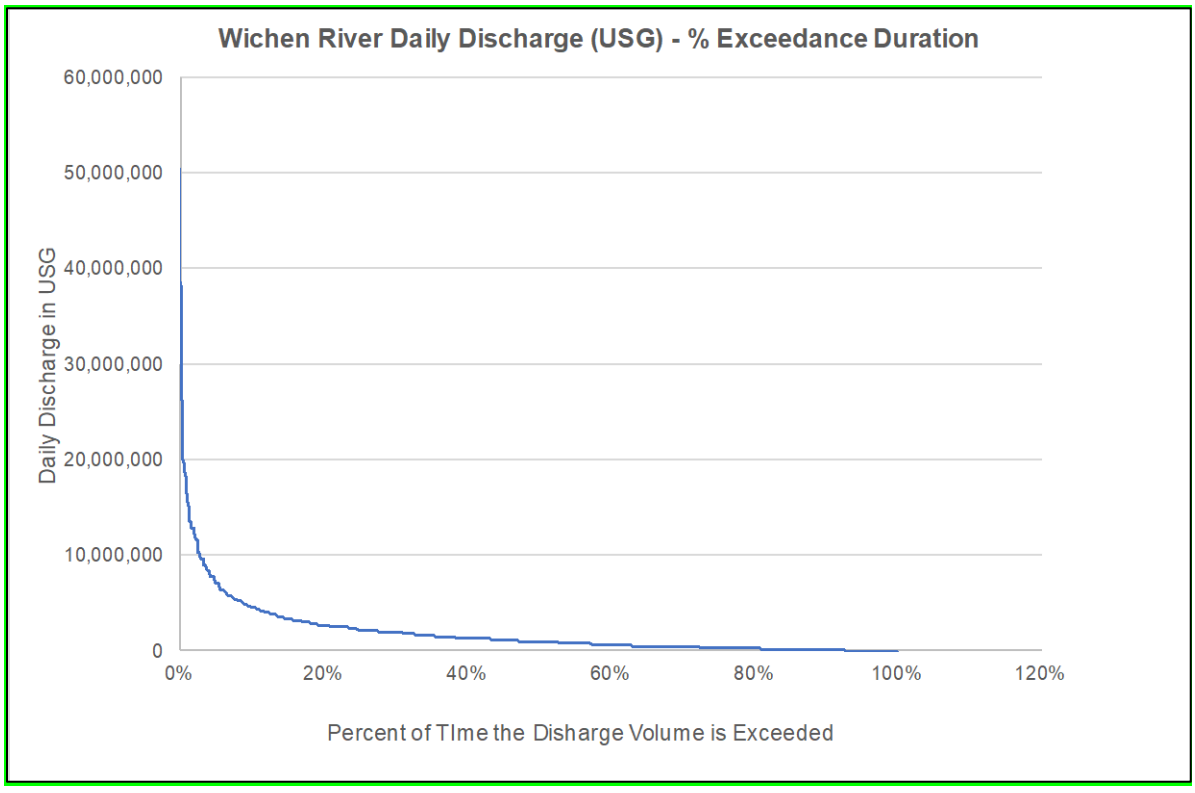
dam has been discussed for many years – it is referenced in detail in the Weno Island Master Plan 1993-2022[11].

46. In 1968 the USGS established two river flow gauging stations on the Wichen river (one at 55m elevation and one at 18 m elevation) and gathered daily flow data for a period of 19 years until 1987. This data is the basis for subsequent analyses relating to the discharge of the Wichen river. Based on the data, the dam proposed in the Master plan would provide storage of 180 million gallons with a sustainable yield of 1.25 MGD. While the development of an impounding reservoir may be a sound long term strategy providing good security of supply, the time required to develop such a project is beyond the CWSSP timeframe – such an undertaking would involve complex land arrangements and significant cost.

47. The focus of the CWSSP for using water from the Wichen River is to construct a run of river intake and the necessary infrastructure to transfer the water to a treatment plant at high level at the Peniesene storage tank (elevation 158 ft). The size of the Water Treatment Plant should be based on the available river flows taking into account any requirement for river regulating flows.

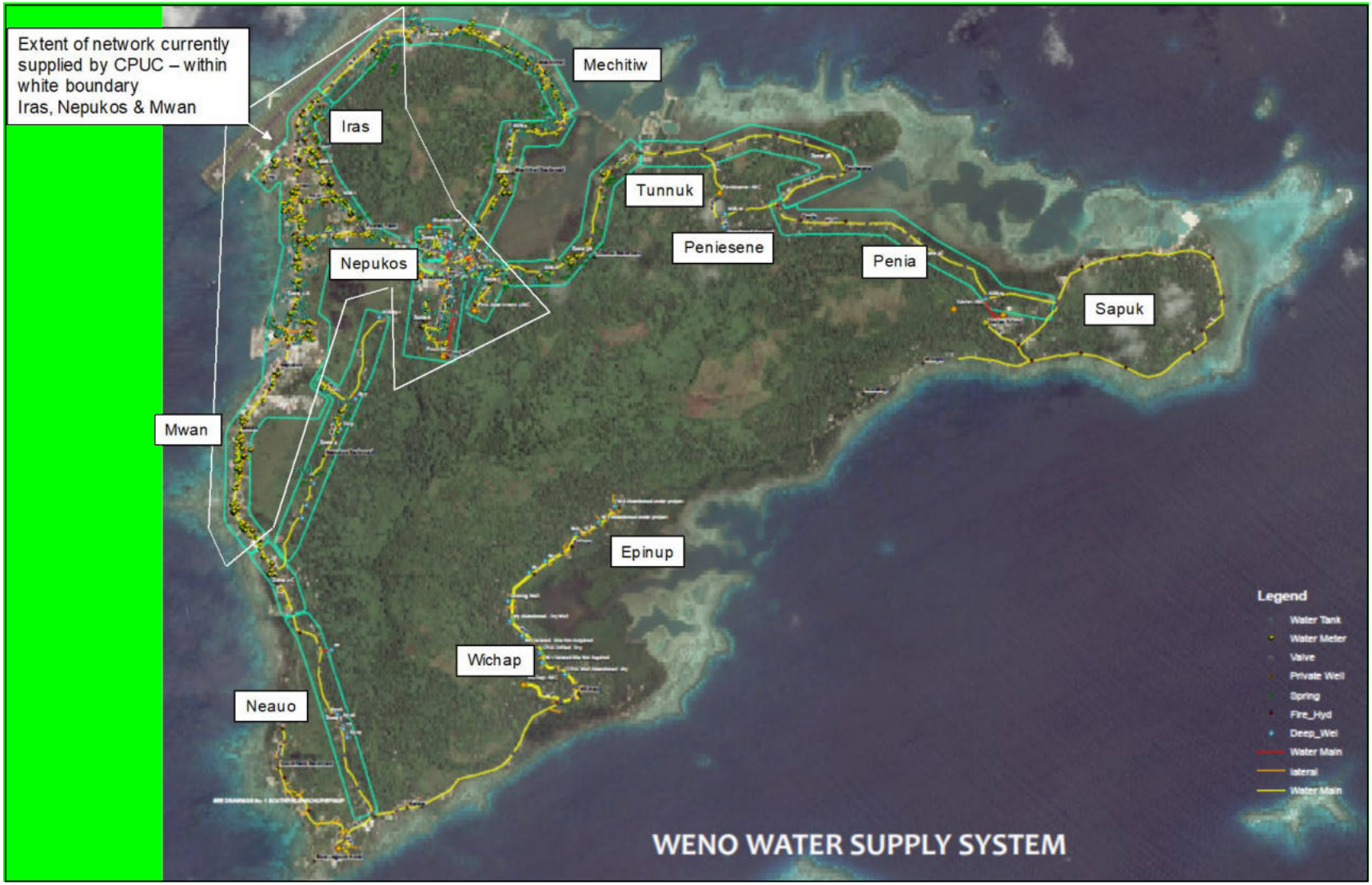
48. From the USGS data the discharge volume at the lower gauging station is almost 3 times higher than that at the high level gauging station; for this reason and for practical purposes related to access and construction the intake is likely to be located in the vicinity of the lower gauging station. The analysis below is based on data from the lower gauging station. Figure 2 below shows the flow gauging data expressed in terms of the amount of time a given discharge was exceeded.

Figure 1: Wichen River Daily Discharge – Exceedance Duration



[11] Water Master Plan 1993 - 2002.

Figure 2: Map Showing the Extent CPUC Water Supply Network



49. The size of the WTP will be at the very low end of the discharge curve and this is difficult to see in Figure 2 but a section of the data between 50% and 100% exceedance is displayed in Figure 3 and this covers the range of flows of interest to CPUC for the WTP. Table 1 shows the percentage of time that the river flow exceeds the tabulated value. In order to maintain river flow for environmental sustainability it is usual for an agreed volume of flow (the river regulating flow) to be maintained in the river after abstraction of water. The table shows the flow duration exceedance for potential abstraction amounts at the gauging point under 4 different river regulating scenarios.

Table 1: Volume Flow in the Wichen River at Elevation 57 ft under Different River Regulating Scenarios

Flow Duration Exceedance %		Wichen River Flow - USG/day			
		River Regulating Flow - USG/day			
%	Days/Yr	*132,100*	*264,201*	*396,301*	*528,402*
95.0%	347	0	0	0	0
90.0%	329	0	0	0	0
85.0%	310	42,272	0	0	0
80.0%	292	126,816	0	0	0
75.0%	274	224,571	92,470	0	0
70.0%	256	301,189	169,089	36,988	0
65.0%	237	417,437	285,337	153,236	21,136
60.0%	219	515,192	383,091	250,991	118,890
55.0%	201	708,058	575,958	443,857	311,757
50.0%	183	837,517	705,416	573,316	441,215

50. Figure 4 illustrates the impact of river regulating low volume on the operability of the Wichen WTP. As the river regulating flow increases the number of days that the plant can be used at full capacity decreases and conversely the number of days when no water is available for the WTP increases. Also shown is the WTP utilization as a percentage of its average annual capacity. Based on the data provided a river regulating flow of 264,200 gallons/day is proposed. Table 2 shows the data from which the illustration is derived.

2. Wichen WTP Design Concept

51. The Wichen River is the largest surface water source in Weno. In the vicinity of the river, CPUC has a well (ADB-10) with a design capacity of 40 gpm. On the hill to the west of the river is a 1 MG water storage tank (this has never been used) at which location it is proposed to construct the WTP. The project concept is to take water from a run of river intake on the Wichen river and transmit the water by gravity to the site of ADB-10 well; at this site a booster station will be constructed and from there a rising main constructed to convey the raw water to the 1 MG storage tank. A new treated water storage tank will be constructed at the WTP site; and a chlorination facility will be incorporated into the plant with water chlorinated prior to storage. A rising main will also be constructed from ADB-10 to the Clearwater storage tank so that water can be transferred from the well to the network in times of low river flow. Figure 5 indicates the location of the intake, raw water booster and WTP.

Figure 3: Wichen River Daily Discharge – Exceedance Duration – 50% to 100%

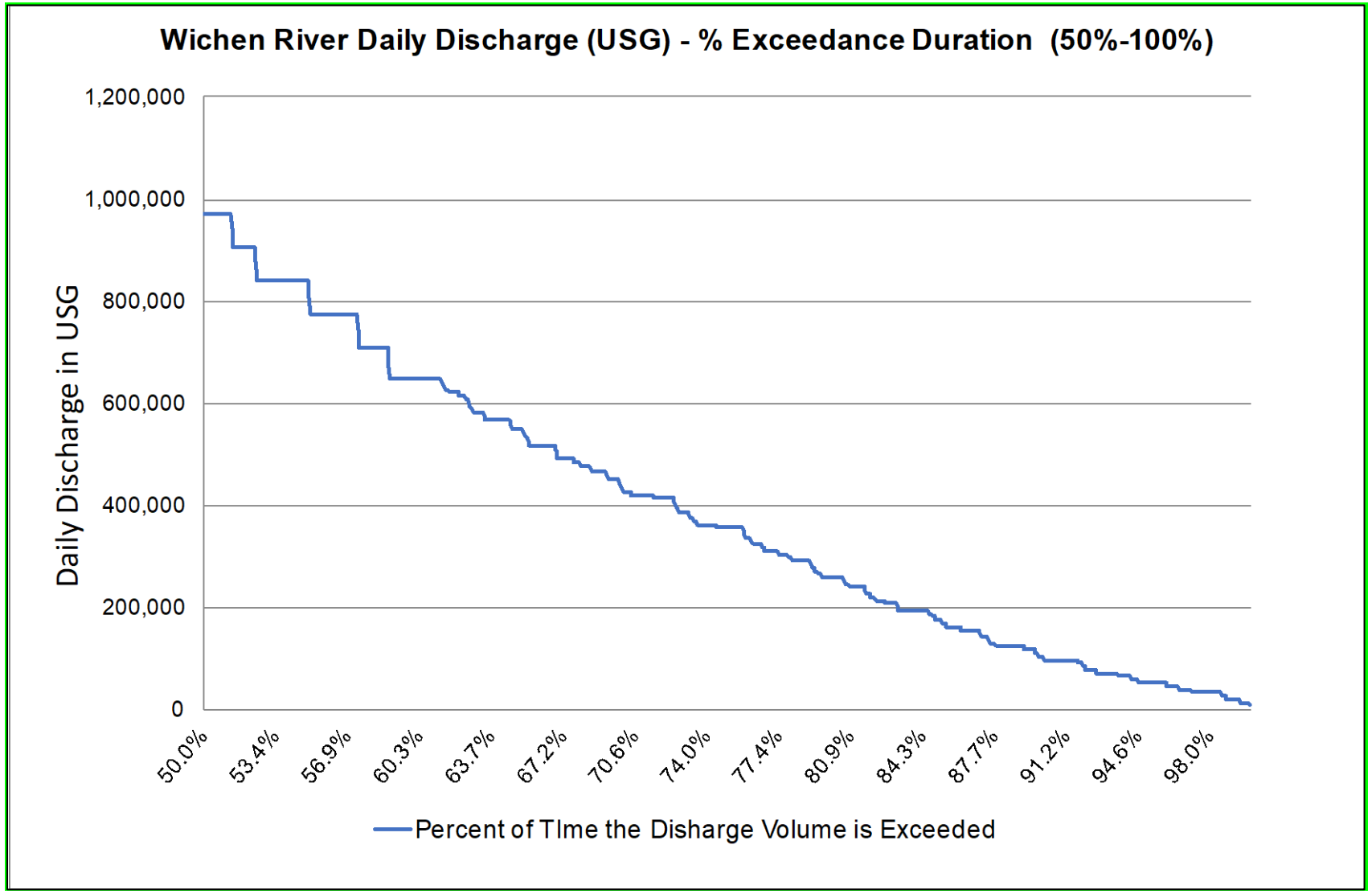


Figure 4: River Regulating and Impact on Water Treatment Plant Operation

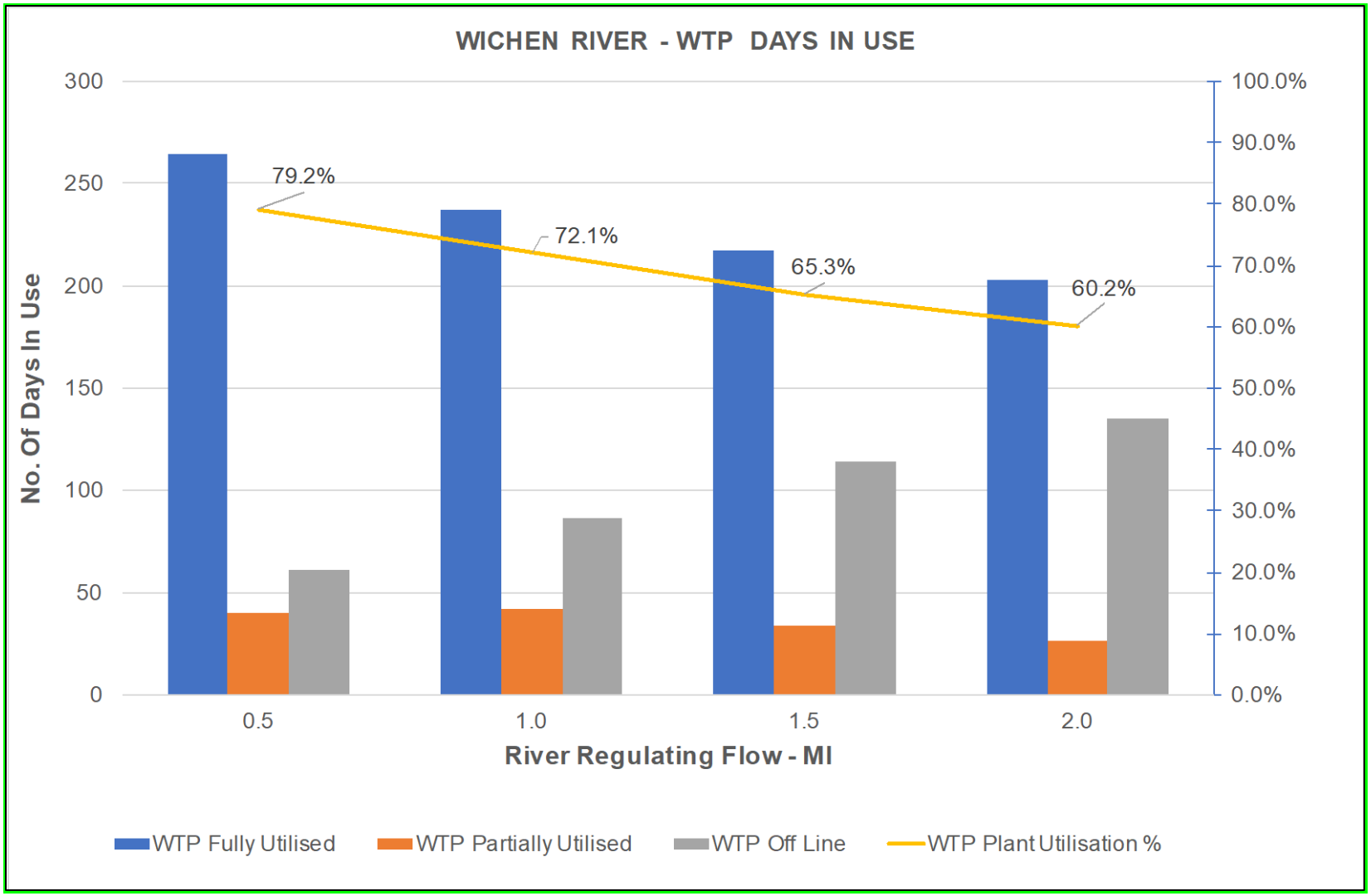


Figure 5: Map of the Wichen River Area

52. This section addresses the ecological impacts of extracting water to complement the hydraulic and economic analysis presented.

53. The Wichen River originates in large seep several hundred meters inland before flowing to Nomenuk Bay. The proposed raw water intake at the Wichen River is at an elevation of 59 ft or 20m above sea level and is only 500m from the bay. The Wichen river downstream of the proposed water intake flows through a well forested catchment with several deep pools in the lower reaches before entering a mangrove dominated ecosystem. It is recognized that Chuuk has a highly modified landscape with many introduced species and widespread damage from World War Two.

54. The Wichen River discharge flow was measured from 1968 to 1988 and is shown in Figure 6. The daily discharge is marked by high flows of up to 70ML/day and periods of extended low flows.

55. In Figure 7, the daily discharge flows are shown for a 2-year period from 1986 to 1988 to visualize and understand the magnitude of extracting 1ML/day for drinking water on water flows. There is little difference is discharge flows for values up to 5 ML/day, indicating that the extraction of water at this rate from these flows appears to have little impact on discharge and water flows downstream.

56. Figure 8 shows the impact of extraction 1ML/d from discharge flows of less than 5 ML/d. At a extraction rate of 1 ML/day during times of drought over a 10 week period from January 87 to March 88, extraction of flows from in late December and mid-February would be below base flow values of 45m^3/day and minimal waters would be flowing downstream.

57. To eliminate this risk, an RRF flow of 1 ML, as previously described, would be required in the river. This RRF would maintain sufficient flows in the river during periods of low flow periods, as an example, mid December 87 to end of January 88, river flows are maintained at these times. On occasions, (February 88 for three weeks); the natural river flow will fall below the RRF of 1 ML and revert to its natural low base flow component. Throughout this period of low flows of 10 weeks, runoff events were common, providing peak flows events of between 5 and 20 ML to provide ongoing flows throughout this period and maintain ecological function downstream.

3. Plant Capacity

58. Based on the data presented in Table 2 it is recommended that a WTP of 264,200 gallons/day is constructed.

Table 2: WTP Use in Days for Different River Regulating Flow Scenarios

WTP Use in Days	River Regulating Flow - Gallons/day			
	132,100	*264,200*	*396,300*	*528,400*
Full capacity	264	237	217	203
Partial capacity	40	42	34	27
Off Line	61	86	114	135
WTP Annual Utilisation	79.2%	72.1%	65.3%	60.2%

Figure 6: Wichen River Daily Discharge from 1968 to 1988

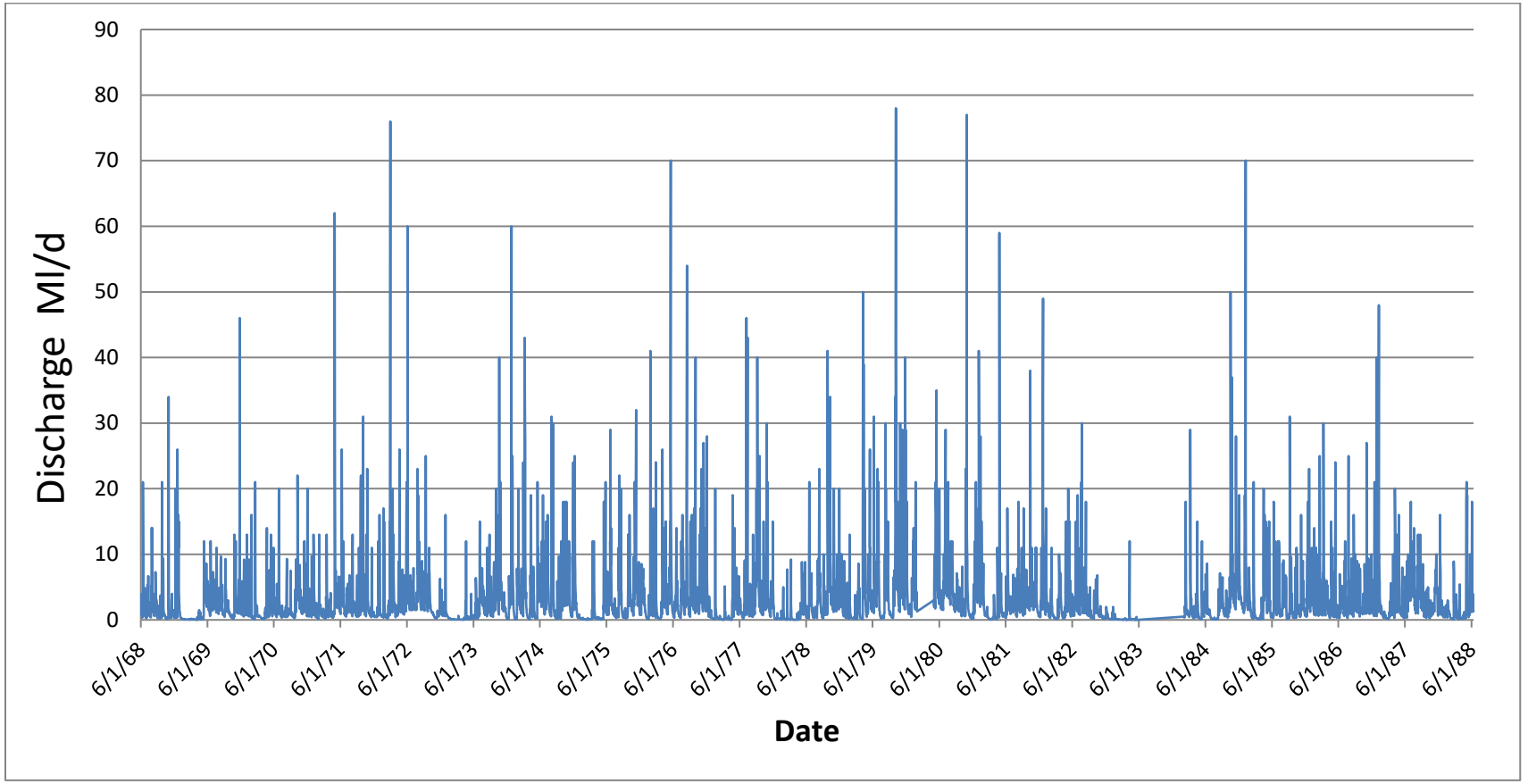


Figure 7: Wichen River Comparative Daily Discharge with No Abstraction and 1ML/day Abstraction

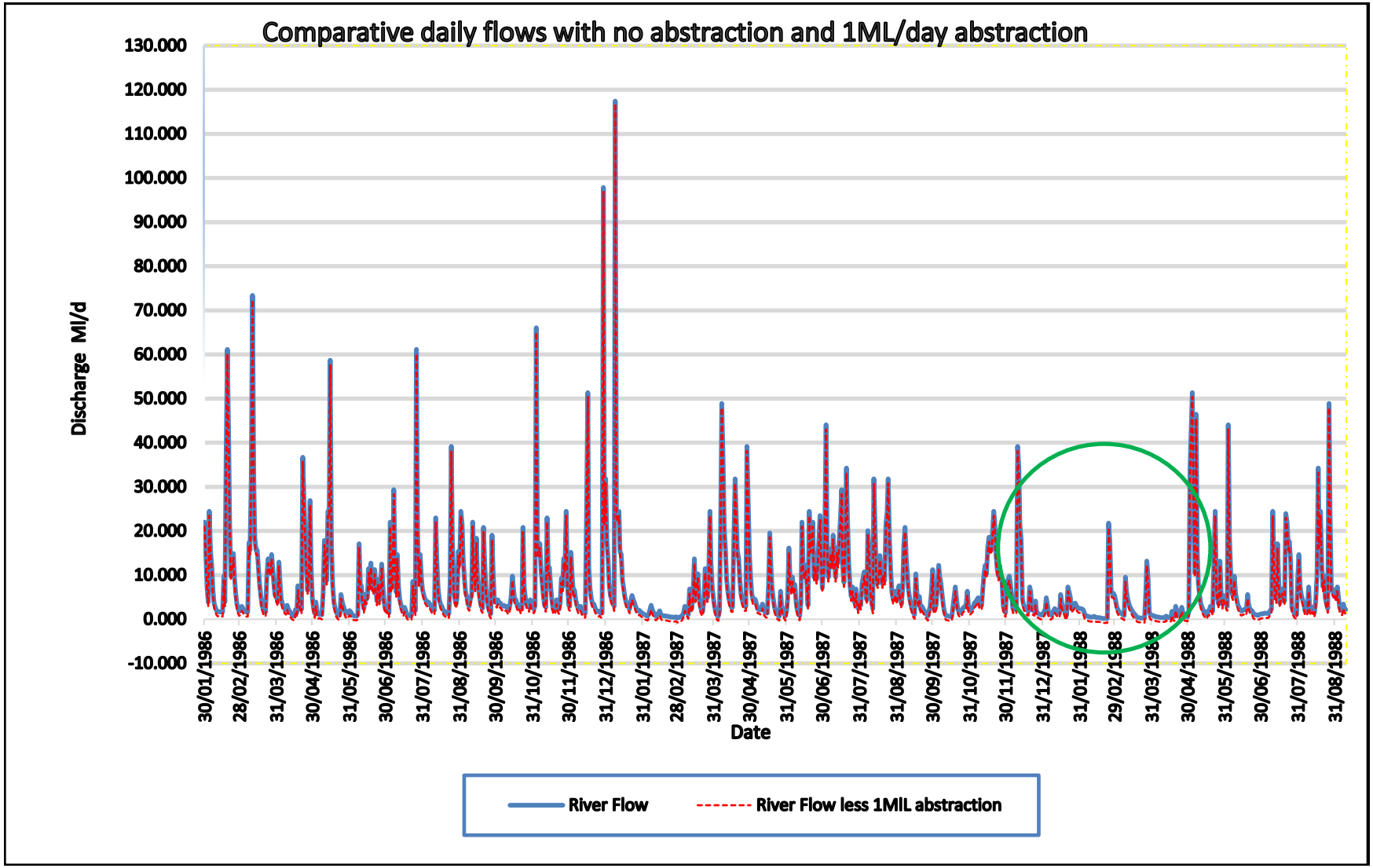
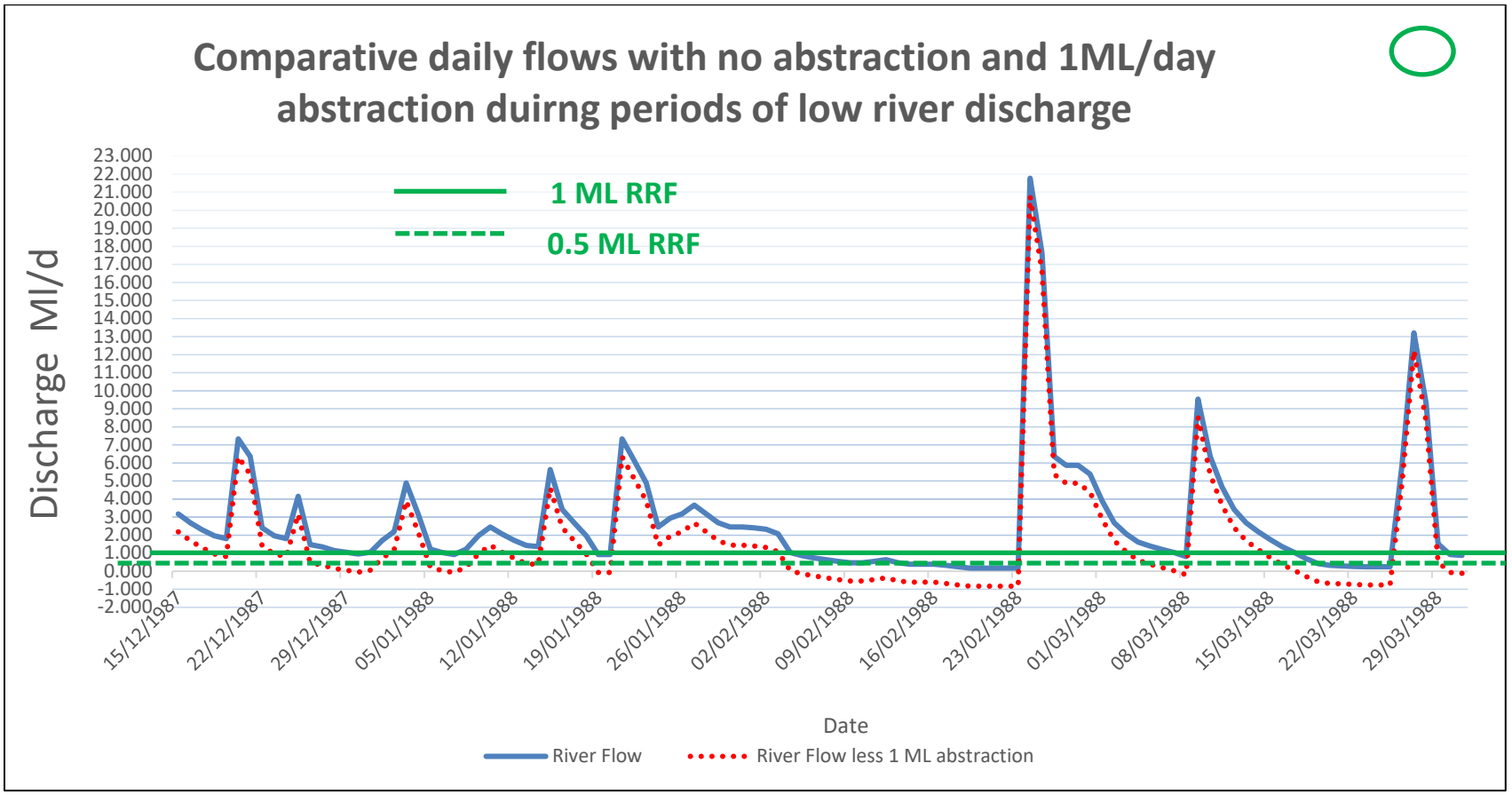


Figure 8: Wichen River Comparative Daily Discharge with No Abstraction and 1ML/day Abstraction during Periods of Low River Discharge



59. It should be noted that with a river regulating flow of 264,200 gallons per day this will mean the plant will not be able to operate at full capacity every day of the year. Table 2 above indicates that the plant will be able to operate at maximum output of 264,200 Gallons/day for around 237 days (7.5 months) per year; it will have no flow for 86 days per year and in the 42 days remaining, will have an average daily usable flow of 165,000 gallons per day – taken over the year, the average daily WTP flow will be 190,550 gallons/day – a utilization factor of 72%.

60. These figures don't take into account the raw water storage at the Peniesene tank (3.5 days at full capacity). The raw water system will be designed to maximize the offtake of water during periods of high rainfall which itself will increase the WTP utilization.

61. It is proposed that the design of the plant is modular with treatment divided into 4 streams each of 66,000 gallons/day. This will allow plant outputs to be matched to river flow as the river flow reduces below plant design flow. River discharge data indicates that one treatment stream operating at 66,000 gallons/day will be able to operate for around 280 days (9.3 months) per year.

4. Raw Water System

62. The existing 1 MUSG (3.8Ml) storage tank at Peniesene will be used as a raw water storage tank. Water from the Wichen river intake will flow initially by gravity pipeline to a raw water pump station to be constructed adjacent to the existing ADB-10 well at elevation 54ft amsl. A booster pump will then transfer this water to the raw water storage tank at Peniesene tank site – inlet level 186ft amsl.

5. Pipelines

63. The raw water gravity main and pumping main will be designed to deliver 3x the WTP design capacity to allow the raw water storage to be filled up during periods of high rainfall. In this way the WTP utilization will be maximized during periods of low rainfall.

64. The components of this system and their characteristics are:

Raw Water Pipe Section	Length m	I.D. mm	Material	Q_{peak} l/s	V_{peak} m/s	$Lift_{peak}$ m	dH m/100m
Gravity Main	250	200	HDPE	34.7	1.1	-	0.58
Booster main	260	200	HDPE	34.7	1.1	43.9	0.58

6. Booster Station

65. An enclosed booster station will be constructed adjacent to the ADB-10 well; The station will house 3 boosters and associated electrical components and controllers. There will be 2 duty and 1 standby, capable of jointly delivering 3x the WTP design capacity. The Pumps will have variable speed motors and will be controlled on the level of the raw water in the storage tank. The estimated energy use of the booster is 0.19 kW/m^3. The proposed footprint for the booster station is $40m^2$. The station will be fenced and a three phase electrical power is available at the location.

7. Water Treatment Process

66. A conventional water treatment process with clarification and filtration will be constructed in modular fashion. The process facilities will be housed in a low-rise warehouse structure and will include a floc tank, filters, chemical storage and mixing tanks and pumps for dosing and

filtration process and electrical controls. The total footprint required for the building is 120 m^2. The filtered water will be disinfected on the inlet to the treated water storage tank using calcium hypochlorite solution – storage, mixing and dosing of the chemicals will occur at the WTP site. Waste from the treatment process will be removed from the clarifier and filters and discharged to drying beds where the sludge will be dried prior to disposal to landfill. The footprint for the drying beds is 50 m^2.

8. Water Storage

67. Treated water will be stored in a new 132,000-gallon storage tank to be constructed in steel on site. With a height of 4 meters.

9. Site footprint

68. The site includes 4 components:
(i) treatment process building – 120 m^2;
(ii) treated water storage tank – 80 m^2;
(iii) sludge drying beds – 50 m^2;
(iv) access and parking space – 150m^2.

69. The footprint will be designed around the raw water tank in an L shape with a total required area of 400m2. Water from the WTP will be used to supply the North Weno area of Sapuk, Penia, Peniesne, Tunnuk and Mechitiw. The treated water tank will also have a connection from the ADB-10 well in Peniesene so that well water can be used to supplement Wichen river water at times of low discharge.

10. ADB-10 Well Reconfiguration

70. The pump at ADB-10 will be replaced with a new pump sized to deliver the current design flow at the revised head (estimated at around 68m) to deliver water to the new treated water storage tank. Upgrades to the electrical system to accommodate this change will be incorporated, as necessary. A new well water rising main will also be constructed from the well headworks to the inlet of the new treated water storage tank. The pipeline characteristics are shown below.

Pipe Section	Length	I.D.	Material	Q_{peak}	V_{peak}	$Lift_{peak}$	dH
	m	mm		l/s	m/s	m	m/100m
Well Rising Main	250	75	HDPE	2.52	0.57	68.3	0.524

71. Note: there is no information available about the operation of well ADB-10; a dynamic drawdown level of -10m from msl has been assumed – this is 15m below the static water level indicated in the ADB report – “Weno Water Investigations Nov06-Feb07”. The estimated energy requirement of the booster at peak flow is 0.31 kW/m^3.

11. Project BOQ

72. The BOQ for the project includes:
(i) raw water intake structure;
(ii) raw water M&E – pump and electrical controls;
(iii) gravity raw water line;
(iv) raw water booster station – civil, M&E;
(v) raw water pumping main and connections to existing storage tank;
(vi) compact, modular conventional WTP - civil structure to contain the plant equipment

(vii) WTP components - high rate clarifier; pressure filters; dosing pumps; chemical store and mixing facilities (for coagulation and chlorination); chlorine dosing pumps;
(viii) treated water storage tank;
(ix) pipework and connections for ADB-10 well rising main to the new treated water storage tank;
(x) borehole pump upgrade to match pump head to the treated water storage inlet; and
(xi) site civils – creation of lay down and parking area; site fencing and security measures.

12. Project Benefit

73. The construction of the WTP at Wichen will allow the connection of an additional 496 connections between now and the end of the CWSSP project in 2027 increasing service coverage from 10.3% to 65.1%. By 2040 there will be a total of 889 connections or 85% service coverage. The project targets of reliability and quality will be met and objectives in relation to NRW in this area will be achieved through the pipe replacement outlined below.

13. Wichap-Epinup Groundwater Improvement

74. A series of wells were constructed some years ago in the Wichap and Epinup areas; some of these wells were dry; however up to 6 of these wells did have water but were never commissioned and brought into service. As a result, the villages of Wichap and Epinup in the south of Weno have never been supplied with water by CPUC.

75. Figure 9 below shows the proposed project area and the locations of six wells along the road through from Wichap to Epinup. At the time of the well construction, a 6" PVC water main was laid from the wells to convey water to the Wichap storage tank – with an inlet elevation 189ft amsl. The tank has not been used by CPUC, however the condition has been assessed and the tank can be re-used with minor remedial works.

76. The green line on the map is the approximate extent of the aquifer that the wells are supplied from.[12]

77. The purpose of this project is to assess the potential yield from the existing boreholes and re-develop them for use – this is likely to require installation of new screens and rehabilitation of headworks along with pumps, motors and control panels. In parallel the Wichap storage tank will be recommissioned and water from the wells will be collected and pumped to the storage reservoir from where water will gravitate to customers in Wichap and Epinup and potentially Neauo.

78. It is also proposed to prospect for new boreholes closer to the Wichap storage tank to minimize the energy required to pump water from the wells to the storage tank.

79. The wells indicated on the map all have potential as effective sources. As part of the project a 6"-PVC filling line was constructed to collect water from the wells and convey it to the Wichap storage tank. There is also a 12" (300mm) AC gravity line running in parallel which was constructed to distribute water to customers in the area. The combined length of these lines is just under 5 km – the condition of the pipelines is not known however it may be prudent from both a hydraulic efficiency and a Health & Safety perspective to abandon the existing lines in situ and construct new mains in HDPE.

80. The extent of the Wichap aquifer is shown in green in Figure 9. Note that all the wells drilled are along the road close to the edge of the aquifer.

[12] Data taken from Weno Master Plan 1993 -2002.

81. The project will undertake a number of activities:

(i) Review the extent of the aquifer by undertaking additional borehole drilling and prospecting on the mountain side of the road closer to the center of the aquifer.
(ii) Undertake a series of tests on the wells already drilled and undertake a rehabilitation plan for those that have good yields.
(iii) Review the condition of the water mains installed in the area and rehabilitate – consider total replacement with HDPE
(iv) Provision of chlorination facility at the Wichap Tank
(v) Easement for pipe installation.
(vi) Lease agreement for all well sites
(vii) Access to new sites for exploratory testing

14. Weno - Well Consolidation

82. Currently all wells providing water to the network pump directly into the water network. All wells require chlorination of supply as it enters the network. In the past there has been no optimization of the pumping regime and cost of production is significant. The wells on Weno fall into four broad groups based on geography and topography and these are:

(i) Nantaku WG
(ii) Nepukos WG
(iii) Nepukos back road WG; and
(iv) Neauo WG.

83. Figure 10 shows the geographic location and extent of the well groups.

84. It is proposed that water from each of these well groups is transmitted to a central storage and onward distribution point for each group. Chlorination will be undertaken at these points. The central point may be at elevation allowing water to be distributed by gravity or distribution using a hydrodynamic booster arrangement.

85. Potential locations for each centralized point within the four well groups have been identified and cost estimates made. Each of these systems are to collect well water in specific zones to centralized point for boosting to storage or direct to distribution.

86. There is a total of 27 wells available for use in Weno. All are set up to pump directly into distribution. A few of the wells have poor quality water and low yields and are not in use; all of the wells require chlorination at the well head before water is pumped into distribution.

87. Of these wells, 24 of them can be grouped into 4 areas in terms of proximity and topography and within each area there is the potential to connect all the wells to a single point of discharge into the network. Three of the wells can be considered as outliers which cannot be easily linked to other wells. The location and grouping of wells are shown in the Figure 10.

88. The project will look at the possibility of having all the wells in a well group discharge into a receiving tank at which the water will be chlorinated prior to distribution either through a distribution booster or by gravity from a storage tank. This will reduce the requirement for chlorination sites significantly and will provide an element of additional storage.

89. This approach is seen as a supplement to the surface water sources providing security of supply when surface water sources reduce during periods of drought.

Figure 9: Proposed Project Area and the Locations of Six Wells along the Road through from Wichap to Epinup

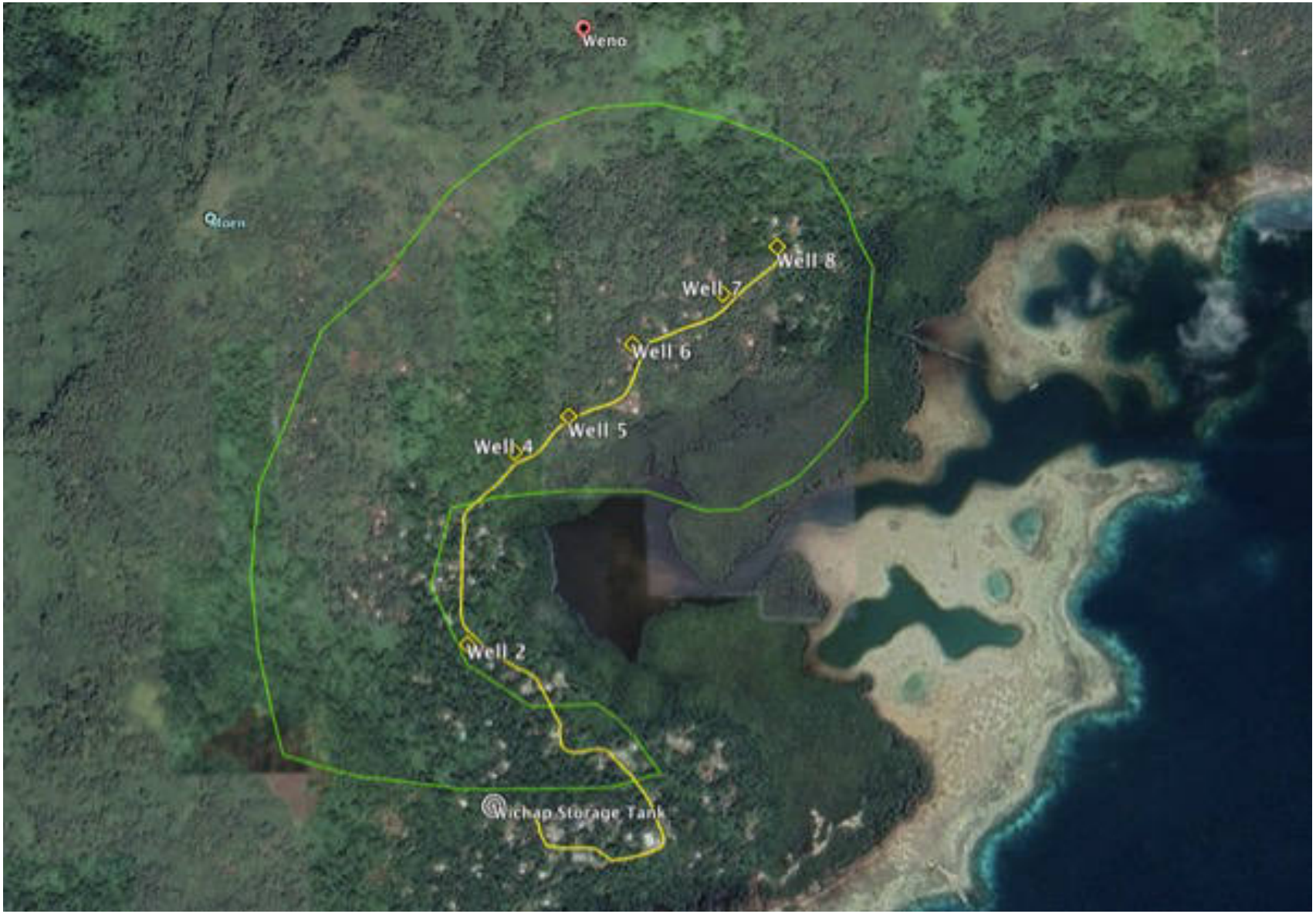


Figure 10: Geographic Location and Extent of the Well Groups

D. Water Network Improvements

1. Weno - Sapuk Booster

90. To boost water from the new Wichen WTP to Xavier Storage Tank (elevation difference of ~59 ft); this will provide reliable supply to Northern Weno – Sapuk; and Winipis/Nukanan

91. A booster station will be constructed adjacent to ADB-14 well within the leased land footprint. A new and dedicated pumping main will convey the boosted water to the water tank at Xavier from where all of Sapuk can be commanded; Figure 11 shows the location of the booster and the extent of the project. The pipeline will be sized to be able to supply the future forecast demand for Sapuk (approximately 371 m^3/day).

92. The anticipated downstream/suction head is expected to be around 25m amsl, and pipeline characteristics constitute - Material – HDPE; i.d. – 150mm; length 500m.

93. The ADB-14 well source will also be connected to the filing line in order to supplement flow to the storage tank in the event that the Wichen source is unable to provide all the water needed.

94. Consideration will also be given to provision of in-line chlorination at the booster station to ensure sufficient residual chlorine in the supply through storage to distribution.

(i) Pipeline easement from the Booster station through Xavier High School to Xavier tank
(ii) Outstanding land issues for the Xavier tank will need to be resolved to ensure access to/use of the storage tank.
(iii) Refurbishment of the Xavier tank
(iv) Offtake enroute to Xavier storage tanks with connection from Xavier outlet gravity line to ensure supply at all times

2. Weno - Pou WTP to Pink Apt Transmission Main

95. It is recognized that there is a need to maximize treatment and storage capacity from Pou source during high rainfall periods. This effectively removes the need for network valving operations to effect water transfer as currently practiced.

96. Figure 12 shows the construction of a transmission line directly linking the Pou WTP storage reservoir to the Pink Apartment storage reservoir. The Pink Apartment storage tank volume is 7.5 Ml (this is approximately 15% larger than the future demand requirement for the whole of Weno island) which is currently under-utilized. Current filling is through the water supply network and this requires a significant amount of operational input.

97. The proposed pipeline in this context will be i.d. 150mm and length 500m and will be capable of transferring 2.25 Ml/d (26l/s) with a minimum residual head at the inlet to the Pink Apartment tank of 2m. Remaining concerns for this component constitutes:

(i) Access through land away from the road network; and
(ii) Landowner cooperation for construction.

Figure 11: Location of the Xavier Storage Tank Booster and the Extent of the Project

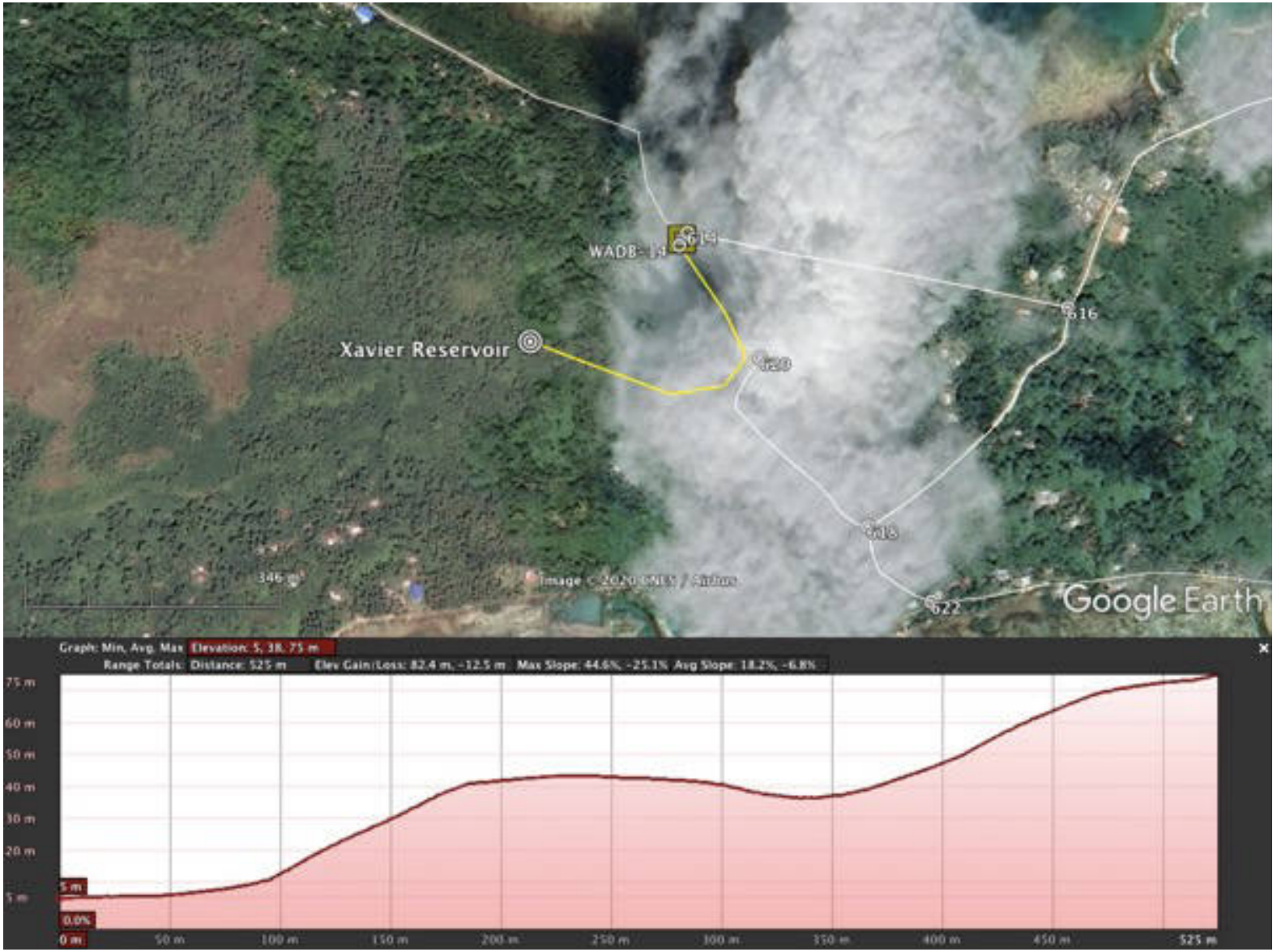


Figure 12: Construction of a Transmission Line Directly Linking the Pou WTP Storage Reservoir to the Pink Apartment Storage Reservoir

3. Weno - Causeway Link Main

98. To create a direct link from Tunnuk to Mechitiw to allow Wichen WTP water to be fed back towards Mechitiw and Iras (Figure 13).

a. Pipeline characteristics: Material – HDPE; i.d. – 200mm; length 650m

99. Estimated peak Flow through the main is 1.5 Ml/d (17.4 l/s); at this flow rate head loss is 0.161m/100m and velocity 0.55m/s; total head loss along the line is 1.0m.

b. Easement for pipe installation

100. There is also a requirement for an easement on the two-bridge crossing across the causeway. The main in this context should be located on the seaward side of the causeway away from the power poles.

4. CPUC Wide - Pipeline Replacement Program

101. To replace water mains in bad condition in order to reduce leakage losses from the system CPUC currently has approximately 27 km of AC pipe network installed in the water supply network. Much of this has not been used for a number of years, especially in the Sapuk, Wichap and Epinup areas.

102. A significant amount of investment is being made in production sources and re-use of the existing water storage tanks in the network. It is important that the water pipeline network is in good condition and does not leak/wastewater being produced and distributed. A provision for water mains replacement of US$2.00m is thus included in the project budget and this will allow replacement of approximately 10km of 150mm network.

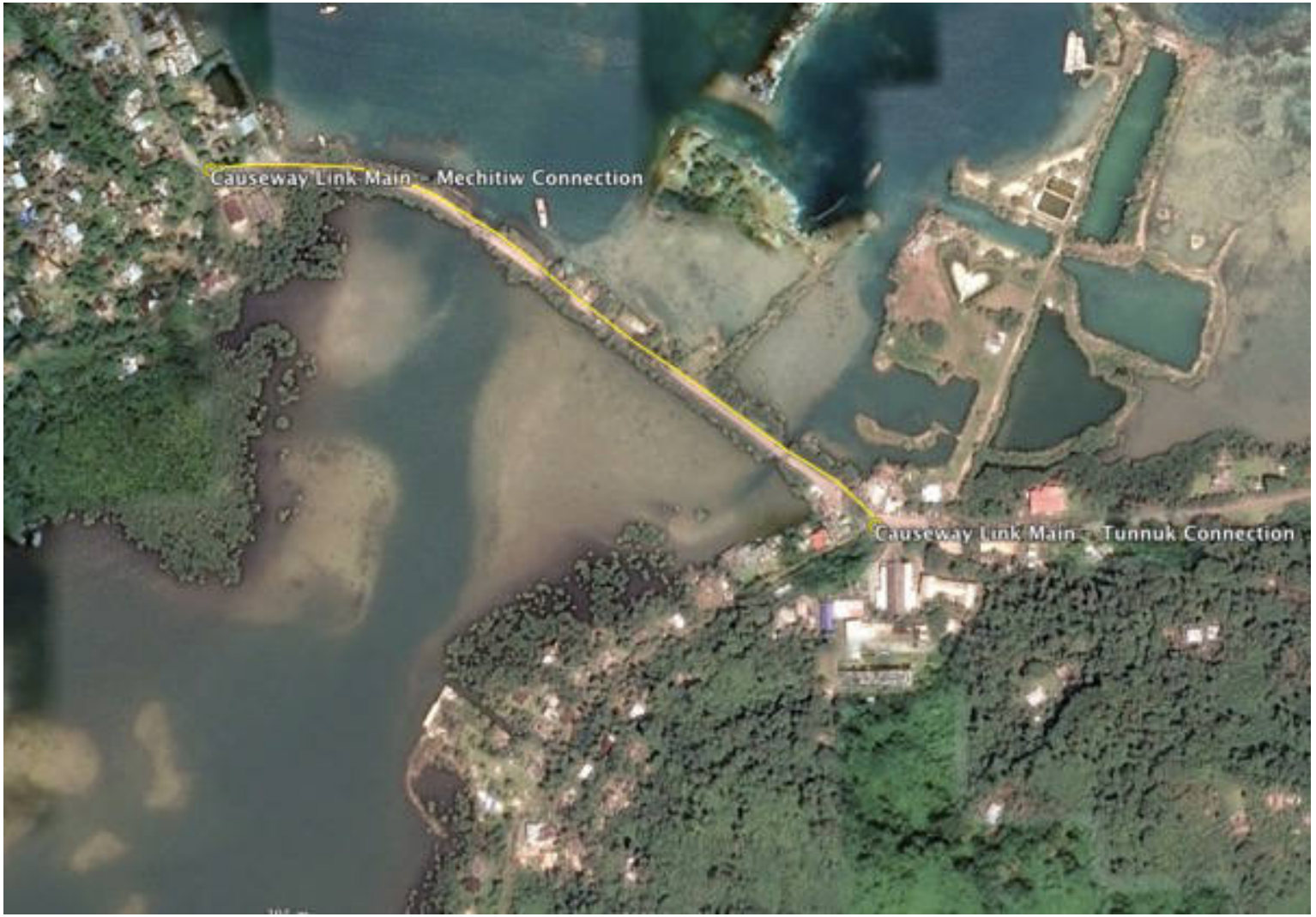
103. The existing network is significantly oversized in many areas – the design of network replacement will be based on a system network modeling at detailed design stage.

(i) Chambers for meters and communications method for signal transfer to central control station;
(ii) Access to roadways where pipelines are beneath road surfaces;
(iii) Easement agreements for multiple small sites;

5. CPUC Wide - Service Connection Replacement

104. To replace all service connections with standardized pipe material to agreed standard for depth of lay and fittings. All service connections will be replaced with service pipe material selected to minimize risk of illegal tapping; and service installation standards to be closely defined and adhered to.

Figure 13: A Direct Link from Tunnuk to Mechitiw across the Causeway to Allow Wichen WTP Water to be Fed Back towards Mechitiw and Iras



E. Sewerage Upgrade Program

1. System Extent and Mapping

105. Figure 14 below shows aerial imagery of Weno Island overlaid with the schematic layout of the sewerage system.

106. The northern and southern arms of the network extend from the sewerage treatment plant (STP) located in Zone 14 in the north west of Weno, adjacent to the airport terminal. There is a total of 14 sewerage zones, each with its own Lift Station assigned with zone number. Within most zones there are smaller capacity pumping stations referred to as Grinder Stations. The pumping stations are identified in Figure 14 by a numbered blue circle for Lift Stations and yellow circle for Grinder Stations.

107. The zones are connected in series i.e. in a linear arrangement, like links in a chain where each lift station pumps to an adjacent zone that is closer to the STP.

108. The raw sewage characteristics specified for the upgrade of the Weno STP are shown in Table 3 and Table 4. The contract documentation for the STP also stipulated the STP "shall be capable of treating and passing without overflow, average dry weather flow of 750,000 gpd or peak flows of 1,112 gpm."

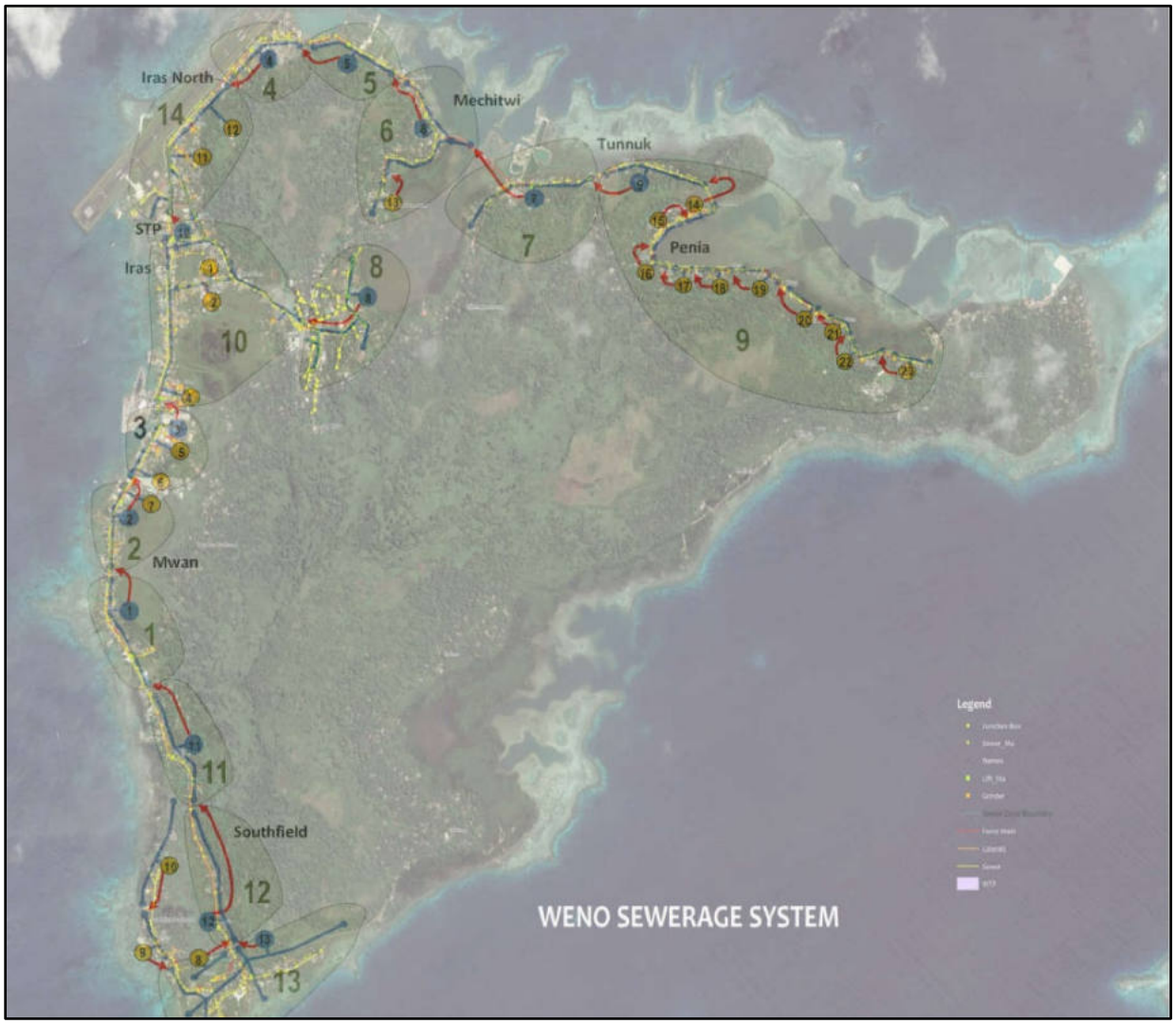
Table 3: Weno STP Design Parameters

Parameter	Units	Average Flow	Peak Flow
Design Flow rate	USMGPD	0.75	1.40
RAS concentration	mg/l	8000	8000
MLVSS concentration	mg/l	2400	2400
MLSS concentration	mg/l	3000	3000
Design mean cell residence time	days	30	12.7
Treatment efficiency based on soluble BOD5	%	98%	97%
Reactor Volume	m3	1183	1183
Digester Volume	m3	683	683
Sludge in ML	kg	6346	6346
Quantity of sludge to be wasted	kg/day	150	380
Estimated recirculation ratio	%	60%	60%
Food to microorganism ratio (F/M)	1/day	0.191	0.287
SOTR	kg/hr	142	171
Recycle Flow rate	m3/hr	150	301

Table 4: Weno STP Assumed Raw Sewage Characteristics

(i)	Chemical Biological Oxygen Demand < 160 mg/L;
(ii)	Total Suspended Solids < 160 mg/L;
(iii)	TKN < 30 mg/L;
(iv)	Ammonia Nitrogen < 20 mg/L;
(v)	Total Phosphorus < 7 mg/L;
(vi)	Minimum pH = 6.8 SU;
(vii)	Maximum pH = 7.4 SU;
(viii)	Minimum Wastewater Temperature 20.0°C;
(ix)	Maximum Wastewater Temperature 28.0°C; and
(x)	inhibitory or toxic compounds or conditions - nil.

Figure 14: Schematic Layout of Sewerage System



109. For the purposes of the assessment of flow capacities for pipework and pump station design, the values in Table 5 have been adopted.

Table 5: Design Parameters for Sewage Flows

Parameter	Value
Flow per EP*	53 - 106 gals/EP/day
EP per Household (HH)	7
Average Dry Weather Flow (ADWF) / HH / day	370 - 740 gpd
Peak Wet Weather Flow (PWWF) for Pumping Station Design	8 x ADWF
Commercial, Government and Hospital Flows	90% of metered water consumption

* EP = Equivalent Population (Person).

F. Additional Household Connections to Existing System

1. Current Status of Household Connections

110. There are currently 390 households, 81 Commercial and 20 Government premises (including the hospital) billed for sewerage connections[13]. A survey conducted by the Chuuk Women's Council[14] collected data from 1876 of the 2030 households on Weno and identified household numbers by village. Using this survey a total of 1650 households were identified as being within the sewerage scheme area (refer Figure 15) indicating that only 24% of households (390/1650) are connected to the scheme. This low usage rate of the existing infrastructure provides significant potential to increase connections to increase utilization of the infrastructure.

111. The Penia and Southfield Backroad areas have sewers, laterals and pump stations without any connections and these areas have not been commissioned since construction. In this context, the Penia sewerage infrastructure shown in Figure 15 has no connections upstream of Grinder Station GS-15. i.e. Grinder Stations GS-16 to GS-23 are not operating. Grinder Stations GS-8, GS-9 and GS-10 in the Southfield Backroad area as also shown in Figure 16 are also not operational with the result that no sewage is collected for treatment from the developments along the backroad.

112. CPUC considers the low percentage of household connections is due to the cost of installing their house drainage to the CPUC sewerage system. It is also possible that households are connected to the CPUC sewerage infrastructure but are not registered in the billing system.

2. Weno Sewage Treatment Plant Inflows

113. Daily flow records were examined to determine the spare capacity for additional connections. A 79 day period of record, between April 2019 and September 2019, was analyzed and the results summarized below in Figure 17. The bar chart in Figure 17 shows the number of days the flow is within a specified range.

[13] CPUC KPI's for Water and Sewerage to March 2020. Spreadsheet by PH Lei.
[14] Chuuk Women's Council Household Survey 2013/14.

Figure 15: Penia Area Sewerage Infrastructure

Figure 16: Southfield Backroad Sewerage Infrastructure

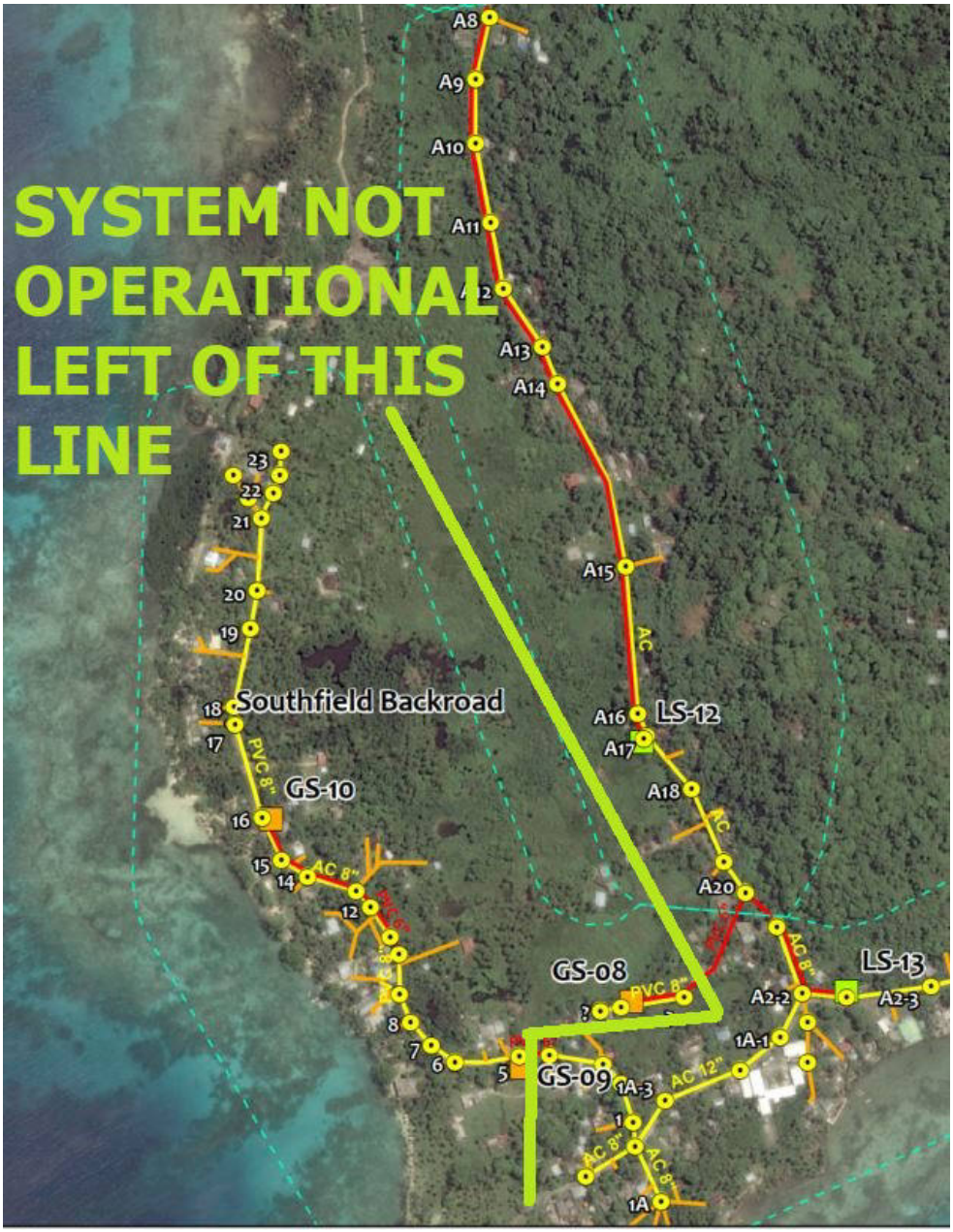
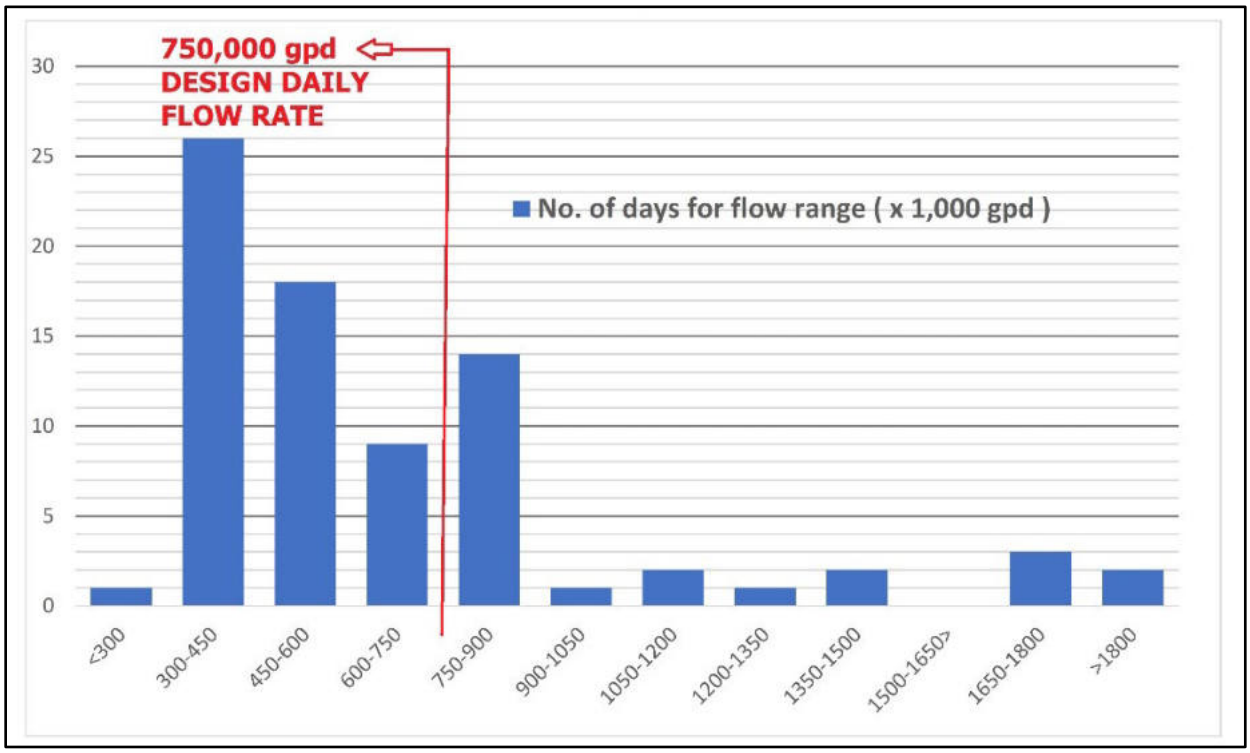


Figure 17: Weno STP Flow Frequency by Flow Range
(79 days of record)



114. Figure 17 indicates a wide range of flows enter the Plant. The minimum flow during the period was 259,000 gpd and the maximum 2.4Mgd. The dominant range of flows, with 56% of the record period, occurred within the range of 300,000 to 600,000 gpd. The average and median flows within this range were 454,000 gpd and 439,000 gpd respectively.

115. The STP in this context is designed for a maximum daily flow of 1,400 gpm (2.02 Mgd)[15]. The records indicate the daily flow exceeded this value, on 2 days out of the 79 days of record examined. As these are for average daily flow, shorter periods of higher flow would have occurred resulting in more frequent and intermittent occurrences of overflows to the bypass. An adjustable weir at the 'splitter box' determines the peak flow rate directed for treatment to the aeration basin. Above this flow rate the sewage overflows to the outfall. The actual flow rate for the current weir setting is unknown.

3. Analysis of WWTP Flow Records

116. There is a clear increase in flow associated with rainfall. Table 6 below shows the average daily inflow to the WWTP by month and the total rainfall for the month. Examination of daily flows following rainfall indicate that flows can remain elevated for several days without additional rain.

[15] Email from Simon Gorman CCB Envico 20 May 2020.

Table 6: Average Monthly WWTP Inflow vs Daily Rainfall

Month 2019	Flow (gpd)	Rainfall (mm)
May	391,789	121
June	719,840	371
July	573,355	296
August	1,150,121	410

117. **Data Accuracy.** The Human Machine Interface (HMI) display at the WWTP is used to log the flow data from the PLC. The HMI does not display a totalized flow and it became evident during the analysis of the paper records they were subject to reading errors. This included identical flows on consecutive days and transcription errors with numbers in the wrong order for other values that did involve totalized readings. An assessment was made for each anomaly and readings were either adjusted, averaged, or deleted from the data set. Whilst 10% of individual readings were anomalous, no systematic errors are believed to exist in the flow records and the distribution of daily flows shown in Figure 7 are considered to give an accurate representation.

4. Capacity for Additional Connections to Existing Infrastructure

a. Factors Affecting the Potential Number of Additional Connections

118. The capacity for the existing sewerage infrastructure to accommodate additional connections will depend upon several factors as follows:

(i) the average daily flow contribution from new connections;
(ii) the capacity of installed pipe network;
(iii) the capacity of the pump stations. This includes both the well volume and pump flow rates;
(iv) the hydraulic and biological capacity of the STP and outfall; and
(v) the current levels of groundwater (non-rainfall dependent) infiltration, peak (rainfall dependent) inflow and infiltration and the ability to reduce the volume of inflow and infiltration.

119. Each of these factors is discussed further below.

b. Average Daily Flow Contribution

120. Figure 17 indicates the range of flows entering the STP and their relative frequency. The design of the elements of a municipal sewerage system adopts a dry weather flow rate per person and then adds allowances for rain fed and groundwater intrusions into the system that increase flows over short and longer term periods i.e. inflow and infiltration (I & I).

121. CPUC water meter records provide information to determine what the base level flow should be without any inflows and infiltration. Table 7 shows the average metered flows per connection per day over the 12-month period to March 2020.

Table 7: Metered Water Flows Per Connection - April 2019 to March 2020

Category	Average No. of Metered Connections	Monthly Min. Consumption (gal/conn/day)	Monthly Average Consumption (gal/conn/day)	Monthly Max Consumption (gal/conn/day)	Estimated Proportion to Sewer	Estimated Average Flow to Sewer (gal/conn/day)
Commercial	80	729	**1001**	2041	90%	**901**
Government	16	1073	**1737**	3028	90%	**1563**
Hospital	1	23122	**34842**	43273	90%	**31358**
Residential	374	309	**359**	399	90%	**323**

122. Applying these average flows to the number of sewerage connections results in a daily flow to the STP of 260,000 gals. This correlates to the lowest recorded daily flow to the STP of 259,000 gals from the period of record examined for Figure 17. This should not be regarded as a direct comparison however considering the 259,000 gals was a single event with the second lowest recorded daily flow 33% higher at 346,200 gals.

123. The reasons for this variability are unknown but could be associated with factors such as, erroneous meter readings, contributions from additional unbilled sewer connections or sustained groundwater infiltration (GWI). Due to these factors, a base flow of 260,000 gpd is not considered a realistic target for an I & I reduction program to achieve.

124. Sustained groundwater infiltration, either due to natural groundwater or water pipe leakage, will be evident through raised flow rates overnight. Whilst there will be some overnight inflow from household connections through usage, leaking taps and cisterns, a proportion will be from GWI.

125. For the purposes of determining the potential increase in household connections, the actual flows currently occurring need to be considered together with the ability to achieve a sustained change in these flows, and preferably a reduction. As indicated from Figure 7 the historical average and median flows are 454,000 gpd and 439,000 gpd respectively. Table 7 shows the minimum average daily flow over a month is 391,789 gpd. Based on these values a range of possibilities are considered in the Section - Pumping Station and Pipe Network Capacity.

126. Some Grinder Stations and Lift Stations will therefore require different pump models or speed and motor changes and potential larger diameter suction pipework. The pipe network however is of adequate capacity for all options. The pumping stations and pipe network in this context will not be the limiting factor to the range of potential increases to household connections.

c. Weno Sewage Treatment Plant Capacity

127. Sewage treatment facilities are designed to a hydraulic capacity and also their biological treatment capacity. The design requirement for biological capacity for the STP is 1001 lb BOD (Biochemical Oxygen Demand) per day with a diurnal peak of 78lb per hour. This design assumes a BOD strength of 160 ppm in the raw sewage. During the upgrading of the plant by CCB Envico, testing of raw sewage showed a value of 50 ppm.[16]

128. The design requirement for hydraulic capacity is 750,000 gpd for the average daily flow and a peak of 1.6Mgd. Inflows to the treatment plant show that whilst for 68% of days; inflows are within the treatment plant capacity. Rain events cause significant increases to the daily flow to

[16] Personal communication with Nick Graham, CCB Envico 21 May 2020.

the extent that for 25 days of the 79 day period of record, the average daily flow exceeded the design capacity. A program to reduce inflow and infiltration is therefore required to ensure this situation is improved or at least not exacerbated by an increase in household connections and flows.

d. Outfall Capacity

129. Operators report the outfall capacity is exceeded during heavy extended rain periods and overflows occur from the 6" relief pipe at RL 12' (approx.) in the Splitter box. Theoretically, for the 1500ft long, 2ft internal diameter pipe, the flow capacity is 510L/s forC=110, 420L/s for C=90. Both values are well above inlet pump station capacity.

130. A review in this context should be undertaken during detailed design to determine the cause of these overflows and the current capacity of the outfall.

e. Assessment of Potential Number of Additional Household Connections

131. An analysis has been carried using a range of flows to determine the potential number of additional household connection for different scenarios. The scenarios use three starting daily flows that may result through an I & I reduction program. Based upon the flow distribution from daily records summarized in Figure 17, a starting daily flow of 450,000gpd has been adopted as the average daily flow that includes infiltration flows but does not include rain fed inflow and infiltration. A value of 60gpm (86,000 gpd) has been assumed as GWI and the minimum flowrate to the STP.

132. Three levels of flow reduction have been adopted as the base condition to determine the additional number of household connections that can be made to reach the STP capacity of 750,000 gpd. The three starting scenarios, labelled High, Medium, and Low are based upon the extent and effectiveness of the I & I program as follows:

(i) **High Reduction**. Rain fed inflows targeted across entire network to minimize wet weather peaks. Infiltration reduced through selective programs based on areas showing high nighttime flows during dry weather continuing until the targeted reduction of flow is achieved. This would include relining of selected sewers and disconnection of abandoned houses.

(ii) **Target reduction-100,000gpd (22%).** *Wet weather instantaneous peak of 2.0 Mgd. Daily 1.6 Mgd (33%). Minimum overnight flowrate reduced to 40gpm.*

  (a) **Medium Reduction** – Activities as per the High Reduction program but to the extent necessary to achieve a lower target.

(iii) **Target reduction - 50,000gpd (11%).** *Wet weather instantaneous peak of 2.0 Mgd. Daily 1.6 Mgd (33%).*

  (a) **Rain Fed Inflows Only** - Rain fed inflows targeted across entire network to minimize wet weather peaks. Disconnection of abandoned houses

(iv) **Target Reduction – Nil to starting flow (remains at 450,000 gpd).** *Wet weather instantaneous peak of 2.0 Mgd. Daily 1.6 Mgd (33%).*

133. Table 8 below summarizes the maximum additional number of households that can connect to the sewerage system and not exceed the STP capacity of 750,000 gpd.

Table 8: Potential Additional Household Connections

Extent of Flow Reduction	Current ADWF Post I & I (gpd)	New Connections Flow / Household (EP)			
		370 (53) gpd	510 (73) gpd	650 (92) gpd	740 (106) gpd
	390 HH + Govt / Com / Hospital	Additional No. of H/H to STP Capacity			
High Reduction	350,000	1090	790	620	540
Medium Reduction	400,000	950	690	540	470
Rain Fed Inflows Only	450,000	820	590	470	400

134. Four values of flow rates for the new connections have been adopted for comparison purposes. The values adopted range from a maximum of 740 gpd per household (106 gpd/EP), which is the current flow rate, reducing by 50% to 370 gpd per household (53 gpd/EP), which equates approximately to the current average household water consumption. The quality of the new house drainage, household plumbing installation, and elimination of any rain fed inflows from the property will determine the flow rate to sewer.

135. Table 8 shows a range of new household connections between 400 and 1090. For 1090 new connections an extensive I & I program will be required together with ensuring quality plumbing, likely to include internal plumbing improvements are undertaken for new and existing connections. For the lower bound of 400 new connections, the focus would only be on reducing rain fed inflows to existing and new connections.

136. If an increase in connections is carried out without any I & I program, the biological capacity of the STP would not be exceeded. However, the frequency of high flows causing hydraulic overload of the STP would increase. This would result in more frequent discharges of poorer quality treated effluent in addition to a higher frequency of overflows of raw sewage.

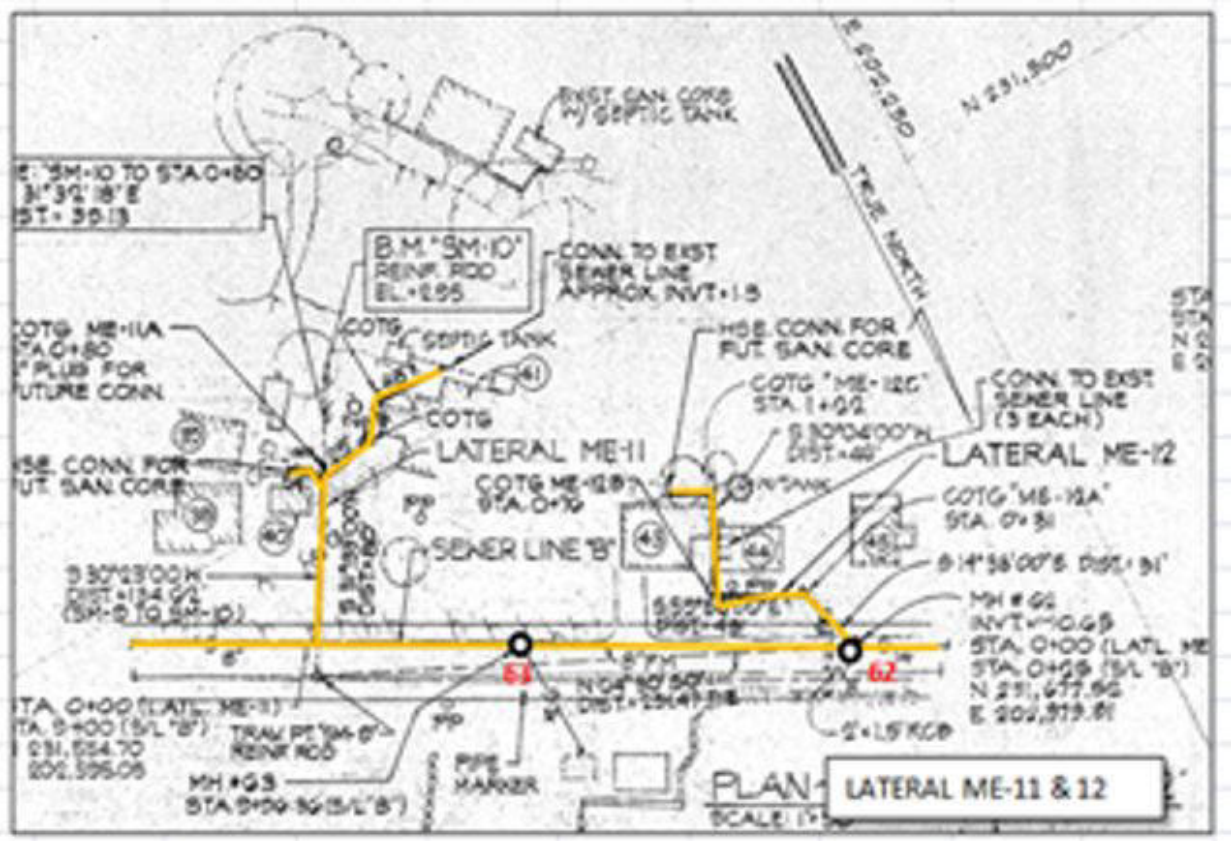
5. Lateral Extensions and House Connections

137. Currently only 390 households are connected to the sewerage scheme. The program to increase this number will primarily occur through connections to the existing network of sewers and laterals.

138. A field survey of the existing network is proposed under the project readiness financing grant to identify all households connected to the network. Updated plans will be prepared showing the locations of the sewerage infrastructure and other relevant features such as houses, roads, tracks, and trees.

139. The completion of these plans will be an essential step ahead of designs for the connection of additional households.

Figure 18: Example Output of Laterals and House Connections Field Survey



G. Inflow and Infiltration Reduction Program

1. Inflow and Infiltration Definitions and Sources

140. Inflow and Infiltration (I & I) are two components that combine to increase flows into a sewerage system above the volume contributed from plumbing fixtures in households, commercial, industrial and government premises.

141. **Inflow** - is defined as flow into the sewerage system from the surface of the ground from rainfall. Examples of inflow include:

(i) cross connection of stormwater pipework or direct entry of rainfed runoff to the sewerage pipes or house drainage, either within the grounds of a property or public infrastructure, e.g. connection of roof downpipes to the sewer house drainage;

(ii) flow into low lying overflow relief gullies (O.R.G). Grated entries to the household drainage system that are installed to provide a point of overflow outside of a house should the house drain or public sewer become blocked, e.g. a paved area outside of a house that has been raised and rainfed runoff flows into the O.R.G.; and

(iii) flow entry into low lying manholes or pits with lids that are damaged of unsealed.

142. **Infiltration** - is slightly different from inflow and is defined as water from the subsurface that infiltrates into the sewer pipeline through loose joints or pipes with defects. Examples of infiltration include:

(i) junctions with sewer pipes and pipe joints that have not been effectively jointed;
(ii) cracks or splits in sewerage pipes; and
(iii) below ground leakage into the walls or base of manholes and pits.

143. There are other factors particularly relevant to Weno that can lead to higher than expected sewer flows. Examples are:

(i) plumbing fixtures that that do not seal correctly, such as leakage from toilet cisterns and dripping or flowing taps. If a water supply system is not operating 24/7 then faucets may be left open awaiting the supply to resume and after filling their receiving container overflow into the sewerage system; and
(ii) illegal, unregistered, or unknown connections result in a higher per capita flow. For Weno the inflows to the sewerage system are always significantly greater than the metered supply volume of water delivered to households.

144. For clarity, a list of common sources of inflow and infiltration into a sewerage system through on-property sources and the sewerage network is provided below. Note the on-property sources will be a major contributor. The total length of pipework within properties is generally equal to, or greater than, the length of pipework of a municipal sewerage system. Whilst Weno has only 498 registered connections, if the average house drainage length is 100 ft and government or commercial drains average 150 ft, on-property drainage is 46% of the entire gravity pipe network.

(i) On Property Sources of I & I to household sewer drainage
  (a) roof drain connections direct from downpipes;
  (b) sub-soil drainage connections;
  (c) low-lying overflow relief gullies collecting rain fed runoff;
  (d) drainage from un-roofed outside areas, such as pig pens or paved patios, subject to rain fed runoff directly piped to the sewer house drain; and
  (e) cracked, damaged or abandoned drainage pipe allowing groundwater entry. Sometimes exacerbated over time by root intrusion.

(ii) Sources I & I to the CPUC Sewerage System
  (a) cross connections with stormwater drainage pits and pipework;
  (b) inflow through unsealed Manhole and Pit lids in low lying areas subject to inundation during rain events;
  (c) groundwater entry into broken pipework, leaking pipe joints and branch connections;
  (d) groundwater entry to manholes and pits, particularly at joints; and
  (e) groundwater or rainfed runoff entry to pumping stations.

H. Recommissioning of Existing Infrastructure

1. Scope of Works

145. For each sub area the purpose of the works to be undertaken is to make connections to all households within the sub area and make good the existing CPUC infrastructure to allow it to operate. This will require connections to existing house drainage and extensions to sewers and laterals where required, to service additional households beyond the coverage of the existing system, wherever reasonable.

146. Inspections are required of the CPUC infrastructure to identify the extent of repairs or replacement of any damaged or defective components. This should include the elimination of any inflow or infiltration to the sewers and laterals prior to the connection of households.

147. For the purposes of cost estimation, it is assumed that 10% of the manholes and pipework will require replacement and each Grinder Station will be equipped with replacement pumps, floats and control panel and fencing of the compound.

2. Southfield Backroad Scheme Commissioning

148. Table 9 shows the infrastructure constructed in the Southfield Backroad area which has been constructed but not commissioned.

Table 9: Southfield Backroad Sewerage Infrastructure to be Recommissioned

Area	Pumps	Junction Box	Manholes	Gravity Pipework (ft)			Force Main
				4"PVC	8" PVC	8" AC	6" PVC
GS- 8	BJM SK-15C 2HP	Unknown	3		400		600
GS- 9	BJM SK-22C 3HP	Unknown	6	500	700		120
GS- 10	BJM SK-22C 3HP	Unknown	11	1100	1700	650	720
		Totals	20	1600	2800	650	1440

3. Penia Area Commissioning

149. The Weno sewerage system was extended to the Penia area by 2016 however the section east of Grinder Station GS-16 was not commissioned. Table 10 provides details of the infrastructure constructed but not commissioned.

Table 10: Penia Sewerage Infrastructure to be Recommissioned

Area	Pumps	Junction Box	Manholes	Gravity Pipework (ft)			Force Main
				4"AC	8" PVC	8" AC	6" PVC
GS- 16	BJM SK-22C 3HP	Unknown	4	500	640	0	140
GS- 17	BJM SK-15C 2HP	Unknown	3	730	650	0	120
GS- 18	BJM SK-22C 3HP	Unknown	5	300	970	0	270
GS- 19	BJM SK-22C 3HP	Unknown	7	520	1100	0	880
GS- 20	BJM SK-15C 2HP	Unknown	4	300	710	0	400
GS- 21	None	Unknown	4	0	1000	0	320
GS- 22	None	Unknown	4	100	570	0	320
GS- 23	None	Unknown	5	200	1140	0	300
		Totals	36	2650	6780	0	2750

150. For the purposes of cost estimation, it is assumed that 10% of the manholes and pipework will require replacement and each Grinder Station will be equipped with replacement pumps, floats and control panel and fencing of the compound.

151. Where low static heads exist (less than 6ft), due to the relatively large 6" diameter and short length force mains, the BJM series pumps in the Penia system may operate outside of their recommended operating range. Pump selection should be checked during detailed design to ensure pumps operate without the throttling of valves.

152. The pumps for stations listed in Table 14 have sufficient capacity to meet the flows resulting from the proposed increase in connections. Upgrades would be required however to meet flows from the Sapuk area should an extension to the system occur in the future. A capacity increase is recommended for GS-14 however for the proposed increase in connections to the Penia area.

I. Weno Wastewater Treatment Plant Refurbishment

1. Previous Upgrades

153. In 2013 a contract for $3.25M was awarded to rehabilitate and upgrade the Weno Wastewater treatment plant (WWTP). The treatment plant had not been operational since 1998. During the period after 1998, the sewage collected by the piped system and pumping station bypassed the WWTP and discharged, untreated, through an outfall that discharged into the ocean at depth of approximately 30 feet, approximately 100 feet beyond the shoreline of the runway, opposite the terminal.

154. The WWTP was upgraded to an average day capacity of 750,000 gallons.

155. The WWTP has generally been operating satisfactorily with high inflows and overflows to the outfall via the bypass the most frequent problem.

156. The management and operators identified several items for repairs and upgrades as shown in Table 11.

Table 11: WWTP Capital Works Submitted for Grant Inclusion

Priority	Item Description	Cost Estimate
1	Control Panel Refurbishment and parts replacement. Local SCADA installation for improved process monitoring and record keeping.	$75,000
1	Instrumentation calibration, maintenance and replacements.	$40,000
2	Clarifier Scraper Refurbishment.	$20,000
2	Kitset Pipe Storage Shed (including local installation)	$120,000
2	Building rehabilitation and maintenance	$25,000
2	Supply and installation of 180 lb per load Incinerator and shed.	$80,000
2	Laboratory Facilities Upgrade	$15,000
2	Spares Parts Replacements	$50,000
3	Plant and Equipment Replacements	$420,000

157. Due to budget constraints only the highest priority items have been included in the Grant program. These items are discussed further below.

a. SCADA and Control Panel Refurbishment

158. Control settings for the WWTP and the status of equipment is currently entered and monitored through a Human Machine Interface (HMI) instrument with a 7" screen mounted in the main control panel at the WWTP. The HMI links with the WWTP Programmable Logic Controller (PLC), to display the status of various pumps and instruments and make adjustments to set points for such parameters as dissolved oxygen levels and level settings which activate equipment.

159. The HMI has proved cumbersome to operate and does not allow for ready access to trends, such as flow, and the maintenance of historical records to compare process parameters at the Plant. It is proposed to supplement the HMI and add a local PC with SCADA software connected to the HMI and PLC to trend more parameters and improve record keeping. Plant controls would be added as appropriate to the desktop PC SCADA and would include the entry of set points and other control parameters currently entered through the HMI.

b. Instrumentation Calibration, Maintenance and Replacements

160. Various instrumentation including, pressure sensors, level sensors, DO probes and laboratory instruments require calibration. Replacements are required for pressure gauges, DO probes and several laboratory instruments.

c. Weno Sewage Treatment Capacity Increase

161. At the design per capita input of 50 gpd, the existing WWTP has a capacity for 15,000 EP. There are currently only an estimated 4,700 EP connected to the sewerage system comprising 2,700EP from Households, 1,600EP from Commercial and Government and 400EP from the Hospital. Whilst the biological loading rate is well within the WWTP's current capacity, flows during wet weather have on a regular basis exceeded the Plant's hydraulic capacity. The I & I program aims to reduce the wet weather inflows and correct this imbalance between biological and hydraulic loading.

162. It is estimated there are currently 1650 households within the sewered area. Each household is occupied by an average of 7 persons. If all households are occupied and connected, the plant loading would be 14,200EP i.e. within the capacity with an allowance for additional commercial connections.

163. Providing the I & I can be controlled, an increase in treatment facilities will potentially not be required until all current households are connected and the sewered area is extended to service more customers. It is most likely however that, even following the proposed I & I reduction program, high flows will continue to be the limiting factor for the treatment capacity of the WWTP. Ongoing vigilance will be required to maintain the flow reductions achieved by the proposed I & I reduction program.

164. Flows and connections should continue to be monitored. Should an increase in sewage treatment capacity be required there is space available at the WWTP site to add a further compact oxidation ditch and central clarifier. Future studies however should consider all options for expansion including consideration of treatment facilities elsewhere on the island.

J. Pumping Station Refurbishments and Upgrades

1. Previous Upgrades or Refurbishment

165. Two significant projects have been undertaken in recent years that have resulted in modifications to pumping stations.

166. **Penia System Extension.** The Penia extension was carried out in conjunction with the Weno WWTP upgrade between 2014 and 2016. The Penia scheme rehabilitated 10 Grinder Stations (GS-14 to GS-23). Only GS-14 and GS-15 are currently operational with the remaining 8 stations in the area ly unused with no household connections.

167. **World Bank Road Project.** As part of the road project commencing in 2013, five Lift Stations (LS-1, LS-2, LS-3 , LS-8 , LS-10) were replaced and their force mains and associated gravity pipework relocated to allow for the road upgrade. A wrong selection of pumps was made in the design, not matching the required duty. The contractor had installed pumps before the error was realized. Modifications have since been made however but CPUC Operations still have concerns about these modifications.

168. A further World Bank Road Project is currently being formulated to upgrade the main circular road around the north east of Weno beyond the Airport runway. The potential impact on CPUC infrastructure should be monitored. The FSM National Government Project Management Office is currently managing the project and has given reassurance that any affected infrastructure will be relocated at the cost of the World Bank project. The details of the works relating to CPUC infrastructure should be reviewed and approved by CPUC to avoid a repeat of the failures in the previous project.

2. Analysis of the Pump Station Network

169. The sewage pump station network has been analyzed to determine if upgrades are required to pump flows resulting from the proposed additional 550 household connections.

170. Data is only available for the number of sewerage connections within each water zone and not within each sewer zone. The connections within each sewer zone were estimated by overlaying the water and sewer zone maps and apportioning connections. The additional connections were then allocated to zones based upon examination of aerial imagery and Chuuk Women's Group survey results.

171. For the purpose of peak flow calculations, the EP gpd loading was adjusted to result in a total daily dry weather flow to the WWTP matching its design capacity of 750,000gpd. Peak flow rates into pump stations were determined using a multiplying factor of 8 x ADWF. The resulting flow was checked against the installed capacity for pumping in a duty/standby mode i.e. a single pump can pump the required flow. The rate of inflow into the downstream pump station was assigned a value of 70% of the upstream pump flow rate to allow for attenuation through the gravity pipe system.

172. Due to the absence of detailed topographic data and pump station operating levels, assumptions were made based on available Google Earth imagery. Table 12 shows the duty points for each pumping station and makes a preliminary assessment of the suitability and capacity of the pump to meet its expected flow with the proposed additional connections. It is noted that it was not possible to determine the actual duty points for the Gorman Rupp pumps

because the speeds are unknown. In this context, the details of the installed pumps at each of the pump stations should be confirmed during detailed design and their duty and actual performance verified.

173. Many of the BJM SK15C and SK22C series pumps do not appear to be operating at their optimal duty points and are either close to, or outside of the limits of their pump curves. For the pump stations with the smallest diameter force mains (GS-01, GS-02, GS-06, GS-12 and GS-13), the pumps operate close to their shut-off head and outside of the pump manufacturers recommended operating range. At the other extreme, GS-17 may operate outside of its curve range with too low head and high flow. Most of the remaining pumps in the Penia Scheme operate at the high flow end of their curve and not at their most efficient duty. It should be noted this analysis is a theoretical assessment based on the information available and should be reassessed during detailed design.

Table 12: Grinder Pump Station Details

		Static Head	Force Main		Est. Approximate Duty Point		Pump Suitability
Station No.	Pump Installed	ft	Length (ft)	Diameter	Head (ft)	Flow (gpm)	
GS- 1	BJM SK-15C 2HP	6' est.	230	1.5"/6"			Field Check Required
GS- 2	BJM SK-22C 3HP	12' est.	270	1.25"/6"			Field Check Required
GS- 3	Not Equipped	-	-	-			
GS- 4	T6A3S-B? 5HP	6' est.	230	2"/6"			Field Check Required
GS- 5	T6A3S-B? 5HP	6' est.	200	2"/6"			Field Check Required
GS- 6	BJM SK-22C 3HP	9' est.	220	1.25"/6"			Field Check Required
GS- 7	T6A3S-B? 5HP	6' est.	220	1.5"/6"			Field Check Required
GS- 8	BJM SK-15C 2HP	20' est.	600	6"	26	160	OK
GS- 9	BJM SK-22C 3HP	12' est.	120	6"	22	230	OK
GS- 10	BJM SK-22C 3HP	9' est.	720	6"	22	230	OK
GS- 11	BJM SK-15C 2HP	6' est.	330	2.5"/6"			Field Check Required
GS- 12	BJM SK-22C 3HP	6' est.	150	1.5"/6"			Field Check Required
GS- 13	BJM SK-22C 3HP	23' est.	560	1.5"/6"			Field Check Required
GS- 14	BJM SK-15C 2HP	12' est.	620	6"	20	190	Low Capacity
GS- 15	BJM SK-22C 3HP	9' est.	230	6"	21	235	OK
GS- 16	BJM SK-22C 3HP	6' est.	140	6"	18	250	OK
GS- 17	BJM SK-15C 2HP	9' est.	120	6"	15	220	Marginal - End of Curve
GS- 18	BJM SK-22C 3HP	9' est.	270	6"	20	240	OK
GS- 19	BJM SK-22C 3HP	6' est.	880	6"	19	245	OK
GS- 20	BJM SK-15C 2HP	9' est.	400	6"	18	200	OK
GS- 21	Not Equipped	9' est.	320	6"			
GS- 22	Not Equipped	6' est.	320	6"			
GS- 23	Not Equipped	9' est.	300	6"			

IV. DESCRIPTION OF THE ENVIRONMENT

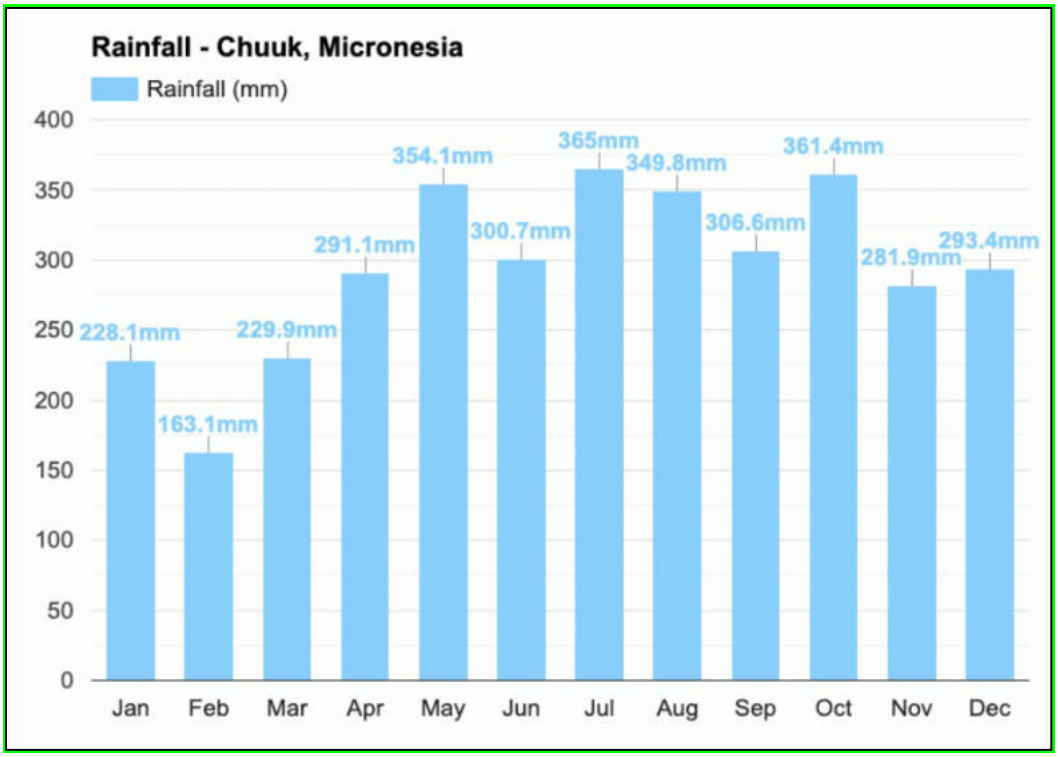
A. Physical Environment

174. Chuuk State is one of the four States of the Federated States of Micronesia located approximately 610 miles southeast of Guam and 424 miles west of the FSM capital island of Pohnpei. Chuuk consists of over 290 islands (less than 20% of which are inhabited) geographically dispersed throughout five regional areas. Chuuk is the most populous of the FSM states, with a population of 48,654 (2010 census). There is a total of 40 municipalities in the State. The lagoon islands account for 16 municipalities and over 75% of the population of the state. The main island of the state, Weno, is located in the Northern Namoneas area of Chuuk Lagoon and is home to around 26% of the population of the state.

1. Climate

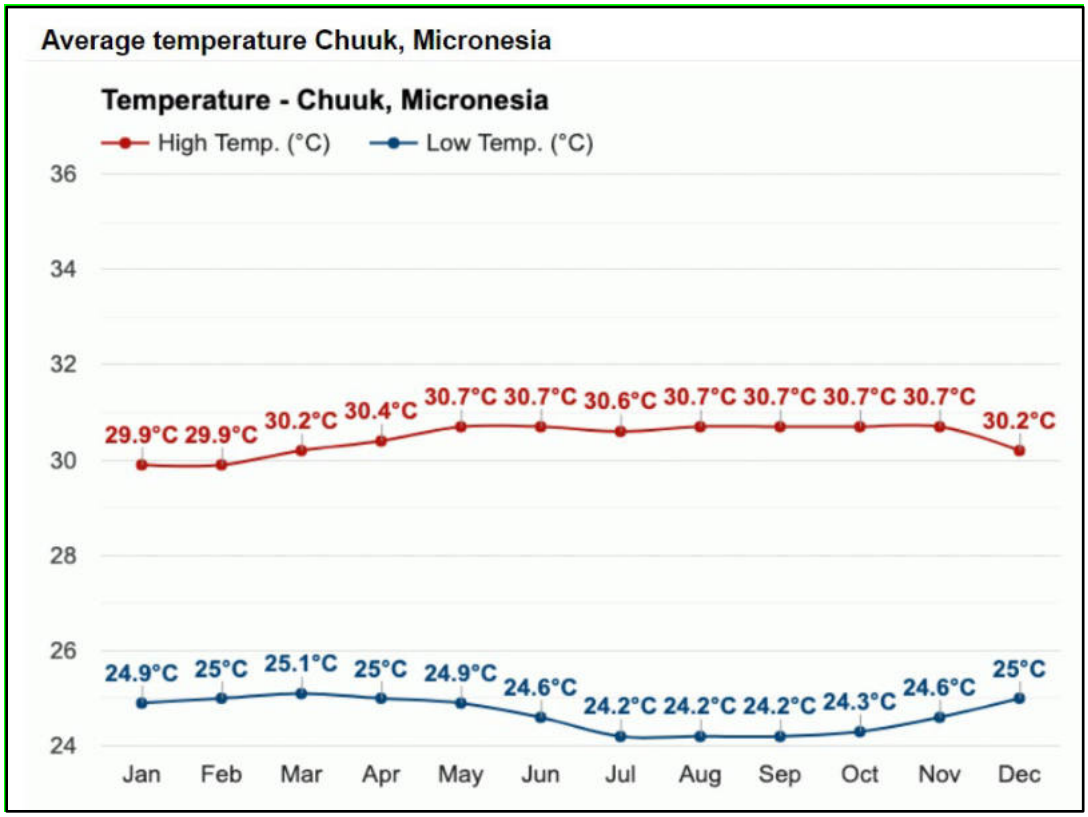
175. The climate in Chuuk is classified as a tropical rainforest climate (Koppen-Geiger climate classification). There is no pronounced summer or winter. Located close to the equator the climate is invariably warm and moist with fairly uniform temperature. The average temperature is around 28 degrees Celsius with a long-term average variation of only 0.3 degrees Celsius throughout the year. Rainfall averages around 3,400mm per year with an average of 264 rain days per year and temperatures 24-30°C year round (Figure 19 and Figure 20).[17]

Figure 19: Average Monthly Rainfall for Chuuk



[17] https://www.weatherbase.com/weather/weathersummary.php3?s=43319&cityname=Chuuk+Islands,+Federated+States+of+Micronesia

Figure 20: Average Annual Minimum and Maximum Temperature for Chuuk



176. In Chuuk, the southeast trade winds are usually established in April and continue until the end of October. During this season, more than 75%of the winds are easterly, and 60% are from east to southeast. The trade wind is steadier and stronger over the southern part of the group of islands. From November to April, the winds blow predominantly between the northeast and northwest, though great variability marks this season, and appreciable percentages of east and south winds occur.[18]

2. Natural Hazards

177. Typhoons and storm waves can occur at any time of year throughout the region. They mostly occur from July to November. They typically peak in August and September. Severe weather can cause flash flooding as well as landslides around the Chuuk region.

178. Droughts, fires, and water shortages are also natural hazards that can impact the region of Chuuk during El Niño events whilst typhoons and flooding occur during La Niña.

179. Chuuk is also vulnerable to the impact of tsunamis due to the inconsistence occurrence of earthquakes in the region. However there have only been two recorded tsunami events since 1849. The last recorded earthquake in the Chuuk region occurred 2015 and was recorded as a 5.1 magnitude event.

180. The Pacific Climate Change Science Program (PCCSP) in 2011 reported annual and

[18] US National Geospatial-Intelligence Agency. 2017

seasonal maximum and minimum temperatures have increased in the region since 1952 by 0.10 degrees Celsius. These temperate trends remain consistent with the global pattern of warming. The PCCSP also highlights the rise in sea-levels since 1993 of 10mm (slightly higher than the global average). Acid acidification has also risen and will threat the surrounding coral reef ecosystems if projected levels continue to increase.

3. Topography

181. Chuuk State comprises a main atoll at Chuuk Lagoon, plus four outer island atoll groups: the Mortlocks (with 11 inhabited atolls or islets) and Oksorod (comprising three groups); Pattiw (having 4 inhabited atolls/ islets); Namonuito (5 inhabited atolls/ islets); and the Halls (4 inhabited atolls/islets). Total land area for all of Chuuk State is a mere 49 square miles.

182. The islands of Chuuk Lagoon lie about 2,300 miles southeast of Tokyo, Japan and 3,400 miles southwest of Honolulu, Hawaii. They are surrounded by a roughly circular barrier reef about 40 miles in diameter. There are 19 high volcanic islands within the lagoon, and numerous low-lying coral islets or motu along the barrier reef. Weno (also known as Moen), the most populous of the islands, is the center of government and commerce.

4. Geology, Landform and Soils

183. The main population center of Chuuk State is the Chuuk Lagoon, a large archipelago with mountainous volcanic islands surrounded by a string of coral islets on a barrier reef. Weno is the location of the Chuuk airport, hosts government facilities, contains a small urban center on approximately one-third of the island, and is one of Chuuk's 19 high volcanic islands, enclosed by a coral ring composed of 87 small and low coral islets forming a lagoon. Chuuk Lagoon, and the relatively large basalt islands left over from previous extrusions and differential weathering, are easily seen inside the coral tracing of what used to be the mouth of a volcano. [19]

184. Stark and Hay (1963)[20] subdivided the volcanic islands of Chuuk into three groups. Weno and Tonoas fall within the Eastern group made of olivine-basalt with minor andesite. Like all the high islands within the main lagoon, Weno island is of volcanic origin. It has steep rugged uplands surrounded by coastal lowlands. The highest point on Weno, Mt. Tonoken, is a distinctive peak that rises some 369 m (about 1,000 feet) above sea level. Soils in the mountainous areas are moderately deep and well-drained. These soils are suitable for cultivation.

185. The volcanic islands are the eroded remnants of a partly submerged inactive large shield volcano and comprise about 97% of the total land area of 35 square miles rising up to 450m above sea level. Many islands have sloping sides ending in narrow coastal flats. The flats are poorly drained and in some places are bordered by mangrove swamps. The volcanic islands are drained by streams most of them short with small drainage areas. Vegetation is generally tropical and lush except in high ridge areas where it is sparse due to rocky soils. The villages on Weno are in the northwest (Sapuk, Penia, Peniesene, Tunnuk, Mechitiw,

[19] William James Smith Jr (2008) The place of rural, remote and least-wealthy small islands in international water development: the nexus of geography–technology sustainability in Chuuk State, Federated States of Micronesia The Geographical Journal, Vol. 174, No. 3, September 2008, pp. 251–268

[20] Stark, J.T., and Hay, R.L., 1963, Geology & Petrography of volcanic rocks of the Truk islands, East Caroline Islands: USGS Professional Paper 409, 39p.

Iras, Nepukos, Mwan, Neiwe, and Wichap, Epinup) and serve as the main center of commerce.

186. A Soil Survey of Islands of Truk, was undertaken by the US Department of Agriculture, Soil Conservation Service in 1980. It is noted that the five map units in this soil survey have been grouped into two general kinds of landscape for broad interpretive purposes[21]. Each of the broad groups and the map units in each group are described in the following paragraphs.

a. Map unit descriptions

187. **Coastal mangrove swamps on coastal strands and on bottom lands.** This group consists of three map units. It makes up about 27% of this survey area. The soils in this group are level and nearly level. The native vegetation is mainly mangrove forest, atoll strand forest, and water tolerant grasses. Elevation is sea level to 3 meters. The mean annual rainfall is about 365 centimeters, and the mean annual air temperature is about 27 degrees C.

188. The soils in this group are shallow and very deep and are somewhat poorly drained and very poorly drained. They formed in organic deposits and coral sand. This group is mainly used for the production of mangrove wood, coconuts, and wetland taro and for urban development.

189. **Chla Insak Variant.** This map unit is along the shoreline of many islands in the survey area. This unit makes up about 13% of the survey area and is flooded daily with ocean saltwater during high tide. It is about 60% Chia soils and 20% Insak Variant soils. The remaining 20% is components of minor extent. The slope is 0 to 2% and the vegetation on this unit is mainly mangrove forest. Elevation is sea level and the mean annual rainfall is about 365 centimeters, and the mean annual air temperature is about 27 degrees C.

190. Chla Soils in this context are in coastal mangrove swamps. These soils are very deep and very poorly drained. They formed in organic deposits overlying coral sand and gravel. The surface layer is mucky or peaty. Below this to a depth of 150 centimeters or more the soils are sandy and are gravelly or very gravelly. Insak variant soils are in coastal mangrove swamps. These soils are shallow and very poorly drained. They formed in a mixture of organic deposits and coral sand. The surface layer is peaty and sandy. Below this to a depth of 25 to 50 centimeters the soils are sandy and very gravelly.

191. Of minor extent in this unit are Naniak and Insak soils. The Naniak soils are very deep and silty, and the Insak soils are moderately deep and sandy. This unit is used for mangrove wood production and wildlife habitat. The main limitations of this unit for mangrove wood production are the shallow rooting depth of the Insak Variant soils and wetness resulting from flooding with ocean saltwater during periods of high tide.

192. **Dublon-Typlc Troporthents (urban land).** Very deep, somewhat poorly drained, level and nearly level soils, and urban land on coastal strands. This map unit is along the shoreline of many islands in the survey area. Slope is 0 to 2%. The vegetation on the Dublon soils is mainly coconut trees. The Typic Troporthents and areas of Urban land are mainly barren of vegetation. Elevation is sea level to 2 meters. The mean annual rainfall is about

[21] Soil Survey of Islands of Truk, Federated States of Micronesia (1980) By William E. Laird, Soil Conservation Service, US Department of Agriculture.

365 centimeters, and the mean annual air temperature is about 27 degrees C. This unit makes up about 8% of the survey area.

193. It is about 40% Dublon soils, 30% Typic Troporthents, and 20% Urban land. The remaining 10% is components of minor extent. Dublon soils are on coastal strands and these soils are very deep and somewhat poorly drained. They formed in water- and wind-deposited sand derived dominantly from coral. The soils are sandy throughout. The Typic Troporthents and Urban land are in many areas near the perimeter of some of the islands in the survey area. They are mostly areas that have been filled with crushed coral.

194. Of minor extent in this unit are Ngerungor and Ngedebus soils. The Ngerungor soils are very deep, very poorly drained, and organic. The Ngedebus soils are very deep, somewhat excessively drained, and sandy. This unit is used for coconut production and for homesite and urban development. The main limitations of this unit for homesite development are a high-water table and hazard of flooding in many areas.

195. **Ngerungor.** Very deep, very poorly drained, level and nearly level soils; on bottom lands. This map unit is on the coastal plains of some islands in the survey area. Slope is 0 to 1%. The vegetation on this unit is mainly tall water tolerant grasses. Elevation is sea level to 3 meters. The mean annual rainfall is about 365 centimeters, and the mean annual air temperature is about 27˚C.

196. This unit makes up about 6% of the survey area. It is about 80% Ngerungor soils and 20% components of minor extent. Ngerungor soils are on bottom lands. These soils are very deep and very poorly drained. They formed in organic deposits. The soils are mucky and peaty throughout. A high-water table is at a depth of 0 to 15 centimeters year-round.

197. Of minor extent in this unit are Mesei Variant and Dublon soils. Mesei Variant soils are moderately deep organic material overlying hard basalt. Dublon soils are very deep, somewhat poorly drained, and sandy. This unit is used for wetland taro production. It has few limitations for this use.

198. **Soils on uplands.** This group consists of two map units. It makes up about 73% of this survey area. The soils in this group are nearly level to extremely steep. The native vegetation is mainly mixed forest. Elevation is 6 to 300 meters. The mean annual rainfall is about 365 to 400 centimeters, and the mean annual air temperature is about 26 to 27 °C.

199. The soils in this group are shallow, moderately deep, and very deep and are well drained. They formed in residuum and colluvium derived dominantly from basic igneous rock. This group is used for subsistence farming, woodland, homesites, watershed, and wildlife habitat.

200. **Tolonler-Dolen.** Very deep, well drained, sloping to extremely steep soils; on uplands. This map unit is in the interior of all islands in the survey area. Slope is 6 to 75%. The vegetation on this unit is mainly mixed forest. Elevation is 6 to 300 meters. The mean annual rainfall is about 365 to 400 centimeters, and the mean annual air temperature is about 26 to 27 °C.

201. This unit makes up about 65% of the survey area. It is about 60% Tolonier soils and 25% Dolen soils. The remaining 15% is components of minor extent. Tolonier soils are on uplands. These soils are very deep and well drained. They formed in residuum and colluvium

derived dominantly from basic igneous rock. The soils are loamy and very stony throughout. Dolen soils are on uplands. These soils are very deep and well drained. They formed in residuum and colluvium derived dominantly from basic igneous rock. The soils are loamy throughout and are stony in the lower part.

202. Of minor extent in this unit are soils that are similar to the Tolonier and Dolen soils but are less than 150 centimeters deep to highly weathered basic igneous rock. Also, in this unit are small areas of Rock outcrop. This unit is used for subsistence farming, woodland, homesites, watershed, and wildlife habitat.

203. This unit is well suited to subsistence tree crop farming and woodland in areas that are not too steep. In the steeper areas, the unit is limited mainly by equipment limitations and the hazard of erosion. If this unit is used for homesite development, the main limitations are slope and stoniness in many areas.

204. **Rocke outcrop Wahrekdam (variant Wahrekdam).** Rock outcrop, and shallow and moderately deep, well drained, nearly level to moderately sloping soils; on uplands. This map unit is in the interior of many islands in the survey area. It is mainly on ridgetops. Slope is 2 to 8%. The vegetation on this unit is mainly mixed forest. Elevation is 10 to 300 meters. The mean annual rainfall is about 365 to 400 centimeters, and the mean annual air temperature is about 27°C.

205. This unit makes up about 8% of the survey area. It is about 50% Rock outcrop and 30% Wahrekdam Variant and Wahrekdam soils. The remaining 20% is components of minor extent. Rock outcrop consists of areas of exposed volcanic rock on ridgetops and of nearly vertical rock cliffs. Wahrekdam variant soils are on ridgetops. These soils are shallow and well drained. They formed in residuum derived dominantly from basic igneous rock. The soils are loamy and very gravelly throughout. Weathered basalt is at a depth of 25 to 50 centimeters. Wahrekdam soils are on ridgetops. These soils are moderately deep and well drained. They formed in residuum derived dominantly from basic igneous rock. The surface layer is loamy and very gravelly. The subsoil is loamy and very cobbly. Unweathered basalt is at a depth of 50 to 100 centimeters.

206. Of minor extent in this unit are Dolen and Tolonier soils. These soils are deep and are more steeply sloping than the major components of the unit. Also, in this unit are small areas of organic Mesei Variant soils that are moderately deep and very poorly drained. This unit is used for subsistence farming, woodland, and wildlife habitat. The main limitations of the unit for subsistence farming and woodland are shallow rooting depth and low available water capacity.

5. Water Resources

207. Chuuk is drained by a number of streams most of them short with small drainage areas. The compacted volcanic material results in a shallow (unconfined) ground water lens.

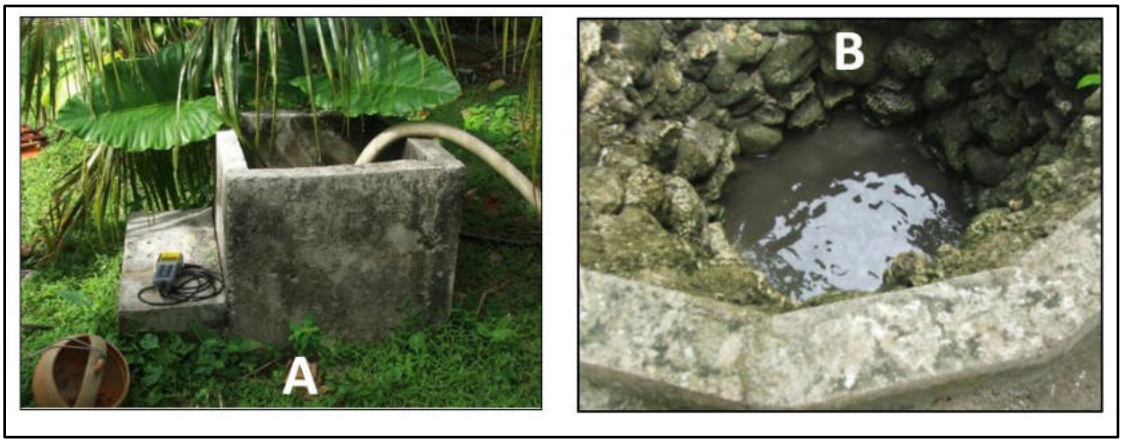
208. Household water use within Weno is derived from either captured rainwater (typically through a roof-gutter system that feeds a large storage tank) or groundwater. Rain catchment water is preferred for most domestic purposes such as drinking and cooking, whereas groundwater, typically accessed through hand-dug wells lined with concrete or rocks, is used for bathing and washing clothes. Communities may also use coconut juice to supplement drinking water.

209. Rain catchment tanks, such as those shown in Figure 21 vary in construction material and size. Older tanks (Left in Figure 21) are made from concrete, whereas newer ones (Right in Figure 21) are made from fiber glass. Depth to water in the hand-dug wells, as shown in Figure 22, ranges from 1 to 3 m. The water is extracted by either a rope and bucket or a small electric pump and is typically shared by several households.

210. To supplement these sources of water, the Chuuk Public Utility Corporation (CPUC) operates the public water supply on Weno Island, serving 378 residential customers (around 19% of total households) and 101 commercial and government customers. CPUC produces 2,500 cubic meters of water per day (m^3/day) of which 95% is sourced from deep wells. CPUC has identified a new potential surface water source from the Wichen River which could expand the water supply, reduce reliance on groundwater and rainwater harvesting, and lower pumping costs.

Figure 21: Roof Catchments

Figure 22:Typical Hand-Dug Wells



Note: Most households have their own catchment tank.

B. Water Quality at Weno

211. CPUC does not have any up-to-date testing data for the Pou WTP raw water source or for the groundwater sources. Historically, the Pou stream had a pH of 7.0, iron 0 mg/L,

Hardness 40 mg/L, sulphate <50 mg/L, nitrate 0 mg/L, total coliforms (per 100 ml) 11 and faecal coliforms 0.

212. Turbidity changes occur with rainfall and whilst a 700,000-gallon raw water tank does remove some turbidity in the settlement process some color cannot be removed by the AVG filter and has caused complaints from consumers in the past.

213. A clarifier and new AVG filter are being installed now and will be commissioned by the end of 2020. The augmentation of the existing treatment process at Pou WTP with a clarifier will greatly improve the removal turbidity, and color and Cryptosporidium.

214. The quality of the surface water in Chuuk is typical tropical run-off water and has been reported by WERI in Guam as excellent from a physical and chemical standpoint as the concentration of all chemicals are well within the maximum guideline values as recommended by WHO.

215. WERI (Water and Environmental Research Institute for the Western Pacific, University of Guam) has found that the physical and chemical quality of the groundwater in Weno is generally good. However, in wells located close to the coast (this will include the Wells in the Wichup area that are proposed to be investigated/rehabilitated) there is a continuing risk of saltwater intrusion if the aquifers are over pumped. It was also concluded that due to bacterial contamination risk the groundwater source should be disinfected.

216. The Wells have pH 6.5-7.0, iron 0-2.4 mg/L (there are 3 wells that have been discontinued due to high iron levels these being wells 83-18, ADB-1, ADB-2), hardness120-280 mg/L, sulphate <50 mg/L, nitrate 0-1.5 mg/L, chlorides typical 12-32 mg/L and faecal coliforms 0.

217. The closest laboratory to Chuuk for water testing is in Guam (WERI). After the JFPR well rehabilitation in 2012 water samples were sent to Guam for analysis unfortunately though the results were never obtained due to payment issues via the executing agency in Pohnpei. Further testing has been provided for under the CWSSP.

218. The EPA carries out regular bacteriological testing however the sampling procedures need to be reviewed. CPUC was carrying out groundwater testing using a handheld monitor for pH, temperature, conductivity, TDS and salinity together with well depth monitoring and controlling draw off from the wells during the dry season as part of the well monitoring program. This will be reintroduced.

C. Air Quality

219. There are no available air quality data for Weno as there is currently no environmental standards being implemented for air quality.

220. In general, the peri-urban areas of Weno, where proposed components will be located, have no major sources of anthropogenic emissions and noise generators. For these areas, it is therefore expected that the average ground level concentrations of sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and particulate matter (PM10) will not exceed the values in IFC's guidelines (EHS Guidelines of April 2007).

D. Biological Environment

1. Terrestrial Flora

a. Description of the natural woody vegetation [22]

221. The Federated States of Micronesia (FSM) is a political unit of four states with 607 small islands in the Caroline Islands group, lying just above the equator, north of New Guinea and east of the Philippines. Each of the four States (Yap, Chuuk, Pohnpei and Kosrae) centers around one or more high islands, and all but Kosrae (109 km^2) include numerous atolls. Yap (100 km^2) and Chuuk (72 km^2) are dominated by plantations of coconut and breadfruit trees and have little or no intact natural forest other than mangroves. Pohnpei (335 km^2), the highest island of the Carolines (734 m), is the most forested in FSM. The following description of the vegetation types on these islands is derived from MacLean et al. (1988) and Mueller-Dombois and Fosberg (1998).

222. **Natural forests (closed Broadleaved Forest–Littoral Forest).** This strand forest is present along rocky shorelines, with such ubiquitous coastal taxa as *Cordia subcordata*, *Guettarda speciosa*, *Hernandia nymphaeifolia*, *Hibiscus tiliaceus*, *Pandanus tectorius*, *Pisonia grandis*, *Thespesia populnea*, *Tournefortia argentea* and *Scaevola taccada*.

223. **Mangrove forest.** Mangroves are extensive in tidally inundated areas and are composed of *Rhizophora spp*., *Bruguiera gymnorrhiza*, *Sonneratia alba*, *Lumnitzera littorea*, *Xylocarpus granatum*, *Nypa fruticans* and *Acrostichum spp*., increasing in stature and declining in species richness eastwards.

224. **Freshwater swamp.** Behind mangrove areas, freshwater swamps extend into the lowlands and form a canopy with *Metroxylon amicarum*, Terminalia carolinensis, *Campnosperma brevipetiolata*, *Barringtonia racemose* and *Hibiscus tiliaceus*.

225. **Montane rain forest.** The higher moist forests are a diverse assemblage of the genera *Glochidion, Myrsine, Elaeocarpus, Syzygium, Psychotria, Timonius, Gynotroches* and *Astronidium* and tree ferns (*Cyathea spp*.) occupying upper slopes on the high islands. The palm genera *Clinostigma* and *Ptychosperma*, and occasionally *Metroxylon*, are common on the slopes.

226. **Open Broadleaved Forest (lowland forest).** Lower slopes not overtaken by secondary forest have remnant groves of *Campnosperma brevipetiolata* and *Elaeocarpus spp*., with *Clinostigma ponapensis* abundant on Pohnpei.

227. **Other wooded land (forest fallow–tree gardens).** Predominantly occupying the lowlands and supplanting the naturally occurring vegetation types mentioned above are gardens of useful trees such as breadfruit (*Artocarpus altilis*), coconut palms (*Cocos nucifera*), mango (*Mangifera indica*) and *Pandanus tectorius* cultivars.

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[22] MacLean, C.D., C.D. Whitesell, T. G. Cole, and K. E. McDuffie 1988. *Timber Resources of Kosrae, Pohnpei, Truk, and Yap, Federated States of Micronesia*. USDA Forest Resource Bulletin PSW-24. 8pp. Mueller-Dombois, D. and F. R. Fosberg 1998. *Vegetation of the tropical Pacific islands.* Springer-Verlag, New York. 733 pp.

228. **Shrubs (lowland scrub).** Primary forest on lower slopes and lowlands of the high islands has been replaced by open savannah with scattered shrubs such as *Myrtella bennigseniana* (Yap) and the genera *Melastoma, Timonius*, *Alphitonia*, *Hedyotis*, *Ambroma*, and *Commersonia*.

229. **Secondary forest.** On Chuuk, which was devastated by Second World War activities, large areas of upland forest are covered by the general *Macaranga*, *Commersonia*, *Acalypha* and *Hibiscus*. Two mountaintops have small areas of diverse forest with the endemic *Schefflera kraemeri*, *Semecarpus kraemeri* and *Atractocarpus carolinensis*.

2. Impacts of Human Habitation

230. The lagoon islands of Chuuk State have the highest percent of land under agroforestry of the high islands of Micronesia. The main subsistence crops are banana, breadfruit, coconuts, and taro. The small areas of intact forest atop the peaks of some lagoon islands are rich in endemic species.

231. The percentage of introduced plants varies between the states with introduced species comprising 22% in Kosrae, 40% in Pohnpei, 37% in Chuuk and 39% in Yap of plant species. Many openings in the forests (from sakau, fires, landslides, etc.) provide opportunities for aggressive vines such as the native Merremia peltata or alien invasive Mile-a-minute (Mikania micrantha) to establish themselves, smothering trees and preventing seedlings and saplings from growing.

232. Today, clearing of native forest is largely to plant sakau (kava or *Piper methysticum*). On Chuuk, the only semi-original forest remaining is scattered in tiny remnants. Landslides followed by invasive alien species have had a catastrophic impact on Chuuk's forests. In all States, swidden farming (shifting slash-and-burn agriculture) of nutrient-demanding crops such as yams by early settlers led to large scale land clearing and nutrient depletion and the consequent spread of savannah.

233. Mangrove forests have been depleted through expansion of coastal infrastructure; increased settlements in littoral areas; and, the harvest of trees for timber and firewood. Figures are not available for loss of mangroves in FSM due to coastal infrastructure but based on global figures this are significant. Rates of deforestation/conversion of mangroves in FSM are probably lower than elsewhere in SE Asia as there is no industrial scale targeting of mangrove habitat (e.g., aquaculture) present in FSM. Over the past 20 years the availability of large amounts of funding for infrastructure improvements under the Compact of Free Association with the U.S. has led to increased dredging, road construction and land clearing. For example, in fiscal year 2007, $6.1 million was allocated to the Infrastructure Sector.

234. Around all settlements, mangroves are the primary sites for refuse landfills, which are subsequently used as land for development. Sedimentation from land-based activities, as well as agriculture, has contributed to the degradation of near-shore coral reef ecosystems in all four states. The harvesting rates of mangroves are thought to be higher of the main islands of Pohnpei and Chuuk, due to their higher human population. The degradation of freshwater wetlands has been severe throughout the federation, due mainly to deforestation and to siltation from unsustainable land use, salinity intrusion, and filling in of wetland areas for home and agricultural development. The traditional practice of converting wetland vegetation in swamp forests for taro cultivation has also affected wetlands in the moist rainforests.

3. Terrestrial Fauna

235. Native terrestrial mammals of the FSM include five endemic species and subspecies of fruit bats of the genus Pteropus and a sheath-tailed bat of the genus Emballonura. Taxonomic and biological studies of the FSM's bats are not complete. Introduced mammals include 3 species of rats, a mouse, deer, pigs, dogs, cats, and from time to time goats, rabbits and cattle, all of which can have damaging impacts on native biodiversity.

236. One hundred and nineteen species of birds have been reported in the FSM. These include 31 resident seabirds, 33 migratory shorebirds, 19 migratory land or wetland birds and 5 vagrant species (Engbring et al.1990). Each State of the FSM has one or more endemic species. They include the Dusky White-eye of Kosrae and Pohnpei, Pohnpei Lory, Pohnpei Greater White-eye, Pohnpei Flycatcher, Pohnpei Mountain Starling, Pohnpei and Chuuk ground dove, Truk greater white-eye, Oceanic flycatcher, Yap Monarch and Yap Greater white-eye. A number of the FSM's birds have become extinct or are declining in numbers.

237. The least understood group of vertebrates in the FSM are the reptiles and amphibians. There is one introduced amphibian (*Bufo marinus*), and over 27 species of reptiles, most of them native and at least 2 endemics. Several species of lizards have been introduced but thus far, there have been no confirmed introductions of the brown tree snake, which has decimated bird and reptile populations on nearby Guam.

238. While there has been some work done on the terrestrial invertebrates of the FSM, reports are scattered, and mostly located outside of the FSM so that a review of FSM's invertebrates is beyond the scope of this report. There are indications however that the invertebrate fauna of the FSM is also rich and interesting. Recent collections in Pohnpei for example have yielded numerous species of land snails, and 50 species of ants.

239. Due to the sparse knowledge of FSM's biodiversity, an up to date list of threatened "species in peril" has not been compiled at national or state levels. Some species present in the FSM are, however, included in the IUCN Red List of threatened species as well as appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the U.S. Endangered Species Act listing of Threatened and Endangered species.

240. The Endangered Species Act of the FSM was carried over from the Trust Territory of the Pacific Islands and is incomplete. As part of its biodiversity program, the FSM should take steps to inventory the status of its biodiversity and to identify FSM species in peril. As this will, of necessity, take some time, it is important to take immediate action to identify and maintain important and critical areas of native habitat so that species will not be lost. Threatened terrestrial native habitat of the FSM includes cloud forest, remaining areas of native forest, native freshwater marsh and riverine systems, swamp forest, and critical areas of mangrove forest and uninhabited atoll seabird and turtle rookeries.

241. Other critical areas such as sea bird roosting and nesting sites, sea turtle rookeries, coconut crab islets and fruit bat roosting sites should also be protected.

a. Mammals

242. Native mammals of the FSM include five species and subspecies of fruit bats of the genus Pteropus and a sheath-tailed bat *[Emballonura semicaudata*]. Taxonomic studies of

the fruit bats are not complete, but all are presently considered endemic species and subspecies. The Pteropus fruit bats (or flying foxes) are considered to be keystone species essential to the long-term survival of forests as they serve to pollinate and disperse seeds of forest species.

243. Other mammals have been introduced including at least 3 rats: the 'Polynesian' rat [*Rattus exulans]* the roof rat [*R. rattus*] and the Norway rat [R*. norvegicus*], mice [*Mus musculus*] dogs, cats, pigs, goats, a few cattle which have not generally persisted, and on Pohnpei, the introduced Philippine deer [*Cervus mariannus*] (Wiles *et al*. 1999.)

244. Studies of marine mammals in the FSM have not been carried out and distribution records are scanty (Eldredge 1991), but it is known that there are a number of species of whales and dolphins within the FSM and a dugong, Dugong was killed in Yap about a generation ago. The endangered species act of the Trust Territory of the Pacific Islands that has been carried over to the FSM lists the Dugong, Blue whale *Balaenoptera musculus* and Sperm whale *Physeter catodon* as endangered species.

b. Birds

245. Some 119 species of birds have been reported in the FSM. These include 31 resident seabirds, 33 migratory shorebirds, 19 migratory land or wetland birds and 5 vagrant species (Engbring et al. 1990). Each State of the FSM has one or more endemic birds. They include the Dusky White-eye of Kosrae and Pohnpei, The Pohnpei Lory, the Pohnpei Greater White-eye, The Pohnpei Flycatcher, The Pohnpei Mountain Starling, the Caroline Islands Ground-Dove on Chuuk and Pohnpei, the Truk Greater White-eye, the Oceanic Flycatcher, the Yap Monarch and the Yap Greater White-eye (Table 14).

Table 13: Categories of birds recorded from the four states of the FSM (after Engbring et al. 1990)

State	Native Land and Wetland Residents	Resident Seabirds	Non-resident Seabirds	Shorebirds, Migrants and Vagrants	Introduced Birds	Total
Kosrae	10	5	9	16	2	42
Pohnpei	20	11	8	20	3	62
Chuuk	17	11	10	33	2	73
Yap	13	6	12	50	3	84

246. A number of Micronesia's birds are declining in numbers and becoming rare. Buden (2000) reports a reduction from the previous survey in total birds per observation station for 18 native resident land birds ranging from 67.4 - 78% in each of 6 major elevation zones. Three species from the FSM are included in the U.S. Endangered species list: the nightingale reed warbler (Chuuk, and Woleai, and Lamotrek atolls in Yap state and Pohnpei), the Pohnpei Greater White-eye endemic to Pohnpei, and the Pohnpei mountain starling. Candidate endangered species include the resident race of Short-eared owl on Pohnpei, the Truk Monarch; the Truk Greater White-eye and the Truk subspecies of the Micronesian Pigeon. The Pohnpei Mountain Starling is on the verge of extinction (Engbring et al. 1990, Buden 1996). Several other species are recently extinct including the Kosrae rail and Kosrae Mountain Starling.

c. Reptiles and Amphibians

247. The least understood group of vertebrates in the FSM are the reptiles and amphibians. There is one introduced amphibian (*Bufo marinus*), and over 27 species of reptiles, all but about two of them being native or possibly introduced with the first human colonists.

248. The reptiles include about 22 species of lizards and at least one snake, the Braminy blind snake *Rhamphotyphlops braminus*. Several species of sea snakes have also been recorded. Among the lizards of the FSM is at least one endemic skink: *Emoia ponapea*, found only in Pohnpei. *Perochirus scutellatus*, the giant Micronesian gecko, thus far is known only on Kapingamarangi and Ulithi atolls, but whether it is endemic to the FSM and overlooked elsewhere, or is a relict species more widely distributed in the past is unknown (Buden 1998).

249. Studies of the reptiles of Micronesia are incomplete, and it is likely that there will be additional records as well as new species. There are also at least four species of sea turtles in the FSM including *Chelonia mydas*, *Eretmocheleys imbricata*, *Dermocheleys coriacea* and *Lepidocheleys olivacea* (Buden and Edward 2001, Falanruw 1975). A few crocodiles have turned up in Yap and Palau in the past.

d. Invertebrates

250. While there has been some work done on the terrestrial invertebrates of the FSM, reports are scattered, and mostly located outside of the FSM so that a review of FSM's invertebrates was beyond the scope of this report. There are indications however that the invertebrate fauna of the FSM is rich and interesting. Recent literature surveys and collections in Pohnpei and Kosrae for example suggest that there are 27 endemic species of land snails and 50 species of ants (Raynor pers. comm.). The forests of Chuuk are host to a giant millipede that seems to occur only in Chuuk and Palau in Micronesia and fireflies (beetles) occur on Yap (Falanruw pers. observ.).

e. Outstanding Features of Each State of the FSM

251. Each state of the FSM has its own outstanding features and biodiversity treasures. Kosrae has magnificent swamp forests dominated by endemic *Terminalia carolinensis* and *Horsfieldia nunu* trees. Pohnpei has the most endemic species in the FSM, Chuuk is also high in endemics. Yap has the most diverse mangroves and agroforests in the FSM. Atolls also have special features such as uninhabited islets with "inland mangroves" (such as *Bruguiera gymnorrhiza*) that apparently make use of the fresh or brackish water lens toward the interior of the islet.

252. Uninhabited islets of atolls are also very important as sites of seabird and sea turtle rookeries and also provide sites for coconut crab larvae to come ashore and develop.

E. Borefield Upgrade of Six Wells along the Road through from Wichap to Epinup

253. Six wells are located along the road through from Wichap to Epinup. At the time of the well construction a 6" PVC water main was laid from the wells to convey water to the Wichap storage tank – with an inlet elevation 189ft amsl. The tank has not been used by CPUC however the condition has been assessed and the tank can be re-used with minor remedial works.

254. The plan is to recommission these bores and store water at the Wichap storage tank. It is also proposed to prospect for new boreholes closer to the Wichap storage tank in order to minimize the energy required to pump water from the wells to the storage tank. Additional borehole drilling and prospecting on the mountain side of the road closer to the center of the aquifer is planned.

255. There may be total replacement with HDPE, after a review of the condition of the water mains installed in the area. In this context, local vegetation clearing will be required for any new drill pads and access tracks, and earthworks for the possible replacement of the 5km pipeline with HDPE. The local vegetation is shown in Figure 23 and consist of gardens of useful trees such as breadfruit (*Artocarpus altilis*), coconut palms (*Cocos nucifera*), mango (*Mangifera indica*) and *Pandanus tectorius* cultivars with scattered shrubs such as the genera *Melastoma, Timonius, Alphitonia, Hedyotis, Ambroma, and Commersonia.*

Figure 23: Proposed Project Area for the Wichap Borefield

[A] Aerial shot of vegetation and housing at the Wichap Borefield; [B] Aerial shot of vegetation and housing around the Wichap borefield; [C] road showing exposed pipeline for the Wichap Borefield [D] the storage tank and associated vegetation for the Wichap borefield

1. Wichen River Catchment

256. The Wichen River originates from a seep several hundred meters inland before flowing to Nomenuk Bay. The proposed raw water intake at the Wichen River is at an elevation of 59 ft or 20m above sea level and is only 500m from the bay. It is noted that the Wichen river downstream of the proposed water intake flows through a well forested catchment with several deep pools in the lower reaches before entering a mangrove dominated ecosystem. It is recognized that Chuuk has a highly modified landscape with many introduced species and widespread damage from World War Two.

257. In Figure 24, the watershed of the Wichen River is largely deforested, though well covered with vegetation. Small pools at the proposed location of the weir can be seen from the drone photos.

258. A small number of houses lie nearby the Wichen River. Local vegetation clearing will be required for the pipeline from the River to the booster station. The local vegetation is shown in (Figure 24) and consist of gardens of useful trees such as breadfruit (*Artocarpus altilis*), coconut palms (*Cocos nucifera*), mango (*Mangifera indica*) and *Pandanus tectorius* cultivars with scattered shrubs such as the genera *Melastoma, Timonius, Alphitonia, Hedyotis, Ambroma, and Commersonia.*

2. Weno-Sapuk Booster

259. To boost water from the new Wichen WTP to Xavier Storage Tank (elevation difference of ~59 ft); this will provide reliable supply to Northern Weno – Sapuk; and Winipis/Nukanan, a booster station will be constructed adjacent to ADB-14 well within the leased land footprint. A new and dedicated pumping main will convey the boosted water to the water tank at Xavier from where all of Sapuk can be commanded. The HDPE pipeline will be 500m long.

260. The ADB-14 well source will also be connected to the filing line in order to supplement flow to the tank in the event that the Wichen source is unable to provide all the water needed. Consideration will also be given to provision of in-line chlorination at the booster station to ensure sufficient residual chlorine in the supply through storage to distribution.

261. A pipeline easement from the Booster station through Xavier High School to Xavier tank is required and local vegetation clearing will be required for the new 500m pipeline. The local vegetation is shown in Figure 25 and consist of gardens of useful trees such as breadfruit (*Artocarpus altilis*), coconut palms (*Cocos nucifera*), mango (*Mangifera indica*) and *Pandanus tectorius* cultivars with scattered shrubs such as the genera *Melastoma*, *Timonius*, *Alphitonia*, *Hedyotis*, *Ambroma*, and *Commersonia.*

3. Link from Tunnuk to Mechitiw across the Causeway

262. A direct link from Tunnuk to Mechitiw across the causeway will allow Wichen WTP water to be fed back towards Mechitiw and Ira. The construction of this pipeline will be on the causeway and will require the placement of the pipeline aboveground adjacent to the roadway. There will be minor clearing and the environmental impact will be minimal.

4. Construction of Transmission Line Linking the Pou WTP Storage Reservoir to the Pink Apartment Storage Reservoir

263. The route of the construction of a transmission line linking the Pou WTP storage reservoir to the Pink Apartment storage reservoir is shown in Figure 12. The Pink Apartment storage tank volume is 7.5 Ml (this is approximately 15% larger than the future demand requirement for the whole of Weno Island). The Pink Apartment tank is currently much under-utilized.

264. Current filling is through the water supply network and requires a significant amount of operational input.

Figure 24: [A] The course of the Wichen River downstream;[B] small pool fast flowing pools in the Wichen River; [C] small pool fast flowing pools in the Wichen River and the surrounding vegetation; and[D] the upstream deforested catchment of the Wichen River

265. The pipeline will be i.d. 150mm and length 500m and will be capable of transferring 2.25 Ml/d (26l/s) with a minimum residual head at the inlet to the Pink Apartment tank of 2m.

266. Local vegetation clearing will be required for the new 500m pipeline. The local vegetation consists of gardens of useful trees such as breadfruit (*Artocarpus altilis*), coconut palms (*Cocos nucifera*), mango (*Mangifera indica*) and *Pandanus tectorius* cultivars with scattered shrubs, such as the genera *Melastoma*, *Timonius*, *Alphitonia*, *Hedyotis*, *Ambroma*, and *Commersonia.*

Figure 25:Proposed Project Area for the Weno-Sapuk Booster

Notes: [A] Aerial shot of vegetation around the Weno -Sapuk route ; [B] Aerial shot of the vegetation up to the Xavier Storage Tank ; [C] The Xavier Storage Tank and surrounding vegetation [D] The booster station and associated vegetation.

F. Protected Areas

267. There are no protected reserve areas in Chuuk.

G. Environmental Values for the Construction and Operation of Water Treatment Plan and Pipeline Routes and Borefield Upgrade Program

268. The major environmental values for the proposed WTP site, pipeline construction for the various sub projects and the borehole upgrade are the terrestrial vegetation communities and the urban and peri urban communities. At present, the terrestrial environmental values are heavily impacted as the native terrestrial vegetation across the Island of Chuuk has largely been displaced

by subsistence farming with the remaining existing vegetation dominated by extensive local and introduced grasslands.

269. Downstream of the Wichen River site, the environmental values of the receiving waters and riparian vegetation are both heavily impacted by peri-urban development and subsidence farming. The environmental values of all of the pipeline routes are primarily in heavily modified terrestrial vegetation communities which are dominated by existing crops and extensive native and introduced grasslands.

270. The peri-urban and urban communities during the construction of the pipelines and upgrade of the bore fields may be affected by noise, dust, and vibration. Management of these impacts by the contractor will minimize impacts on these environmental values on affected households.

H. Socioeconomic Resources

1. Sociocultural Context

271. The social assessment that follows is an overview derived from secondary sources[23] to profile the beneficiary population, inform a framework for stakeholder consultation, for incorporating socioeconomic information for the ESMP and subsequent environmental planning during the designed stage of selected activities.

272. **Population.** Prior to European contact, the present-day Federated States of Micronesia were part of a group of islands whose pan-Micronesian subsistence and seafaring populations were in sporadic contact through circular migration to trade with each other, participate in ceremonies, intermarry, give and receive mutual support in times of natural and other disasters. The indigenous people of the Federated States of Micronesia, who constitute most of the population, are ethnically Micronesian, and speak distinct dialects of Austronesian languages that are part of the Malayo-Polynesian family.

273. Though there is broad cultural similarity amongst the States, in the relative historical isolation of the islands, different customs, local practices and strategic interests have developed according to island, village, class, kinship and religious affiliations. These, rather than ethnicity or indigenous status per se, are generally the basis of differences within and between States. Most of the population is now Christian, with only 4.6% either professing another or no religion.

274. **Social organization.** Urban population in 2010 accounted for only 22% of the total in the Federated States of Micronesia. The family and village are still central to social organization and identity. Especially on the high islands, society is stratified by descent group affiliation, title, age, and land relationships, which are the traditional basis of wealth and the conspicuous generosity that is the mark of a leader. However, disease and depopulation in the colonial period eroded the powerbase of traditional leaders, which depended on a large labor-force to work lands. The coral atolls are generally more egalitarian, and place more emphasis on specialized knowledge and achievement, though age and gender are still important social markers. Churches are now focal

[23] The most recent complete published body of census-based statistics derives from the 2000 census, reported in 2006; see http://www.spc.int/prism/country/fm/stats/. This data is used where analysis of 2010 census data is not yet to hand. Preliminary results of the 2010 Census of Population and Housing are available at the Office of Statistics, Budget & Economic Management, Overseas Development Assistance and Compact Management, http://www.sboc.fm. Some data used is from the Sample-based 2005 Household Income and Expenditure Survey (HIES).

points of community interaction, though especially in Yap, men's houses that were formerly the centers of village power are maintained as meeting places and uphold traditional arts and culture.

275. **Land.** In pre-colonial times, land was generally plentiful, though with higher population densities in Chuuk than in the other States. Since the dramatic decline in population due to post-contact epidemics, and the continuing overall trend to decline due to later marriage, lower birthrates and migration, population pressure has not been a large issue in the country, though ownership, use, control and inheritance of particular plots may still be locally sensitive.

276. In Chuuk, most land and aquatic areas are privately owned and acquired through inheritance, gift or, recently, by purchase. In all states, land cannot be sold to non-citizens of the FSM, thus these land and aquatic ownership patterns greatly influence the strategies and actions required to sustainably manage the natural resources of the nation.

277. Some States have made a concerted effort to have land titles registered, and to declare unregistered land as Government land. Custom mechanisms for ascertaining land rights have played an important part in this process. In some States, Government land may be designated as Homestead land for eligible clans and individuals and could be legally allocated as replacement land if eminent domain powers were exercised in downstream projects.

278. **Household and housing characteristics.** Most households comprise nuclear or extended families, with around one quarter providing a home for a parent or another relative. In 2000, average household size was 6.7, with a tendency to smaller households on Yap and larger in Chuuk. Female headed households accounted overall for 18% of the total, though 27% in Yap.

279. Most homes in 2000 were single detached dwelling units. A further 9% of dwellings had an attached unit; only 2% were in apartment blocks. Half had piped water and electricity, but only a quarter had any form of sanitary waste disposal, except in Kosrae, where over 70% enjoyed this facility. By 2010, four out of five had an improved drinking water supply, and three out of five an improved toilet facility, and household size had dropped to 6.1, an indication of the trend to depopulation.

280. **Gender and social status.** In 2010 the sex ratio was 103 males to 100 females. Micronesian societies are matrilineal, and inheritance of land and other assets is traditionally through women. However, the senior male of the lineage, often a woman's older brother, is generally the manager of landed estate, and males exercise most political and economic power. The senior male decides on inheritance, which may be exercised in favor of matrilateral or patrilateral kin, within or outside the village.

281. This ambilateral allocation of inheritance by family heads is a potential source of disagreement about land. Partly for this reason, the traditions of village exogamy and cross-cousin marriage, which tend to consolidate alliances and interests in clan land, are still a cultural preference in many areas. Women traditionally defer to men, and the sexes do not generally mix freely in social situations.

282. In the subsistence sector, traditional division of labor assigns domestic chores, and the care of infants and the elderly to women and children. Women plant, weed and harvest subsistence produce, weave mats and tend livestock while men perform the heavy agricultural labor tasks such as construction, ground-breaking, ditching and fencing. Generally, women fish and gather in the lagoons, while men fish outside reefs. In the non-subsistence economy, both sexes have new opportunities to which education and language skills are important enablers of access.

283. The Constitutions of the nation and of each individual State specifically exclude discrimination or exclusion on grounds of sex, language, national origin, ancestry, race, in most cases social status, religion and in one case dialect. FSM's accession to the Convention for the Elimination of all forms of Discrimination Against Women (CEDAW) in September 2004 is a reaffirmation of its commitment to the principle of gender equality.

284. Recent social assessments[24] found approximately 20% of households in FSM are led by females and female-led households have a lower annual average income than male-led households in Chuuk, Pohnpei and Yap. The latest available data (2013) found female-led households to have a 9% lower income than male-led households. The income gap is particularly significant in Chuuk (40% lower for female-led than for male-led households). This is in the context of Chuuk already having significantly lower income per household than other States. In Pohnpei and Yap the income gap is 7% and 10%, respectively.

285. In Kosrae, the total income of female-led households is higher than for male-led households, but by only 2%. This may reflect a higher proportion of households with male members working outside FSM.

2. Education

286. Literacy levels are generally high. Over 95% of those 15-24 or older are literate, with women's rates at 96% slightly higher than men at 94.2% in 2000. Overall, girls have higher participation rates than boys at both elementary and high school levels, though Yap, the most traditional State, features lower high school enrolment rates for girls than boys. In 2000, 11.7% of persons over 25 were college graduates. This rose to 11.8% in 2010.

287. Due to the multiplicity of indigenous languages and dialects, which though related, are not always easily mutually intelligible, English has been adopted as the sole official language, and is the medium of instruction in high schools and tertiary institutions. Good English language ability is an advantage in the employment market. In 2010, 75.9% over the age of five were literate in English, with higher levels amongst the young and those of economically active age.

3. Employment and Incomes

288. Overall, 78% of the population is rural, and subsistence farming and fishing are still the main means of livelihood. Almost half the women and two thirds of the men of economically active age participate in the labor force. One third of working men, and more than half working women (56%) are in unpaid occupations. The 2010 unemployment rate for men is 15.5%, and 17% for women. While most households engage in agricultural production and fishing (94.6% and 70.7% respectively in 2010), only around 1% produces exclusively for sale. Around 10% sells some of their production.

289. Of those aged 15 or more with cash income in 2000, 43% received wages or salaries, 21% had income from their own business, 41% received remittance income and 7% received social security or other income from Government. Public administration, education, health, social work and utilities supply accounted for just over half of paid jobs. The only other significant sector was wholesale and retail repair and supply of vehicles and household goods, which employed 13% of the work force.

[24] Castalia. 2018. Energy Master Plans for the Federated States of Micronesia – Social Assessment Report.

290. Average household income in 2005 was $13,421. Female headed households earned over $2,000 less than the average, while foreigners (non-FSM residents) earned almost $7,000 more than the average. These figures include cash and non-cash income, so are not necessarily a good indication of purchasing power for cash goods. Per capita GDP on a Purchasing Power Parity basis was estimated at US$3,165 in 2012.[25]

4. Socioeconomic Survey 2020 – Chuuk

291. This survey was conducted on all 11 villages on Weno over a two-week period in June 2020. This socioeconomic survey on water supply and sanitation infrastructure is a component of a larger task to support CPUC's feasibility plan to expand and improve water and sewerage services to the population on Weno Island. This survey identified and determined the social, gender, and cultural factors as well as gaps in accessing safe water and sanitation to offer recommendations for improving water and sewerage services.

292. Furthermore, the household survey engaged with communities to raise public awareness on water, safe sanitation, and hygiene practices.

293. The household survey has 96 questions divided into 8 sections/themes:
- (i) Personal information of respondent,
- (ii) Information about household,
- (iii) Information on Water Source for the Household,
- (iv) Sanitation/Hygiene facilities and practices,
- (v) Access to water and sewage utilities and services,
- (vi) Maintenance of Water and Sanitation,
- (vii) Inventory of Land and Property, and
- (viii) Social Information about household.

5. Methodology

294. Water and Sanitation project teams consisted of 1 advisor, 1 project manager, 3 supervisors, and 44 surveyors. The advisor and project manager worked closely with the ADB team and CPUC in establishing the 96 questions.

295. There was a total of 44 surveyors who worked in teams of two, so a total of 22 pairs. The surveyors were supervised by three supervisors: one for the villages of Sapuk, Penia, Peniesene, Tunnuk and Mechitw; one managed Iras, Nepukos and Mwan, and the other coordinates Neauo, Wichap and Epinup. The activity for household survey started on Wednesday, 3 June 2020 and was concluded on 26 June 2020.

296. Surveyors and supervisors were trained on the use of the Kobo Toolbox App used for the surveys. Surveys were carried out both on paper and on phone per the Kobo Toolbox App.

297. Surveys covered 1524 households on Weno Island.

6. Results and Discussion of Survey

[25] Castalia. 2018. Energy Master Plans for the Federated States of Micronesia – Social Assessment Report.

298. **Personal information of respondents.** For those who participated in the household survey, 52% were male and 47% were female, the median average age of respondents was 46 (Figure 26).

Figure 26: Sex of the Respondents

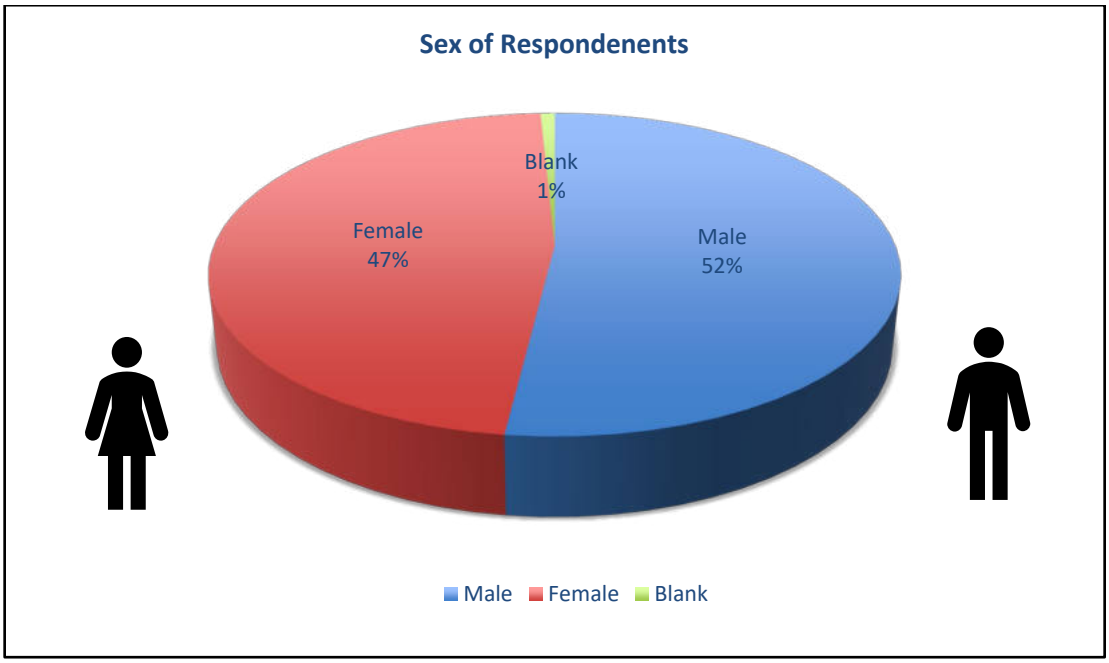
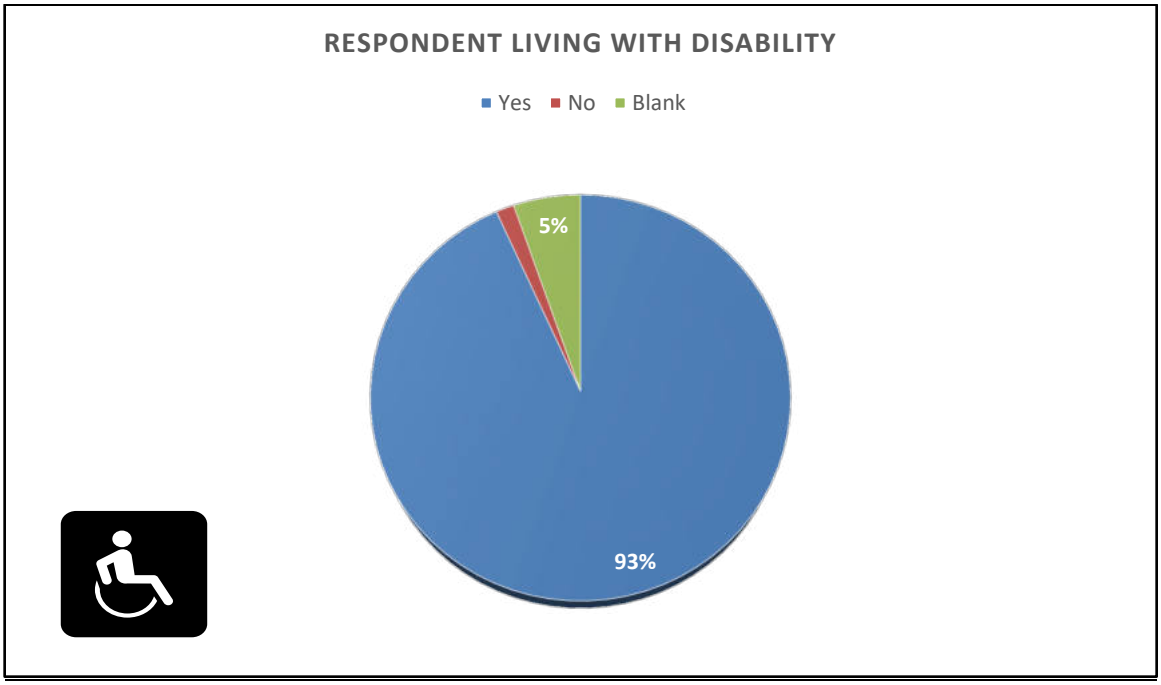


Figure 27: Number of Respondents Living with a Disability



299. Of the respondents, only 5% reported to have a disability, 93% reported no disability and 5% with partial disability (Figure 27). The majority of the respondents were married, making up 69%, 15% are reported to be single, 12% to be widowed and 4% have been divorced or separated (Figure 28).

Figure 28: Marital Status of Respondents

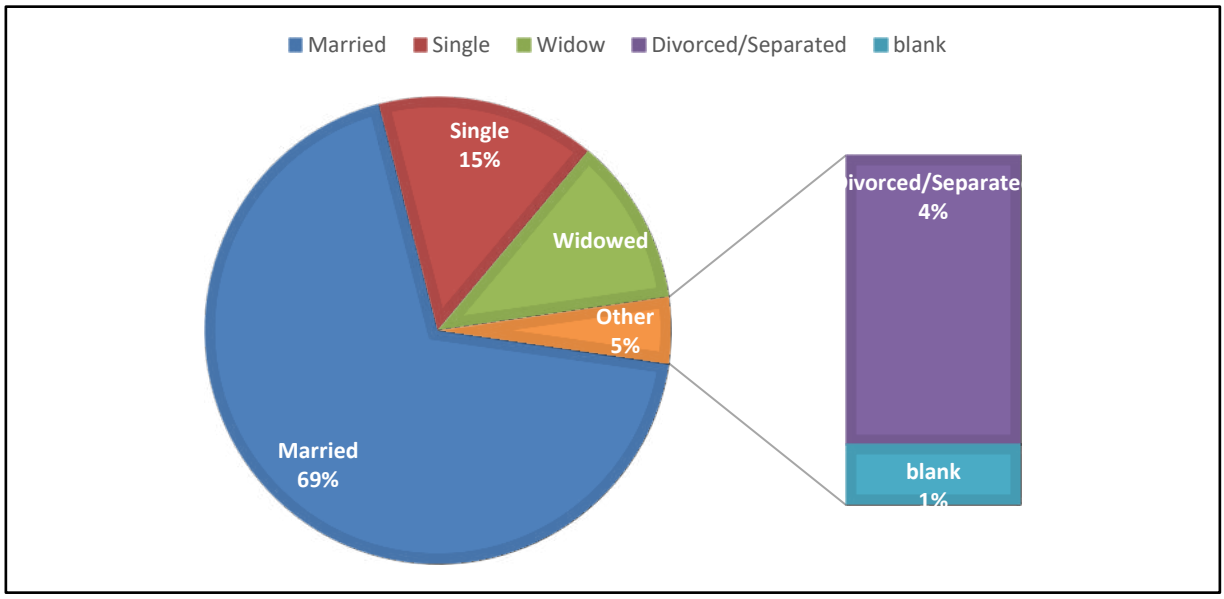
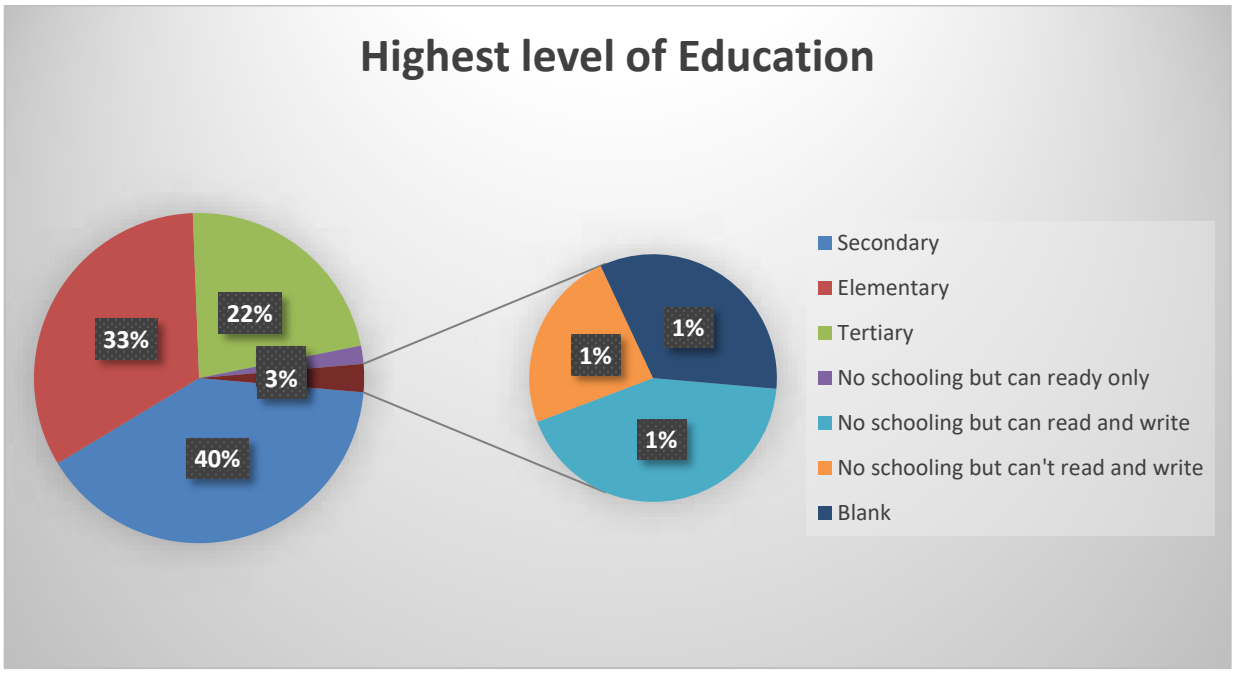


Figure 29: Education Level of Respondents



300. Most respondents report to have completed education with 40% completing secondary level, 22% reported to have finished university/college level or some vocational training. About 2% have no schooling with some and limited reading and writing skills (Figure 29).

301. **Information about households.** For the households 74% head of households are male, 24% are female, the rest were listed as other gender or left blank. Less than 10% are sponsored members of the households (Figure 30). For the households, only 46% households reported to make $200 and below per payday. A ratio of 4 males to 1 female in the household bring in the income (Figure 31). The main source of income is business and government employment with remittances as the secondary household income for majority of the households (Figure 32).

Figure 30:Sex of Head of Households

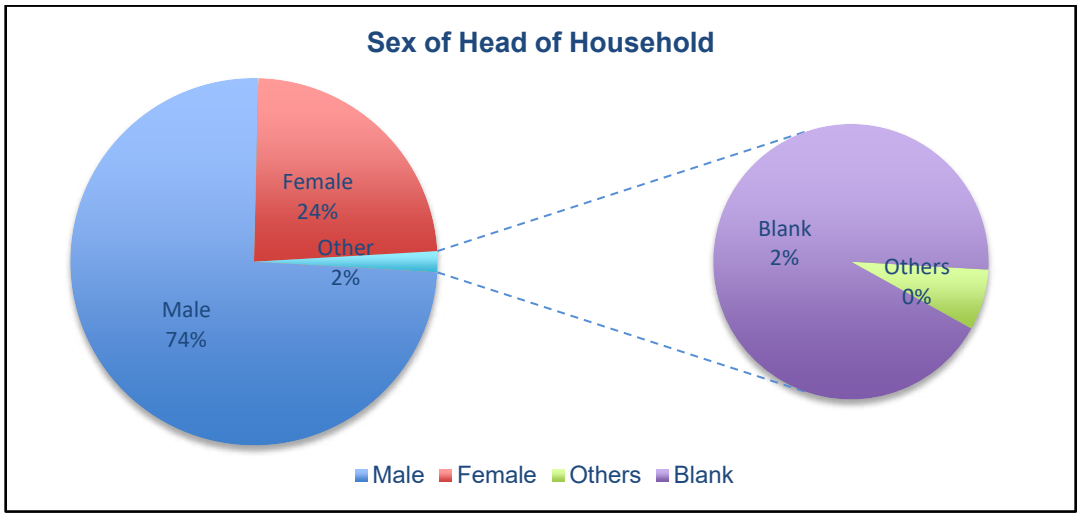


Figure 31: Earning Capacity of Households

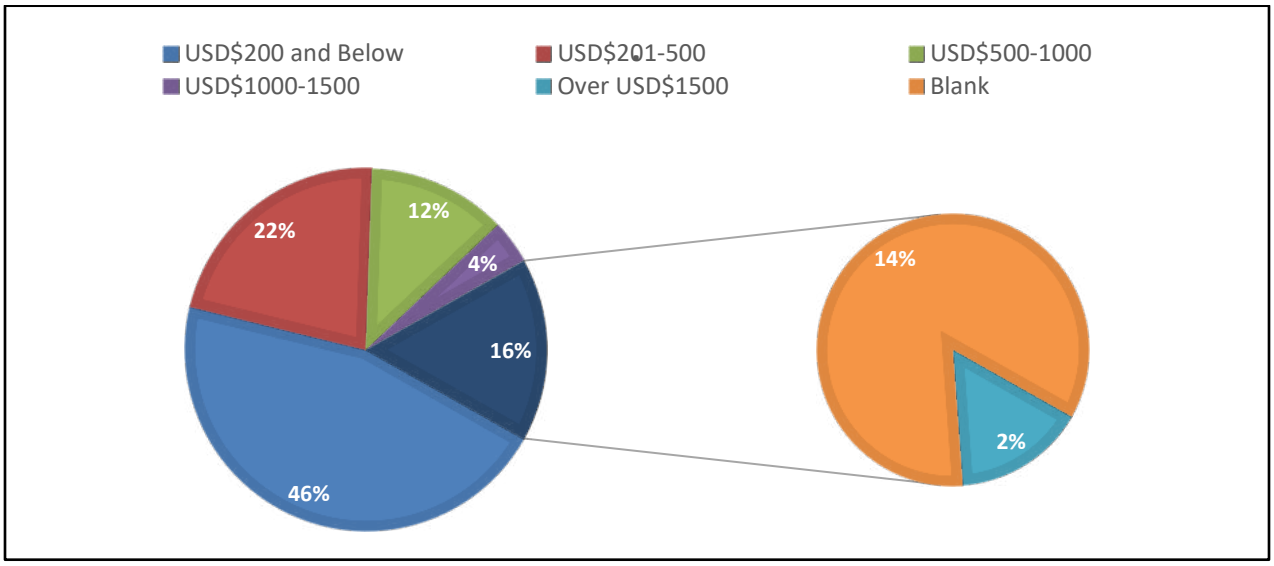
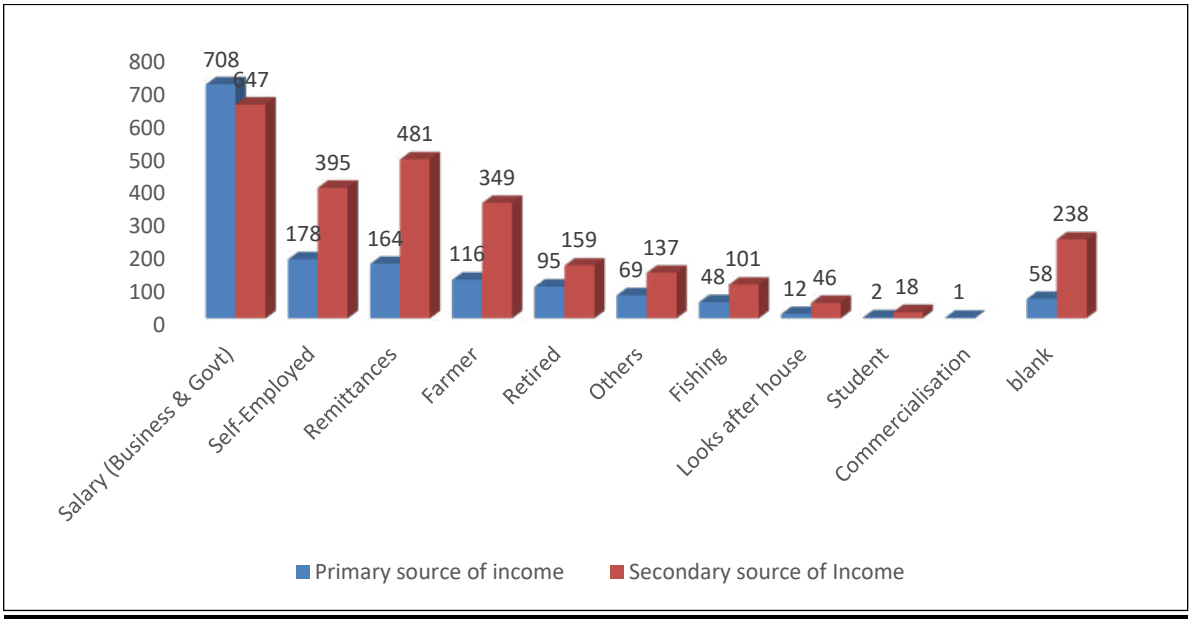


Figure 32: Source of Income for Each Household



302. **Source of household water.** The prime source of water for general household use and for water and drinking comes from water tank or rain catchment. Only 21% of household rely upon CPUC water as their main source of household water. For drinking and cooking, only 4% of households use CPUC water for that purpose. Interestingly, most households reported that they have access to safe drinking water without relying on CPUC. The number one use for household water is bathing follows by cooking and washing clothes (Figure 33).

303. A total of 357 households reported to use 5 gallons for cooking and drinking and of 303 household reported to using 10 gallons for drinking and cooking per week. Gallons of water mostly ranging from 0 gallon to 20 gallons per week. Most households reported they obtain water for cooking and drinking from water tanks from rain catchment. Deep well and rain catchment are the primary sources for bathing. For washing clothes, most households rely on deep well water.

304. Even with the reliance on rainwater catchment, 78% of households reported to have access to safe drinking water (Figure 34). A total of 365 households reported spending nothing per month on managing general water use (Figure 35).

305. About 85% of households are willing to pay for $10 a month for a clean water supply and connections with CPUC, while 55% of households are willing to pay for $20/month for clean water from CPUC to be connected to their homes (Figure 36). Around 42% households are willing to pay $25 as one-off charge to be connected to CPUC's water system, while only 4% are willing to pay $50 for installation of water (Figure 37).

Figure 33: Sources of Household Water

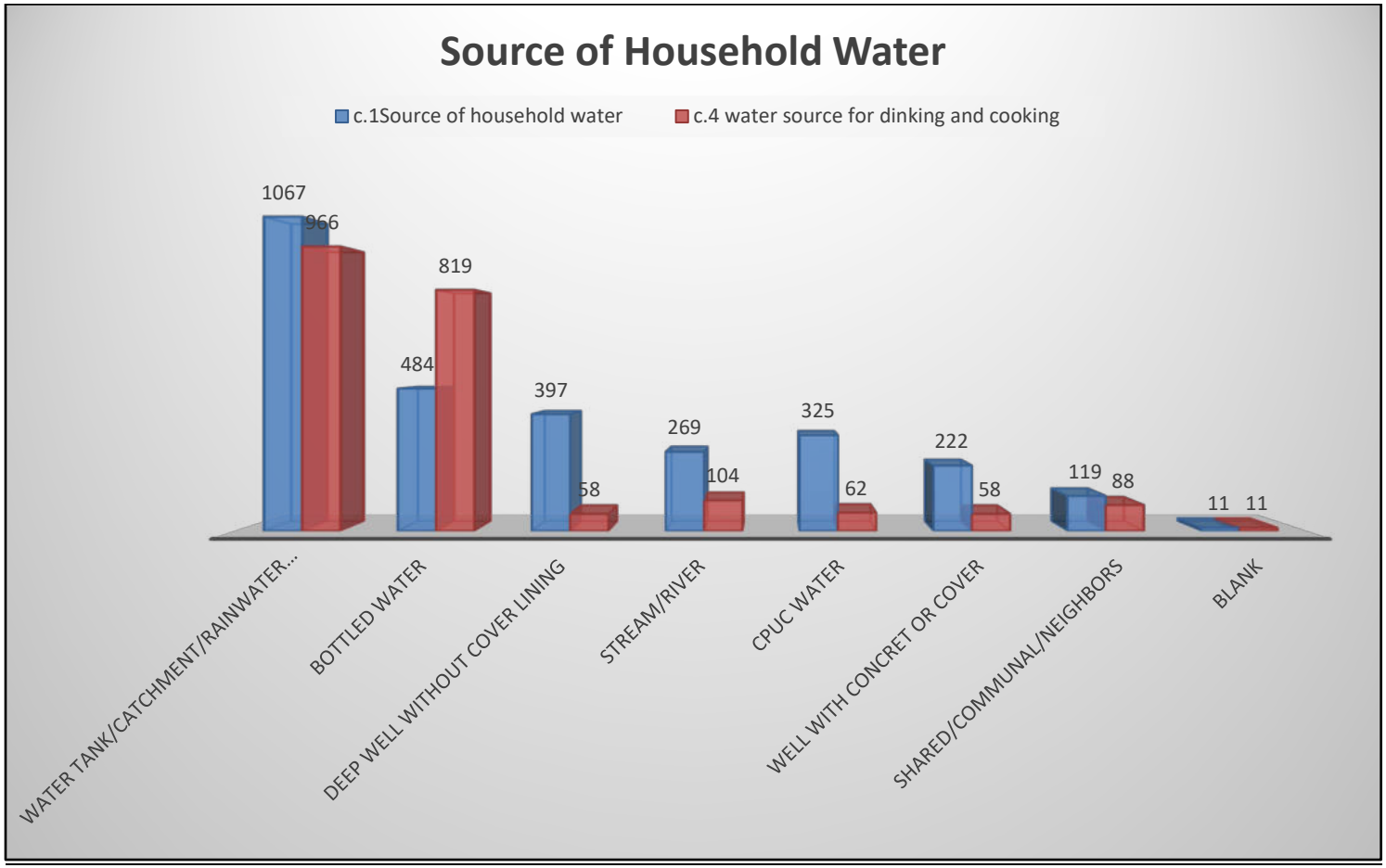


Figure 34: Access to Safe Drinking Water for Each Household

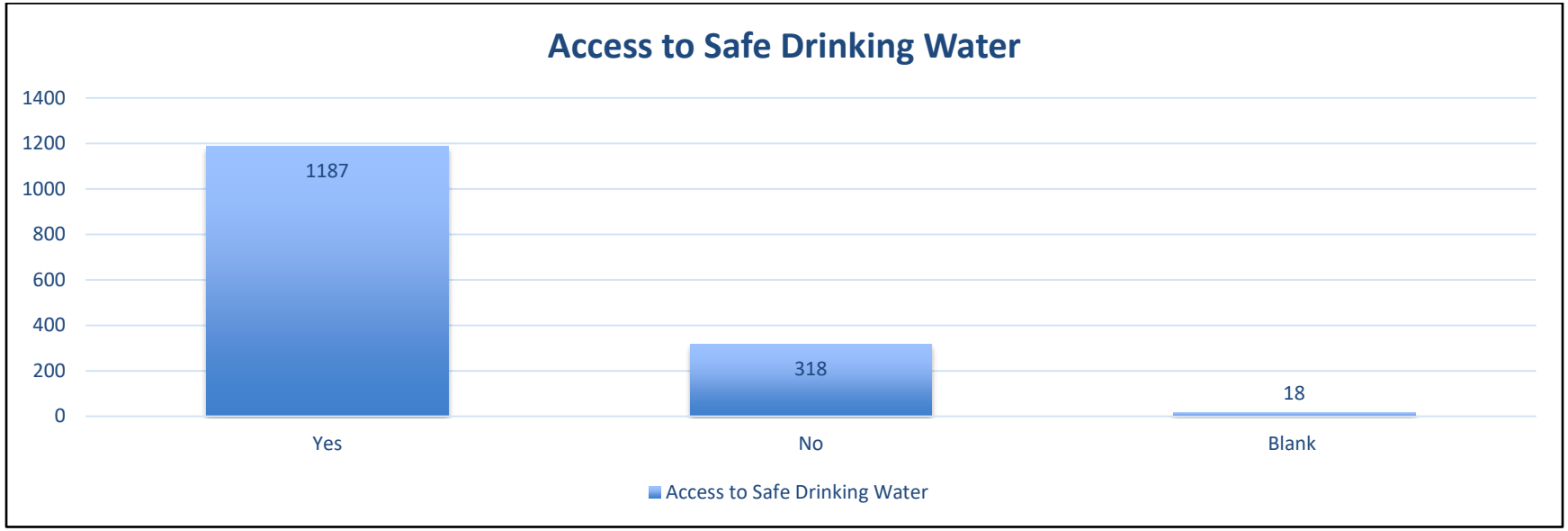
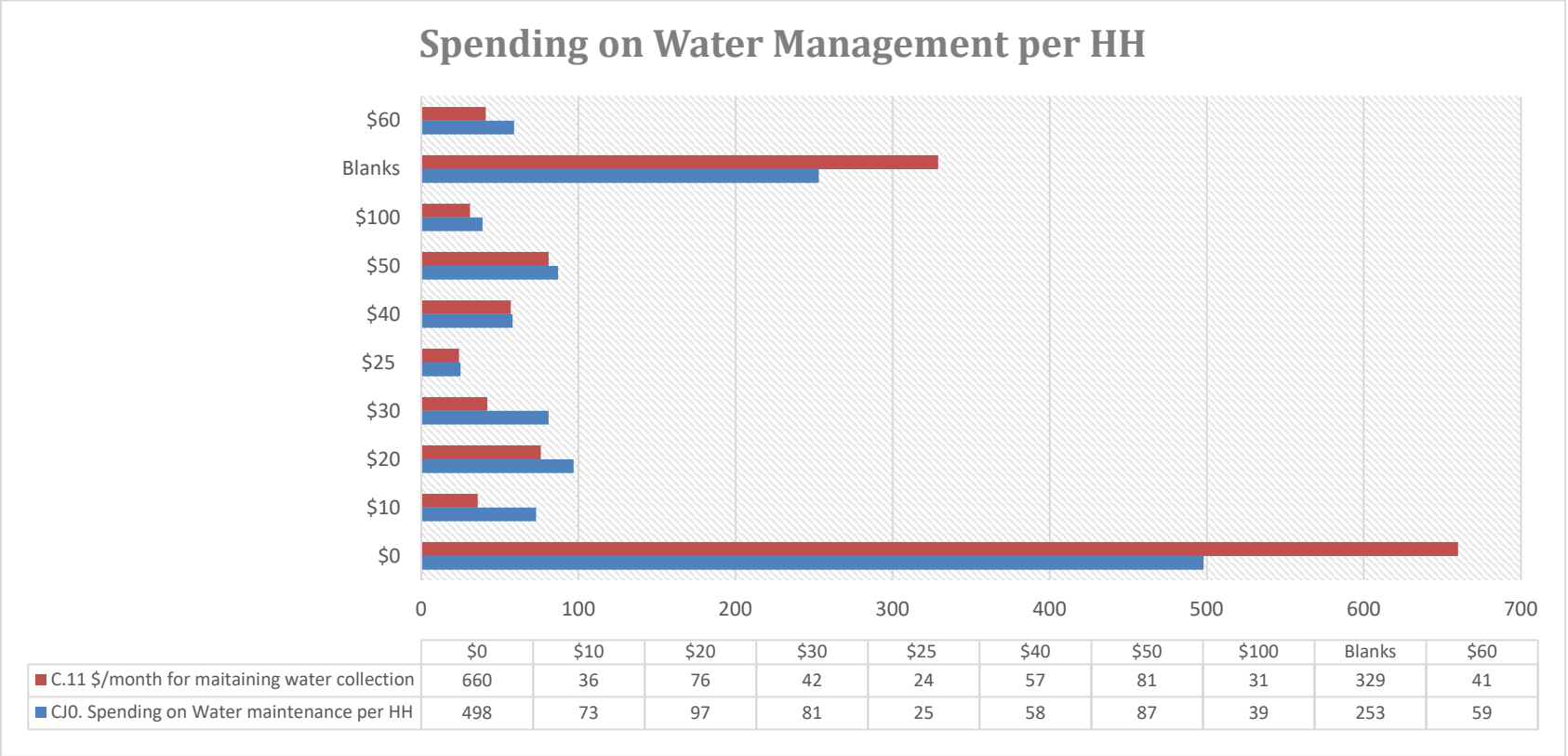


Figure 35:Spending on Water per Household



	$0	$10	$20	$30	$25	$40	$50	$100	Blanks	$60
C.11 $/month for maitaining water collection	660	36	76	42	24	57	81	31	329	41
CJ0. Spending on Water maintenance per HH	498	73	97	81	25	58	87	39	253	59

Figure 36: Willingness to Spend per Household

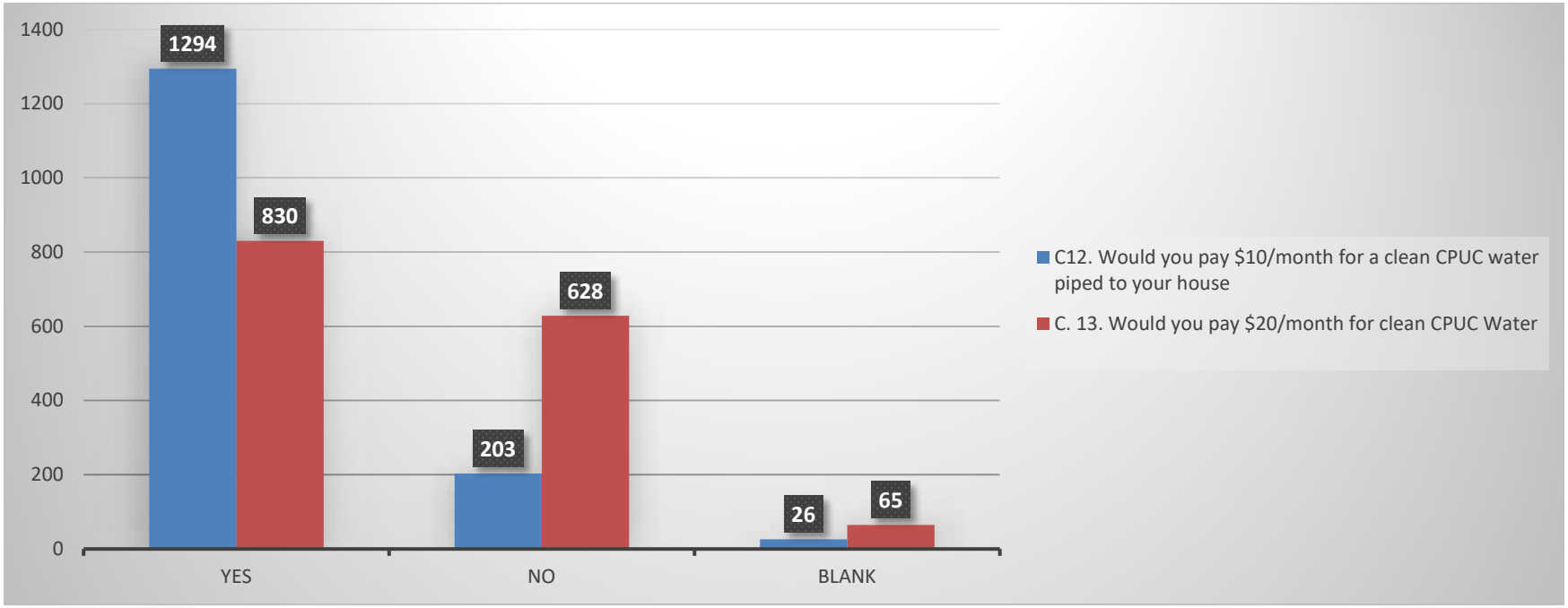
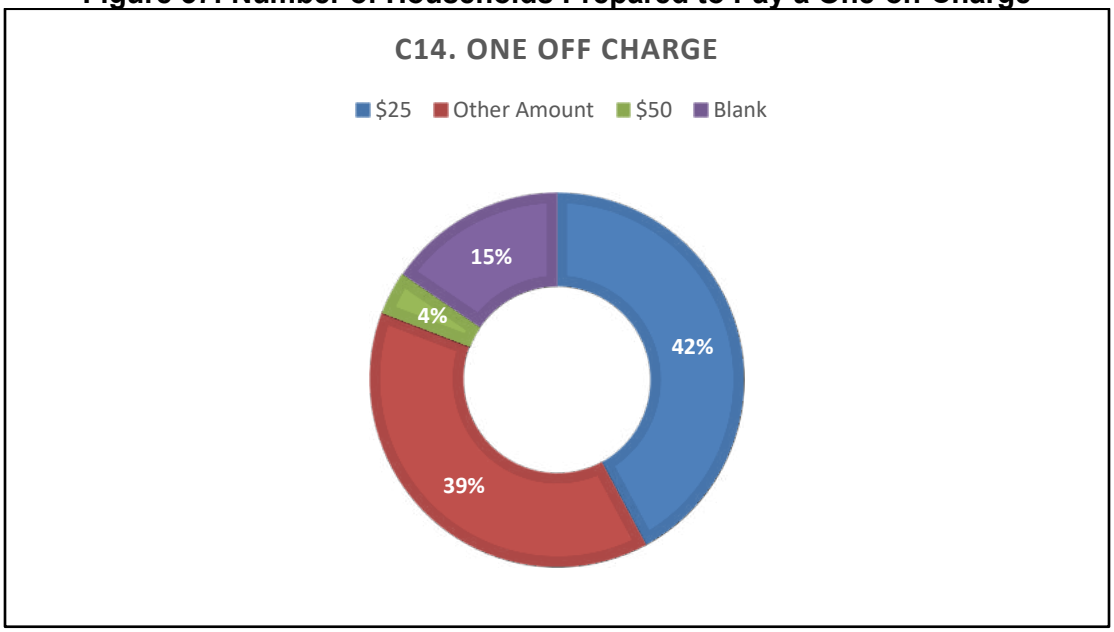


Figure 37: Number of Households Prepared to Pay a One-off Charge



306. **Access to sanitation facilities.** A total of 77% households have access to sanitation facilities (Figure 38). Around 42% of households reported to having indoor flush toiled connected to their own septic tank, 22% households are connected to CPUCs sewage system. Another 18% reported to use outdoor benjo or the basic pit latrine. Graph below shows other types of sanitation facilities used by different households on Weno (Figure 39).

Figure 38: Number of Households with Access to Sanitation

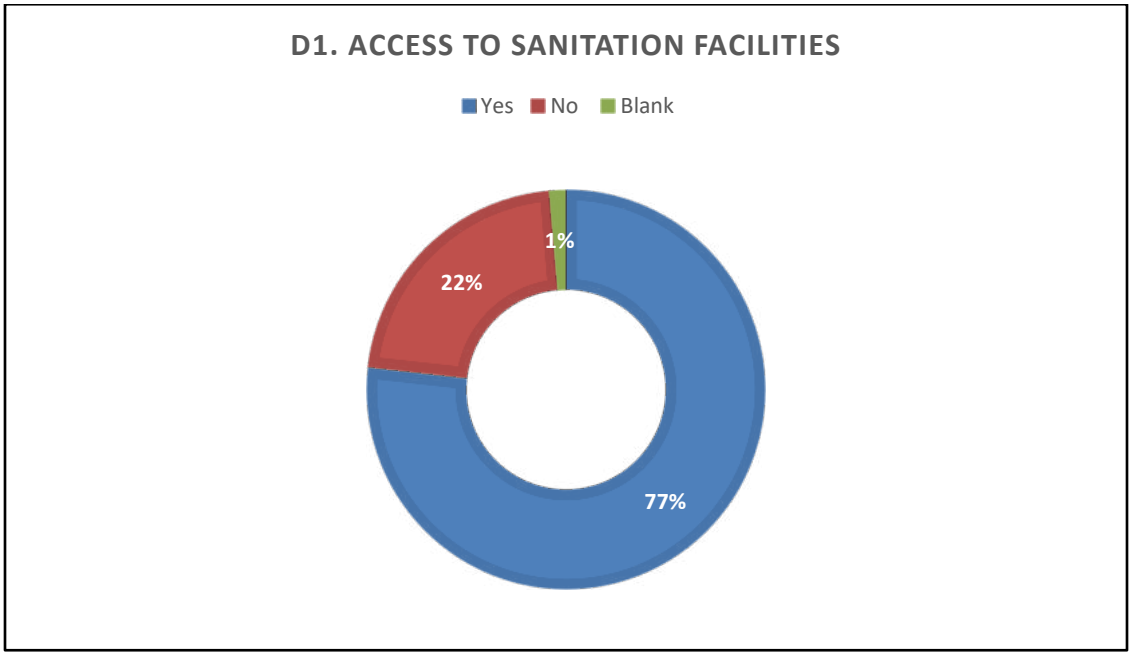
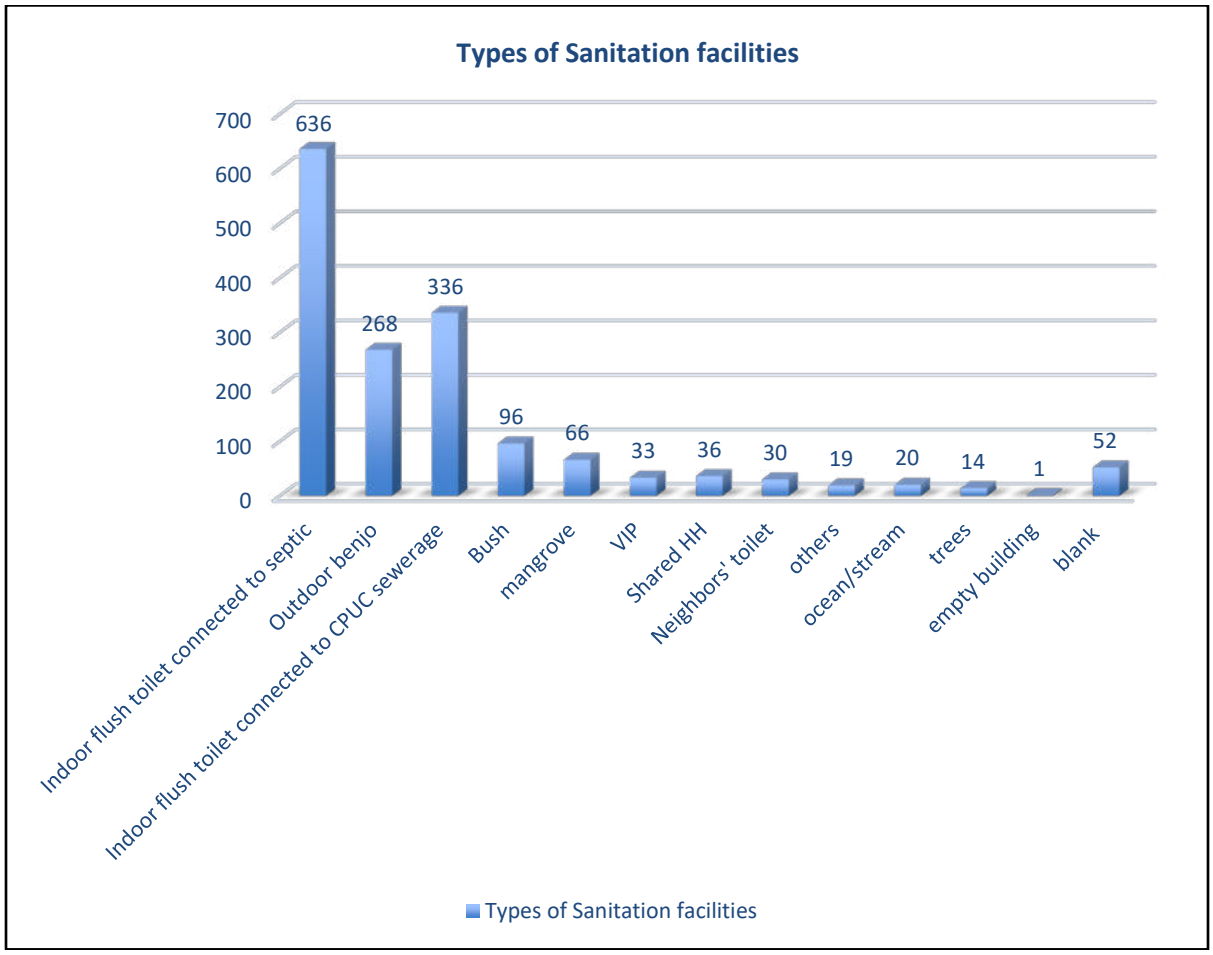


Figure 39: Type of Sanitation Available at Each Household



307. **Access to water and sewage facilities.** Not many households on Weno are connected to CPUCs water system. This survey shows that only 19% are connected to CPUC's water system, while 84% of households are not connected. Among the households, only 22% households pay for water while, 67% of homes are not paying for water (Figure 40).

308. Around 51% households that pay for water reported to spend between $10-$30 per month, 17% spent between $10-$30 and the other 10% spent less than $10 (Figure 41). For payment of water, surveys reported that 27% of fathers (male) compared to 14% mothers who pay for water. Furthermore, household also reported that 3% of their sons and 3% of their daughters pay for water as well, around 903 surveys were left blank.

309. As for sanitation facilities, only 20% are connected to public sewage and 73% are not connected to the sewerage system. Within the households 22% of the fathers of the households are responsible for paying sewer services while only 9% of mothers, pay for sewage system. About 5% households are connected to someone else's sewerage system. Surveys further reported that only 15% households pay for their sewage and 61% of households are not paying for sewage (Figure 42).

Figure 40: Access to Water on Weno

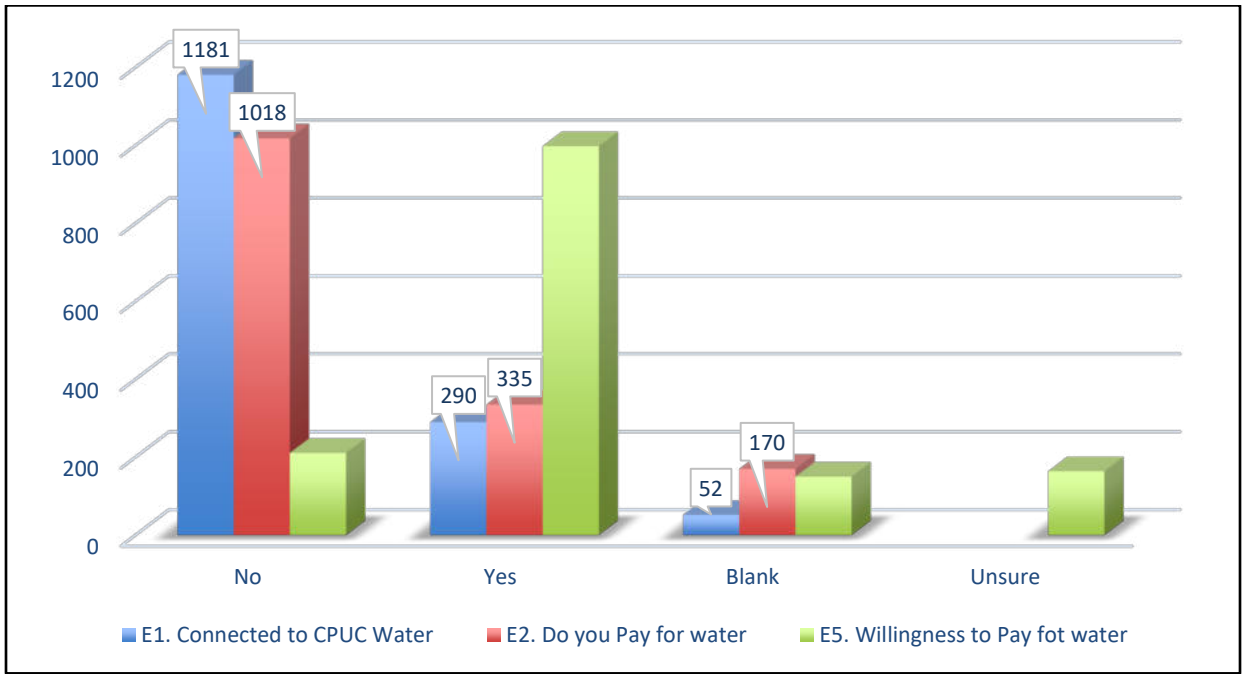


Figure 41:Spending on Water per Month for Each Household

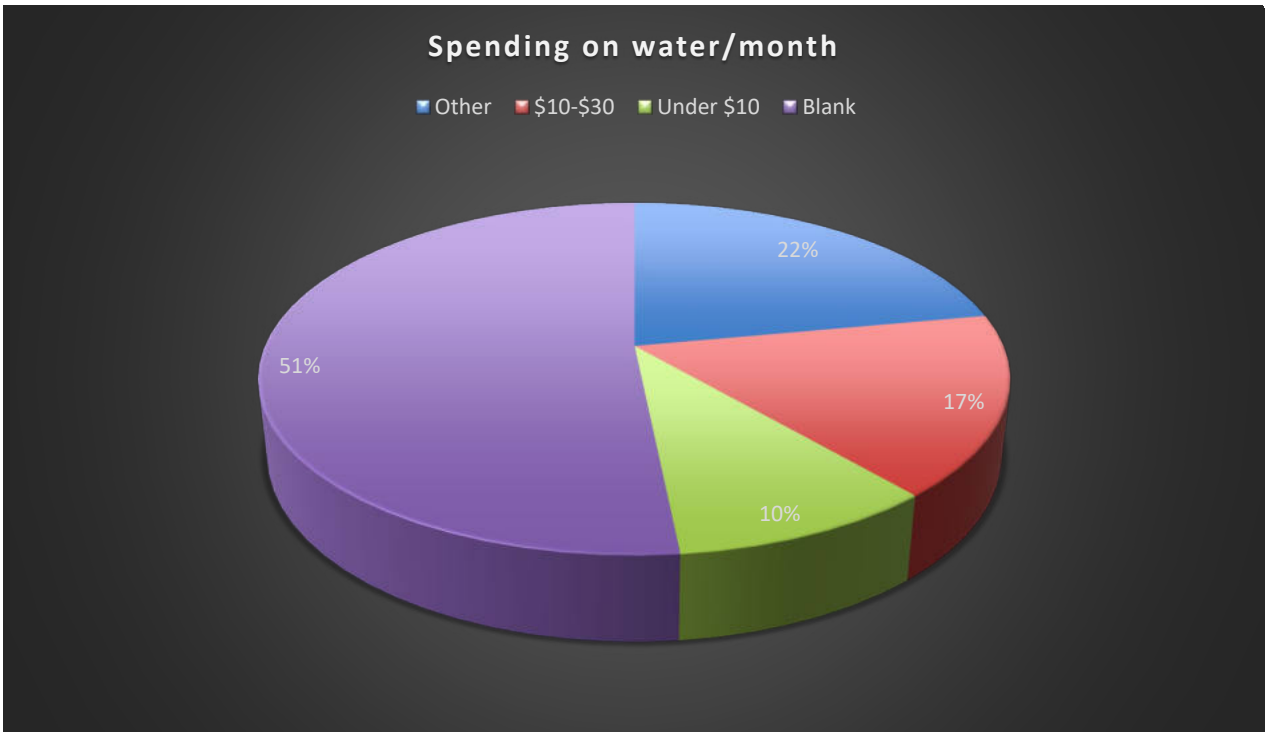
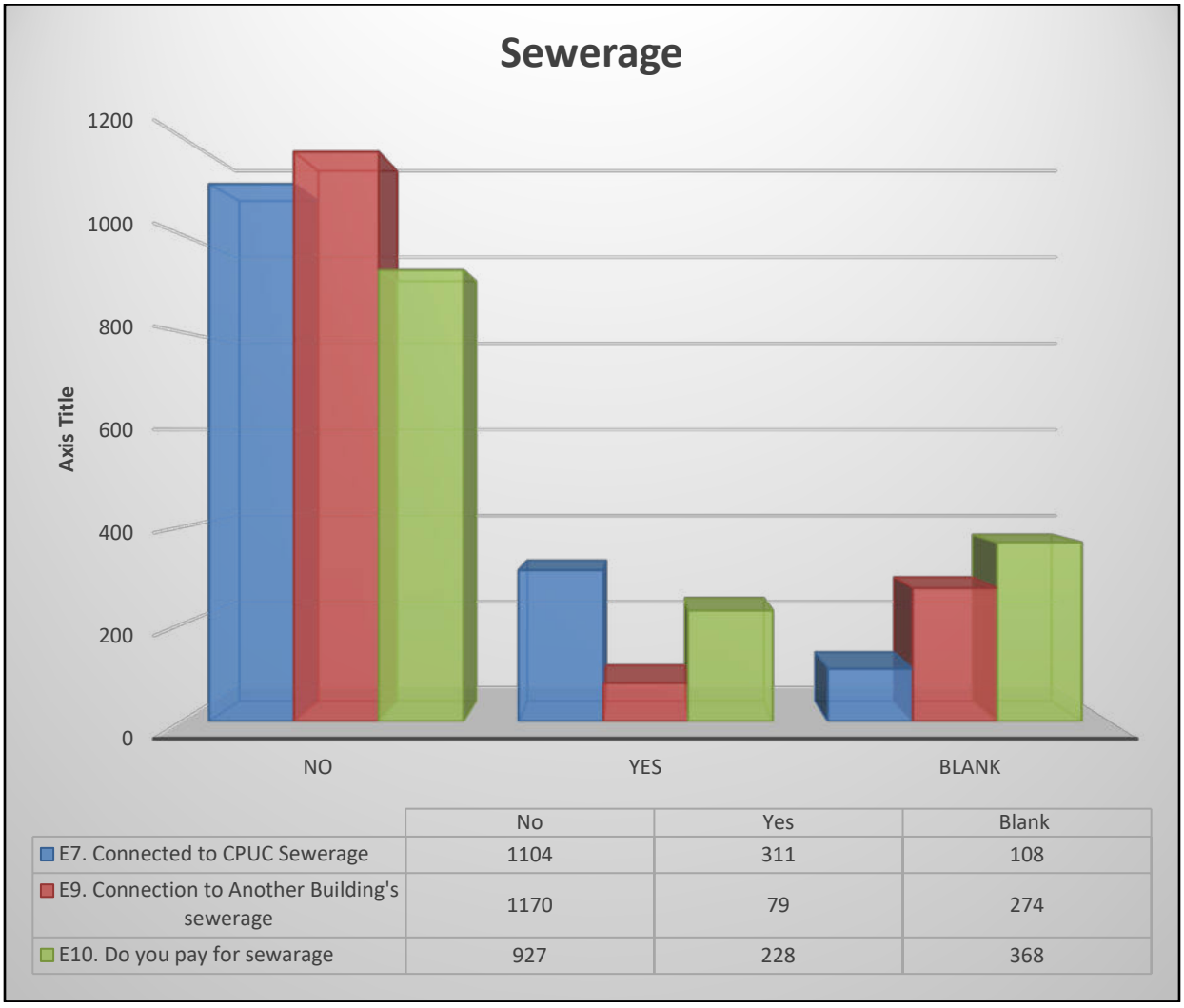


Figure 42: Household Sewerage Connections



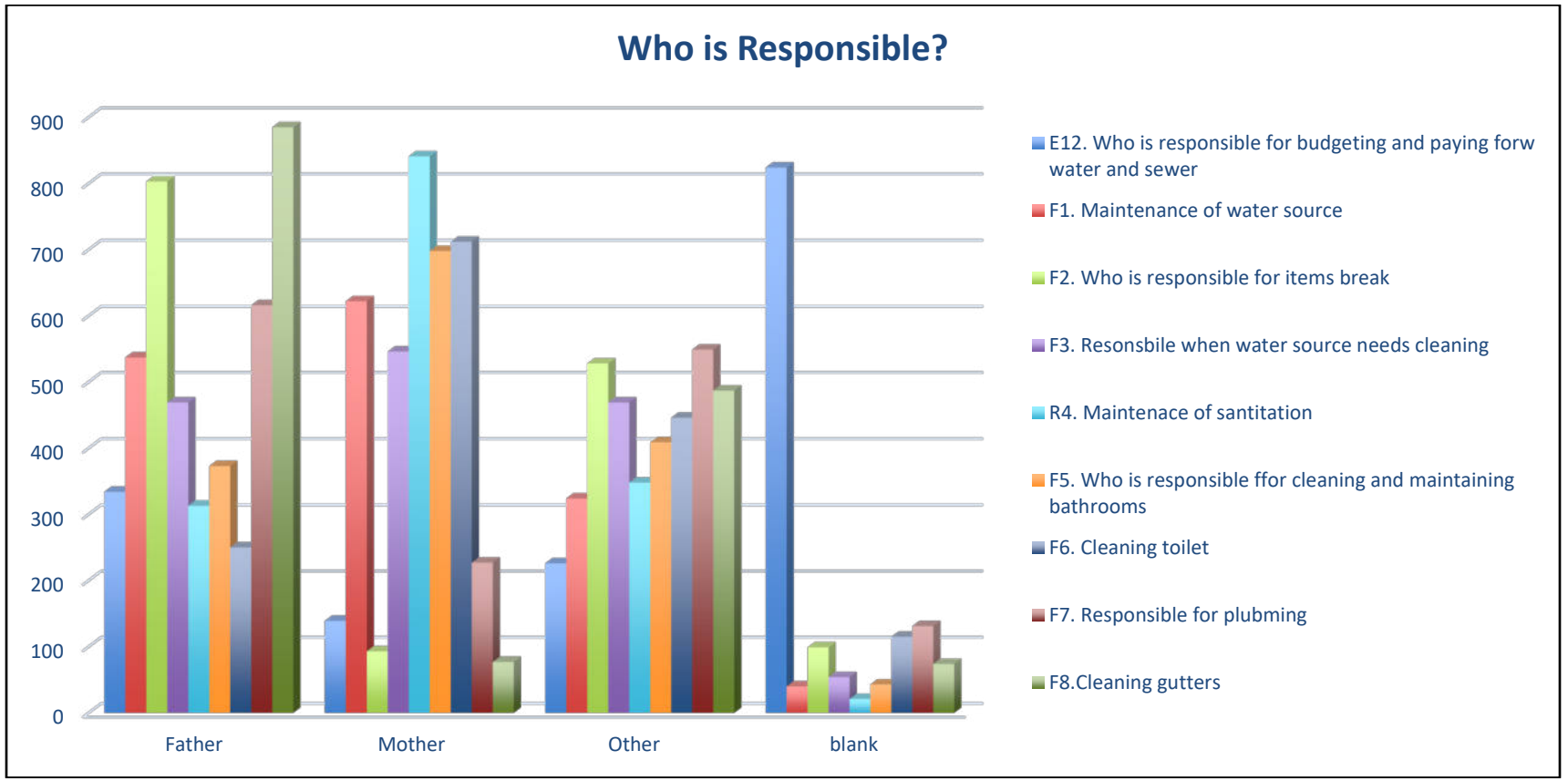
	No	Yes	Blank
E7. Connected to CPUC Sewerage	1104	311	108
E9. Connection to Another Building's sewerage	1170	79	274
E10. Do you pay for sewarage	927	228	368

310. **Maintenance of water and sanitation.** For most households, 41% of the mothers are responsible for maintaining their water source while 25% is maintained by the fathers. However, when water infrastructure needs fixing, 53% of fathers are responsible, while only 6% of the mothers and 35% of other family members undertake the fixing of the structures.

311. Around 36% of households reported that mothers are responsible for cleaning the household water areas, while 21% are maintained by fathers and 23% are cleaned by other members. When it comes to cleaning facilities 47% of mothers, 29% of other members, and 16% of fathers are responsible for cleaning toilet facilities. However, when it comes to plumbing 40% of fathers, 15% of mothers and 36% of other family members are responsible for plumbing of their sanitation facilities.

312. For cleaning gutters and pipes, 58%o of fathers, 31% of other family members and only 5% of mothers are responsible of this task. In addition, 45% of male members in households are responsible for taking care of their household livestock. When it comes to cleaning, the house, cleaning the yard and cooking and washing, more women are reported to be responsible for these tasks (Figure 43).

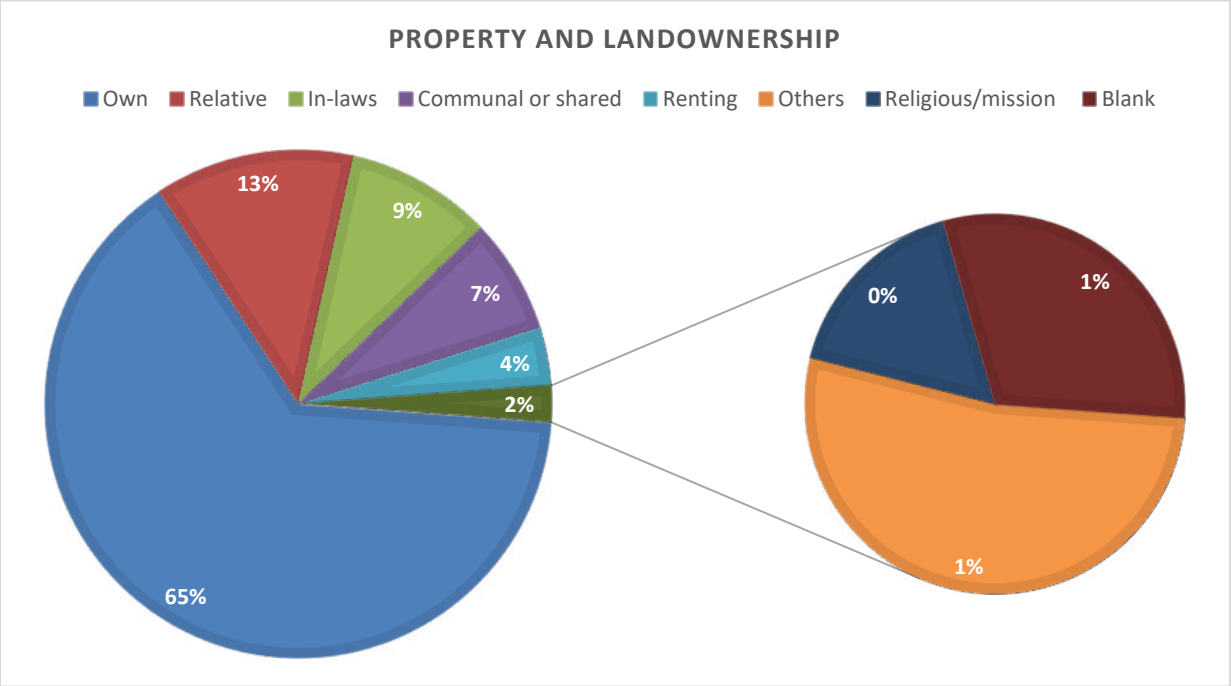
Figure 43: Responsibility Matrix for Water and Sewage Management in Each Household



G. Land Property

313. Most households are located on their property or their own land. The biggest challenge that each household face in relation to water is mostly shortage of water, since most households rely heavily on water catchment or rain catchment so when there is no rain, most households on Weno will face this challenge (Figure 44).

Figure 44: Property and Land Ownership Breakdown for Each Household



314. **Social information.** Domestic duties at the household level is managed by the women. Most households rely on water catchment with not many households connected to CPUC lines. Women are essential in maintenance and cleaning both water and sewerage source and while most of the respondents claimed to be married, more women are responsible for cleaning and maintaining water and sanitation facilities.

315. The largest challenge mentioned by households is the lack of connections to the CPUC water supply primarily when water shortages are prevalent during drier seasons of the year. In summary, water quantity rather than water quality is seen as major need by the Weno community. There is large degree of water self-sufficiency however this can become limiting during periods of low rainfall.

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

316. The operational environmental issues will be addressed at design stage to ensure the long-term management and mitigation; and these will include:

(i) curtailment of water abstraction from the Wichen River to ensure a minimum level of river flow;
(ii) inclusion of sludge drying facilities at the WTP and implementation of a sludge management/handling plan by CPUC;
(iii) implementation of a chemical management/handling plan by CPUC;
(iv) implement a well monitoring program to be able to track aquifer performance; and
(v) community liaison on best practice for pit latrine and septic tank management by CPUC.

A. Design and Pre-construction Phase

317. Design and pre-construction considerations include need for environmentally responsible procurement; climate change vulnerability; grievance management; disruption of utilities and services; disposal of excavation spoils; potential damage to archaeological and cultural assets; extraction of construction materials; and biosecurity matters.

1. Environmental Management System and Environmentally Responsible Procurement

318. Throughout the Project, for implementation of environmental safeguards to be effective, an environmental management and monitoring system will be established. The PMU will ensure that the EMP is updated, as required, based on detailed design and incorporated into the bid documents.

319. The bid documents will also specify other environmental management requirements such as: (i) requirements to comply with applicable standards; (ii) the contractor will designate an environmental, health and safety officer (EHSO) and describe the reporting/communication lines and channels; (iii) the monitoring and reporting requirements; and (iv) delivery of induction, training and awareness sessions for workers and the community.

320. Prior to works commencing at the project site, the contractor will prepare and submit a site-specific construction EMP (CEMP) to the PMU, the CEMP will be based on the project EMP and detail the construction methodology and program to be undertaken at each site, identify the risks associated with that construction methodology and detail mitigation measures to avoid or reduce the risks. The PMU will review and approve the CEMP. The PMU no objective is required before the Contractor can start work.

321. Once works commence, the EHSO will conduct monitoring of compliance of activities with the approved CEMP and the PMU will undertake inspections and audits of the effectiveness of the contractor's implementation of the approved CEMP. PMU will devise the checklist to be used for the inspections and audits and will consolidate the inspection/audit findings along with summaries of the contractor's monthly reporting. ADB will undertake review missions which will report on, inter alia, overall implementation of social and environmental safeguard requirements.

322. The project has established a grievance redress mechanism (GRM) to address concerns and resolve complaints and issues raised on any aspect of Project and subproject implementation. Safeguards concerns will be addressed through the GRM.

323. The CEMP will outline how the contractor will implement the relevant elements of the GRM and how and when they will provide information about construction activities and timing to the community. The contractor will provide information about the works, impacts and mitigation/control measures to the community in a timely and effective manner. The contractor's liaison and communication with the community will be guided by the Project's CCP.

324. Workers and sub-contractors will be inducted to the site and this will include awareness and training on the provisions and requirements of the CEMP and how it is to be implemented.

2. Climate Change Vulnerability

325. Climate change resilience is a critical consideration because Chuuk State is vulnerable to the effects of droughts and flooding.

3. Disruption to Utilities and Services

326. Prior to construction activities, CPUC and the contractors will:
- (i) During detailed design coordinate with utility providers to obtain information about locations of services and utilities;
- (ii) coordinate with the other utility companies regarding potential disruptions;
- (iii) make provisions to preserve the operation of current facilities, and
- (iv) notify affected households and establishments well in advance of disruptions

4. Improper Disposal of Excavation Spoils

327. Construction activities may generate excess excavation materials for the upgrade of water supply and sanitation pipelines, the borefield upgrade and the WTP.

328. The PMU will:
- (i) require the contractors to submit a plan for the disposal of excess excavation spoils, and
- (ii) undertake inspection and approval of the contractors' suggested disposal sites prior to actual construction.

5. Damage to Unknown Archaeological and Cultural Assets

329. While there is no information at present of any archaeological and cultural assets that may be affected by excavations works, precautions will be taken to avoid potential damage to any archaeological and cultural assets. These will include:
- (i) inclusion of a chance finds procedure in the CEMP; and
- (ii) inclusion of provisions in tender and contract documents requiring the contractors to immediately stop excavation activities and promptly inform the local authorities and the Chuuk Museum on the presence of any unknown archaeological and cultural assets.

6. Sourcing of Local Construction Materials

330. Construction materials will be sourced by the contractor from local suppliers. An earthmoving application will be required from the Chuuk State EPA. Quarries and borrow pits will be required to meet the following criteria:

(i) Existing operations with development consents/BMP will be used
(ii) borrow pits will be covered by required government permits or approvals,
(iii) will not be located within 300 meters of any urban area sensitive receptors,
(iv) topsoil will be saved for rehabilitation during closure of the quarries and borrow pits, and
(v) will be provided with drainage and sediment flow controls
(vi) proper closure of the quarries and borrow pits will be required. This will include fencing and placement of warning sign to the public.

7. Land Access and Use

331. The WTP, the borefield upgrade and water supply and sanitation pipelines will be accessed by road with some access points to the pipeline requiring CPUC to notify local landholders in advance.

8. Biosecurity of Imported Material (Invasive Species/Diseases)

332. All construction equipment i.e. bulldozers, excavators, backhoes will be sourced locally i.e. from FSM or nearby areas and as such will limit any bio-security concerns focusing on plant invasive species/disease control.

333. International bio-security controls for shipping of machinery is required to meet the acceptable cleanliness standards of the relevant countries' Department of Agriculture or be refused entry into that country. It is the importer's responsibility to ensure all machinery that arrives in the Chuuk to be free from biosecurity risk material, such as soil, seeds, plant, and animal material.

B. Construction Phase Impacts on the Physical Environment

1. Impact Areas

334. The upgraded WTP and booster station at the Peniesene site and all upgraded water supply pipelines for both water supply and sanitation and the bore field upgrade at the various locations. A weir will be constructed on the Wichen River and details will be confirmed after detailed design. Also, small scale works for pit latrines and septic tanks in the SW area of the island will be undertaken.

2. Modification of Site Topography

335. Construction activities at the WTP may require some benching and the installation of retaining walls and will be confirmed after detailed design. Some additional clearing and pad preparation will be required for the WTP and the booster station. Removal of vegetation will be required.

336. Site clearance and vegetation removal will be required for the water supply pipeline between the raw water intake on the Wichen River to the booster station then on to the WTP. The pipelines will be constructed along a highly modified vegetation corridor by trenching, then backfilling after the pipe has been laid. A similar approach will be required on the Pou River upgraded water supply line.

337. The access roads to the upgraded WTP, raw water intake and booster station sites will be upgraded. These upgrades will be on the same alignment as the existing center line alignment, where available, and all work will be within the existing formation. No modification of overland flow paths is proposed.

3. Soil Erosion and Sedimentation

338. Potential source of sediment runoff includes site clearing, ground leveling, excavations for the foundation of structures and pipelaying. These activities can release soil materials to the surrounding areas during rainy periods if not provided with sediment control measures.

339. During the augmentation of the WTP, construction activities may involve substantial amounts of earthworks. The contractor will be required to have a sediment erosion control plan that details each construction activity, this plan will be included as a part of the CEMP. Where required the contractor will design sediment control measures, which may include but not be limited to: small interceptor dikes, pipe slope drains, grass bale barriers, silt fence, sediment traps, and temporary sediment basins to divert surface runoffs away from the exposed areas.

340. The material removed during trenching, before pipe laying, backfilling, and compaction, will in the event of rainfall, be contained by grass bale barriers, silt fence, sediment traps, and temporary sediment basins, preventing sediments from moving offsite.

4. Storage Use and Transportation of Hazardous Materials

341. The use of oil products and other hazardous materials may be used in the construction activities of the proposed project. Fuel, oil, grease, paints, and solvents associated with the operation of heavy equipment and vehicles may accidentally be released to the environment during construction and adversely affect water quality and aquatic life. Mitigation measures, where required, include:

(i) Prepare a hazardous substances management plan and an emergency response plan as part of the CEMP.
(ii) ensure all storage containers are in good condition with proper labeling; and
(iii) store waste oil used lubricant and other hazardous wastes in tightly sealed containers to avoid contamination of soil and water resources.

342. Measures for clean-up and handling of contaminated materials will include:

(i) immediate clean-up of spills;
(ii) oil stained wastes and used oil to be collected and disposed of through recyclers /authorized waste handlers and disposal in authorized waste facilities;
(iii) ensure availability of spill cleanup materials such as absorbent pads;
(iv) restoration of temporary work sites will include removal, treatment, and proper disposal of oil contaminated soils;
(v) discharge of oil contaminated water into the environment to be prohibited; and
(vi) construction personnel designated to handle fuels/hazardous substances to be trained particularly in spill control procedures.

5. Air Pollution

343. On-site dust generation and use of vehicles and equipment can be expected during dry periods from activities associated with site clearing, ground leveling, and excavations for pipe

laying. Wind blowing on large stockpiles of construction materials such as soil and aggregates. Contractors will be required to:

(i) conduct regular water spraying of roads, work areas and other construction-related facilities to minimize dust generation;
(ii) ensure construction materials stockpiles are covered or sprayed with water, as appropriate, to prevent fine materials from being blown;
(iii) prohibit use of equipment and vehicles that emit dark sooty emissions;
(iv) provide trucks transporting loose construction materials such as sand, gravel, and spoils with tight tarpaulin cover or other suitable materials to avoid spills and dust emission; and
(v) prohibit burning of all types of wastes generated at the construction sites, as well as other project-related facilities and activities.

6. Solid Waste Management

344. Construction activities are expected to generate solid wastes including used wood materials, steel works cuttings, paint and solvents containers, used packaging materials, on-site office solid wastes, used oil from equipment, unused aggregates, and surplus earth materials. These solid wastes may cause aesthetic problems and will be potential sources of contaminants for surface runoffs and pollution of nearby water bodies. Contractors will be required to:

(i) prepare a waste management plan as part of the CEMP;
(ii) provide garbage bins and facilities within the project site for temporary storage of construction waste and domestic solid waste;
(iii) separate solid waste into hazardous, non-hazardous and reusable waste streams and store temporarily on-site in secure facilities with weatherproof flooring and roofing;
(iv) ensure that wastes are not haphazardly dumped within the subproject site and adjacent areas;
(v) regularly dispose of wastes to the local landfill; and prohibit burning of all types of wastes; and
(vi) after completion of work activities, contractors will be required to remove construction wastes from sites and implement the required restoration of disturbed sites.

345. All these activities will be reflected in the CEMP which will contain a waste management plan describing all waste types, amounts, disposal method, transport documentation requirements, and details of licensed waste treatment/recycling facilities for each waste stream.

346. Demolition wastes shall be assessed for recycling and disposal, including the determination if any of the wastes are hazardous and prescribe the appropriate handling and disposal for such wastes.

C. Construction Impacts on the Biological Environment

1. Impacts on Rare or Endangered Species

347. There are no Red Listed terrestrial or aquatic species in the Project influence area.

2. Terrestrial Habitat Alteration

348. Construction activities will not involve alteration of important terrestrial habitats since the sites are highly modified. A small area will be cleared during the construction of the new WTP. Any remaining land cleared, and not required for construction, may be seeded as part of the revegetation program.

349. Clearing of vegetation along the pipeline routes at Wichen River will be for a combined distance of approximately 800m and up to 5 m wide. After the pipelines have been laid and backfilled, the site will be regularly maintained for access. A similar approach will be required on the Pou River upgraded water supply line.

3. Aquatic Ecological Impacts

350. Soil erosion controls at all sites during construction will be undertaken to maintain water quality at Causeway and downstream in Wichen River by minimizing any increase in turbidity. A similar approach will be required on the Pou River upgraded water supply line.

351. Solid waste will be collected and stored as per the Waste Management Plan so that no litter enters Wichen River and waters adjacent to the Causeway.

D. Construction Impacts on the Socio-Economic Environment

1. Construction Noise and Vibration

352. Trucks and construction equipment, which can generate noise of 80 dB(A) from a distance of 30 meters are potential sources of noise during construction. The issue is particularly important in the urban areas of Weno, along the road where water supply pipelines will be installed for the Wichen River offtake and the site for the WTP.

353. Significant vibration from construction activities are not expected since pipeline installation will not involve heavy compaction activities. Contractors will be required to:

(i) provide prior notification to the community on schedule of construction activities;
(ii) whenever applicable, provide noisy equipment with noise reduction covers;
(iii) position stationary equipment that produce elevated noise levels, such as diesel generators and air compressors, as far as practicable from houses and other receptors;
(iv) prohibit operation of noisy equipment and construction works in populated areas and where sensitive receptors are found during nighttime (19:00 – 06:00);
(v) in necessary nighttime operation, ensure prior notification and consultation will be made with affected people and local officials, and implement suitable noise reduction measures;
(vi) locate concrete batching plant, and rock crushing plant at a reasonable distance away from inhabited areas and sensitive receptors; and
(vii) conduct regular noise level monitoring to determine compliance with WHO guidelines for noise which should not exceed 55 dB(A) near residential areas during daytime and 45 dB(A) for nighttime.

2. Vehicular Traffic Congestion and Hindrance to Public Access

354. Construction activities and any temporary or partial road closures may cause traffic congestion and hinder public access, particularly in the urban areas of Weno. Contractors will be required to:

(i) prepare a traffic management and control plan as part of the CEMP and provide traffic management personnel to direct the flow of traffic in the vicinity of the construction sites and construction-related facilities;
(ii) closely coordinate with local authorities for any closure of roads or rerouting of vehicular traffic;
(iii) provide prior notification to the community on schedule of construction activities;
(iv) provide traffic signs in the vicinity of the construction sites to direct motorists and pedestrians; and
(v) schedule construction activities with consideration to periods of heavy presence of people such as festivities, processions, parades, etc. to minimize disruption to local activities.

3. Potential Social Issues Due to Influx of Workers

355. A labor influx plan will be required from the contractor to address amongst others:
(i) Measures to minimize contact with local residents to prevent the risk of spread of communicable diseases including STI's and HIV;
(ii) induction of all workers on Project requirements regarding safeguards (including child protection), GRM and CCP requirements;
(iii) agreement to and implementation of protocols (including code of conduct) concerning the workers contact with the local communities;
(iv) ensuring that sufficient water supply and temporary sanitation facilities are provided for workers at work sites in order that community infrastructure is not over- burdened; and
(v) security at contractor's yard to control unauthorized access and prevent entry of the public (especially children).

4. Occupational Health and Safety

356. Health and Safety will be managed in accordance with the USA - OSHA (Occupational Safety & Health Association) and where gaps exist best practice will be employed.

357. The contractor is required to have a full-time health and safety representative that will be responsible for ongoing compliance including regular auditing and updates to project specific health and safety documentation.

358. The health and safety plan in the CEMP, shall generally include the following:
(i) accident and incident reporting;
(ii) emergency plans;
(iii) first aid plans;
(iv) materials safety, storage, and handling;
(v) pit inductions;
(vi) permits for high risk work;
(vii) inspections and auditing;
(viii) regular meeting procedures;
(ix) specific safe work methodologies;
(x) plant and equipment testing;
(xi) training records and certifications; and
(xii) management and reporting structures.

359. This document will be a live document a will be subject to amendment should site conditions, methodologies, guidelines, laws or codes of practice change during the course of the works.

360. Risks to the contractor's workforce are those reasonably expected in a Water Treatment Plant construction project, no extraordinary risks are identified. This includes but is not limited to working at heights, confined spaces, deep excavations, live electrical systems, live hydraulic and pneumatic systems, lifting and craneage and use of power tools. Site specific risks do exist, and it is expected that the contractor will develop work methodologies that consider all latent conditions. Bidders for the project are required to demonstrate their experience in similar projects.

361. Contractors will be required to:

(i) prepare and implement a health and safety plan (HSP) as part of their CEMP[26];
(ii) ensure that a properly equipped and resourced first aid station is available at all times;
(iii) provide potable water and adequate sanitation facilities;
(iv) provide personal protective equipment (PPE) suitable to tasks and activities undertaken to minimize exposure to a variety of hazards;
(v) provide fire-fighting equipment and fire extinguishers in workshops, fuel storage facilities and any sites where fire hazard and risk are present;
(vi) ensure that all workers are aware of emergency response and medical evacuation procedures;
(vii) ensure that only suitably qualified and experienced staff are utilized on the project works; and
(viii) guarantee the work practices, skills, qualifications and experienced of all subcontractors engaged to work on the project works. This shall include off site fabrication. To this end where the subcontractors' systems, rules and policies are of a lesser standard to that of the head contractor, the head contractor shall require their sub contactors to abide by their systems, rules and policies.

362. Hazards to construction workers include sharp edges, falling objects, flying sparks, chemicals, noise and various potentially dangerous situations. It is contractors' duty to protect their employees from workplace hazards that can cause injury. A clean environment is also necessary to enable the workers to maintain good health and hygiene. Contractors will be required to:

(i) prepare and implement a health and safety plan (HSP) as part of their CEMP;
(ii) ensure that a properly equipped and resourced first aid station is available at all times;
(iii) provide potable water and adequate sanitation facilities;
(iv) provide personal protective equipment (PPE) suitable to tasks and activities undertaken to minimize exposure to a variety of hazards;
(v) provide fire-fighting equipment and fire extinguishers in workshops, fuel storage facilities, and any sites where fire hazard and risk are present; and
(vi) ensure that all workers are aware of emergency response and medical evacuation procedures.

[26] This will include a health and safety plan aligned with the WHO 2020 Considerations for public health and social measures in the workplace in the context of COVID-19. https://www.who.int/publications-detail/considerations-for-public-health-and-social-measures-in-the-workplace-in-the-context-of-covid-19

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

5. Community Health and Safety

364. Many of the measures to manage occupational health and safety will help mitigate the risk to the community. The movement of construction vehicles, trench excavations, and various activities may pose hazards to the public, particularly in the more urban areas of Weno. Contractors will be required to:

(i) implement the various plans to minimize health and safety risks to the public;
(ii) use barriers and install signage to keep the public away from constructions sites and excavation sites;
(iii) provide prior notification to the community on schedule of construction activities;
(iv) provide security personnel in hazardous areas to restrict public access;
(v) operate construction night light in the vicinity of construction sites;
(vi) provide adequate safe passage for public, as necessary, across construction sites; and
(vii) ensure that any access to properties or establishments that have been disrupted or blocked by the ongoing construction activities, are reinstated as quickly as possible or alternative access is provided.

365. Directly affected persons such as those living in close proximity will be consulted prior to the start of works on site through community consultation and awareness sessions as detailed in the CCP.

E. Operation Phase Environmental Impacts

366. Operational phase impacts will include risks to employee and public safety; health hazards due to poor water quality.

367. The settled floc at the WTP will be stored in ponds. The small volume of supernatant from these ponds will be released to a leachate drain area of introduced grasses. Run off from this area to a watercourse, presents a low risk to the aquatic environment. According to a review of the effects of residual flocculants on the aquatic receiving environment by the Auckland City Council, New Zealand, there appears to be a small risk to the natural aquatic environment arising from potential losses of unbound residual flocculants from treatment ponds. Impacts are likely to be low level and also likely to not be significant in relation to other factors which govern the health of aquatic communities. The benefit of reduced sediment levels in discharges is considered to outweigh the risk of any low-level impacts attributable to residual flocculants.[27]

368. Sludge drying facilities at the WTP will be included and implemented as part of the sludge management/handling plan by CPUC. The dried sludge will be transported to the solid waste disposal facility as required.

[27] Auckland City - Overview of the Effects of Residual Flocculants on Aquatic Receiving Environments – TP 226 - www.aucklandcity.govt.nz › documents › technical publications ›

369. The CPUC in conjunction with WASH sponsored programs will provide the community with best practice access and learnings for pit latrine and septic tank management pre and post installation of pit latrines/septic tanks.

370. A well monitoring program including well dipping for water level measurement and water quality testing should be implemented to track aquifer performance. Quarterly testing programs are a proposed first step.

371. The Chuuk Environmental Protection Agency (EPA) has the capacity to collect and manage samples and to analyze some water quality parameters (e.g. turbidity, presence of coliforms, conductivity, etc). However, EPA does not have the capacity to conduct more sophisticated laboratory analysis such as BOD, COD, heavy metals, and organic compounds and such tests will need to be undertaken by an accredited laboratory (closest are in Guam, Hawaii, or the Philippines). The project may finance the purchase of WQ testing equipment for CPUC and EPA as well as provide training in lab testing methods and to establish a WQ monitoring program.

372. In addition, there will be a curtailment of water abstraction program from the Wichen River to ensure a minimum level of river flow. Re-establishment of local vegetation will also take place to reduce any soil erosion from the site, so that water quality downstream in Wichen River will be maintained by minimizing increases in turbidity.

373. During operations, solid waste will continue to be collected and stored as per the Waste Management Plan so that no litter enters Wichen River.

374. Operators will prepare health and safety maintenance manuals[28] that include Health and Safety considerations to address the prevention, reduction and control of occupational injury and illness in operating water supply and sanitation facilities. The manuals will include information on: (i) clearly identifying conditions that may cause acute worker health and safety problems, (ii) requirements that all workers should comply during normal operations and emergency situations, and (iii) training requirements for health and safety in operating the facility.

1. Chlorination Operational Risk and Safety

375. The use of chlorine gas as a disinfectant may pose safety risks. To reduce the operational risk and safety of WTP and at the borefield:

(i) workers will be trained on health and safety aspects of operating a water supply tank;
(ii) a facility health and safety manual will be prepared;
(iii) chlorine gas cylinders will be kept in separate safety rooms with the design fully compliant with AS/NZS 2927;
(iv) a system will be established for safe use and handling of chlorine materials in the work place;
(v) workers will be provided with the appropriate PPE for chlorine use and handling; and
(vi) an 8-foot-high fence will be erected to control access and avoid exposing the public to any hazard due to the presence of the water supply tank.

[28] This will include a health and safety plan aligned with the WHO 2020 Considerations for public health and social measures in the workplace in the context of COVID-19. https://www.who.int/publications-detail/considerations-for-public-health-and-social-measures-in-the-workplace-in-the-context-of-covid-19

VI. GRIEVANCE REDRESS MECHANISM

A. Purpose

376. This Grievance Redress Mechanism (GRM) is designed to deal with grievances from the general public in relation to CPUC managed projects at all stages of the project cycle. This GRM is the accepted process undertaken by CPUC with respect to grievance redress.

377. The mechanism allows for affected parties to make known grievances as they arise and aims to provide a predictable, transparent, and credible process to all parties, resulting in outcomes that are seen as fair, effective, and lasting.

B. Process

378. The CPUC GRM is a three-stage process during any stage of which the grievance may be considered, by both parties, to have been resolved and closed off.

1. Stage 1

379. Any grievance should first be made known to CPUC Project Manager (PM) in charge of the project being implemented. This may initially be verbally however a monitoring form must be prepared and signed off by the party raising the grievance–support to filling in the form can be provided by CPUC to the aggrieved party.

380. On receipt of the Grievance Monitoring form the PM will hold a meeting with the aggrieved party in an attempt to resolve the grievance within 5 working days of the grievance being raised. Following the discussion, the grievance may either be resolved or need to be escalated to Stage 2.

381. A Stage 1 Grievance Outcome form should be prepared by the PM confirming either:

(i) the grievance has been resolved and the means of resolution; and
(ii) the grievance has not been resolved; and outlining CPUC Projects Team position on the grievance.

382. The Stage 1 Grievance Outcome form should be signed by both parties and a copy provided to the party raising the grievance. This form should include next steps in the process if they consider the issue not to be resolved.

2. Stage 2

383. If the grievance is not resolved under Stage 1, the grievance should then be referred to the General Manager of CPUC.

384. The General Manager will be provided with the Stage 1 Grievance Outcome form and a meeting arranged with the aggrieved party within 10 working days of issue of the form to discuss and try to resolve the grievance.

385. Based on the discussion the General Manager will issue a Stage 2 Grievance Outcome form confirming either:

(i) the grievance has been resolved and the means of resolution; and
(ii) the grievance has not been resolved and outlining CPUC General Manager position on the grievance.

386. The Stage 2 Grievance Outcome form should be signed by both parties and a copy provided to the party raising the grievance. This should include next steps in the process if the issue has not been resolved.

3. Stage 3

387. If the grievance is not resolved under Stage 2 the grievance should then be referred to a three-member Grievance Tribunal comprised of:

(i) a member of the Board of CPUC;
(ii) the PS (or designate) and
(iii) an independent member selected by GM CPUC and Board Chairman.

388. All prior Grievance Outcome reports will be made available to the Tribunal; A meeting with the aggrieved party shall be held within 10 working days of issue of the Stage 2 Grievance Outcome Form.

389. Within 5 working days of the Tribunal meeting a formal response will be issued to the aggrieved party outlining the Tribunal's decision on the grievance raised.

390. The Tribunal's decision will be final.

C. Miscellaneous

391. Whenever a grievance is resolved to the satisfaction of both parties, at whichever Stage this is achieved a written record of the agreement must be made and signed by both parties.

392. At all stages of the process the aggrieved party has the right to be represented by a third party at their own cost. The GRM nor its final decision does not affect the legal rights of the individual.

393. CPUC are responsible to maintain an accurate register of grievances and the manner in which they are dealt with.

394. CPUC Projects Team must hold a grievance review meeting at least once every 6 months to report on all grievances received and in process.

395. A Grievance Log must be maintained by the CPUC Projects Team and an annual report provided to the GM of CPUC. This should identify grievances raised (month and to date), grievances resolved (month and to date) and balance of grievances outstanding with specific actions pending. Key information to be included in the grievance log.

VII. CONSULTATION AND INFORMATION DISCLOSURE

396. Information disclosure, public consultation, and public participation are part of the overall planning, design and construction of the proposed subprojects.

A. Public Consultation

397. During 2019, CPUC has undertaken extensive consultation with the Weno communities, to formally discuss the proposed upgrade Water Supply and Sanitation project. A formal letter of Assurance was signed by the Major, deputy Major, Village Chiefs and Commissioners of Weno Municipality representing the residents and the landowners of the Weno Municipality with the intent of the letter to allow CPUC undertake the project without any interference form the landowners of Weno Municipality. This letter is attached in Appendix A.

398. There was a good understanding from the community of the preparatory work that is currently underway for the project and the community have expressed their gratitude in regard to the initiative taken by CPUC to undertake the IEE so that the potential adverse impacts of the project are identified and managed so that any impacts are socially and environmentally acceptable.

399. The notes of these consultation meetings including date, location, number participants by male and female are found in Appendix A.

400. It is stressed that consultation is an ongoing process throughout the course of the project, so that it will allow community members to express their views and concerns in relation to the construction of WSS.

B. Consultations during Project implementation

401. The Project's CCP will be updated early in Project implementation. The CCP will guide the future consultation and participation activities to be facilitated and undertaken by CPUC. Whenever necessary, stakeholder consultations will be conducted for specific issues that may arise during the design phase. Stakeholder consultations will be continued throughout the construction phase on an area by area basis to address any potential problems.

402. These will be conducted by CPUC's PMU, contractors, and implementation consultants prior to commencement of construction activities. The construction consultations will address stakeholders' specific concerns related to construction activities in their area, including the scheduling of activities and the potential nuisances to the public. Records of environmental and social complaints, received during consultations, field visits, informal discussions, and/or formal letters, together with the subsequent follow-up and resolutions of issues will be kept by CPUC's PMU.

Table 14: Summary of Community Consultation Meeting about the WSS Project

Meeting Date/Time	Attendance	Concerns Raised	Responses (CPUC)
12 October 2019	Epinup Meeting Minutes	Will the water supply be adequate to Epinup village?	With the existing deep wells and water storage there is

Meeting Date/Time	Attendance	Concerns Raised	Responses (CPUC)
			enough water to supply Epinup village.
		Who will do the work or project? Can they hire workers from Epinup?	The work will be contracted to construction companies, and yes people from this village can always apply to work.
13 December 2019	Mwan	Many projects in Chuuk are allocated to very few and selected individuals and families and will the water project be faired to all the people in Mwan?	This project is aimed to remove and replace the existing waterlines and including the existing deep wells.
		Why some parts of Mwan village is not getting CPUC water for sometimes?	Because of the major losses of water through the old waterlines after the new pavement road the gate valves are being isolated until the lines are replaced under the new water project.
6 December 2019	Neauo	Will the water project waterline go as far as the house far from the main road?	With the support of the community to allow CPUC to work beyond the road, yes, we can extend the water lateral to your house.
		Will the water project also be considered improving and re-activating wells and spring water in Neauo village?	Deviation of the scope of works we will take note of the question to share with CPUC management.
24 October 2019	Eor Sapuk	Why it takes time for the tanker to deliver water to Sapuk?	CPUC is trying its very best to deliver your water on time, as we only have two tanker to deal with the entire island, for now it is very difficult but CPUC is trying its very best.
		Will the water project also have considered improving wells and spring water in Nemwan village?	Deviation of the scope of works we will take note of the question to share with CPUC management.

Meeting Date/Time	Attendance	Concerns Raised	Responses (CPUC)
15 November 2019	Nemwan Sapuk	Why is the One Million Gallons storage tank in Sapuk solely supplied water to Xavier High School and not servicing the entire community in Sapuk?	For now, Xavier High School is storing its catchment water collected from rain as well as the deep well in Epinun. Not Sure about the setup between CPUC and Xavier High School.
		Why the price for the water tanker delivery is not the same?	The CPUC customers with electrical account and water account have less price than the ones with no account.
9 April 2020	Weno Peniesene Villiage	I am one of the landowners, my property is on top of the wichon river, call (pangeruk) that's were the main water come from, so I agree to give full permission to CPUC to go head and used, to support everyone needs water.	

VIII. ENVIRONMENTAL MANAGEMENT PLAN

A. Introduction

403. Environmental assessment has determined that the Project will have less than significant impacts on the local environment. Subprojects can be implemented in an environmentally acceptable manner with appropriate mitigation measures to avoid or minimize the environmental impacts.

404. The EMP includes: (i) implementation arrangement, mitigating measures to be implemented, and (iii) required monitoring associated with the mitigating measures. It also describes institutional roles and responsibilities during pre-construction, construction, and operation phases.

B. Institutional Arrangements

405. The MOFT is the Project executing agency and CPUC is the implementing agency, operating through a PMU which will include various specialists.

1. Project Management Unit

406. CPUC has established a PMU to prepare and implement the Project. The PMU will include a Safeguards and Community Liaison Officer (SCLO). The SCLO will ensure that all subprojects are implemented in accordance with the Project's environmental assessments and development consents are obtained, and compliance with each subproject EMP and development consent conditions is monitored and reported.

2. Construction contractors

407. The contractors undertaking the works will be responsible for ensuring that their activities comply with the environmental safeguard requirements of the contract including the technical specifications. The contractor will prepare a CEMP for review and approval by the PMU. The CEMP will be activity, site and subproject-specific and detail how the contractor intends to meet the environmental management requirements identified in the EMP of the IEE. It will be designed to ensure that appropriate environmental management practices are applied throughout the construction period. The CEMP will include all of the site-specific and sub- plans necessary to meet the standards and targets set out in the EMP. The contractor will be required to employ a full-time environmental health and safety officer (EHSO) to ensure compliance with all requirements concerning environmental, health and safety, and labor regulations during construction.

3. Chuuk State Environment Protection Agency

408. The EPA will review the development consent applications and issue, either with or without conditions. The EPA will be invited to participate in joint inspections and audits during construction activities.

409. A summary of the environmental management responsibilities for the Project is presented in Table 17.

Table 15: Summary of environmental management responsibilities in the Project

Project Implementation Organization	Management Roles and Responsibilities
Asian Development Bank	• Review and approve IEEs/EMPs • Review bidding documents • Review executing agency and implementing agency's submissions for procurement of goods, equipment, works and services • Conducts project review missions, midterm review mission and project completion review mission to assess project implementation progress of all outputs, compliance of project to covenants including safeguards requirements • Review semi-annual and annual EMR
Ministry of Finance and Treasury (executing agency)	• Guide and monitor overall project execution • Financial oversight • Ensure flow of funds to the implementing agency and the timely availability of counterpart funding
Project Steering Committee (PSC)	• Responsible for oversight and providing guidance and strategic direction to CPUC with respect to project implementation • Ensure that the PMU is provided with the necessary resources to effectively carry out its duties and responsibilities.
CPUC (implementing agency)	• Responsible for overall project implementation and monitoring at the implementing agency level • Ensure adequate funding available for the PMU • Submit semi-annual and annual monitoring reports to ADB • Assist in resolving complaints brought through the GRM that have not been resolved at lower levels
CPUC Project Management Unit	• Responsible for overall project management, implementation and monitoring • Review and coordinate evaluation of bids for works, goods, and consultant services • Responsible for CPUC's application for a Development Consent • Prepare the IEEs and EMPs based on the detailed design and submit to ADB for clearance • Ensure environmental safeguard concerns are incorporated in the detailed engineering design • Disclose safeguard documents, as appropriate • Conduct awareness and consultations as per the CCP • Monitor on site construction progress and quality • Engage as appropriate specialist consultants in order to complete specific engineering inspections as required • Receive and a response to all contractor related requests for information, extensions of time and variations. • Arrange and attend regular progress meeting on site • Recommend changes to the drawings, specifications and program for the employer's approval. • Submit monthly, quarterly, semi-annual, and annual monitoring report to CPUC Management • Review and clear the CEMP of contractors • Review contractor's monthly reports • Implement the GRM and maintain records of complaints/grievances • Ensure the contractor observes the GRM requirements • Ensure contractor compliance with required resources for mitigation measures as reflected in the CEMP

Project Implementation Organization	Management Roles and Responsibilities
PMU Safeguards and Community Liaison Officer (SCLO).	• Ensure IEEs/EMPs are updated based on changes in site conditions, if required, and ensure their disclosure in locations and form accessible to the public; • Coordinate with the preparer of bid documents for the inclusion of IEEs/EMPs and CEMP frameworks in the bidding documents and civil works contracts; • Ensure required government permits and clearances acquired by CPUC prior to actual construction activities; • Establish system for monitoring environmental safeguards of the Project as described in the IEEs/EMPs; • Review, monitor, and evaluate the effectiveness of implemented mitigation measures and recommend corrective actions whenever necessary; • Prepare monthly environmental monitoring reports for consolidation to the semi-annual monitoring reports for CPUC and ADB; • Ensure grievance redress mechanism is activated prior to the start of construction; • During construction, conduct site visits and coordinate with the project engineers to ensure that required environmental mitigation measures are implemented at the construction sites, and • Coordinate with the contractors' environment and safety officers to ensure that environmental awareness trainings for workers are done.
Contractor	• Prepares and submit prior to construction the CEMP for review by PMU's Environment Specialist for approval by PMU • Understand the EMP requirements and allocate necessary resources for implementation • Activates an Environmental Health and Safety Officer (EHSO) to ensure that the contractor complies with all requirements concerning environmental, health and safety, and labor regulations during construction • Implement construction activities with the required mitigation measures • Conduct environmental monitoring as required by EMP • Act promptly on complaints and grievances concerning the construction activities in accordance with the project's GRM • Submit monthly progress reports on CEMP/EMP implementation to PMU
Chuuk State EPA	• Responsible for processing of CPUC's application for a Development Consent • Monitors construction progress for compliance with the terms of the issued Development Consent • Monitors implementation of the mitigation measures and the EMP in general

C. Environmental Mitigations and Monitoring Matrices

410. The EMP (including monitoring requirements) is presented in Table 16 for Environmental Mitigation and Monitoring Plan of Upgraded Pipework at Wichen River, Causeway Link, Pou WTP storage reservoir, and Xavier Storage Tank. Table 17 is for associated sewerage pipework upgrades, and Table 18 for the upgraded pipework to Wichen River and the upgraded WTP. Table 19 is specifically for the Environmental Mitigation and Monitoring Plan for Upgraded Bore Fields at Wichap to Epinup and Weno Consolidation.

Table 16: Environmental Mitigation and Monitoring Plan of Upgraded Pipework at Wichen River, Causeway Link, Pou WTP Storage Reservoir, Xavier Storage Tank and Other Associated Water Pipework Upgrades

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
PRE-CONSTRUCTION							
Climate change vulnerability of all pipeline projects	Climate change adaptation measures are: (i) results of engineering assessment on potential site erosion of the routes involved with pipework upgrades; and (ii) appropriate erosion protection for the pipework will be determined to avoid structural failures of the pipeline when unprotected against soil erosion.	Part of detailed design cost	Contractor	CPUC's PMU	Engineering drawings and specifications considered climate change adaptation features	Verify engineering drawings and specifications	CPUC PMU Cost
Implementation of all of the pipeline projects into the project's EMP	Tender documents and construction contract of the pipework will include provisions that will: (i) require the contractors to prepare their respective Contractor's Environmental Management Plan (CEMP) prior to the start of the construction activities with details of staff, resources, implementation schedules, as well as monitoring and reporting procedures; (ii) issue a CEMP framework as guidance for the contractor in preparing a CEMP as part of his bid proposal; and (iii) require the PMU to review and approve the CEMP prior to site mobilization.	Part of contractors' bid cost	Contractor	CPUC's PMU	CEMP prepared by contractors	CEMP submittal by contractors to PMU/ prior to commencement of site works	To be undertaken as per contractor's contract

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
Complaints due to project- related impacts	CPUC's PMU and the contractors will: (i) establish the approved project's grievance redress mechanism (GRM); (ii) publicize the existence of the project's GRM through public awareness campaigns, website, billboards, public notifications, etc; (iii) ensure that the names and contact numbers of representatives of the contractors and CPUC's PMU are placed on notice boards at agreed locations and/or website.	Part of contractors' bid cost	Contractor and CPUC's PMU	CPUC's PMU	Consultation meetings; specific provisions in tender documents on nuisance & problems to public;	Verify meetings documentation; Verify tender documents; verify the in-placed CACs/ after completion of meetings, once after tender documents prepared	CPUC PMU Cost
Disruption of utilities and services	CPUC and the contractors will: (i) coordinate with the other utilities companies regarding the potential disruptions; (ii) make provisions to preserve the operation of current facilities, and (iii) affected households and establishments will be notified well in advance of such disruptions.	Part of contractors' bid cost	Contractor and CPUC's PMU	CPUC's PMU	Contractor's coordination with the other utility companies; notification of affected households and establishments	Verify contractor's coordination meetings and notifications/ after completion of meetings and notifications	CPUC PMU Cost
Disposal of excavation spoils	The PMU will: (i) require the contractors to submit a plan for the disposal of excess excavation spoils, and (ii) undertake inspection and approval of the contractors' suggested disposal sites prior to actual construction.	Part of contractor's bid cost	Contractor	CPUC PMU	Contractor's disposal plan for excess excavation spoils	PMU disposal sites' inspection/ after contractor's submittal	CPUC PMU Cost

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
Potential damage to unknown archaeological and cultural assets	Tender documents and construction contact will include a provision that will: (i) require construction activities to be stopped immediately upon discovery of any unknown archaeological and cultural assets; and (ii) the contractor will promptly inform the local authorities and the Chuuk State National Museum.	Part of contractor's bid cost	Contractor	CPUC PMU	Specific provision in tender documents on archeological/ cultural relics	Verify tender documents/ once after tender documents prepared	CPUC PMU Cost
CONSTRUCTION							
Soil erosion and sediment loss from construction sites	The contractor will divert surface runoffs away from the exposed areas and prevent sediments from moving offsite. Measures may include, as appropriate for site conditions: (i) small interceptor dikes, (ii) pipe slope drains, (iii) grass bale barriers, (iv) silt fence, (v) sediment traps, and (vi) temporary sediment basins; total exposed area will be minimized as the conditions allow.	Part of contractors' bid cost	Contractor	CPUC PMU	Disturbed sites; use of appropriate sediment controls	Visual inspection of sites; plans verification/ daily during rainy periods	CPUC PMU Cost
Extraction of local construction materials	The contractor will provide sufficient information on the quarries and borrow pits to be used including commercial sources; The following will be required for quarries and borrow pits: (i) only licensed quarries will be used or the contractor will obtain its own licenses (ii) borrow pits will be covered by required government permits or approvals, (iii) will not be located within 300 meters of any urban area sensitive	Part of contractors ' bid cost	Contractor	CPUC PMU	Government permits or approvals of quarries and borrow pits; operational plan; drainage and sediment flow controls; tops soil management	Verification of material supply through dockets, inspection of stockpiles on establishment and at least weekly	As per contractor's contract

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	receptors, (iv) topsoil will be saved for rehabilitation during closure of the quarries and borrow pits, (v) will be provided with drainage and sediment flow controls, and (vi) closure will include fencing and placement of warning sign to the public. An earthworks permit will be collected from the Chuuk State EPA.						
Oil and other hazardous materials releases.	To prevent accidental releases, where required, the contractors will implement the following: (i) provide, if required, maintenance shops, fuel and oil depot with impermeable flooring with sump where wash water and sludge can be collected for proper disposal; (ii) refueling and servicing of equipment should only be carried out in specified areas adequately equipped to avoid leaks and spills that could contaminate soil and water resources; (iii) chemicals, hazardous substances and fuel will be stored on-site within an enclosed and covered secure area that has an impervious floor and impervious bund around it, (iv) storage area will be located away from water-courses, flood-prone areas and danger areas, (v) equipment maintenance areas and fuel storage areas will be provided with drainage leading to an oil-water separator that will be regularly skimmed of oil and maintained to ensure efficiency;	Part of contractors bid cost	Contractor	CPUC PMU	Measures required to prevent accidental releases; measures for clean-up and handling of contaminated materials; training records of personnel for hazardous materials; records of accidental releases	Visual inspection of sites; records verification/ daily	CPUC PMU cost

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	(vi) regularly check containers for leakage and undertake necessary repair or replacement; (vii) store hazardous materials above flood level; (viii) ensure all storage containers are in good condition with proper labeling; and (ix) store waste oil, used lubricant and other hazardous wastes in tightly sealed containers to avoid contamination of soil and water resources; Measures for clean-up and handling of contaminated materials include: (i) undertake immediate clean-up of spills, (ii) oil stained wastes and used oil should be collected and disposed of through recyclers / authorized waste handlers and disposal in authorized waste facilities; (iii) ensure availability of spill cleanup materials such as absorbent pads, (iv) restoration of temporary work sites will include removal, treatment, and proper disposal of oil contaminated soils, (v) discharge of oil contaminated water into the environment will be prohibited; and (vi) construction personnel designated to handle of fuels/hazardous substances will be trained particularly in spill control procedures.						
On-site dust due to construction activities	The contractor will be required to do the following: (i) regular water spraying of roads, work areas and other construction-related facilities to minimize dust generation; (ii) construction materials stockpiles	Part of contractors ' bid cost	Contractor	CPUC PMU	Dust generation, water spraying, cover of stockpiles, smoke emitting equipment, open burning of materials	Visual inspection of sites/ daily	CPUC PMU cost

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	and spoils with potential for significant dust generation to be covered or sprayed with water, as appropriate, to prevent fine materials from being blown; (iii) prohibit use of equipment and vehicles that emit dark sooty emissions; (iv) hauling trucks transporting loose construction materials such as sand, gravel, and spoils to be provided with tight tarpaulin cover or other suitable materials to avoid spills and dust emission; and (v) prohibit burning of all types of wastes generated at the construction sites, as well as other project-related facilities and activities.						
Solid waste management	The contractor will be required to: (i) provide garbage bins and facilities within the project site for temporary storage of construction waste and domestic solid waste; (ii) separate solid waste into hazardous, non-hazardous and reusable waste streams and store temporarily on-site in secure facilities with weatherproof flooring and roofing; (iii) ensure that wastes are not haphazardly dumped within the project site and adjacent areas; (iv) regular disposal of wastes to the local Landfill; (v) prohibit burning of all types of wastes; (vi) remove the construction wastes from the sites after work completion, and (vii) implement the required restoration of disturbed sites.	Part of contractors' bid cost	Contractor	CPUC's PMU	Construction waste, waste separation, temporary on- site waste storage, regular disposal records, surplus materials not removed upon completion	Visual inspection of sites/daily	As per contractor's contract

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	The CEMP shall contain a waste management plan and describing all waste types, amounts, disposal method, transport documentation requirements, and details of licensed waste treatment/recycling facilities for each waste stream.						
Construction noise and vibration	The contractor will control noise generation from their activities near residential areas. The contractor will: (i) provide prior notification to the community on schedule of construction activities; (ii) provide noisy equipment with noise reduction covers whenever applicable; (iii) position stationary equipment that produce elevated noise levels, such as diesel generators and air compressors, as far as practicable from houses and other receptors; (iv) prohibit operation of noisy equipment and construction works in populated areas and where sensitive receptors are found during nighttime (19:00 – 06:00); (v) make prior notification and consultation with the affected people and local officials for necessary nighttime operation; (vi) locate concrete batching plant, and rock crushing plant at a reasonable distance away from inhabited areas and sensitive receptors; and (vii) conduct regular noise level monitoring to determine	Part of contractors' bid cost	Contractor	CPUC's PMU	Noise levels not to exceed 55 dB(A) near residential areas during daytime and 45 dB(A) for nighttime; noisy equipment not to be operated between 19:00– 06:00hrs; regular noise level monitoring by contractor	Use of sound levels meter; visual inspection of sites/ daily	As per contractor's contract

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	compliance with WHO guidelines for noise which should not to exceed 55 dB(A) near residential areas during daytime and 45 dB(A) for nighttime						
Vehicular traffic congestion and hindrance to public access	The contractor will: (i) prepare a traffic plan and provide traffic management personnel to direct the flow of traffic in the vicinity of the construction sites and construction-related facilities; (ii) closely coordinate with local authorities for any closure of roads or rerouting of vehicular traffic; (iii) provide traffic signs in the vicinity of the construction sites to direct motorists and pedestrians; and (iv) minimize disruption to local activities by timing the construction activities with consideration to the schedules of festivities, processions, parades, etc.	Part of contractors' bid cost	Contractor	CPUC's PMU	Contractor's traffic plan and traffic management personnel; traffic signs in vicinity of construction sites; contractor's work schedule related to festivities, processions, parades, etc.	Traffic plans verification; visual inspection of sites/ daily	CPUC PMU
Community health and safety	The contractor will: (i) use barriers and install signage to keep the public away from constructions sites and excavation sites; (ii) provide security personnel in hazardous areas to restrict public access; (iii) operate construction night light at the vicinity of construction sites; and (iv) whenever necessary, provide adequate safe passageways for the public crossing the construction sites whose access to properties, establishments, etc. has been disrupted or blocked by the ongoing	Part of contractors' bid cost	Contractor	CPUC's PMU/ Contractor	Work sites safety plan; warning signs, barricades, and night lamps for open excavations, lighting system for nighttime operations; adequate safe passageways for the public crossing the construction sites. All aspects of the labor influx management plan.	Work sites safety plan verification; visual inspection of sites/ daily/weekly All aspects of the labor influx management plan. visual inspection of sites/daily/ weekly	As per contractor's contract/ CPUC PMU Cost

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	construction activities. A labor influx plan will be required from the contractor to address amongst others: (i) Measures to minimize contact with local residents to prevent the risk of spread of communicable diseases including STI's and HIV. (ii) induction of all workers on Project requirements regarding safeguards (including child protection), GRM and CCP requirements; (iii)agreement to and implementation of protocols (including code of conduct) concerning the workers contact with the local communities; (iv) ensuring that sufficient water supply and temporary sanitation facilities are provided for workers at work sites in order that community infrastructure is not over- burdened; (v)security at contractor's yard to control unauthorized access and prevent entry of the public (especially children).						
Occupational health and safety at work sites	The contractor will implement good practices of occupational health and safety at the construction sites by: (i) implementing a construction site health and safety management plan (CSHSMP), (ii) ensuring that an equipped first aid station is available at all times, (iii) providing the workers with potable water and adequate sanitation facilities, (iv) providing the workers with personal protective equipment (PPE) to minimize exposure to a variety of	Part of contractors bid cost	Contractor	CPUC PMU	Health and safety plan; first aid station; PPE, sanitation, facilities; firefighting equipment and fire extinguishers	Health and safety, plan verification; visual inspection of sites/ daily/weekly	As per contractor's contract

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	hazards, and (v) providing firefighting equipment and fire extinguishers in workshops, fuel storage facilities, and any sites where fire hazard and risk are present.						
Monitoring and Reporting	During the pre-construction phase any gaps in the baseline will be filled. It is in the pre-construction phase where requirements for environmental monitoring in the construction phase can be legally required by placing specific provisions on environmental monitoring in the: (i) project specifications, (ii) bidding documents, and (iii) construction contracts. Relevant aspects of each subproject's EMP shall be incorporated in these documents. The PMU shall verify if these aspects are incorporated in the said documents first during submission of the draft documents and later during submission of the draft final documents.	Part of specs preparation cost	Contractor	CPUC's PMU	Specific provisions on environmental monitoring in the: (i) project specifications, (ii) bidding documents, and (iii) construction contracts.	Verify that these aspects are incorporated in the said documents during submission of the draft documents and later during submission of the draft final documents.	As per contractor's contract
OPERATIONS							
Public health risk due to unplanned outages and emergencies of the water supply system	Mitigations include: (i) identification of potential causes of unplanned outages and emergencies shall be conducted during operation of the water supply system and updated as necessary; (ii) written management procedures for unplanned outages and emergencies as required by the water safety plan implementation (advocated by WHO); (iii) regular	Part of CPUC's operational cost	CPUC's operations personnel	CPUC's Operations Dept. Mgt.	Written management procedures for unplanned outages and emergencies (per water safety plan); schedule of inspection and maintenance of pumping systems, emergency backup systems and automatic transfer	Verify regular inspection and maintenance/ weekly; verify implementation of operating procedures manual/ weekly; verify implementation of water supply	Visual inspection

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	inspection and maintenance of the backup power supplies and pumping stations to ensure uninterrupted operation during power failure; (iv) regular inspection and maintenance of pumping systems and emergency backup systems to ensure that these are in good working conditions; (v) implement flushing and disinfection, as necessary, during unplanned outages and emergencies to prevent microbial contamination of the water supply system; (vi) written standard operating procedures manual to be available at the facilities to provide guidance to the water supply system's staff on how to handle unplanned outages and emergencies; (vii) regular training of water supply system's staff on how to handle unplanned outages and emergencies				CPUC switch of the backup power supplies at the water pumping stations; standard operating procedures manual for unplanned outages and emergencies; flushing and disinfection plan for unplanned outages and emergencies; training of water supply system's staff; unplanned outages and emergencies	flushing and disinfection plant/ after incidents.	

Table 17: Environmental Mitigation and Monitoring Plan for Sewerage Pipework Upgrades

Environmental Issues/Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
PRE-CONSTRUCTION							
Climate change vulnerability of all pipeline projects	Climate change adaptation measures are: (i) results of engineering assessment on potential site erosion of the routes involved with pipework upgrades; and (ii) appropriate erosion protection for the pipework will be determined to avoid structural failures of the pipeline when unprotected against soil erosion.	Part of detailed design cost	Contractor	CPUC's PMU	Engineering drawings and specifications considered climate change adaptation features	Verify engineering drawings and specifications	CPUC PMU Cost
Implementation of all of the pipeline projects into the project's EMP	Tender documents and construction contract of the pipework will include provisions that will: (i) require the contractors to prepare their respective Contractor's Environmental Management Plan (CEMP) prior to the start of the construction activities with details of staff, resources, implementation schedules, as well as monitoring and reporting procedures; (ii) issue a CEMP framework as guidance for the contractor in preparing a CEMP as part of his bid proposal; and (iii) require the PMU to review and approve the CEMP prior to site mobilization.	Part of contractors' bid cost	Contractor	CPUC's PMU	CEMP prepared by contractors	CEMP submittal by contractors to PMU prior to commencement of site works	To be undertaken as per contractor's contract

Environmental Issues/Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
Complaints due to project-related impacts	CPUC's PMU and the contractors will: (i) establish the approved project's grievance redress mechanism (GRM); (ii) publicize the existence of the project's GRM through public awareness campaigns, website, billboards, public notifications, etc.; (iii) ensure that the names and contact numbers of representatives of the contractors and CPUC's PMU are placed on notice boards at agreed locations and/or website.	Part of contractors' bid cost	Contractor and CPUC's PMU	CPUC's PMU	Consultation meetings; specific provisions in tender documents on nuisance & problems to public;	Verify meetings documentation; Verify tender documents; verify the in-placed CACs/ after completion of meetings, once after tender documents prepared	CPUC PMU Cost
Disruption of utilities and services	CPUC and the contractors will: (i) coordinate with the other utilities companies regarding the potential disruptions; (ii) make provisions to preserve the operation of current facilities, and (iii) affected households and establishments will be notified well in advance of such disruptions.	Part of contractors' bid cost	Contractor and CPUC's PMU	CPUC's PMU	Contractor's coordination with the other utility companies; notification of affected households and establishments	Verify contractor's coordination meetings and notifications/ after completion of meetings and notifications	CPUC PMU Cost
Disposal of excavation spoils	The PMU will if required: (i) require the contractors to submit a plan for the disposal of excess excavation spoils, and (ii) undertake inspection and approval of the contractors' suggested disposal sites prior to actual construction.	Part of contractor's bid cost	Contractor	CPUC PMU	Contractor's disposal plan for excess excavation spoils	PMU disposal sites' inspection/ after contractor's submittal	CPUC PMU Cost

Environmental Issues/Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
Potential damage to unknown archaeological and cultural assets	Tender documents and construction contact will include a provision that will: (i) require construction activities to be stopped immediately upon discovery of any unknown archaeological and cultural assets; and (ii) the contractor will promptly inform the local authorities and the Chuuk State National Museum	Part of contractor's bid cost	Contractor	CPUC PMU	Specific provision in tender documents on archeological/ cultural relics	Verify tender documents/ once after tender documents prepared	CPUC PMU Cost
CONSTRUCTION							
Soil erosion and sediment loss from construction sites	The contractor will divert surface runoffs away from the exposed areas and prevent sediments from moving offsite. Measures may include, as appropriate for site conditions: (i) small interceptor dikes, (ii) pipe slope drains, (iii) grass bale barriers, (iv) silt fence, (v) sediment traps, and (vi) temporary sediment basins; total exposed area will be minimized as the conditions allow.	Part of contractors' bid cost	Contractor	CPUC PMU	Disturbed sites; use of appropriate sediment controls	Visual inspection of sites; plans verification/ daily during rainy periods	CPUC PMU Cost
Extraction of local construction materials	The contractor will provide sufficient information on the quarries and borrow pits to be used including commercial sources; The following will be required for quarries and borrow pits: (i) only licensed	Part of contractors' bid cost	Contractor	CPUC PMU	Government permits or approvals of quarries and borrow pits; operational plan; drainage	Verification of material supply through dockets, inspection of stockpiles on establishment and at least	As per contractor's contract

Environmental Issues/Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	quarries will be used or the contractor will obtain its own licenses (ii) borrow pits will be covered by required government permits or approvals, (iii) will not be located within 300 meters of any urban area sensitive receptors,(iv) topsoil will be saved for rehabilitation during closure of the quarries and borrow pits, (v) will be provided with drainage and sediment flow controls, and (vi) closure will include fencing and placement of warning sign to the public. An earthworks permit will be collected from the Chuuk State EPA.				and sediment flow controls; tops soil management	weekly	
Oil and other hazardous materials releases.	To prevent accidental releases, where required, the contractors will implement the following: (i) provide, if required, maintenance shops, fuel and oil depot with impermeable flooring with sump where wash water and sludge can be collected for proper disposal; (ii) refueling and servicing of equipment should only be carried out in specified areas adequately equipped to avoid leaks and spills that could contaminate soil and water resources; (iii) chemicals, hazardous substances and fuel will be stored on-site within an	Part of contractors' bid cost	Contractor	CPUC PMU	Measures required to prevent accidental releases; measures for clean-up and handling of contaminated materials; training records of personnel for hazardous materials; records of accidental releases	Visual inspection of sites; records verification/ daily	CPUC PMU cost

Environmental Issues/Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	enclosed and covered secure area that has an impervious floor and impervious bund around it, (iv) storage area will be located away from water-courses, flood-prone areas and danger areas, (v) equipment maintenance areas and fuel storage areas will be provided with drainage leading to an oil-water separator that will be regularly skimmed of oil and maintained to ensure efficiency; (vi) regularly check containers for leakage and undertake necessary repair or replacement; (vii) store hazardous materials above flood level; (viii) ensure all storage containers are in good condition with proper labeling; and (ix) store waste oil, used lubricant and other hazardous wastes in tightly sealed containers to avoid contamination of soil and water resources; Measures for clean-up and handling of contaminated materials include: (i) undertake immediate clean-up of spills, (ii) oil stained wastes and used oil should be collected and disposed of through recyclers / authorized waste handlers and disposal in authorized waste facilities; (iii) ensure availability of spill cleanup materials such as absorbent pads, (iv)						

Environmental Issues/Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	restoration of temporary work sites will include removal, treatment, and proper disposal of oil contaminated soils, (v) discharge of oil contaminated water into the environment will be prohibited; and (vi) construction personnel designated to handle of fuels/hazardous substances will be trained particularly in spill control procedures.						
Onsite dust due to constructio n activities	The contractor will be required to do the following: (i) regular water spraying of roads, work areas and other construction-related facilities to minimize dust generation; (ii) construction materials stockpiles and spoils with potential for significant dust generation to be covered or sprayed with water, as appropriate, to prevent fine materials from being blown; (iii) prohibit use of equipment and vehicles that emit dark sooty emissions; (iv) hauling trucks transporting loose construction materials such as sand, gravel, and spoils to be provided with tight tarpaulin cover or other suitable materials to avoid spills and dust emission; and (v) prohibit burning of all types of wastes generated at the construction sites, as well as other project-	Part of contractors' bid cost	Contractor	CPUC PMU	Dust generation, water spraying, cover of stockpiles, smoke emitting equipment, open burning of materials	Visual inspection of sites/daily	CPUC PMU cost

Environmental Issues/Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	related facilities and activities.						
Solid waste manageme nt	The contractor will be required to: (i) provide garbage bins and facilities within the project site for temporary storage of construction waste and domestic solid waste; (ii) separate solid waste into hazardous, non-hazardous and reusable waste streams and store temporarily on-site in secure facilities with weatherproof flooring and roofing; (iii) ensure that wastes are not haphazardly dumped within the project site and adjacent areas; (iv) regular disposal of wastes to the local Landfill; (v) prohibit burning of all types of wastes; (vi) remove the construction wastes from the sites after work completion, and (vii) implement the required restoration of disturbed sites The CEMP shall contain a waste management plan and describing all waste types, amounts, disposal method, transport documentation requirements, and details of licensed waste treatment/recycling facilities for each waste stream.	Part of contractors' bid cost	Contractor	CPUC's PMU	Construction wastes, waste separation, temporary on-site waste storage, regular disposal records, surplus materials not removed upon completion	Visual inspection of sites/ daily	As per contractor's contract

Environmental Issues/Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
Construction noise and vibration	The contractor will control noise generation from their activities near residential areas. The contractor will: (i) provide prior notification to the community on schedule of construction activities; (ii) provide noisy equipment with noise reduction covers whenever applicable; (iii) position stationary equipment that produce elevated noise levels, such as diesel generators and air compressors, as far as practicable from houses and other receptors; (iv) prohibit operation of noisy equipment and construction works in populated areas and where sensitive receptors are found during nighttime (19:00 – 06:00); (v) make prior notification and consultation with the affected people and local officials for necessary nighttime operation; (vi) locate concrete batching plant, and rock crushing plant at a reasonable distance away from inhabited areas and sensitive receptors; and (vii) conduct regular noise level monitoring to determine compliance with WHO guidelines for noise which should not to exceed 55 dB(A) near residential areas during daytime and 45 dB(A) for nighttime	Part of contractors' bid cost	Contractor	CPUC's PMU	Noise levels not to exceed 55 dB(A) near residential areas during daytime and 45 dB(A) for nighttime; noisy equipment not to be operated between 19:00 – 06:00hrs; regular noise level monitoring by contractor	Use of sound levels meter; visual inspection of sites/daily	As per contractor's contract

Environmental Issues/Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
Vehicular traffic congestion and hindrance to public access	The contractor will: (i) prepare a traffic plan and provide traffic management personnel to direct the flow of traffic in the vicinity of the construction sites and construction-related facilities; (ii) closely coordinate with local authorities for any closure of roads or rerouting of vehicular traffic; (iii) provide traffic signs in the vicinity of the construction sites to direct motorists and pedestrians; and (iv) minimize disruption to local activities by timing the construction activities with consideration to the schedules of festivities, processions, parades, etc.	Part of contractors' bid cost	Contractor	CPUC's PMU	Contractor's traffic plan and traffic management personnel; traffic signs in vicinity of construction sites; contractor's work schedule related to festivities, processions, parades, etc.	Traffic plans verification; visual inspection of sites/daily	CPUC PMU
Community health and safety	The contractor will: (i) use barriers and install signage to keep the public away from constructions sites and excavation sites; (ii) provide security personnel in hazardous areas to restrict public access; (iii) operate construction night light at the vicinity of construction sites; and (iv) whenever necessary, provide adequate safe passageways for the public crossing the construction sites whose access to properties, establishments, etc. has been disrupted or blocked by the ongoing construction	Part of contractors' bid cost	Contractor	CPUC's PMU/ Contractor	Work sites safety plan; warning signs, barricades, and night lamps for open excavations, lighting system for nighttime operations; adequate safe passageways for the public crossing the construction sites. All aspects of the labor influx management	Work sites safety plan verification; visual inspection of sites/ daily/weekly All aspects of the labor influx management plan. visual inspection of sites/ daily/weekly	As per contractor's contract/ CPUC PMU Cost

Environmental Issues/Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	activities. A labor influx plan will be required from the contractor to address amongst others: (i) Measures to minimize contact with residents to prevent the risk of spread of communicable diseases including STI's and HIV. (ii) induction of all workers on Project requirements regarding safeguards (including child protection), GRM and CCP requirements; (iii)agreement to and implementation of protocols (including code of conduct) concerning the workers contact with the local communities; (iv) ensuring that sufficient water supply and temporary sanitation facilities are provided for workers at work sites in order that community infrastructure is not over- burdened; (v)security at contractor's yard to control unauthorized access and prevent entry of the public (especially children).				plan.		
Occupational health and safety at work sites	The contractor will implement good practices of occupational health and safety at the construction sites by: (i) implementing a construction site health and safety management plan	Part of contractors bid cost	Contractor	CPUC PMU	Health and safety plan; first aid station; PPE, sanitation, facilities; fire-fighting	Health and safety, plan verification; visual inspection of sites/ daily/weekly	As per contractor's contract

Environmental Issues/Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	(CSHSMP), (ii) ensuring that an equipped first aid station is available at all times, (iii) providing the workers with potable water and adequate sanitation facilities, (iv) providing the workers with personal protective equipment (PPE) to minimize exposure to a variety of hazards, and (v) providing firefighting equipment and fire extinguishers in workshops, fuel storage facilities, and any sites where fire hazard and risk are present.				equipment and fire extinguishers		
Monitoring and Reporting	During the pre-construction phase any gaps in the baseline will be filled. It is in the pre-construction phase where requirements for environmental monitoring in the construction phase can be legally required by placing specific provisions on environmental monitoring in the: (i) project specifications, (ii) bidding documents, and (iii) construction contracts. Relevant aspects of each subproject's EMP shall be incorporated in these documents. The PMU shall verify if these aspects are incorporated in the said documents first during submission of the draft documents and later during submission of the draft final documents.	Part of specs preparation cost	Contractor	CPUC's PMU	Specific provisions on environmental monitoring in the: (i) project specifications, (ii) bidding documents, and (iii) construction contracts.	Verify that these aspects are incorporated in the said documents during submission of the draft documents and later during submission of the draft final documents.	As per contractor's contract

Environmental Issues/Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
OPERATIONS							
Public health risk due to unplanned outages and emergencies of the sewerage system	Mitigations include: (i) identification of potential causes of unplanned outages and emergencies shall be conducted during operation of the sewerage system and updated as necessary; (ii) written management procedures for unplanned outages and emergencies as required by the sewerage safety plan implementation; (iii) regular inspection and maintenance of the backup power supplies and pumping stations to ensure uninterrupted operation during power failure; (iv) regular inspection and maintenance of pumping systems and emergency backup systems to ensure that these are in good working conditions; (v) written standard operating procedures manual to be available at the facilities to provide guidance to the sewerage system's staff on how to handle unplanned outages and emergencies; (vi) regular training of sewerage system's staff on how to handle unplanned outages and emergencies.	Part of CPUC's operational cost	CPUC's operations personnel	CPUC's Operations Dept. Mgt.	Written management procedures for unplanned outages and emergencies (per sewerage ; schedule of inspection and maintenance of pumping systems, emergency backup systems and automatic transfer of the backup power supplies at the sewerage pumping stations; plan for unplanned outages and emergencies; training of sewerage system's staff; unplanned outages and emergencies	Verify regular inspection and maintenance/ weekly; verify implementation of operating procedures manual/ weekly;	Visual inspection

Table 18: Environmental Mitigation and Monitoring Plan of Wichen River WTP Upgrade Project

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
PRECONSTRUCTION							
Climate change vulnerability of Wichen WTP Upgrade	Climate change adaptation measures are: (i) results of engineering assessment on potential site erosion of the Wichen River WTP Upgrade to be used as the basis for climate change adaptation considerations;	Part of detailed design cost	Contractor	CPUC's PMU	Engineering drawings and specifications considered climate change adaptation features	Verify engineering drawings and specifications/ once	As per contractor's contract
Implementation of the Wichen River WTP Upgrade Project's EMP	Tender documents and construction contract of the Wichen River WTP Upgrade will include provisions that will: (i) require the contractors to prepare their respective Contractor's Environmental Management Plan (CEMP) prior to the start of the construction activities with details of staff, resources, implementation schedules, as well as monitoring and reporting procedures; (ii) issue a CEMP framework as guidance for the contractor in preparing a CEMP as part of his bid proposal; and (iii) require the Owner's Engineer to review and approve the CEMP prior to site mobilization.	Part of contractors' bid cost	Contractor	CPUC's PMU	CEMP prepared by contractors	CEMP submittal by contractors to PMU Project Manager prior to commencement of site works	CPUC PMU cost

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
Complaints due to project-related impacts	CPUC's PMU and the contractors will: (i) establish the approved project's grievance redress mechanism (GRM); (ii) publicize the existence of the project's GRM through public awareness campaigns, public notifications, etc. (iii) ensure that the names and contact numbers of representatives of the contractors and CPUC's PMU are placed on notice boards at agreed locations and/or website.	Part of contractors' bid cost	Contractor and CPUC's PMU	CPUC's PMU	Consultation meetings; specific provisions in tender documents on nuisance & problems to public; GRM activated with community advisory committees (CACs) created	Verify meetings documentation; Verify tender documents; verify the in-placed CACs/ after completion of meetings, once after tender documents prepared	CPUC PMU cost
Disruption of utilities and services	CPUC and the contractors will: (i) coordinate with the other utilities companies regarding the potential disruptions; (ii) make provisions to preserve the operation of current facilities, and (iii) affected households and establishments will be notified well in advance of such disruptions.	Part of contractors' bid cost	Contractor and CPUC's PMU	CPUC's PMU	Contractor's coordination with the other utility companies; notification of affected households and establishments	Verify contractor's coordination meetings and notifications/ after completion of meetings and notifications	CPUC PMU cost

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
Disposal of excavation spoils	The owner's Engineer will: (i) require the contractors to submit a plan for the disposal of excess excavation spoils, and (ii) undertake inspection and approval of the contractors' suggested disposal sites prior to actual construction.	Part of Contractor's cost	Contractor	CPUC's PMU	Contractor's disposal plan for excess excavation spoils	PMU sites' inspection/ after contractor's submittal	CPUC PMU cost
Potential damage to unknown archaeological and cultural assets	Tender documents and construction contact will include a provision that will: (i) require construction activities to be stopped immediately upon discovery of any unknown archaeological and cultural assets; and (ii) the contractor will promptly inform the local authorities and the Chuuk State National Museum about the presence.	Part of specs preparation cost	Contractor	CPUC's PMU	Specific provision in tender documents on archeological/ cultural relics	Verify tender documents/ once after tender documents prepared	CPUC PMU cost
CONSTRUCTION							
Soil erosion and sediment of construction sites	The contractor will divert surface runoff away from exposed areas and prevent sediments from moving offsite. Measures may include, as appropriate for site conditions: (i) small interceptor dikes, (ii) pipe	Part of contractors' bid cost	Contractor	CPUC's PMU	Disturbed sites; use of appropriate sediment controls	Visual inspection of sites; plans verification/ daily during rainy periods	CPUC PMU cost

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	slope drains, (iii) grass bale barriers, (iv) silt fence, (v) sediment traps, and (vi) sediment basins; total exposed area temporary will be minimized as the conditions allow.						
Extraction of local construction materials	The contractor will provide sufficient information on the quarries and borrow pits to be used including commercial sources; The following will be required for quarries and borrow pits: (i) only licensed quarries will be used or the contractor will obtain its own licenses (ii) borrow pits will be covered by required government permits or approvals, (iii) will not be located within 300 meters of any urban area sensitive receptors, (iv) topsoil will be saved for rehabilitation during closure of the quarries and borrow pits, (v) will be provided with drainage and sediment flow controls.	Part of contractors' bid cost	Contractor	CPUC's PMU	Government permits or approvals of quarries and borrow pits; operational plan; drainage and sediment flow controls; topsoil management.	Visual inspection of sites; plans verification/ weekly	CPUC PMU cost

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
Oil and other hazardous materials releases.	To prevent accidental releases, the contractors will, as required, implement the following: (i) provide maintenance shops, fuel and oil depot with impermeable flooring with sump where wash water and sludge can be collected for proper disposal; (ii) refueling and servicing of equipment should only be carried out in specified areas adequately equipped to avoid leaks and spills that could contaminate soil and water resources; (iii) chemicals, hazardous substances and fuel will be stored on-site within an enclosed and covered secure area that has an impervious floor and impervious bund around it, (iv) storage area will be located away from water-courses, flood-prone areas, and danger areas, (v) equipment maintenance areas and fuel storage areas will be provided with drainage leading to an oil-water separator that will be regularly skimmed of oil and maintained to ensure efficiency; (vi) regularly check containers for leakage and undertake necessary repair or replacement; (vii) store hazardous materials above flood level; (viii) ensure all	Part of contractors' bid cost	Contractor	CPUC's PMU	Measures required to prevent accidental releases; measures for clean-up and handling of contained materials; training records of personnel for hazardous materials; records of accidental releases.	Visual inspection of sites; records verification/ daily/weekly	CPUC PMU cost

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	storage containers are in good condition with proper labeling; and (ix) store waste oil, used lubricant and other hazardous wastes in tightly sealed containers to avoid contamination of soil and water resources; Measures for clean-up and handling of contaminated materials include: (i) undertake immediate clean-up of spills, (ii) oil stained wastes and used oil should be collected and disposed of through recyclers / authorized waste handlers and disposal in authorized waste facilities; (iii) ensure availability of spill cleanup materials such as absorbent pads, (iv) restoration of temporary work sites will include removal, treatment, and proper disposal of oil contaminated soils, (v) discharge of oil contaminated water into the environment will be prohibited; and (vi) construction personnel designated to handle of fuels/hazardous substances will be trained particularly in spill control procedures.						

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
On-site dust control due to construction activities	The contractor will be required to do the following: (i) regular water spraying of roads and work areas to minimize dust generation; (ii) construction materials stockpiles and spoils with potential for significant dust generation to be covered or sprayed with water, (ii) hauling trucks transporting loose construction materials such as sand, gravel, and spoils to be provided with tarpaulin cover or other suitable materials to avoid spills and dust emission; and (iv) prohibit burning of all types of wastes generated at the construction sites, as well as other project-related facilities and activities.	Part of contractors' bid cost	Contractor	CPUC's PMU	Dust generation, water spraying, cover of stockpiles, smoke emitting equipment, open burning of materials	Visual inspection of sites/ daily	CPUC PMU cost
Solid waste management	The contractor will, as required, (i) provide garbage bins and facilities within the project site for temporary storage of construction waste and domestic solid waste; (ii) separate solid waste into hazardous, non- hazardous and reusable waste streams and store temporarily on-site in secure facilities; (iii) ensure that wastes are not haphazardly dumped within the project	Part of contractors' bid cost	Contractor	CPUC's PMU	Construction wastes; waste separation, temporary on-site waste storage, regular disposal records, surplus materials not removed upon completion	Visual inspection of sites/ daily	CPUC PMU cost

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	site and adjacent areas; (iv) regular disposal of wastes to the local Landfill; (v) prohibit burning of all types of wastes; (vi) remove the construction wastes from the sites after work completion, and (vii) implement the required restoration of disturbed sites. The CEMP shall contain a waste management plan describing all waste types, amounts, disposal method, transport documentation requirements, and details of licensed waste treatment.						
Construction noise and vibration	The contractor will reduce noise generation from their activities near residential areas by (i) providing prior notification to the community on schedule of construction activities;(ii) providing noisy equipment with noise reduction covers whenever applicable; (iii) position stationary equipment that produce elevated noise levels, such as diesel generators and air compressors, as far as practicable from houses	Part of contractors' bid cost	Contractor	CPUC's PMU	Noise levels not to exceed 55 dB(A) near residential areas during daytime and 45 dB(A) for nighttime; noisy equipment not to be operated between 19:00 – 06:00hrs; regular noise level monitoring by	Use of sound levels meter; visual inspection of sites/ daily	CPUC PMU cost

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	and other receptors; (iv) prohibit operation of noisy equipment and construction works in populated areas and where sensitive receptors are found during nighttime (19:00 – 06:00); (v) make prior notification and consultation with the affected people and local officials for necessary nighttime operation; (vi) locate concrete batching plant, and rock crushing plant at a reasonable distance away from inhabited areas and sensitive receptors; and (vii) conduct regular noise level monitoring to determine compliance with WHO guidelines for noise which should not to exceed 55 dB(A) near residential areas during daytime and 45 dB(A) for nighttime				contractor		
Vehicular traffic congestion and hindrance to public access	The contractor to: (i) prepare a traffic plan and provide traffic management personnel to direct the flow of traffic in the vicinity of the construction sites and construction-related facilities; (ii) closely coordinate with local authorities for any closure	Part of contractors' bid cost	Contractor	CPUC's PMU	Contractor's traffic plan and traffic management personnel; traffic signs in vicinity of construction sites; contractor's	Traffic plans verification; visual inspection of sites/ daily	CPUC PMU cost

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	of roads or rerouting of vehicular traffic; (iii) provide traffic signs in the vicinity of the construction sites to direct motorists and pedestrians; and (iv) minimize disruption to local activities by timing the construction activities with consideration to the schedules of festivities, processions, parades, etc.				work schedule related to festivities, processions, parades, etc.		
Community health and safety	The contractor will: (i) use barriers and install signage to keep the public away from constructions sites and excavation sites; (ii) provide security personnel in hazardous areas to restrict public access; (iii) operate construction night light at the vicinity of construction sites; and (iv) whenever necessary, provide adequate safe passageways for the public crossing the construction sites whose access to properties, establishments, etc. has been disrupted or blocked by the ongoing construction activities	Part of contractors' bid cost	Contractor	CPUC's PMU	Work sites safety plan; warning signs, barricades, and night lamps for open excavations, lighting system for nighttime operations; adequate safe passageways for the public crossing the construction sites	Work sites safety plan verification; visual inspection of site/ daily	CPUC PMU cost

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
Potential social issues due to influx of imported workers	Measures include: (i) induction of the workers on requirements of the project's regarding community health and safety, grievance redress mechanism, and consultation and communications plan; (ii) implementation of protocols concerning the workers contact between the local communities; (iii) implementation of a communicable disease awareness and prevention program on the risk of disease spreading including sexually transmitted diseases and HIV and (iv) contractor's yard will be secured by a fence and provided with warning signs to control unauthorized access and prevent entry of the public.	Part of contractors' bid cost	Contractor	CPUC's PMU	Check implement of workers inducti required protocol, awareness and prevention progra the risk of disease spreading	Records verification and visual inspection at start of work and monthly	CPUC PMU cost
Construction monitoring.	Contractors are expected to implement the relevant aspects of each project's EMP as per their approved CEMP during execution of the construction activities as stipulated in their contracts. The contractors' CEMP will detail the monitoring plan (based on the subproject EMP) with details on staff, resources, implementation schedules, and monitoring	Part of contractors' bid cost	Contractor	CPUC's PMU	CEMP	Visual inspection of sites/daily	As per contractor's contract

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	procedures (parameters, frequency etc).						
Reporting.	Overall, the Project will establish a system of reporting. The contractor will prepare monthly reports which will include a section on compliance with the approved CEMP, corrective actions, training and the like. This will also record any grievances lodged and project communications undertaken by the contractor. The PMU will review and consolidate information from the monthly reports of all subprojects. The quarterly progress report (QPR) prepared by the PMU will include a section on safeguards implementation summarizing the monthly reports (including training and capacity development activities).	Part of contractors' bid cost	Contractor	CPUC's PMU	Data collected from inspections, GRM, training reports, monthly reports, quarterly summary reports by PMU	Visual inspection of sites/ daily	As per contractor's contract

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
Occupational health and safety at work sites	The contractor will implement good practices of occupational health and safety at the construction sites by: (i) implementing health and safety management plan (HSP), (ii) ensuring that an equipped first aid station is available at all times, (iii) providing the workers with potable water and adequate sanitation facilities, (iv) providing the workers with clean eating areas, (v) providing the workers with personal protective equipment (PPE) to minimize exposure to a variety of hazards, and (vi) providing fire-fighting equipment and fire extinguishers in workshops, fuel storage facilities, and any sites where fire hazard and risk are present.	Part of contractors' bid cost	Contractor	CPUC's PMU	Health and safety plan; first aid station; PPE, sanitation facilities; fire-fighting equipment and fire extinguishers	Health and safety plan verification; visual inspection of sites/weekly	CPUC PMU Cost
OPERATIONS							
Health hazard due to delivery of poor water quality	CPUC will implement its updated water safety plan as advocated by the WHO to: (i) prevent contamination of the water sources, (ii) treat the water to reduce or remove contamination that could be present and meet the water	Part of CPUC's operational cost	CPUC's Operations Dept.	CPUC's Operations Dept. Mgt	Water safety plan implemented	Verify water safety plan implementation. water sampling and laboratory test/monthly for bacteria. annual	Part of CPUC's operational cost

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	quality targets, and (iii) prevent re-contamination during storage, distribution and handling of drinking water.					for physical and chemical	
Wichen River WTP Upgrade operational risk and safety	Measures to reduce the operational risk and safety of WTP include: (i) workers will be trained on health and safety aspects of operating a WTP; (ii) a facility health and safety manual will be prepared to address the prevention, reduction and control of occupational injury and illness. The manual will among others: clearly identify conditions that may cause acute workers health and safety problems, specify requirements that all workers should comply during normal operations and emergency situations, and specify training requirements for health and safety; (iii) reduce the risks associated with the use of chlorine gas as disinfectant by observing the following chlorine gas cylinders will be kept in separate safety rooms and equipped with fully automated chlorine gas shutoff system, establish a system for the safe use and handling of chlorine materials in the workplace,	Part of CPUC's operational cost	CPUC's Operations Dept.	CPUC's Operations Dept. Mgt	Use of facility health and safety manual, chlorine handling procedures, workers' PPE for chlorine use and handling, facility fence	Visual inspection; records verification/ weekly	Visual inspection

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	and provide the workers with the appropriate PPE for chlorine use and handling; and (iv) provide the facility with a five-foot- high fence to control access and avoid exposing the public to any hazard due to the presence of the water supply tank						
Public health risk due to unplanned outages and emergencies of the water supply system	Mitigations include: (i) identification of potential causes of unplanned outages and emergencies shall be conducted during operation of the water supply system and updated as necessary; (ii) written management procedures for unplanned outages and emergencies as required by the water safety plan implementation (advocated by WHO); (iii) regular inspection and maintenance of the backup power supplies and the associated Automatic Transfer Switch (ATS) of the backup power supplies at the water pumping stations to ensure uninterrupted operation during power failure; (iv) regular inspection and maintenance of pumping systems and emergency backup systems to ensure that these are in good working conditions; (v)	Part of CPUC's operational cost	CPUC's Operations Dept.	CPUC's Operations Dept. Mgt	Written management procedures for unplanned outages and emergencies (per water safety plan); schedules of inspection and maintenance of pumping systems, emergency backup systems, and automatic transfer of the backup power supplies at the water pumping stations; standard operating procedures manual for unplanned outages and	Verify regular inspection and maintenance/ weekly; verify implementation of operating procedures manual/ weekly; verify implementation of water supply flushing and disinfection plan/ after incidents	Visual inspection

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementation	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	implement flushing and disinfection, as necessary, during unplanned outages and emergencies to prevent microbial contamination of the water supply system; (vi) written standard operating procedures manual to be available at the facilities to provide guidance to the water supply system's staff on how to handle unplanned outages and emergencies; (vii) regular training of water supply system's staff on how to handle unplanned outages and emergencies.				emergencies; flushing and disinfection plan for unplanned outages and emergencies; training of water supply system's staff; unplanned outages and emergencies		

Table 19: Environmental Mitigation and Monitoring Plan for Upgraded Bore Fields at Wichap to Epinup and Weno Consolidation.

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementatio	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
PRE-CONSTRUCTION							
Climate change vulnerability of Borefield sites	Climate change adaptation measures are: (i) results of engineering assessment on potential site erosion at the borefield sites .	Part of detailed design cost	Contractor	CPUC's PMU	Engineering drawings and specifications considered climate change adaptation features	Verify engineering drawings and specifications	CPUC PMU Cost
Implementation of the Borefield rehabilitation program and the project's EMP	Tender documents and construction contract of the Borefield rehabilitation works will include provisions that will: (i) require the contractors to prepare their respective Contractor's Environmental Management Plan (CEMP) prior to the start of the construction activities with details of staff, resources, implementation schedules, as well as monitoring and reporting procedures; (ii) issue a CEMP framework as guidance for the contractor in preparing a CEMP as part of his bid proposal; and (iii) require the PMU to review and approve the CEMP prior to site mobilization.	Part of contractors' bid cost	Contractor	CPUC's PMU	CEMP prepared by contractors	CEMP submittal by contractors to PMU/ prior to commencement of site works	To be undertaken as per contractor's contract

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementatio	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
Complaints due to project-related impacts	CPUC's PMU and the contractors will: (i) establish the approved project's grievance redress mechanism (GRM); (ii) publicize the existence of the project's GRM through public awareness campaigns, website, billboards, public notifications, etc; (iii) ensure that the names and contact numbers of representatives of the contractors and CPUC's PMU are placed on notice boards at agreed locations and/or website.	Part of contractors' bid cost	Contractor and CPUC's PMU	CPUC's PMU	Consultation meetings; specific provisions in tender documents on nuisance & problems to public;	Verify meetings documentation; verify tender documents; verify the in-placed CACs/ after completion of meetings, once after tender documents prepared.	CPUC PMU Cost
Disruption of utilities and services	CPUC and the contractors will: (i) coordinate with the other utilities companies regarding the potential disruptions; (ii) make provisions to preserve the operation of current facilities, and (iii) affected households and establishments will be notified well in advance of such disruptions.	Part of contractors' bid cost	Contractor and CPUC's PMU	CPUC's PMU	Contractor's coordination with the other utility companies; notification of affected households and establishments	Verify contractor's coordination meetings and notifications/ after completion of meetings and notifications.	CPUC PMU Cost
Disposal of excavation spoils	The PMU will: (i) require the contractors to submit a plan for the disposal of excess excavation spoils, and (ii) undertake inspection and approval of	Part of contractor's bid cost	Contractor	CPUC PMU	Contractor's disposal plan for excess excavation spoils	PMU disposal sites' inspection/ after contractor's submittal	CPUC PMU Cost

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementatio	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	the contractors' suggested disposal sites prior to actual construction						
Potential damage to unknown archaeological and cultural assets	Tender documents and construction contact will include a provision that will: (i) require construction activities to be stopped immediately upon discovery of any unknown archaeological and cultural assets; and (ii) the contractor will promptly inform the local authorities and the Chuuk State National Museum about the presence	Part of contractor's bid cost	Contractor	CPUC PMU	Specific provision in tender documents on archeological / cultural relics	Verify tender documents/ once after tender documents prepared	CPUC PMU Cost
CONSTRUCTION							
Soil erosion and sediment loss from construction sites	The contractor will divert surface runoffs away from the exposed areas and prevent sediments from moving offsite. Measures may include, as appropriate for site conditions: (i) small interceptor dikes, (ii) pipe slope drains, (iii) grass bale barriers, (iv) silt fence, (v) sediment traps, and (vi) temporary sediment basins; total exposed area will be minimized as the conditions allow.	Part of contractors' bid cost	Contractor	CPUC PMU	Disturbed sites; use of appropriate sediment controls	Visual inspection of sites; plans verification/ daily during rainy periods	CPUC PMU Cost

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementatio	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
Oil and other hazardous materials releases.	To prevent accidental releases, where required, the contractors will implement the following: (i) provide, if required, maintenance shops, fuel and oil depot with impermeable flooring with sump where wash water and sludge can be collected for proper disposal; (ii) refueling and servicing of equipment should only be carried out in specified areas adequately equipped to avoid leaks and spills that could contaminate soil and water resources; (iii) chemicals, hazardous substances and fuel will be stored on-site within an enclosed and covered secure area that has an impervious floor and impervious bund around it, (iv) storage area will be located away from water-courses, flood-prone areas and danger areas, (v) equipment maintenance areas and fuel storage areas will be provided with drainage leading to an oil-water separator that will be regularly skimmed of oil and maintained to ensure efficiency; (vi) regularly check containers for leakage and undertake necessary repair or replacement; (vii)	Part of contractors' bid cost	Contractor	CPUC PMU	Measures required to prevent accidental releases; measures for clean-up and handling of contaminated materials; training records of personnel for hazardous materials; records of accidental releases	Visual inspection of sites; records verification/ daily	CPUC PMU cost

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementatio	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	store hazardous materials above flood level; (viii) ensure all storage containers are in good condition with proper labeling; and (ix) store waste oil, used lubricant and other hazardous wastes in tightly sealed containers to avoid contamination of soil and water resources; Measures for clean-up and handling of contaminated materials include: (i) undertake immediate clean-up of spills, (ii) oil stained wastes and used oil should be collected and disposed of through recyclers / authorized waste handlers and disposal in authorized waste facilities; (iii) ensure availability of spill cleanup materials such as absorbent pads, (iv) restoration of temporary work sites will include removal, treatment, and proper disposal of oil contaminated soils, (v) discharge of oil contaminated water into the environment will be prohibited; and (vi) construction personnel designated to handle of fuels/hazardous substances will be trained particularly in spill control procedures.						

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementatio	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
On-site dust due to construction activities	The contractor will be required to do the following: (i) regular water spraying of roads, work areas and other construction-related facilities to minimize dust generation; (ii) construction materials stockpiles and spoils with potential for significant dust generation to be covered or sprayed with water, as appropriate, to prevent fine materials from being blown; (iii) prohibit use of equipment and vehicles that emit dark sooty emissions; (iv) hauling trucks transporting loose construction materials such as sand, gravel, and spoils to be provided with tight tarpaulin cover or other suitable materials to avoid spills and dust emission; and (v) prohibit burning of all types of wastes generated at the construction sites, as well as other project-related facilities and activities	Part of contractors' bid cost	Contractor	CPUC PMU	Dust generation, water spraying, cover of stockpiles, smoke emitting equipment, open burning of materials	Visual inspection of sites/ daily	CPUC PMU cost
Solid waste manage ment	The contractor will be required to: (i) provide garbage bins and facilities within the project site for temporary storage of	Part of contractors' bid cost	Contractor	CPUC's PMU	Construction wastes, waste separation, temporary	Visual inspection of sites/daily	As per contractor's contract

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementatio	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	construction waste and domestic solid waste; (ii) separate solid waste into hazardous, non-hazardous and reusable waste streams and store temporarily on-site in secure facilities with weatherproof flooring and roofing; (iii) ensure that wastes are not haphazardly dumped within the project site and adjacent areas; (iv) regular disposal of wastes to the local Landfill; (v) prohibit burning of all types of wastes; (vi) remove the construction wastes from the sites after work completion, and (vii) implement the required restoration of disturbed sites. The CEMP shall contain a waste management plan and describing all waste types, amounts, disposal method, transport documentation requirements, and details of licensed waste treatment/recycling facilities for each waste stream.				on- site waste storage, regular disposal records, surplus materials not removed upon completion		
Construct ion noise and vibration	The contractor will control noise generation from their activities near residential areas. The contractor will: (i) provide prior notification to the community on schedule of construction activities; (ii)	Part of contractors' bid cost	Contractor	CPUC's PMU	Noise levels not to exceed 55 dB(A) near residential areas during daytime and 45 dB(A) for	Use of sound levels meter; visual inspection of sites daily	As per contractor's contract

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementatio	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	provide noisy equipment with noise reduction covers whenever applicable; (iii) position stationary equipment that produce elevated noise levels, such as diesel generators and air compressors, as far as practicable from houses and other receptors; (iv) prohibit operation of noisy equipment and construction works in populated areas and where sensitive receptors are found during nighttime (19:00 – 06:00); (v) make prior notification and consultation with the affected people and local officials for necessary nighttime operation; (vi) locate concrete batching plant, and rock crushing plant at a reasonable distance away from inhabited areas and sensitive receptors; and (vii) conduct regular noise level monitoring to determine compliance with WHO guidelines for noise which should not to exceed 55 dB(A) near residential areas during daytime and 45 dB(A) for nighttime.				nighttime; noisy equipment not to be operated between 19:00–06:00hrs; regular noise level monitoring by contractor		
Vehicular traffic congestion and hindrance to	The contractor will: (i) prepare a traffic plan and provide traffic management personnel to direct the flow of traffic in the vicinity of the	Part of contractors' bid cost	Contractor	CPUC's PMU	Contractor's traffic plan and traffic management personnel;	Traffic plans verification; visual inspection of sites/daily	CPUC PMU

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementatio	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
public access	construction sites and construction-related facilities; (ii) closely coordinate with local authorities for any closure of roads or rerouting of vehicular traffic; (iii) provide traffic signs in the vicinity of the construction sites to direct motorists and pedestrians; and (iv) minimize disruption to local activities by timing the construction activities with consideration to the schedules of festivities, processions, parades, etc.				traffic signs in vicinity of construction sites; contractor's work schedule related to festivities, processions, parades, etc.		
Community health and safety	The contractor will: (i) use barriers and install signage to keep the public away from constructions sites and excavation sites; (ii) provide security personnel in hazardous areas to restrict public access; (iii) operate construction night light at the vicinity of construction sites; and (iv) whenever necessary, provide adequate safe passageways for the public crossing the construction sites whose access to properties, establishments, etc. has been disrupted or blocked by the ongoing construction activities.	Part of contractors' bid cost	Contractor	CPUC's PMU/ Contractor	Work sites safety plan; warning signs, barricades, and night lamps for open excavations, lighting system for nighttime operations; adequate safe passageways for the public crossing the construction sites. All aspects of	Work sites safety plan verification; visual inspection of sites/ daily/weekly. All aspects of the labor influx management plan. visual inspection of sites/ daily/weekly	As per contractor's contract/ CPUC PMU Cost

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementatio	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	A labor influx plan will be required from the contractor to address amongst others: (i) Measures to minimize contact with residents to prevent the risk of spread of communicable diseases including STI's and HIV. (ii) induction of all workers on Project requirements regarding safeguards (including child protection), GRM and CCP requirements; (iii)agreement to and implementation of protocols (including code of conduct) concerning the workers contact with the local communities; (iv) ensuring that sufficient water supply and temporary sanitation facilities are provided for workers at work sites in order that community infrastructure is not over- burdened; (v)security at contractor's yard to control unauthorized access and prevent entry of the public (especially children).				the labor influx management plan.		
Occupational health and	The contractor will implement good practices of occupational health and safety at the construction	Part of contractors bid cost	Contractor	CPUC PMU	Health and safety plan; first aid station; PPE,	Health and safety, plan verification; visual	As per contractor's contract

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementatio	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
safety at work sites	sites by: (i) implementing a construction site health and safety management plan (CSHSMP), (ii) ensuring that an equipped first aid station is available at all times, (iii) providing the workers with potable water and adequate sanitation facilities, (iv) providing the workers with personal protective equipment (PPE) to minimize exposure to a variety of hazards, and (v) providing firefighting equipment and fire extinguishers in workshops, fuel storage facilities, and any sites where fire hazard and risk are present.				sanitation, facilities; firefighting equipment and fire extinguishers	inspection of sites/ daily/weekly	
Monitoring and Reporting	During the pre-construction phase any gaps in the baseline will be filled. It is in the pre-construction phase where requirements for environmental monitoring in the construction phase can be legally required by placing specific provisions on environmental monitoring in the: (i) project specifications, (ii) bidding documents, and (iii) construction contracts. Relevant aspects of each	Part of specs preparation cost	Contractor	CPUC's PMU	Specific provisions on environmental monitoring in the: (i) project specifications, (ii) bidding documents, and (iii) construction contracts.	Verify that these aspects are incorporated in the said documents during submission of the draft documents and later during submission of the draft final documents.	As per contractor's contract

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementatio	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	subproject's EMP shall be incorporated in these documents. The PMU shall verify if these aspects are incorporated in the said documents first during submission of the draft documents and later during submission of the draft final documents.						
OPERATIONS							
Public health risk due to unplanned outages and emergencies of the water supply system	Mitigations include: (i) identification of potential causes of unplanned outages and emergencies shall be conducted during operation of the water supply system and updated as necessary; (ii) written management procedures for unplanned outages and emergencies as required by the water safety plan implementation (advocated by WHO); (iii) regular inspection and maintenance of the backup power supplies and pumping stations to ensure uninterrupted operation during power failure; (iv) regular inspection and maintenance of pumping systems and emergency backup systems to ensure	Part of CPUC's operational cost	CPUC's operations personnel	CPUC's Operations Dept. Mgt.	Written management procedures for unplanned outages and emergencies (per water safety plan); schedule of inspection and maintenance of pumping systems, emergency backup systems and automatic transfer of the backup power supplies at the water pumping stations; standard	Verify regular inspection and maintenance/ weekly; verify implementation of operating procedures manual/ weekly; verify implementation of water supply flushing; and disinfection plant/ after incidents.	Visual inspection

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementatio	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	that these are in good working conditions; (v) implement flushing and disinfection, as necessary, during unplanned outages and emergencies to prevent microbial contamination of the water supply system; (vi) written standard operating procedures manual to be available at the facilities to provide guidance to the water supply system's staff on how to handle unplanned outages and emergencies; (vii) regular training of water supply system's staff on how to handle unplanned outages and emergencies.				operating procedures manual for unplanned outages and emergencies; flushing and disinfection plan for unplanned outages and emergencies; training of water supply system's staff; unplanned outages and emergencies		
Health hazard due to delivery of poor water quality	CPUC will implement its updated water safety plan as advocated by the WHO to: (i) prevent contamination of the water sources, (ii) treat the water to reduce or remove contamination that could be present and meet the water quality targets, and (iii) prevent re-contamination during storage, distribution and handling of drinking water.	Part of CPUC's operational cost	CPUC's Operations Dept.	CPUC's Operations Dept. Mgt	Water safety plan implemented	Verify water safety plan implementation. Water sampling and laboratory test/ monthly for bacteria. Annual for physical & chemical parameters	Part of CPUC's operational cost

Environmental Issues/ Potential Environmental Impact	Proposed Mitigation Measure or Enhancement Measure	Mitigation Cost	Implementatio	Supervision/ Monitoring	Aspects/ Parameters to be monitored	Means of Monitoring/ Frequency	Monitoring Cost
	The Chuuk Environmental Protection Agency (EPA) has the capacity to collect and manage samples and to analyze some water quality parameters (e.g. turbidity, presence of coliforms, conductivity, etc). However, EPA does not have the capacity to conduct more sophisticated laboratory analysis such as BOD, COD, heavy metals, and organic compounds and such tests will need to be undertaken by an accredited laboratory (closest are in Guam, Hawaii, or the Philippines).						

IX. MONITORING AND REPORTING

411. Environmental monitoring is required across all phases of subproject implementation. The monitoring meets two objectives to ensure: (i) that mitigation measures are effective in reducing/managing impacts, and identify corrective actions as required; and (ii) that safeguard requirements are being complied with by the contractor and the implementing agency (on behalf of government).

412. **Pre-construction monitoring**. During the pre-construction phase any gaps in the baseline will be filled. It is in the pre-construction phase where requirements for environmental monitoring in the construction phase can be legally required by placing specific provisions on environmental monitoring in the: (i) project specifications, (ii) bidding documents, and (iii) construction contracts. Relevant aspects of each subproject's EMP shall be incorporated in these documents. The PMU shall verify if these aspects are incorporated in the said documents first during submission of the draft documents and later during submission of the draft final documents

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413. **Construction monitoring**. Contractors are expected to implement the relevant aspects of each project's EMP as per their approved CEMP during execution of the construction activities as stipulated in their contracts. The contractors' CEMP will detail the monitoring plan (based on the subproject EMP) with details on staff, resources, implementation schedules, and monitoring procedures (parameters, frequency etc.).

414. Compliance with the approved CEMP will be the basis for inspections and audits by PMU and the ADB. The BCD will include provisions requiring the contractor to submit their CEMP which will include a section on monitoring which should be linked to allocation of budget and staff for implementation.

415. **Reporting**. Overall, the Project will establish a system of reporting. The contractor will prepare monthly reports which will include a section on compliance with the approved CEMP, corrective actions, training and the like. This will also record any grievances lodged and project communications undertaken by the contractor. The PMU will review and consolidate information from the monthly reports of all subprojects. The quarterly progress report (QPR) prepared by the PMU will include a section on safeguards implementation summarizing the monthly reports (including training and capacity development activities).

416. A semi-annual safeguard monitoring report will be submitted to ADB. This report will be based on the QPR and will include the environmental performance of each subproject/component.

417. **Institutional arrangements**. The Ministry of Finance and Treasury (MOFT) is the executing agency, while CPUC is the implementing agency for the Project. The project steering committee (PSC), is responsible for oversight and providing guidance and strategic direction to CPUC with respect to project implementation. CPUC has established a project management unit (PMU) to prepare and implement the project. The PMU is responsible for overall project management, project delivery, safeguards implementation, and monitoring.

X. CONCLUSION AND RECOMMENDATIONS

418. The project covered in this assessment offer benefits to Weno by ensuring adequate supply of potable water and upgraded sanitation.

419. The environmental screening process has identified and addressed the minor nature of the environmental issues of the proposed projects. All projects are in urban/peri-urban locations which are highly modified. The impacts of works are noted to be site-specific, largely limited to the construction footprint and can be mitigated and managed to acceptable levels provided the measures identified in the IEE and environmental management plan (EMP) are implemented.

420. The contractors will prepare their construction EMP (CEMP) based on the project EMP and detail and reflect their construction methodology and approach to the main construction elements, risk assessment and mitigation measures. The PMU, with support from the construction supervision consultant, will review and clear the CEMP prior to commencement of any physical works including site clearance

421. Based on the potential environmental impacts and risks of the proposed projects, there are no significant negative environmental impacts or risks that cannot be mitigated or managed. Monitoring and reporting of the approved CEMP by the PMU and supervision consultants will ensure that each subproject is implemented in an environmentally acceptable manner.

XI. BIBLOGRAPHY

Auckland City - Overview of the Effects of Residual Flocculants on Aquatic Receiving Environments – TP 226 - www.aucklandcity.govt.nz › documents › technical publications ›

Asian Development Bank. 2017. *Guidelines for climate proofing investment in the water sector: Water supply and sanitation*. Manila.

Asian Development Bank. 2004. Omnibus Infrastructure Development Project. Manila.

Asian Development Bank 2019. Project Readiness Financing Report. Federated States of Micronesia: Preparing the Chuuk Water Supply and Sanitation Project. Manila.

Asian Development Bank 1996. Water Supply and Sanitation Project. Manila

Asian Development Bank 2008. Weno Water Supply Well Remediation Project. Manila

Asian Development Bank 2019. Country Operations Business Plan: 11 Small Pacific Island Countries, 2020–2022. Manila.

Dilley, M and others. 2005. Natural Disaster Hotspots - A Global Risk Analysis. The International Bank for Reconstruction and Development / The and Columbia University. Washington, DC.

International Finance Corporation. 2017. General EHS Guidelines: Environmental, Air Emissions, and Ambient Air Quality. Washington, DC.

Government of the Federated States of Micronesia. 2011. Summary Analysis of Key Indicators from the FSM 2010 Census of Population and Housing. Palikir. More recent data is unavailable.

World Health Organization. 2017. *Guidelines for Drinking-Water Quality*. 4th Edition. Geneva.

APPENDIX A: CONSULTATION MEETINGS (2019 TO 2020)

Community consultations held by CPUC

Date	Community	Participants	Male	Female
10 October 2019	Epinup Village	34	26	8
23 June 2020	Nepukos Village	12	6	6
13 December 2019	Mwan Village	24	22	2
6 December 2019	Neauo Village	23	18	5
24 October 2019	Eor, Sapuk Village	23	15	8
15 November 2019	Nemwan, Sapuk Village	22	20	2
22 November 2019	Nukanap, Sapuk Village	19	15	4
01 Nov ember 2019	Winipis, Sapuk Village	17	12	5
19 October 2019	Wichap Village	23	19	4
9 April 2020	Penisiene Village	25	20	5
14 July 2020	Weno	34	26	8
	Total	**211**	**162**	**49**

1. Three focus group discussions were also held by CPUC between 11 to 17 July 2020 targeting selected women and youth leaders and members. In-depth discussions were also held to validate key socioeconomic results, willingness and ability to pay, gender roles regarding water supply and sanitation, land requirements, and concerns and recommendations by participants.

Focus group discussions

Date	Group	Participants	Male	Female
10 July 2020	Women Leaders and volunteers	6		6
11 July 2020	Youth representatives	3	3	
11 July 2020	Community representatives	2		2

2. A socioeconomic survey was conducted between 3-26 June 2020 covering about 75% of households within 11 villages of Weno (1,521 of 2030 households, 2010 Census). During the survey, the enumerators also briefed each household about the proposed project and general scope of works prior to administering the survey.

3. During the public consultations, there was a high level of support for the project from all elected leaders, chiefs, and landowner representatives from Weno. The high level of support stems from their priority to have a reliable and safe water supply and sanitation services in Weno that for a long time had been an issue in the capital of Chuuk. During the socioeconomic survey and FGDs, households have reportedly resorted to relying on multiple sources of water including rainwater and piped spring water for drinking, ground water for household use such as washing and cleaning, and although costly, buying bottled water for drinking. This is common for most households in all 11 villages on Weno.

4. During the public consultations carried out by CPUC, the following were the main points raised by participants:

(i) interest to be involve in local employment during construction;
(ii) how will CPUC to ensure fairness in terms of project benefits and not only to few families;
(iii) impact to the project if the landowners do not agree with the lease;
(iv) are households far from the road to be connected to the water supply and sanitation services;

(v) inquiries if old water sources and tanks in the consulted villages be rehabilitated and become operational again under the project including tanks built by the Japanese during World War 2;
(vi) delay of CPUC tanker water delivery and different water charges for households connected and not connected with power;
(vii) adequacy of water supply for everyone;
(viii) at least one landowner offering land to CPUC to lease under the project; and
(ix) if compensation for works within the easement or someone's land to be provided by CPUC and availability of funding from CPUC.

5. The Table below provides a summary of the key discussions during the community consultations.

Summary of community consultation minutes

Date	Site/Discussions	Comments/Questions	Response
Oct 2019-June 2020	1. Introduction of the proposed project and required land.	All participants appreciate the proposed project.	
	Epinup, Neauo and Winipis	1. Who will do the construction? Can they hire people from our village?	Construction companies and yes, people from here can apply to work. (CPUC OT)
	Mwan and Nukanap	2. Many projects in Chuuk are allocated to a very few individual families. Will the water project be fair to all people?	Yes. The project objective is to remove and replace the existing waterlines and deep wells. (CPUC OT)
	Mwan, Neauo, Sapuk inc Eor , Nemwan, Nukanap and Winipis	4. If landowners disagree, what will happen to the project?	ADB can withdraw from the project should there be disagreement with the project. However, the law can intervene to settle or move the project forward.
	Neauo, Mwan, Eor, Nemwan and Winipis	4. Will the water project also consider reactivating the spring water in our village?	Deviation of scope of works. We wiill take note and will share with CPUC management.
	Eor and Winipis	5. Why it takes a long time for CPUC truck to deliver water to our place?	CPUC is trying its best but only have 2 tankers to deliver to the whole island.
	Neauo, Eor and Winipis	6. Will the water line go as far as the houses far from the road?	Yes, with the support from the community to allow CPUC to work beyond the road, CPUC can extend the water lateral to your house.

Date	Site/Discussions	Comments/Questions	Response
	Eor, Nemwan, Nukanap and Winipis	7. Why the price for water tanker delivery is not the same?	The CPUC Customers with water and power account have discounted price than those without an account.
	Additional Questions from the ff. villages: 1. Epinup Village	8. Will the water supply be adequate for Epinup village?	Yes, there is adequate water to supply the village with the existing deep wells and water storage. (CPUC Outreach Team)
		9. If Wichap village do not allow waterline to cross to Epinup, then village will not be able to access water?	ADB may withdraw grants if this happens. (CPUC OT)
		10. Are there lands available for CPUC that have water source?	We are taking note of this for future consideration. (CPUC OT)
		11. There are existing Japanese built water tanks that can be repaired and used for water storage.	Response as above.
		12. Will there be dispute to excavate and work along the easement? (Mr. Satoshy)	No. As long as the works is within the right of way (ROW). (CPUC OT)
		13. I own lands in Suksou, Fanmeina, Winuun, Neinketen (Epinup Village) and Sapuk Village that CPUC can lease. (Kerementa Ermut)	We will look into this offer should CPUC need lands.
	2. Nepukos Village	14. Minutes of meeting still to be provided.	
	3. Mwan Village	15. Frequently sewer manholes near Logan Memorial Church overflows and spill onto my property. Can CPUC fix the problem?	Please call CPUC number at 330-2763 to fix it. Most likely an overflow is caused by power fluctuations and other mechanical issues affecting operations of lift stations.
		16. Any funds to lease the lands that CPUC will use for the project?	Yes, there is fund for the project but unsure of lease funds.
		17. Why some parts of Mwan at times do not get CPUC water?	Due to water loses from water lines. After the new road pavement project, the gate

Date	Site/Discussions	Comments/Questions	Response
			valves are to be replaced under the new water project.
4.	5. Nemwan, Sapuk Village	18. Why does the Million Gallon storage tank in Sapuk only supplies water to Xavier High School and not entire Sapuk Village?	Unsure about arrangement between CPUC and Xavier High School.
	5. Nukanap, Sapuk Village	19. If the water project will involve excavation and removal of land, then we will claim for compensation?	Will inform CPUC.
		20. If the water lines placed in our lands in Nukanap, will the water be free of charge for the residents?	No. We will install water meters. Water will not be free.
		21. if the residents of Nukanap and disagree and not allow the water project, is it going to affect the electricity provided by CPUC?	Yes, it will affect the service.
	6. Wichap Village	22. Minutes of meeting to be provided.	
	7. Penisiene Village	23. Call for support for the project by Lt. Governor John Elimo.	
	8. Weno	24. Anselmo Daniel: asking question about the land issue with the outdated rates, what are alternative options attractive to landowners?	CPUC is reviewing and looking into rates. There seems to be a 4.5% increase in GDP. CPUC is willing to go with that with additional 1% inflation—decision however must be in accordance with the law. CPUC does not pay landowners for water pipes that run underground. It only pays when there is a nuisance and when it affects value of property. (Kembo Mida, CEO, CPUC)

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		25. Dr. Margarita Cholymay congratulates CPUC and encourages CPUC to continue conducting public consultation and outreach especially to the community. Also wishes for the landowners to be giving. The ADB grant is very important to Chuukese community and it's a real blessing for them.	
		26. Vice President Redley Killion wants to thank CPUC for successfully getting such important grant for developing the state infrastructure.	
		27. Will the pipes or services reach the far remote communities on top of the hill of Epinup and Wichap and other areas without access to CPUC pipes? (Vthree Raisom and Kathy Sos)	It is possible but we also need the experts in surveying and analyzing before we can answer accurately. (Kembo Mida, CEO, CPUC)
		28. What is the project timeline? (Johnny Meippen)	Early 2021 we expect to start but project is up until 2027. We may experience delay due to COVID 19 and with our expert team unable to reach Weno. (Kembo Mida, CEO, CPUC)
		29. Have you secured the water tanks? (Tesime Kofot)	We're in the process as we're reviewing the law for rates and meeting with all the landowners.