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REGIONAL CENTRE FOR THE PROMOTION OF ENVIRONMENTAL PLANNING AND APPLIED STUDIES (PEPAS)
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MISSION REPORT

Subject	:	Urban water supply and sanitation programmes
Place visited	:	Chuuk, Federated States of Micronesia
Dates of mission	:	13-23 April 1992
Author and designation	:	Mr B. Fisher, Sanitary Engineer, WHO(PEPAS)
Title of project	:	WHO Western Pacific Regional Centre for the Promotion of Environmental Planning and Applied Studies (PEPAS)
Participating agencies	:	Department of Human Resources Department of Health Services Department of Planning and Statistics Government of the Federated States of Micronesia World Health Organization
Source of funds	:	Regular budget

Key words

Water supply - outer atolls / Sanitation

ICP/RUD/001		16 July 1992
RS/92/0106	Unrestricted	English only

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EXECUTIVE SUMMARY OF A MISSION REPORT

Mr B. Fisher Author(s)	Chuuk, Federated States of Micronesia Place(s) visited	13-23 April 1992 Dates of mission
RS/92/0106 Report series number	WP/ICP/RUD/001/RB/92 Project identifier	01.201.DT.01 Activity code

Objectives of mission:

(1) To report on the status of Moen water supply;
(2) to recommend priority measures to improve the quantity and quality of water supply;
(3) to advise on operation and maintenance aspects of existing water supply and sewerage systems; and
(4) to recommend long-term improvements necessary to extend Moen water supply and sewerage systems.

Summary of activities, findings, conclusions and recommendations:

The writer visited Weno Island, Chuuk State from 13 to 23 April 1992. In addition to a study of the existing sewage treatment plant and water supply facilities in Weno, field visits were made to the islands of Tonowas and Piis Paneu.

A state of emergency exists in Chuuk State because of the water shortages resulting from a prolonged drought. The current urban supply in Weno only provides water for two to four hours daily. New groundwater sources need to be developed urgently. Until a 24-hour supply has been achieved, other improvements required such as leakage surveys, water quality monitoring, metering, etc. will be difficult to implement. The writer was also requested to study the water supply situation in rural areas. The development of groundwater sources by constructing properly protected wells in the centre of the atolls was also recommended.

Various measures to improve the Weno Sewage Treatment Plant operation were recommended. The plant mainly needs new low lift chopper pumps, rehabilitated sludge drying beds, and better operator facilities. The writer was also asked to advise on the necessity of chlorination of the effluent and a marine outfall study. In view of the absence of problems caused by the effluent reaching the sea, it was recommended that no chlorination of effluent or marine outfall study was warranted at the present time.

Key words : Water supply - outer atolls / Sanitation

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1. PURPOSE OF MISSION

The mission was undertaken within the framework of collaboration of the WHO Western Pacific Regional Centre for the Promotion of Environmental Planning and Applied Studies (PEPAS) in providing technical cooperation to Member States. It was carried out in response to a request from the Department of Human Resources, Pohnpei, for collaboration in the field of water supply and sanitation, and was covered by an exchange of correspondence dated 24 January 1992.

WHO provided the services of a PEPAS staff member who visited Chuuk State, Federated States of Micronesia from 13 to 23 April 1992 under the following terms of reference:

(1) to report on the status of Moen water supply;

(2) to recommend priority measures to improve the quantity and quality of water supply;

(3) to advise on operation and maintenance aspects of existing water supply and sewerage systems; and

(4) to recommend long-term improvements necessary to extend Moen water supply and sewerage systems.

On arrival in Chuuk, the writer was additionally asked to study the water supply situation in the outer islands in view of the serious drought currently experienced by the entire State.

2. BACKGROUND

The island of Weno is the capital of Chuuk State, Federated States of Micronesia and has a population of about 21 000 inhabitants. Water supply and sanitation services have not kept pace with population growth or other island development. At the time of the writer's visit, the annual rainfall over the previous six months had been less than half the normal level with an even more pronounced reduction over the preceding eight weeks. Water services to parts of the island had ceased entirely and an intermittent daily service of two to four hours only was provided elsewhere. Even in times of normal rainfall, the water supply does not adequately serve the population in terms of both quality and quantity. Sewerage services are also inadequate reaching less than 20% of the population. Additionally, the sewage treatment plant is not being operated efficiently.

3. ACTIVITIES AND FINDINGS

The itinerary of the visit and officials contacted are given in Annexes 1 and 2 respectively.

3.1 Weno water supply

The prolonged drought and subsequent deterioration of the water supply has focused attention on the need for development and upgrading of the reticulation system. During the assignment, the two main surface water sources, the Pou and Wichen Rivers, were inspected but their flows were only of the order of 1 litre/sec. at each site. (A short summary of these site visits is provided in Annex 3). It is therefore apparent that future development of water resources to cope with dry season demand must be directed to groundwater sources. Currently, well production is about 3 400 cubic metres per day from 24 wells operating about 22 hours per day. Salt water intrusion is becoming more likely at several pump sites as a result of increased pumping for extended hours. Further groundwater sources should be sought in the south-east and northern parts of the island as these areas are remote from existing sources and have very limited piped supplies. Currently, a United States Geological Survey Team is conducting a one-month survey of existing and future well sites for future water supply planning. Chlorination is currently being carried out at four of the well sites and at the Pou River water treatment plant. Chlorination equipment elsewhere has fallen into a state of disrepair and requires replacement. Each new unit will cost approximately US$3 500 for a fully mounted skid pump dosing package.

It is apparent that the first priority above all other considerations is to increase the water supply into the system to obtain a 24-hour service throughout the year. Until this is achieved, other factors such as service extensions for both sewerage and drinking water, water quality control, wastage, leakage and metering cannot be properly addressed. Indeed with the intermittent supply conditions linked to overpumping of wells, both the quality and quantity of the existing supply can be expected to deteriorate further.

Bacteriological testing is carried out at various sites on a random basis by the Environmental Health Section of the Department of Health Services. In most cases, the total coliform count has been ascertained. Generally the results show the water is safe but occasionally unacceptable levels are recorded. Warning notices by radio to the public to boil water are given as several boreholes are unchlorinated and are also not properly sealed. These factors together with negative pressures in the parts of the reticulation without water will always render the supply prone to contamination. In view of the lack of an effective response to adverse readings showing pollution, it is not recommended that the monitoring function be extended to fully cover the supply sources and the thirty kilometres pipe in the main distribution system. However, it is recommended to monitor for faecal coliforms rather than total coliforms in future testing. When the supply is fully chlorinated and a 24-hour service is provided in the future, it is suggested that residual chlorine be checked daily and faecal coliforms examination be performed weekly.

Salinity should be monitored by the Public Works Department to prevent further loss of wells by salt water intrusion caused by overpumping.

The Chuuk State Development Plan (1992-96) includes a project submission for repairing and rehabilitation of the existing water supplies systems in Weno and Tonowas. One of the objectives is to reduce water waste in the Weno system from an estimated 60% of total water use to 10%. There does not appear to be any supporting evidence for this high level of losses but certainly, a leak detection programme should be proceeded with although the intermittent nature of the supply makes it more difficult to carry out.

The current two to four-hour service is estimated to provide 3 400 cubic metres per day to approximately 12 000 people. This high level of consumption is caused by both leakage and wasteful use.

When the water supply in Weno has been rehabilitated to provide a 24-hour service, the supply should be metered to deter excessive water use. Even in the current time of intermittent supplies and publicity programmes to encourage careful use of water, many instances of wasteful practices were evident during inspections. Additionally, the present lack of charges do not provide any incentive for the use of water saving devices such as dual flush cisterns, low flow shower heads, spring loaded taps, etc.

3.2 Weno wastewater treatment plant

3.2.1 Plant design

The Weno Sewage Treatment Plant uses the contact stabilization process with the following stages: aeration zone, reaeration basin, clarifier and aerobic sludge digestor. The effluent from the clarifier after scum removal flows through a marine outfall to the sea. Provision is made for sludge draw-off from the digestor tank to sludge drying beds.

The original plant included a comminutor and chlorination equipment but both have been out of service for several years. A nearby building contains the operators' restroom, laboratory, aeration equipment, chlorination room, communitor and pumphouse.

The plant is located in a suitable area, being near the sea and remote from residential areas.

The daily flow treated at the plant at the time of the visit was estimated at 1 500 cubic metres per day which is only about a quarter of the plant's design capacity.

3.2.2 Comminutor

The comminutor is beyond repair and should be replaced.

3.2.3 Low lift pumps

These pumps cannot be operated at two speeds as designed and should be replaced by pumps able to simultaneously chop and pump solids without plugging or binding. Installation of this type of pump will remove the need for additional screening and a replacement comminutor. However, manually cleaned screens with comminutor are also suitable and comparative costs should be obtained before a final choice is made.

3.2.4 Flow recorders

The effluent flow recorder is a recent installation but has never been put into use. As flow information is important for operation purposes, this recorder should be put into service. As an alternative, it would be relatively easy to install a scale by the existing V-notch outlet weir that could be easily read by operation staff.

The effluent flow at the time of the writer's visits was estimated to be 25 litres/sec. at the V-notch. As this is a particularly dry period in Weno, it is expected that inflow and infiltration into the sewers would be minimal. As the water supply was also intermittent, the flow of sewage would also be at a particularly low level.

3.2.5 Aeration and sludge transfer

In the time available, the writer was not able to ascertain the effectiveness of the aeration that was being carried out in the contact aeration unit and the final quality of the effluent.

However, final sludge removal from the aerobic sludge digestor has only been carried out once in the last two years.

3.2.6 Chlorination unit

The chlorination of effluent has been discontinued for many years. To reintroduce this process would cost over US$20 000 a year in operation in addition to the cost of equipment and installation. Therefore, it is regarded as a low priority in comparison to the chlorination of drinking water particularly as the drinking water supply is only chlorinated to a very small degree (10% of the water produced) and yet the benefits of this would be much greater. Current practice is to chlorinate sewage treatment plant effluent when either drinking water supplies, shellfish beds or bathing beaches are likely to become health hazards from the effluent. This does not occur at the present time.

The large room containing the chlorination equipment should be converted into a storeroom and working area for the maintenance staff.

3.2.7 Sludge drying beds

The two sludge drying beds are of sufficient size (40 metres x 24 metres and 43 metres x 24 metres) to dewater the sludge from the plant but their condition has deteriorated through lack of use and maintenance and they now require complete rehabilitation. The layout originally allowed for removable dividing walls between concrete posts but it is recommended the compartments be redesigned with concrete block walls. The plant growth and dried sludge in the beds require removal and the sand replaced as necessary.

The prevailing temperature and rainfall in Micronesia are such that properly maintained beds will be able to dewater the output of sludge from the plant for the foreseeable future.

3.2.8 Marine outfall

The treated effluent is discharged into the Chuuk lagoon at a depth of 8 metres through a 580 metres long 450 millimetres diameter main. At the present flow levels, no health hazards or unsightly polluted areas are evident. A marine outfall study is under consideration but the writer considers that this is not necessary at the present time. Effluent flows are at a particularly low level and the areas of the outfall obviously comply with the relevant regulations. When the laboratory becomes functional again, it will be possible to monitor accurately the condition of the receiving water.

3.2.9 Laboratory

The laboratory's sole useful assets appear to be the airconditioner, incubators and the refrigerator.

No tests have been carried out for a considerable period. As a minimum, the laboratory should be able to carry out the following tests: total solids, dissolved solids, settleable solids, BOD_5, dissolved oxygen, pH, turbidity and faecal coliform.

3.2.10 Water supply at the plant

The sewage treatment plant is currently without any water supply from the town during daylight hours. This deficiency creates a health hazard and an extremely poor working environment for both the operation and maintenance staff. The town water supply can be expected to provide an improved service if and when the present drought ends. However, a 30-cubic metre tank and pressure unit should be installed at the plant to supplement the town supply and ensure a 24-hour water supply is available.

3.2.11 Miscellaneous

Facilities for workmen at the plant are extremely poor and the following deficiencies were noted:

(1) No operation manuals available on how to run the plant. (These should be available from the designers).

(2) No facilities for washing and showering. The toilet is not in working order.

(3) No ventilation in the plant and no lighting of pump wells. This is possibly dangerous to the operators.

(4) No water supply at the plant.

(5) No lockers and coffee break areas.

Manual scum removal should be carried out more frequently as floatable items were reaching the effluent at the time of each visit.

3.2.12 Cost of remedial measures

The following priority measures are necessary to get the plant into a reasonable standard of operation:

(1)	Replace comminutor and existing pumps by two low lift chopper pumps (capacity approx. 20 litres/sec.) Cost for two pumps		US$40 000
(2)	Installation of flow recorder on the effluent weir and put in working order		-
(4)	Repair sludge drying beds:		
	(a) remove vegetation and dry sludge	3 000	
	(b) replace drainage system	5 000	
	(c) replace sand as required	5 000	
	(d) construct side walls and splash pads, etc.	10 000	
	(e) contingencies	5 000	
	Total:	US$28 000	28 000

(5)	Conversion of chlorination room for maintenance staff	2 000
(6)	Supply of laboratory equipment	6 000
(7)	Construct 30-cubic metre tank and equip with pressure unit	15 000
(8)	Provide operator facilities, showers, working toilets, etc.	15 000
(9)	Contingencies	14 000
	Grand total:	US$120 000

When these measures have been carried out, it will be possible to further assess the operation of the plant for possible improvements to the design.

3.3 Rural water supplies

The outer islands in Chuuk State are now virtually without surface water sources and it is necessary to develop point sources using groundwater. Hand dug wells should be excavated in the flat coastal areas where depths to the fresh water lens are less than 3 metres and the distance from the sea is sufficient to avoid salt water intrusion at low rates of extraction (0.3 litres/sec.). To prevent pollution of these wells, the top two metres should be lined and the well covered and equipped with a diaphragm handpump. These handpumps may be installed at a distance from the well in a convenient locality near the house as they are suction pumps. The suction pipe should be sized according to the following table:

Distance between well and pumps (metres)	Pipe diameter (millimetres)
0 - 15	20
15 - 80	25
80 - 150	30
150 - 500	40
over 500	50

Diaphragm pumps specifically for village use costing approximately US$125 each are recommended. These pumps are very easily maintained by the community. It is suggested that a pilot project to demonstrate their suitability be carried out by the Environmental Section of the Department of Human Resources in one of the outer islands.

4. CONCLUSIONS AND RECOMMENDATIONS

(1) Chlorination of dug wells for rural water supply is not worthwhile on a routine basis. Chlorination of storage tanks should be considered when outbreaks of disease are evident. Chlorination using 70% HTH tablets is a convenient method.

(2) Protected dug wells should be constructed to augment existing roof catchments supplies on the small islands in Chuuk. These wells should be lined and covered by watertight concrete slab and equipped with handpumps. Water from these wells also enable pour flush latrines to be retained in working order. Diaphragm handpumps as modified for rural water supply conditions are recommended. These pumps have the advantage of simplicity and are easily maintained at economical prices. They can also be installed away from the well if necessary up to distances of several hundred metres.

(3) The first priority in Weno water supply is to restore a 24-hour service and extend it to all the population i.e. quantity is more important than quality at this stage. Chlorination of each well is highly desirable and while it should be a long-term aim, under current circumstances, the immediate need and optimum solution for Weno's current water problems is the development of additional well sources on the northern and south-eastern coasts.

(4) Wells should be monitored for salinity content to prevent over pumping and subsequent abandonment of the wells.

(5) Metering should be introduced to Weno water supply when a year-round 24-hour service has been achieved.

(6) Without any laboratory tests, the effluent quality is difficult to assess. The priority actions to be taken to bring the plant into a satisfactory level of operation are listed in Section 3.2. When these improvements have been carried out, the plant may require further modification to cope with the development of tourism, a fish storage facility, and a chicken processing operation.

(7) An operator's manual and log book system should be developed for the sewage treatment plant.

(8) The present sewage treatment and marine outfall are not causing an unacceptable health risk to the community. The chlorination of the effluent from the sewage treatment plant or a study of the marine outfall is not justified at the present time.

5. ACKNOWLEDGEMENTS

The writer wishes to thank Mr J. Kono, Coordinator, Environmental Protection Agency, Chuuk, and Mr M. Chowdhury, UNV Engineer, Department of Planning and Statistics in particular, and all other national staff listed in Annex 2 who assisted the writer on this assignment.

ANNEX 1

ITINERARY

Monday, 13 April 1992	
a.m.	Met members of Taskforce for Drought Met Dr K. Aniol, Director of Health Services
p.m.	Visited Weno Water Supply Well System
Tuesday, 14 April 1992	Visited Tonowas Island
Wednesday, 15 April 1992	
a.m.	Visited Pou River Intake, Weno
p.m.	Visited Weno Sewage Treatment Plant Visited Laboratory, Department of Health Services
Thursday, 16 April 1992	
a.m.	Visited Wichen River Intake
p.m.	Visited Weno Water Reticulation System
Friday, 17 April 1992	Easter Holiday
Monday, 20 April 1992	
a.m.	Visited Pumping Stations and Weno Sewage Treatment Plant
p.m.	Visited Environmental Protection Agency Visited Public Works Department
Tuesday, 21 April 1992	Visited Piis Paneu Island and Weno marine outfall
Wednesday, 22 April 1992	Visited Weno Sewage Treatment Plant
	Debriefing - Mr K. Billy, Director of Planning and Statistics Dr K. Aniol, Director of Health Services Mr J. Kono, Coordinator, Environmental Protection Agency Mr M. Chowdhury, UNV Engineer, Department of Planning and Statistics
Thursday, 23 April 1992	Meeting with the Governor, Chuuk State, Mr S. Gouland
	Depart from Chuuk

ANNEX 2

LIST OF OFFICIALS CONTACTED

1.	Mr S. Gouland	Governor of Chuuk State
2.	Dr K. Aniol	Director of Health Services Department of Health Services (DHS)
2.	Mr S. William	Deputy Director of Health Services, DHS
3.	Mr L. Fred	Chief, Sanitation Section, DHS
4.	Mr K. Billy	Director of Planning and Statistics
5.	Mr M. Chowdhury	UNV Engineer, Department of Planning and Statistics
6.	Mr J. Kaminanga	Director of Public Works
7.	Mr S. Winter	Consultant, Appropriate Technology Enterprises
8.	Mr Robert Goodwin	Chief, Technical Adviser UNDTCD Water Resources Project MIC/89/203
9.	Mr Ismael Dobich	Director of Public Affairs Department Chairman of Taskforce for Drought
10.	Mr J.K. Kono	Coordinator, Environmental Protection Agency, Chuuk

ANNEX 3

SUMMARY OF VISITS TO INTAKES, WENO

1. Wichen River

This proposed intake site was visited on 15 April 1992 after a few days of occasional and sometimes heavy showers. The site is at elevation 55 metres above sea level approximately and 2 kilometres from the island road. The flow at the time of visit was estimated at only l litre/sec. The intake structures already constructed will allow for sedimentation in the upper dam and sand filtration in the 5 metres x 5 metres concrete chamber situated 20 metres below the dam. The intake pipe in the dam should be raised a metre from the base of the reservoir to obtain better quality water.

The sand filter will need to use coarse sand of uniform grade to ensure reasonable periods between cleaning.

2. Pou River

The existing intake for the Weno water supply on the Pou River was visited on 16 April 1992 after a few days of occasional showers. The site is reached after a steep climb to an elevation of around 90 metres above sea level. The flow at the time of visit was estimated at 1 litre/sec. The intake is poorly designed and allows leaves and debris to fall into the large ditch which precedes the steel grating covering the pipe intake. The grating allows debris to be washed through it periodically and in addition, all mud and sediment from the floor of the ditch passes into the pipe system. A better arrangement would have been a screened pipe intake located half a meter above the floor of the canal.