South Pacific Regional Environment Programme

Report on the **National Environmental Pollution Awareness Workshop**

Niue

Held in Niue
on 28 September - 2 October 1992

Published in July 1994
in Apia, Western Samoa

Foreword

Rapid and uncontrolled urbanisation, development and population growth cause pollution of land, freshwater resources, estuarine, coastal and marine waters and atmosphere. Public health is also affected through contaminated domestic water supplies, shellfish, and recreation areas. Wastes that are improperly managed or disposed of result in situations which gravely affect the human and natural environment.

Pollution is no longer only a problem of developed countries. It has also left its mark in the Pacific islands. As more countries gain political independence, they must develop their own economies and so are turning to manufacturing industries, mining, agriculture and tourism to do this. Advanced technology is introduced with these industries. New machinery and manufactured products are introduced onto islands, changing the types and amount of waste generated on land.

Island people who have lived in developed countries often return home and continue their life styles in their home country, including what they eat, wear and use. And this changes the waste generated. Unlike a decade ago, today's wastes are more bulky, undegradable, toxic, hazardous and difficult to dispose of by conventional methods or natural means. As most island nations lack suitable land for disposal, more waste means it can no longer be dumped anywhere and anyhow. This is now the most common pollution source for the land and marine environments in the Pacific.

Regional pollution studies show that the land, sea and atmosphere of most Pacific countries are already polluted, and that land-based pollution accounts for most waste loads. Pollution is also a common concern in most countries' National Environmental Management Strategies (NEMS). Most countries have pollution, yet few fully realise the dangers of not taking remedial action now.

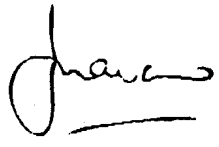
The South Pacific Regional Environmental Programme (SPREP) has developed a Regional Pollution Prevention programme to address the problem. Pollution awareness, through regional and national workshops, is a vital component. These workshops pave the way for implementing other components of the programme.

A series of national workshops were planned for the region in 1993/94, starting in six NEMS countries. Three have been held to date: in Niue, Kiribati and Tuvalu. This report describes the event at Niue, and is also designed as a training manual for anyone wishing to conduct similar training.

This workshop aimed to:

- introduce the subject of pollution to government decision-makers and administrators and non government organisations
- show the current state of their natural and human environment;
- visit potential pollution sources and identify problem areas; and,
- recommend how pollution could be avoided, prevented or minimised in their country.

SPREP acknowledges the role of the United Nations Development Programme (UNDP) in providing the funds for these workshops and this publication, and Wesley Ward for helping to publish the report.



Vili A. Fuavao

Director

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Meeting Report

1. Introduction

As part of the environmental awareness-raising process associated with production of a National Environmental Strategy (NEMS) for Niue, a Pollution Awareness Workshop was convened from 28 September to 2 October, 1992. This workshop was organised by the South Pacific Regional Environment Programme (SPREP) and the Deparatment of Community Affairs, Government of Niue. The workshop agenda is attached as Annex 1.

Funding for the Workshop was provided by the United Nations Development Programme (UNDP) as part of a broader UNDP assistance project called PMI (*Planning and Implementtion of Pacific Regional Environment Programme)* which concentrates on regional and in-country institutional strengthening and training of environmental managers.

This workshop, which drew participants from a wide cross-section of the Niuean community (see participants list in Annex 2), was the first in a series of Pollution Awareness Workshops held in Pacific island countries in association with NEMS.

As a corollary to this general pollution awareness-raising activity, specific training of laboratory technicians in water quality testing was undertaken for a five-day period following the workshop. The focus for both the workshop and the trainng activity, which concentrated on water quality, served to highlight one of the major environmental concerns facing the small island country of Niue.

Official Opening

The Workshop was opened with a prayer by Rev. Liva Tukutama followed by an opening address by the Honourable Tama Posimani, Minister for Community Affairs. His opening address appears as Annex 3.

The Director of the South Pacific Regional Environment Programme (SPREP), Dr Vili Fuavao, addressed the workshop and presented the Government of Niue with Laboratory Testing Equipment provided to assist future Water Quality Testing. His address is attached as Annex 4.

Procedure

Mr Bradley Punu, Environment Officer, Government, Niue, outlined workshop procedure for the week.

Ms Neva Wendt, SPREP Team Leader, National Environmental Management Strategies (NEMS) outlined the role of NEMS in Niue, SPREP's assistance to Niue's newly established Environment Unit and the rationale for this first environmental awareness workshop. A summary of her presentation is attached as Annex 5.

Workshop Sessions

Day 1:

1. Introduction to Water Supplies for Domestic Purposes

Mr Navitalai Litidamu,
Fiji School of Medicine.

A summary of this paper is attached as Annex 6, Handout 1.

Discussion:

Participants raised questions relating to existing asbestos roofing surfaces and their appropriateness as water-catchment surfaces. Whilst it was suggested that rainwater catchment and storage in tanks was valuable, the roofing surfaces in Niue would need careful assessment for suitability. Asbestos surfaces are obviously not desirable. Even other roofing surfaces would need to be kept clean and the initial ten minutes of downpour not collected to allow cleaning time.

Participants questioned whether boiling water would get rid of chemical contamination. It was stressed that boiling would **only destroy bacteria** but not reduce chemicals.

2. Niue's Domestic Water Supply System

Mr. Hakai Pihigia, Deputy Director of Works, and Mr. Deve Tatagi, Superintendent - Building

This paper is shown in Annex 6, Handout 2. A diagram-matic presentation was also shown of a cross section of Niue showing groundwater resources. The vulnerability of this groundwater was well explained and the importance of seeking community co-operation in preventing pollution and wasteage was stressed. Reference was also made to Niue's draft *Five Years National Water Development Plan,* produced in May 1992.

Discussion

Participants raised matters such as:

- oil spilt at the Power House, which could pollute the water lens;
- differing readings from bores some of which are not near human settlement but nevertheless give readings showing contamination. The explanation of this point is internal movement of water which could result in spread of pollution; and,
- water useage (approx. 1.6 million litres per year) and the impact of increased population on such useage patterns.

  This point was raised in relation to the uncertainty regarding the thickness of the water lens. It was stated that Water Regulations were currently being developed.

3. Introduction to Water Sampling, and Reasons for Water Sampling

Mr. Navitalai Litidamu.

His presentation is summarised in Annex 6, Handout 3.

Discussion

Participants were keen to identify whether or not pesticide contamination exists in the water supply. Concern was expressed at the high pesticide useage in Niue. It was suggested that greater public awareness of the hazards of pesticides was urgently needed together with stronger regulations relating to pesticide importation, handling, storage and disposal.

Day 2

4. How Water Samples Are Acquired

Mr. Navitalai Litidamu

Lecture and demonstration notes are given in Annex 6, Handout 4.

Discussion:

Timing for water sample analysis was discussed. Bacterial samples sent to New Zealand should be analysed within 30 hours. Those sending samples should ensure that the date is within this time frame. However, equip-ment provided by SPREP will allow bacterial analysis to be carried out in the Niue Health Department Laboratory. Training will be given on 5-9 October 1992 to ensure that the Laboratory Technicians are familiar with the operation of the new equipment.

Analysis for chemical contamination could still only be undertaken overseas. The cost of this additional equipment is very high and it was suggested that a donor be sought to enable this analysis to be also carried out in Niue.

5. Water Supplies, Sanitation and the Environment

Mr. Holo Tafea, Chief Public Health Officer

This paper appears in Annex 6, Handout 5.

Discussion

Considerable discussion followed the present-ation of this topic. The Health Inspector explained that the past practice of weeding around the bores with weedicides has now stopped. There was a call for speeding up the process of *Water Legislation,* and for more local assessment of and input into the draft *Five Year National Water Development Plan.*

There was concern about possible effects on the marine environment with the dump located on the island's outer rim. It was noted that its placement was to protect the inland groundwater lens, however, it should be monitored for possible marine pollution.

It was suggested that Niue required an waste inventory and assessment of possible pollution sources (e.g. existing industries). Human wastes from septic tanks are currently disposed of at the dump. The design of the current soak-type septics may also need investigation.

Possible seepage from grave sites into the water lens was raised. Incidents of illegal dumping of human and animal wastes into open *makatea* pits were mentioned. Although mostly obsolete now, there still exist, as well as some long-drop toilet systems. These waste disposal matters highlighted the need for more extensive monitoring of wastes.

6. Water Sampling in Niue: Purpose, Interpreting Data, and Storing and Reviewing Monitoring Data

Mr. Holo Tafea

An example of Routine Water Sample Results was also given. This appears as Annex 6, Handout 6.

Discussion:

Discussion centred on interpreting the data collected and its assessment by decision makers. Sampling is undertaken every 3 months. Figures for the last sampling showed some high coliform counts: however all *E. coli* were counts were negative.

Participants were keen to learn exactly what these terms meant, and how they could interpret the readings. They were also keen to see data over an extended period so that they could see trends over time, i.e. whether regular samplings were showing an increase in potential pollution.

7. Water Standards Used in Water Quality Monitoring

Mr. Laisiasa Tulega (SPREP)

This paper concentrated on explaining water quality standards, such as those established by the World Health Organisation (WHO) was given . This paper appears as Annex 6, Handout 7.

8. Incidence of Water-Related Disease in Niue

Dr. Harry Nemaia, Director of Health, Niue

This paper appears as Annex 6, Handout 7.

Discussion

It was considered that contamination prevention was more relevant than water treatment. Participants again referred to the 1981 draft *Legislation on Water Quality* and questioned its slow process. It was pointed out that water pipes in villages are old and need assessment. The importance of protecting 200 metres (surface recharge area) around bores was stressed. The bore at the former piggery farm at the airport was given as an example of the need to have this 200-metre area unpolluted. It was also stated that there is a need to look at sources of pollution. He called upon participants to note the link between previous cases of diarrhoea and high readings indicating possible water contamination.

Day 3:

9: . . Introduction to Water Pollution

Mr. Laisiasa Tulega

This paper is attached as Annex 6, Handout 9.

Discussion

Concern was expressed relating to use of fibrolite roofs as water catchment areas for tanks. Participants questioned whether the old fibrolite roofs and new fibrolite being imported contained asbestos. It was considered appropriate to request government to ensure that products imported into Niue, be free of matter banned elsewhere such as asbestos.

Disposal of mercury (from dental use) and other chemicals needed to be addressed. Similarly, disposal of used vehicles pose a problem, a solution which needs to be considered.

10. Identifying Land-Based Pollution Sources and Determining Water Quality Sampling Points

Mr Laisiasa Tulega

A demonstration was given of equipment made available by the Fiji School of Medicine for testing for chemical contamination.

Participants identified the following points as potential sources of pollution:

- Oil from power-house
- Anaana caves, illegal dumping of animal and household wastes
- Chemical Pesticide Storeage site
- Agricultural Research Station
- Cave at the Primary School
- Business/Commerce Office
- Abbatoir
- Sewerage Dump
- Bore sites near agriculture station

11. Field Visit

Participants were taken on a tour of the island to identify various sources of land-based pollution. Samples were taken at declared sampling points. The sites visited were:

Site 1: *Agriculture Department's dump site for disused agricultural chemicals.*

This site, close to the airport, contained broken packages and corroded drums and its location close to a water bore is a major cause for concern.

Site 2: *Aviation fuel storage tanks.*

This site needs to be upgraded to ensure that any fuel spilled could be collected in a concrete area surrounding the tanks. This site is also close to the airport water bore and there is concern relating to possible spillage.

Site 3: *Disused piggery [near airfield]*

This site showed the importance of land-use planning. This proved a good exampleof the importance of monitoring water catchment areas. The piggery was closed due to its close proximity to the water catchment area and fear of contamination.

Site 4: *Recreation area - Avatele*

This sampling site examined marine water. It was considered an important area to sample because of its potential as a tourist attraction. The location of a public toilet close to the beach is a potential pollution source.

Site 5: *Bore hole near "Island Styles"*

This site has potential for several sources of pollution from past use of agricultural chemicals, nearby residences (within the 200 metre limit from bore holes) and its proximity to the road.

Site 6: *Anaana*

This is a site of illegal dumping in the cracks between the rocks. This highlights the need for greater public awareness.

Site 7: *Dump area*

This all-purpose dumping area was visited and seemed to highlight the need for a management plan for Waste Disposal. The location of the dump on the outer rim, makes it an important sampling point for marine environmental monitoring.

Site 8: *Mini- brewery*

This new facility was visited and regarded as an important sampling point given the concentration of activities such as the Public Works, Mini-Brewery and the Niue Hotel. The Mini-Brewery facility was examined and its system explained. An Environmental Impact Assessment (EIA) has already been undertaken of the Mini-Brewery and suggested measures complied with.

Site 9: *Wharf area*

A sample of seawater was taken at this site which is one of the concentrated activities. (Shipping, yachting, road access etc.)

Site 10: *Power station oil seepage*

This area is in close proximity to a bore hole. The waste oil which is not only a pollutant but also a fire hazard, is potentially a major problem for the environment.

Day 4:

12: Development and the Environment

Mr. Terry Chapman, Secretary to Government, Niue

Mr Chapmen stressed the custodial role that people have for their land and the responsibility they have for environmental protection. He outlined the relationship between environment-al policy and sustainable development.

Discussion

Participants called on the Secretary to Government to support the recommendations from the workshop. They requested his assistance especially in:

- ensuring a more speedy passage through Cabinet of the draft *Water Legislation*;
- ensuring environmental impact assessment (EIA) for all development activities; and,
- inclusion of the marine environment in the draft 5-year *National Water Development Plan.*

Session 2: Interpretation and General Discussion on Results of Water Samples Acquired from Declared Sampling Points

The samples obtained on the field visit were interpreted by **Mr. Navitatai Litidamu** and discussed by participants. The results were examined for turbidity, pH, dissolved oxygen, conductivity, salinity, nitrate, and ammonia. Explanations of standards used in water quality monitoring are outlined in Annex 6, Handout 7.

Discussion

The dissolved oxygen reading in the wharf areas was a concern. Similarly, the conductivity reading at the wharf area showed signs of pollution. The wharf area receives direct pollution, e.g. batteries dumped in water, the presence of yachts, etc.

It was pointed out that these were only one set of samples, and that the picture could change at another time.

It was stressed that although most of the results indicated that the water quality is currently good, this should not encourage complacency. Increased tourism will be dependent on good water quality, for drinking water and marine water.

Considerable discussion ensued regarding the activities currently undertaken in Niue, in town and villages, on waste disposal and pollution abatement.

Several important points were:

- the need for more adequate public awareness to prevent dumping of rubbish on bush tracks when there is already an adequate rubbish collection service;
- the need to encourage more composting;
- the importance of properly constructed septic tanks;
- the need for more recycling;
- the need for toilet facilities and garbage tins at tourist spots; and
- the importance of using existing church meetings and the Primary Health Care Committee to disseminate environmental awareness information

13. Designing a Water Pollution Control and Monitoring Programme

Mr. Laisiasa Tulega on

This paper appears as Annex 6, Handout 10. Discussion was held on ways of preventing pollution and alternative methods of pollution control.

Session 3: Hospital Laboratory Visit

Participants visited this faciity to observe how field samples were tested with the laboratory equipment provided by SPREP.

Day 5:

14. People and the Environment in Niue

Mr. Bradley Punu

This paper appears as Annex 6, Handout 11.

15. Workshop Evaluation

The results of this evaluation appear as Annex 7.

Workshop Recommendations

Workshop participants developed a set of strategies and recommendations to the Government to act on pollution problems in the country. These are presented in Table 1.

A set of actions requiring immediate action were developed by the participants. These were to be presented to the Government.

These were:

1) ***Power Station***

   Relating to waste oil.

2) ***Sewerage Dump***

   Management Plan required, together with a proper dumping facility pond.

3) ***Pesticide Removal from near the Airport.***

4) ***Avaition Fuel Requires improved Storage Facility*** - *concreting.*

5) ***Bore Site near "Island Styles"***

   Better concrete encasement of bore.

6) ***Anaana***

   Erect sign relating to illegal dumping.

7) ***Set up Sampling Points***

   e.g. marine sampling near dump).

8) ***Sample Points near Hotel, Mini-Brewery and Public Works.***

9) ***Place Garbage Collection Bins at Wharf Area.***

Table 1: Recommended strategies and other recommendations to the Government of Niue.

Legislation/Regulations	*Monitoring (Sampling/ Testing)*	*Planning*	*Training*	*Education/ Community Awareness*
Water (Useage/Waste-age/Pollution) **(Urgent Implementation)** **-Waste Disposal** (Incl. Haz. Merc. and Weedicides) (Incl. Illegal dumping) (Incl. Recycling) (Incl. Grave Sites) Enforcement process of Health Inspector -EIA Public Provision under existing Mining Act. Bore Holes Conservation Management More stringent control of burning periods.	**-Inventory of Pollution Sources** **-Water Sampling** (Regulate Site Tests) **-Inventory of Wastes** (Past & Present) **-Monitoring Marine Environment** **-Testing for Chem. Contam.** (Seek donor for add'l equipment.) **-Testing Tank Water/Septic** **-Base Level Data** **-Radioactivity & Health Study/Asbestos** **-Burning**	**-5 Year Water Develop. Plan** (Discussion &public input) **-Land Use Plan** (Accounting for traditional ownership). **-Building Codes** (Tanks, design, water & septic asbestos). Lead in paint. **-Recycling Waste** **-Oil Spill Contingency** (Implement Plan (Wharf) **-Garbage Bins** Can recycle bins at general sites (e.g.wharf) **-Dump Mgmt.** Plan **-Link with SPREP on Waste disposal.** **-Task Force** **-Public Mtg./Discussion**	**-Lab Technicians** **-Public Works** **-Health Inspectors** **-Agriculture Department** **-Private Sector** **-NGOs** (Community, Churches) **-Environment Officer** -Teacher Training (Lab. Training). One day w/shop -People involved are ones appropriate.	**-School curriculum** **-Field Visits** Water Testing (Sr. School Students) **-Village Councils** **-Women's Councils** **-Radio/TV** **-Videos** (SPREP copies) **-Niue Environment Week** (Constitution Celebration) **-Public Discussion of all development proposals and reports.** **-Private Enterprise** **-Churches**

Annexes

Annex 1: Agenda of the National Pollution Awareness Workshop - Niue 28 September - 2 October 1992

Monday 28 September

09.00-09.30 am	Official Opening
09.30-10.00	**MORNING TEA**
10.00-10.30	Introductory address by *Dr. Vili Fuavao*, Director of SPREP
10.30-11.00	Address by NEMS Team Leader on Workshop and the role of NEMS in the Region. *Ms. Neva Wendt* - SPREP
11.00-12.00 pm	Introduction to water supplies for domestic purposes. *Mr.Navitalai Litidamu*-Fiji School of Medicine.
12.00-01.00	**LUNCH**
01.00-02.00	Niue Domestic Water Supply System. Director of Works, Niue - *Hakai*
02.00-02.30	**AFTERNOON TEA**
02.30-03.30	Introduction to Water Sampling and Reason for Water Sampling. *Mr. Navitalai Litidamu.*

Tuesday 29 September

08.00-09.00	Reasons for taking samples regularly and remedial actions to be taken when water samples results are unsatisfactory. a) at source b) in treatment plant c) distribution system d) in homes *Mr. Laisiasa Tulega - SPREP*
09.00-9.30	**MORNING TEA**
09.30-10.30	How water samples are aquired (lecture and demonstrations). *Mr. Navitalai Litidamu.*
10.30-11.15	WHO Standards for Water Supplies. *Mr. Laisiasa C. Tulega*
11.15-12.00	Water Sampling in Niue. Discussion on Data Management. Review use of monitoring data. Principal Health Inspector, *Mr. Holo Tafea.*
12.00-01.00	**LUNCH**
01.00-02.00	Water supplies, Sanitation & the Environment. *Mr Holo Tafea.*
02.00-02.30	**AFTERNOON TEA**
02.30-03.30	Water related diseases incedence in Niue. *Dr. Harry Nemala* - Director of Health, Niue Government.
06.00-08.00	Cocktail--Island Style Restaurant

Wednesday 30 September

08.00-09.00	Identification of Land-based Pollution Sources and determining water quality sampling points: *Mr L.C. Tulega*
09.00-09.30	**MORNING TEA**
09.30-12.00 pm	Tour of Island Identifying various source of Land-based Pollution sources and taking of samples from declared sampling points.
12.00-01.00	**LUNCH**
01.00-02.00	Strategy of controlling land water pollution - *Neva Wendt.*
	UNICED Video tape - Rio.
02.00-02.30	**AFTERNOON TEA**
02.30-03.30	Development & the Environment - *Secretary to the Government,* Niue.

Thursday 1 October

08.00-09.00	Strategy/Recommendations
	Designing a water pollution control and monitoring programme - *Mr. L.C. Tulega.*
09.00-09.30	**MORNING TEA**
09.30-12.00 pm	Acquiring Samples from declared sampling points and demonstration of the useof equipment. *Mr. Navitalai Lititdamu.*
12.00-01.00	**LUNCH**
01.00-02.30	Hospital Laboratory Visit

Friday 2 October

08.00-09.00	The Public and the Environment., *Mr Bradley Punu.*
09.00-09.30	**TEA BREAK**
09.30-09.45	Evalutation of Seminar and Group Recommendations for National Pollution Strategy - *Chairperson.*
09.45-10.45	Group Evaluation
10.45-11.15	Group Presentation and Recommendation - *Chairperson.*
11.15.11.30	NEMS Team Leader - *Ms. Neva Wendt.*
11.30-12.00	Closing Address- Niue Government.

Annex 2: Participants List

Mr. Faapoi AKESA
Mr. Trudy CULLIN
Mr. Fao FALETOGIA
Mr. Sione HAUTUTU
Mr. Piasoni HEKA
Mrs. Talaese HIKUTONGOTON(
Mr. Sani E. LAKATANI
Mr. Laga LAVEINI
Mr. Luavasa MAKAOLO
Mr. Tonu MAUTAMA
Mr. Tom MISIKEA
Mr. Masini MOUGAVALU
Ms. Judy NEMAIA
Mr. Manina NOSA
Mrs. Lapati PAKA
Mr. Brendon PASISI
Mr. Kuso PAVINI
Mr. Pony PIHIGIA
Mr. Holo TAFEA
Mr. Herman TAGALOAILUGA
Mr. Deve Talagi
Mr. Fuku TONGAHAI
Rev. Liva TUKUTAMA
Mr. Kenriek VIVIANI

RESOURCE PERSON:

Mr. Bradley PUNU

Annex 3: Opening Address by the Honourable Tama Posimani, Minister for Community Affairs.

Honourable Cabinet Ministers, the Director of the South Pacific Regional Environment Programme (SPREP), the Secretary to Government, Directors, participants and observers who are present here this morning. It gives me great pleasure to officially open this workshop on Water Pollution this morning. I would like to acknowledge the first visit of Dr Vili Fuavao to Niue, and also for the occasion of this being the first workshop under the National Environment Management Strategy Project (NEMS) to be held locally. We welcome you and your team to our small island - The Rock. We are proud to be a member of SPREP and we are very happy to be associated with the staff, who are involved with the NEMS programme. It is, through this relationship, that we have been able to make a break- through in the establishment of the Environment Unit, in the Department of Community Affairs. Since then, we have been working very closely with NEMS staff in the various areas that we have identifled and approved to be implemented. We have taken this move as the first step towards our effort to address some of the main concerns on the environment. We believe that we have given our support, energy and the attention that is needed to speed up the pace in pursuit, and solve some of the problems, as they begin to be visible in the community.

We have up to now participated in several environment workshops in other countries, and we are very happy to learn from others, the many lessons and experiences that they have had in their countries. At this stage, although there are other workshops to be held in future, we are eager to look at new activities, to be undertaken in the next stage of the NEMS programme. In this regard, we foresee our involvement to pursue what we have brought back with us from Rio. We believe that Niue will try its best, to facilitate the process in the effort by SPREP to deal with issues of regional and international interest and concern. In saying this, we are aware of our limited local resources yet we stand strong to provide our moral support. In this respect, we are looking at SPREP to guide and assist us in providing technical expertise, conduct research and training, and more importantly the necessary funding for our environmental projects. We have completed several reviews, underthe NEMS project and it is our hope that some of the recommendations will receive your support and approval in future.

As for this workshop on Water Pollution, this is an area, that will be covered adequately during the five days training. There will be discussions and questions raised on related issues by the participants. The opportunity and time should be treated as highly important.

It is my sincere hope that all of us, especially the participants and observers, will receive full attention and interest.

In concluding this key note address I wish you all a very fruitful workshop, and at the same I hope that you will enjoy some of the social activities, that we have arranged during your stay on Niue - The Rock.

May I take this opportunity also to express on behalf of the Government, our most sincere appreciation to the Director of SPREP, for the continued interest and support to us, and since you will not be here at the closing of the workshop, we wish you a safe trip back to Samoa and SPREP headquarters.

Annex 4: Opening Comments by Dr Vili A. Fuavao, Director, SPREP.

Mr Chairman , Bradley Punu

Hon. Minister for Community Affairs, Tama Posimani

Hon. Minister for Finance, Young Vivian

Rev. Liva Tukutama

Heads of Departments

Participants, Friends

Ladies and Gentlemen

It is a pleasure and indeed an honour for me to be in Niue and to address you this morning. The manner and hospitality that you have accorded me and my colleagues from SPREP since our arrival on Friday morning has made us feel very much at home in your beautiful Niue. Honourable Minister - thank you for honouring us with your presence this morning. Your message is clear and no doubt will be a guiding light to the workshop throughout this week.

On Saturday morning we drove around the island and I was impressed with the vegetation and how you have so carefully designed the recreation areas to fit into the natural environment and not the opposite. I am therefore convinced that our effort should be directed at protecting your natural environment, which I must admit seems relatively unspoiled compared to the other countries of the region. There is no time for complacency as we do not have the resources nor cannot afford to repeat the mistakes of other parts of the world. Mr Chairman, the South Pacific Regional Environment Programme (SPREP) became the newest, independent regional organisation in July 1991. This decision by the regional governments reflected the global recognition of the need to reverse the environment degradation and exploitation of our limited natural resources. This is the central message of the Rio Summit which I had the privilege of attending together with you Mr Minister. The SPREP Secretariat, based in Apia, is therefore faced with a monumental task of assisting the countries of the region to address the environmental issues and turning the Rio Summit's results into reality. SPREP believes strongly that one can have economic developnent without compromising and indeed exploiting one's natural resource base. The underlying factor, Mr Chairman, is that we need development to raise the standard of living of our people but these developments can only be sustained through sound environment practices. This is the whole thrust of "Sustainable Development".

SPREP's involvement and assistance to Niue since SPREP's inception in 1982 had been modest until two years ago. This was due mainly to lack of resources and perhaps lack of awareness on your and our sides of the potential of SPREP to provide expert advice and resources to undertake environmental activities in Niue. When I took over as the Head of SPREP in early 1990, I set out to strengthen the Secretariat, diversify the activities of the organisation and to extend these activities to include all countries and territories in the South Pacific region, particularly the smaller countries and most vulnerable ones like Niue, Tokelau Islands, Tuvalu, Marshall Islands, Kiribati, Nauru who had not previously benefitted much from the organisation. This goal has not yet been fully achieved. However, the situation has improved dramatically and we have come a long way since 1990 as evidenced by my presence in your midst today.

With the financial assistance of UNDP, the Asian Development Bank (ADB) and the Australian Government, SPREP is able to assist eleven countries (Niue included) in preparing a National Environmental Management Strategy (NEMS) and at the same time strengthen the in-country capacity to deal with environmental issues and to promote community awareness on the importance of environment to our existence. Mr Chairman, I I was very much aware of the considerable strain on country resources caused by demands of implementation of regional projects initiated by regional organisations. I strongly believe that it is important not only to strengthen capacity of regional organisations like SPREP but perhaps more important to strengthen in-country capacity to deal with the issues in the local context. SPREP's commitment to this philosophy is evident by SPREP providing the Niue Government with resources to meet the salaries of the Environment Officer, Mr Bradley Punu for the ensuing two years.

We are also happy to assist Father Glover in his efforts to keep Niue free of aluminium cans thus avoiding possible harm to the environment.

My staff are here this week and next week to conduct a water quality workshop as part of our human resource development programme under NEMS. Further, we are happy to be able to donate to your government a full water quality testing unit.

In January/February 1993, the SPREP Environmental Education Officer will be visiting Niue to assist your teachers in incorporating Environmental Education into the formal teaching in both primary and secondary schools.

Niue is one of the 13 countries that will benefit from SPREP's Biodiversity programme - a USD10 million dollars project over 5 years. SPREP was only too glad to provide a legal expert in response to your request for assistance recently.

Finally, the preparation of NEMS for Niue is proceeding as planned. We hope that NEMS will provide guidelines and a strategy to enable you to address the most pressing environment issues facing Niue. From our end, SPREP views NEMS as guidelines for us for **further future assistance** to you in our combined pursuance of "Sustainable Development" for Niue.

Mr Chairman, let me reiterate both SPREP and my personal commitment to assist Niue to achieve "Sustainable Development". Your support of SPREP in the past has been instrumental in the development of SPREP and I look forward to your continuing support in the future. As they say, all good things must come to an end. I have to leave Niue on Wednesday morning. Nevertheless my short visit here has given me a feeling for your needs and areas when we can help each other.

Let me leave you with this thought this morning. A strong foundation has been initiated for SPREP to assist and vice- versa, let us use it as a basis of long relationships between Niue and SPREP. SPREP is fully commited to assist you but it also needs your commitment to make our combined goal of "Sustainable Development" for Niue a reality.

Finally, I hope you will honour SPREP by accepting our invitation to a cocktail function at the Island Style Restaurant tomorrow night. If you have not received your invitation, please do not let it stop you from coming as my guest. This is to avoid the Tongan way where your invitation usually arrives the day after the function.

To you Honourable Minister and your government, please accept our humble thank you for your hospitality and accepting us to your beautiful Niue. On the other hand, I am not surprised at all as the hospitality and Fakaalofa spirit of Niue is reknowned in the Pacific region.

Fakaaue lahi atu.

Annex 5: Address by Ms Neva Wendt, Team Leader/NEMS, SPREP.

Pollution Awareness Workshop, and the Role of NEMS in the South Pacific Region

It is gratifying for the South Pacific Regional Environment Programme (SPREP) to see how enthusiastically the government of Niue is tackling environmental issues and currently utilising the assistance available through SPREP for environmental management and protection activities.

Prior to 1991 SPREP had very little contact with Niue. In fact, since SPREP's establishment in 1982 only 2 visits had, to our knowledge, been made by SPREP officers and these were both in the early stages of our programme's development. Representatives of the Government of Niue had participated in SPREP's Inter-governmental meetings and Treaty negotiating meetings but little in-country environmental protection assistance had been given. This was the result of a limited SPREP budget (in our early days) and a small pool of technical officers stretched to capacity located at the South Pacific Commision headquaraters in Noumea, New Caledonia--- a considerable distance from Niue.

SPREP's recent relocation to Apia, Western Samoa and its more recent increases in financial assistance, especially associated with its new autonomous status as a separate regional organisation are making it more feasible for SPREP to develop greater contact with your government and is placing us in a better position to assess and discuss with you your technical needs.

Your Secretary to Government stated in 1991:

*"The Niue Government has been concerned with environmental issues over many years but **social and economic priorities** have diverted its attention from this sector. One of the biggest constraints facing the government is the establishment of an environmental on-going advisory, administrative and technical structure at a time when budgeting support from New Zealand was being significantly reduced. This has meant that the environment issues have been dealt with on a piecemeal basis."*

> Terry M.Chapman, Secretary to Government, (and Chairman, Environmental Task Force, Niue Country Report, July 1991) for the United Nations Conference on Environment and Development (UNCED) Brazil.

In 1991 SPREP commissioned two consultants to undertake a *National Report for Niue* to clarify the pertinent issue's relating to Niue's environmental situation. The report was presented to the United Nations Conference on Environment & Development (UNCED) which met in Brazil in June this year at which Niue was represented by your Minister for Community Affairs, Director of Community Affairs representative of Public Works.

The formulation of the Niue Environmental Task Force and the production of the Niue National Report was the forerunner to SPREP's assistance to Niue through the National Environmental Management Strategies (NEMS) Project.

The purpose of the NEMS project is to provide the type of assistance highlighted previously by your Secretary to Government--the need for institutional strengthening-support to an administrative and technical structure for environmental management. Associated with this are increased training activities and development of a National Environmental Management Strategy (NEMS) - a plan which ensures that all activities undertaken in Niue, will take account of protection of the environment.

Niue's Concerted Action Plan (NCAP) stressed the importance of maintaining a "living community" and securing Niue's survival as a distinctive cultural group. It is appropriate that a NEMS be developed at this cruicial time when Niue is pursuing economic self-sufficiency and promotion of economic development opportunities essential to the maintenance of a "living community."

Potential economic development activities such as controlled tourism links appropriately with the need for an environmental management strategy.

Environmental Issues

- good quality water supply
- adequate waste disposal system

The availability of an adequate supply of safe drinking water is crucial to Niue and to any future development activities. Protection of the freshwater lens is thus extremely important. Concern has been expresed over coliform concentrations in some boreholes (from septic tanks and piggeries) and contamination from heavy use of weedicides. Concern also exists over uranium in surace soils being leaded down into the ground water system.

A **fresh water monitoring program is needed.**

Water Lens Monitoring

1. Determination ofi its biological content
2. Determination of its chemical content
3. Determination of its radioactive content
4. Determination of its salinity

A waste management programme, emphasising the recycling and reduction of waste at source, is also required.

> *These issues should be addressed in an overall strategy for environmental management and sustainable development in Niue.*

Handout 1: Introduction to Water Supplies for Domestic Purposes

Water is a necessity to life and second only to air in importance as a basic need for the existence of human life in this planet. Even our own body is composed of about three-quarters water and no one can last more than four or five days without drinking water. Apart from its drinking use, water is also utilised for bathing, cooking, washing and maintaining general cleanliness in and around the home. It is difficult to imagine any clean and sanitary environment without water. Water is also extensively used in industry and very often the location of commercial and industrial establishments is dictated by the availability of a water supply.

Modern civilisation is impossible without water. In fact the whole history and progress of civilisation has been closely associated with the availability of water as evidenced by the flowering of villages, towns and cities along water courses.

Sources of Water Supplies

The sources of supply of water for households are as follows:

- Surface water - pond, stream, river and lake
- Underground water - well, bore, holes, springs
- Rainwater
- Sea - demineralised water

Rivers

The hygenic quality of river water depends largely upon the number of man-made activities along the course of the river. The smaller the river and the greater number the activities, the more likelihood of the water to be heavily polluted.

Two things serve to reduce the risk of bacteria pollution of rivers:

i) the sterilising effect of the sun and air on the water, and

ii) the amount of dilution which take place when pollutants enter the water

The most primitive form of river sanitation is to 'zone' the bank and oblige the people to take their drinking water from the highest point of the stream convenient to all. Bathing, washing and watering of animals should be carried out in successive zones downstream. River water should only be consumed after it has been boiled or disinfected.

An improvement on this method is to construct a dam fairly high up-stream and lead the water to the village by a pipe line. The water is stored in a reservoir and is made available to individual households by pipe. When this is done the land which drains into the river above the dam, known as 'catchment area' should be depopulated and no human occupation allowed.

Lakes

Lake water is generally clearer because it has had time to deposit its sediment and its natural state is good because of its exposure to the sun and air. Zoning can also be done and people living near the lake take their water from lake-side.

Springs

Spring water is usually pure when it reaches the surface of the soil, however, pollution normally takes place from the ground in the vicinity. It can be clean and safe to be consumed if it is well protected. A protected spring should have the following:

- fenced all the way around and a gate that is closed and opened only when someone wants to get water;
- a drain around the spring to let surface and excess water away;
- cemented stone wall half a meter high around the spring;
- a pipe coming out from this wall and the water is taken from this pipe; and
- a cover over the spring to keep out animals, birds, insects and dirt.

Spring water is commonly used as a source of piped water supply.

Wells

Wells are classified as Shallow, Deep and Artesian. Shallow well water is unsafe for human consumption as it is mostly superficial ground water and is subjected to contamination especially from human and animal excreta. Deep well is one which penetrates the upper impermeable layer and taps the water lying above the next impermeable layer. It is usually clean and safe if it is properly protected. A well is properly protected if:

- it is at least 20 metres away and uphill from any latrine or rubbish dump;
- it is lined inside with stones or concrete;
- there is a parapet wall around it which is at least half a metre high;
- it has a removable cover and a clean device (pump) for drawing water;
- there is a drain to remove surface and rain water; and
- people do not wash in it and allow dirt to get into it.

Artesian is bored well and water from this should is normally 'hard' but it should be safe for drinking if mineral content is low.

Rain-water

Rain-water is purely distilled water but as it falls it may pick up impurities from the atmosphere, for example smoke and gases near cities, salt near the sea, dust in dry regions.

In rural areas the rainwater is generally safe provided it is properly collected and stored.

Rain-water will be clean if:

- it enters the tank through a screen to keep out leaves, dirt and insects;
- the tank is covered to avoid dirt and be mosquito-proof;
- the tank is emptied and cleaned at the beginning of the rainy season;
- the water is taken from the tank either through a tap or with a pump (if below ground tank);
- containers for carrying water and storing at home are clean before use; and a rain-water separator is used.

Rain-water is mainly 'soft' and particularly suitable for laundry purposes.

Handout 2: Niue's Domestic Water Supply System

It is with privilege that I am able to share with you aspects of how our local domestic water system works. But before I do that, I would like to just touch briefly on the history of Niue's water system, which I presume some of the course participants know more about than I do.

History

People in earlier times relied heavily on freshwater pockets mostly found in caves and usually just a few meters below ground level. The people usually lived within the vicinity where water could be easily found, so water back then was a rare commodity - even more so in times of drought or long periods of dry spells which most of us have experienced at one time or another.

Later on, the people had to rely on water catchments held in reserve in community reservoirs, usually situated beside the church and other community facilities where only large water catchment facilities could be found. The reservoirs were either built into the ground or at ground level. Most are still standing but only one, if I can recall correctly, is still in use. Very few households had their own private source until shortly after the devastating hurricanes of 1959 and 1960. Prior to this time it was not unusual for family feuds to be sparked over a bucket of water, a few of us here might remember those times. The housing scheme was introduced after these hurricanes and 400 gallon concrete tanks were issued for every household, which for a while, adequately met the needs of the people. But they still relied on the community water reservoirs during dry periods.

The first underground water activity ever done on Niue was the hand dug well at Fonuakula in the fifties, I don't have the exact year.

As the standard of living increased in the mid sixties, demand for water also increased. Bore holes were sunk and windmills were used as a means of drawing water from artesian reservoirs to communal reservoirs, and later to communal taps (water scheme). By the early seventies, windmills aged and as a result became susceptible to high winds. Different bores had to be sunk and diesel powered water pumps were used. In the late seventies and early eighties these were converted to electrical powered pumps. The infrastructure was gradually developed and improved with time.

As in the mid sixties, demand for water became an indicator of the increasing high standards of living. When the demand for water increased in the mid eighties, larger water bores had to be sunk, submersible pumps installed and piping network upgraded; bigger reservoirs were also installed. At the same time, infrastructural improvements included accessibility of water to all occupied dwellings and community facilities, moving away from communal outlets.

The first investigations about Niue's geology were carried out by J.C. Schofield from 1959 to 1978 and Jacobsen & Hill in 1980. However the main investigations concerning the hydrogeology were carried out by G. Jacobsen & P.J. Hill in 1980 (Bureau of Mineral Resources, Australia). A revision of this report, including supplementary investigations was published by P.W. Williams in 1985 from the Department of Geography of the Auckland University. Another main investigation was recently carried out by a Hydrogeologist from the United Nations, Mrs Bettina Salzmann-Wode.

Briefly the hydrogeological system can be summarised as follows:

(a) There exists only one fresh water lens;

(b) The water table determined to be between 1.7m and 1.5m above M.S.L. in the interior basin and increased on 3-4m above M.S.L. in the outer rim. This means that the water table lies approximately 33.5m below G.L. in the interior basin and 56-57 below G.L. in the outer rim.

(c) The thickness of the fresh water lens is about 35m from the centre of Niue and increases to more than 100m towards the coastal areas, especially along the northern and southern side of the island.

(d) A water table map shows the morphology of the water table. Areas of low water table can be described as groundwater valleys. The brackish springs on the coasts can be interpreted as run offs from the groundwater valleys - fissures, dissolution channels. It also shows direction of groundwater flow which is considered to be faster in fissured/cavernous zones than in undisturbed zones.

Some Technical Data on Our Water System

Niue at present has 15 water bores which supplies water for human consumption and mostly situated at the outer rim of the island, near the vicinity of inhabitants, all but one with submersible pumps which draws water at a faster rate. Three drought relief water bores are situated in the interior basin of the island using diesel pumps.

Marvilated tanks are used as reservoirs and the capacity ranges from 95kl to 456kl depending on the size of the village (95,000-456,000 litres). At present about 96% of occupied households have access to piped water either inside the dwelling or within the boundaries of the homestead. All households are fed from the storage tanks by means of gravity flow or pressure pump system.

A current project

The Water Resources Assessment and Development project was designed to improve the government's ability to deliver safe, potable water sufficient for household, agriculture, and light industrial use for the entire population of Niue.

In April 1991, as part of this project, Miss Nwe Nwe Nyo, UNV Water and Sanitary Engineer was recruited to upgrade the design of the present water system and to prepare a Five Year National Water Development Plan. Other parts of this project include recruiting an expert on Water Legislation and Regulations to assist in the drafting of required new water regulations, improved skills and capabilities of the personnel in the Water and Sanitation sector, improve the capability of the government to monitor and protect the quality of its water resources, establish a leak and waste policy programme, and a water conservation programme.

The present system is barely able to cope with the demand and the implementation of the rest of the project will certainly improve our water system. Another issue I would like to share with you is the wastage of water. We are all guilty of this; some doing it without conscious thought, others deliberately. Some of the water bores are too close to the dwellings and animal activities and are likely to be contaminated in future, if not already contaminated. The building code that will come into effect on the 1st October 1992 covers the proper design of septic tanks.

The Water Legislation and Regulations (once completed and approved by Cabinet) covers the restriction of human animal activities to 200m away from the water bores.

A study by the Public Works Department in 1981 revealed that domestic use of water averages out at 180 litres/h/d. Another study by the Water and Sanitation Engineer in 1991 reflected a figure of 150 litres/h/d. Both studies revealed that 100-116 litres/h/d was for domestic use and the rest accounted for loss and wastage. A maintenance programme played a vital role in reducing losses through faults, but wastage by the people remains a problem.

Some of the problems that exist with the present water distribution system:

(a) Inadequate pressure in the system for end users;

(b) Inadequate water supply for the agricultural, industrial and tourist activities;

(c) Existing water bores too close to dwellings;

(d) Lack of trained personnel to design, operate and maintain the system; and,

(e) Excessive loss of water due to leakage but mainly wastage.

Some proposals for immemdiate action:

(a) To improve the quality of the water resource;

(b) To train personnel in designing, operating, and maintaining the system;

(c) To implement the Five Year National Water Development Plan. This plan covers the demand for the projected population and island's development plan until the year 2001; and,

(d) To finalise the existing draft of the Water Legislation and Regulations and to submit for Cabinet approval.

In conclusion ladies and gentleman, Niue has adequate groundwater which is suitable for drinking and it is estimated that 198,653,000m3 surplus water annually, can be expected. The Water Resources Assessment and Development project is funded by the UNDP in coordination with the Niue Government, which was designed to improve government ability to provide safe and sufficient water for the growing demand.

People just take for granted that provision of water is free and that there is plenty of it down there without any thought of conserving its quality and the costs incurred in distributing water to them. Already the Government in coordination with AIDAB and UNDP have spent substantial financial assistance to create the existing system.

Let me quote you some figures:

- is budgetted for the electricity alone in providing water to the consumers for 1992/93 financial year
- on top of that $90,000 for maintaining the system
- water supply assests about 0.5 of a milllion dollars

Costs required to upgrade the existing systems in each village is estimated to be about half a million dollars. To implement the rest of the project, Niue depends mostly on foreign aid. Another point to think about is, we only have one source of water down there and if we pollute it, where will that leave us?

Ladies and gentleman, on behalf of Public Works Department I thank you for your attention.

Handout 3: Introduction to Water Sampling

Introduction

Pure water does not exist in nature because water is universal solvent and tends to dissolve almost anything it comes into contact with. Because of this, water always contains a lot of impurities which may be divided into broad categories of:

- Physical;
- Chemical;
- Bacteriological;
- Biological; and,
- Radiological impurities.

These impurities in water can be examined and analysed by using various methods and special equipment both in the laboratory and in the field.

Reasons for Water Sampling

In public health practice the objects of the analysis of samples of water are mainly:

- To determine safeness of water for human consumption
- To assist in the maintenance of good water standard

To meet the above objectives water samples are taken at various stages of water development;

a) **Initial sampling.** Samples are taken for physical, chemical and bacteriological examinations of water from newly constructed systems or sources before they are operated and lopened for public use. Examination results could then be used to ascertain the quality of water and the type of treatment needed, as seen in Table 1.

Table 1: Bacteriological considerations, *in coliforms per 100 ml water sample.*

Count	*Suggested Treatment*
less than 50	chlorination alone
50 to 5,000	complete treatment
5,000 to 50,000	double treatment
more than 50,000	unsuitable source

b) **Periodic or routine sampling.** To monitor water quality and ascertain variations from standards and possible contamination. This also assesses the efficacy of water treatment, when samples are examined before and after treatment.

It is important to note that the examination of any single sample indicates only the condition of the water at the time the sample taken, it is valueless for any other purpose. Sampling should be done systematically and the results recorded upon a chart or graph. In this way seasonal and other variations may be be noted and any deviation from standard may be assessed and investigated.

Examination of Water

In order to assess the quality and safety of any given water supply, it is necessary to examine or analyse representative samples of water. Visual inspection alone is not sufficient to enable one to determine whether a given water is safe to drink or not since it may contain dangerous impurities such as pathogen, even if in appearance it is crystal clear, sparkling and free from tastes and odours. Purity of water is investigated by chemical and by bacteriological examination.

The examination that are performed on water may be classified as follows;

a) Physical examination

This is to find out the physical attributes of water, turbidity, colour, taste and odour. Strictly speaking, dirty looking or smelly water is not necessarily dangerous but it occurs in nature that it is almost always so. besides, dirty water is unappealing and unesthestic and hence people may turn to other more dangerous sources.

b) Chemical examination

The amount of chemical impurities that may be present is measured or estimated by appropriate chemical determinations. Among the substances or attributes routinely measured are pH, alkalinity, total solids, chloride, hardness and iron. Sometimes, manganese, sulfates, and other rare metals are also determine if their presence is suspected.

Chemical examination enables us to determine and assess the behaviour of the water in the pipes and in the human body, and gives us a chemical picture of the impurities present. In turn the results enables us to state whether the chemical substances are present in excessive amounts or within prescribed limits.

c) Bacteriological examination

This is probably the most important single test since it enables us to find if the water is potentially dangerous and whether or not the kind and number of bacteria present constitute a health hazard. Water intended for huamn consumption should not contain any pathogenic or disease causing germs. Actually, the tests is made to detect the present of "indicator organisms" rather than the dangerous pathogens themselves since the detection of the latter is much more difficult and time consuming.

d) Biological examination

This is done on a rather large sample and the impurities concentrated for microscopic examination. The kind and amout of microscopic life are then determined using appropriate laboratory techniques and apparatus.

e) Radiological examination

Unless there is reason to suspect their presence, the radioactive contaminants of water are generally not determined. However, water receiving waste from nuclear installations or radioisotope laboratories should be examined. Also, if rain water is suspected of atmospheric contamination through nuclear weapons testing, a sample of this rain water should be analysed immediately if only to remove any public apprehension about its safety.

Sampling Frequency and Number

a) Initial examination

The physical, chemical and bacterilogical examinations of water from newly constructed systems or sources are required before they are operated and opened for public use.

b) Periodic examination

Water from existing souces is subject to bacteriological examination as often as possible but the interval shall not be longer than a month, while general systemic chemical examination shall be conducted every six months or oftened. Examination of water sources shall be conducted yearly for possible radioactive contamination.

The frequency of sampling should also take into account the past freqency of unsatisfactory samples; the quality of raw water treated; adequacy and capacity of treatment; the risk of contamination from the source and the system; the dangers of epidemics arising.

Location of sampling points

Water samples should not be taken from the same point on each occassion but should be rotated through other areas or zones of the distribution system. A common habit which may yield misleading resoults is the collection of samples from the same points month after month. If the water system is drawing from different sources then water from each source should be periodically sampled.

Co-odination with Laboratory

The need for coordination between sample collectors and laboratory personnel should be obvious. A lot of samples are rejected by the laboratory due samples arriving and remaining in the airport or bus station for days or arriving at the laboratory on weekends when the lab is closed or any similar practices that impair the usefulness of the smaple. It is also important to confirm from the laboratory ehter they would be able to accept your samples before they are sent. The laboratory could be flooded with samples and may not able to examine new ones in time.

Frequency of sampling should take into account:

- the past frequency of unsatisfactory samples;
- the quality of raw water treated;
- the adequacy and capacity of treatment;
- the risk of contamination from the source and the system; and,
- the dangers of epidermics arising.

Handout 4: Acquiring Water Samples

Sampling for bacteriological examination and contamination during collection should be avoided. When several samples for various examinations are collected on the same occasion from the same source, the sample for bacteriological examinations should be taken first, to avoid possible contamination of the sampling point.

Containers

Sterilised glass bottles provided with either ground glass stoppers or plastic screw caps should be used for collection of samples. Both the stopper and the neck of the bottle should be protected by a paper or a thin aluminium foil cover. For waters that have been chlorinated, bottles containing 0.1 ml. of a 3% solution of sodium thiosulphate for every 120 ml. of water sample should be used.

The sample bottle should be kept unopened until the moment it is to be filled. The stopper or screw should be removed with care to avoid soiling. During sampling, the inside portion of the stopper and neck of the bottle should not be handled and should be protected from contamination. The bottle should be held near the base; it should be filled without rinsing and the stopper or cap replaced immediately.

Sampling Procedures

The procedure for sampling should be as follows :

1. Sampling from a tap on a distribution system

It should be ascertained that the tap chosen is supplying water from a service line directly connected with the main and not, for instance, on reserve from a cistern or storage tank. The tap should be cleaned, flamed to sterilise and opened fully and the water allowed to run to waste for 2 or 3 minutes or more to permit clearing the service lines. The flow from the tap should be restricted to permit filling the bottle without splashing. Leaking taps which permit water to flow over the outside must be avoided and any external tap fittings (i.e hoses, nozzles etc.) should be removed before sampling.

2. Sampling Directly from Source (i.e river, stream, lake, reservoir, spring or shallow well.)

The aim is to obtain a sample that is representative of the water which will be taken for purposes of supply to consumers. It is therefore important that the following points are noted:

- do not take samples too near to the bank or too far from the point of draw off;
- avoid areas of stagnation;
- avoid collecting floating debris or sediment in water sample; and
- if wading into the water is required, take water sample upstream of yourself.

Samples can often be taken by holding the bottle near its base in the hand and plunging it, neck downwards, below the surface. The bottle should then be turned until the neck points slightly upwards, the mouth being directed towards the current and away from the sampler so that water coming into contact with the hands will not enter the bottle. If no currents exist as in a reservoir, a current should be artificially created by pushing the bottle horizontally forward in a directon away from the hand. If it is not possible to collect samples from these situations in this way, a weight may be attached to the base of the bottle, which can then be lowered into the water. Special apparatus which permits mechanical removal of the stopper of the bottle below the surface is required to collect samples from the depths of a lake or reservoir.

Open wells from which water is drawn by rope and bucket or other similar devices are practically certain to contain coliform organisms and therefore should not ordinarily be sampled for bacteriological examination.

3. Sampling from a deep well

If well is fitted with a pump, water should be pumped to waste or for a sufficient time (about five minutes) to remove the water present in the water column. The pump outlet must be sterilised before the sample is collected.

If there is no pumping machinery a sample can be collected directly from the well by means of a sterilised weighted bottle. In this case, care should be taken to avoid contamination of the sample by any surface scum.

4. Location of sampling points

The location of the sampling points at pumping stations, as well as in the distribution system, should be as such to enable proper supervision of the bacteriological quality of the water supply to be maintained. Inspection of the entire water supply system from the source to the consumer's premises is of utmost importance and the inspector in consultation with the certifying authority, should decide on the location of the sampling points.

5. Sample volume

The volume of the sample of water should be sufficient for carrying out all the test required and should not be less than 100 millilitres.

6. Identification of samples

All samples of water should be accompanied by complete and accurate identifying and descriptive data. Samples not identified should not be accepted for examination.

Preservation and storage

The bacteriological examination of a water sample should be started promptly after collection to avoid unpredictable changes. If samples cannot be processed within 6 hours after collection, the use of ice coolers for storage of water samples during transport to the laboratory is recommended. Time lapsing between collection and examination, should in no case exceed 30 hours. The time and temperature of storage of all samples should be considered in the interpretation of data.

When there is likely to be delay in getting samples to the laboratory, the sample can be

filtered through a membrane at the site of collection. The membranes after filtration are placed in a petri dish. The samples may also be placed in a transport medium of coconut water and the bottle shipped to the laboratory. In either case, the transport medium should be recorded.

Sampling for physical and chemical examination

For general chemical examination, a sample of at least 2 litres is required; it should be collected in a chemically clean bottle made of good quality neutral glass, practically colourless, and which is fitted with either a ground-glass stopper or plastic screw-cap.

The bottle should be rinsed out at least three times with the water that is to be sampled before the bottled is filled.

In collecting samples for chemical analysis, the general recommendations given for the collections of samples for bacteriological examination should be folowed. Sample both upstream and downstream of points of effluent discharge to determine net effect of discharge.

In the collection of samples from mineralised sources, the bottle should be completely filled and the stopper securely fastened.

Samples should be transported to the laboratory with as little delay as possible and should be kept cool during transport. Chemical analysis should be started as soon as practical after collection of the sample, and in any case should not be delayed for more than 72 hours.

A record should be made of every sample collected, and every bottle be identified, preferably by attaching an appropriate tag or label which includes sufficient information to provide positive identification of the sample at some later date, e.g. name of sample collector, date sampled, time of sampling, location of sampling, water temperature, details of any treatment of the water, and any data which may be needed for future reference, such as weather conditions, water level and strain flow. Sampling points should be fixed by detailed description, by maps, or with the aid of buoys or landmarks, in such a manner as to permit their identification by other persons.

Collection of samples of both raw and treated water for examination for toxic substances should be carried out every three months, and more frequently when sub-tolerance levels of toxic substances are known to be generally present in the source of supply, or where such pollution exists as; for example in an area where industries may be discharging toxic wastes into sources of a water supply.

Samples for general systematic chemical examination should be collected at least once every three months in supplies serving more than 50,000 inhabitants. More frequent sampling for chemical examination may be required for the control of water treatment processes.

Handout 5: Water Supplies, Sanitation and the Environment

Mr Holo Tafea, Chief Public Health Officer

Introduction:

Water is a gift from our God. Water is very important to human lives and all other creatures created by Him. Without water we cannot exist. But on the other hand water is a killer, if we do not look after it. Water is a source of water-borne diseases throughout the world.

My presentation is only related to activities carried out in the department and also its objectives.

Underground water is our main water supply throughout the entire community. Rain water is another source of water supply which people store in their cement tanks (400 gallons) and few store in their own large water tanks.

Treatments

There has been no treatment of our water supply system . Because of this, the Department of Health, following results of water supply testing advised the public to boil water before consumption. On a government request, the WHO adviser, Dr. Paul Guo, visited Niue last year and his recommendation was made to the Government.

Control Measures

Control measures carried out are : health education to villages, other organizations and available media on the island. To assist with any water problems the Health Department invites the Plumbing Overseer from the Public Works Department on each village inspection day . This arrangement was found to be very effective. He is able to repair any problems on the same day or the following day. This issue was also addressed in the meeting as well as advising the villages to report any water problems to the Public Works Department or Department of Health.

The Problems

Chemicals and Fertilisers Use

This is a concern by the Department of Health. We are aware that there are many chemicals and fertilsers being used on Niue without any controlling programme. One particular chemical that we use everyday is gramoxone (weed killer). However I do hope that SPREP and NEMS will assist us with this problem . With the equipment provided by them we can manage to monitor the problem.

Animals Wandering

Animals wandering is another problem to the Department of Health. On the island there are many pigs wandering in villages and in the bush. Dogs are also in villages.

Our soil is porous and faecal matter can easily seep through to our water lens. We have regulations but sometimes we are reluctant to enforce them.

Caves, Toilet, Septic Tanks, Pigsties and Burial

It is prohibited to dispose of toilet and septic tank waste in caves. It is recommended that pigstye and burial distance be 200 meters from the waterbore. The public was advised that all pits should be cemented. Burial sites have to be on the seaward side to protect water lens. It is also recommended that septic tanks be water tight.

Solid Waste Disposal

This area is located on top of the quarry. It is an issue that still requires proper management. However, after use, it has to be covered with waste soil by the Plumbing Section and sprayed by the Department of Health.

Refuse Disposal

All refuse dumps were selected on the seaward sites provided to protect water bores inland. Refuse collection is carried out once a week in rural areas and scenic sites; twice a week in the urban areas. Illegal dumping is prohibited throughout the whole island except those dumps approved by the Department of Health.

Water Quality

Our water quality is still a problem to the community and to the Department of Health. This includes solid waste disposal and sewage disposal, and possible eutrophication (see fig. 1). There are minor public health problems not mentioned in this presentation. The Department of Health has to carry out all preventative measures to minimise existing problems.

Solutions

There are major environmental health solutions which need to be carried out, i.e. health prevention and promotion, workshops, management and training.

Objectives

(1) To organise and manage water control programmes more effectively making water safe for human consumption;

(2) to maintain the quality of water;

(3) to reduce numbers of water-borne diseases;

(4) to provide people with training and skills to continue the prevention and promotion programmes; and

(5) to make Niue Island a community free of water borne disease and problems.

Conclusion

I wish to acknowledge SPREP (Director and his staff) and also the NEMS Project for organising this training course in Niue. It is my experience that we local people still have problems with our water. Wasting of water is one of our major ones. I am sure that each one of us realises the problems which can happen if we continue to waste water. When you return to your individual groups please educate our people : Water is very important to us. It is a **goal** in our lives.

Kia leveki a e tuatolu oti ha tautolu a vai!

God Bless!

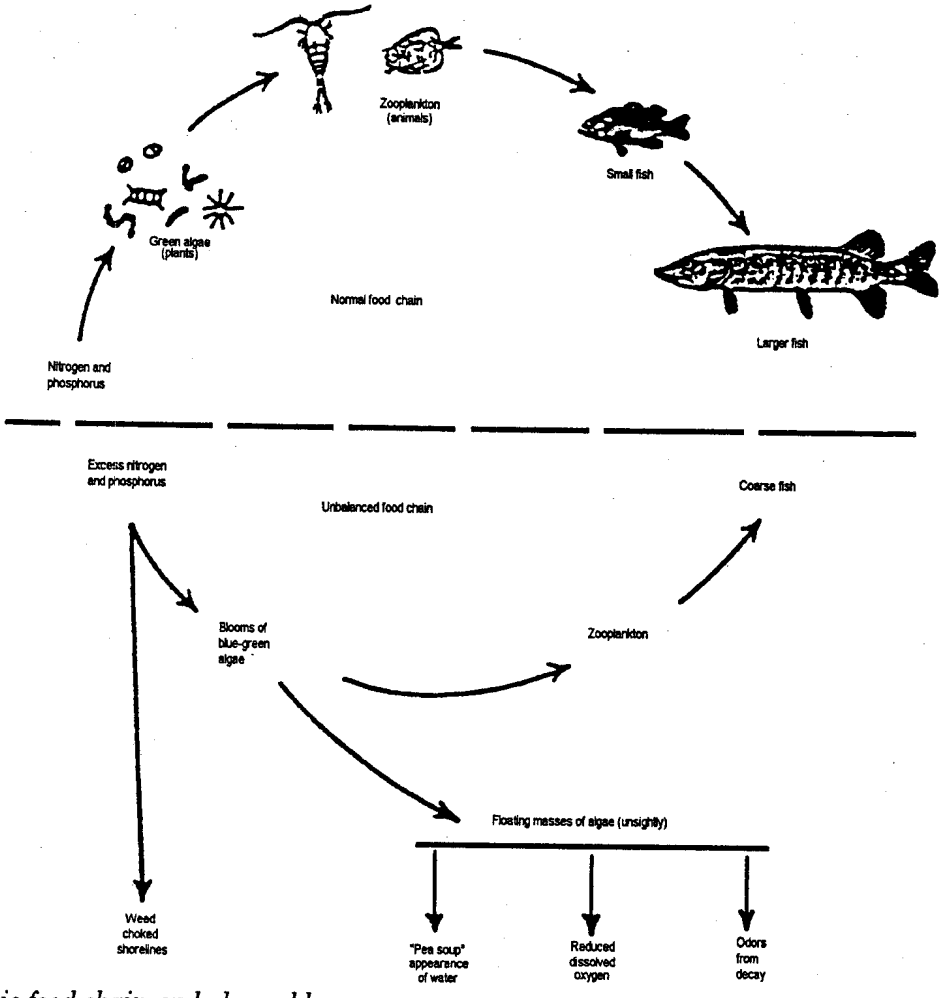

Fig. 1: The aquatic food chain, unbalanced by eutrophication, compared with normal succession.

Handout 6: Routine Water Samples

Table 1 below shows the test results for all water samples taken from waterbores on **30 June 1992**.

Vaiea waterbore is out of working order, so no sample taken from this waterbore.

As you have seen in my monthly report for June that SPl, Hakupu, Liku, Lakepa, Mutalau, Toi and Hikutavake waterbore found more than 16.00 /100 mls coliforms; but *E. coli* found negative. It would still be interesting to know which coliforms are present in our waterbores.

Table 1: Test results for water samples taken on 30 June 1992.

Site	*Total coliform count (no. / 100ml water)*	*Presence of* E. coli *positive (pos) or negative (neg.)*
SPl (Alofi Airport)	>16.00	neg.
SP2 (Alofi Airport)	< 2.2	neg.
SP3 (Alofi Tuila)	< 2.2	neg.
SP4 (Alofi Tuila)	< 2.2	neg.
Tamakautoga	5.1	neg.
Avatele	< 2.2	neg.
Hakupu	> 16.0	neg.
Liku	16.0	neg.
Lakepa	> 16.0	neg.
Mutalau	> 16.0	neg.
Toi	16.0	neg.
Hikutavake	> 16.0	neg.
Namukulu	< 2.2	neg.
Tuapa	< 2.2	neg.

Handout 7: Water Standards for Monitoring Water Quality

H.T. Nemaia, Director of Health

To ensure that water used for drinking purposes and water around us can sustain life, some sort of water standards have to be set and have to be met by those involved in the water industries. The most widely used standards are the:-

1. Standard for Raw Water Classification;
2. Drinking Water Standards;
3. Swimming Water and Shellfish Standards; and,

1. Standard of Raw Water Classification.

The classification of raw water for drinking can sometimes be useful indicating under what conditions a water source could be used or whether it is inadvisable to use it at all for public supply purposes. As for other water it could indicate the degree of pollution of that particular water sampled. In any such classificationthe bacteriological content of a water sample plays a dominant part.

The two main analyses used for bacterial quality are:

- the **total coliform** count, which estimates the number of bacteria of the "coli aerogenes" group in a sample, these being of both faecal and non -faecal origin; and,
- the **faecal coliform** count, which estimates the numbers of *E. coli* bacteria, for a sample, these being a particular strain of bacterial from the coli-aerogenes group which orginates from faeces.

Hence, the total coliform count denotes the likelihood of sewage polution, and the faecal coliform count confirms any pollution as being of human or animal origin. Also the number of such bacteria present per unit volume of water (usually 100 ml), indicate the degree of pollution.

In the early edition of the WHO European Standards (1958, 1963, 1968 and 1971), now withdrawn, an attempt was made to classify raw water according to their degree of bacterial contamination, as shown in Table 1, below. Four classes of water identified, labelled i-iv, of which the most heavily polluted (iv) has over 5,000 coliform bacteria per 100 ml, was defined as a " source to be used only when unavoidable".

An EC Directive of 1975 continues a similar classification, but for surface water source only. Three categories of surface water are designated, At, A2 and A3 and the bacterial guide levels set for each are the same as for the WHO categories, II and III respectively. Mandatory chemical limits for toxic substances are also set and these correspond to the mandatory limits set for toxic substances in drinking water in these instances (the majority) where reduction by normal treatment process is unlikely to occur.

Table 1: Classification of Raw Water According to Bacterial Numbers (as proposed at one time in the WHO European Standards).

	Classification	***Total coliform bacteria per 10 ml***	***Faecal coliform bacteria per 100 ml***
(i)	Bacterial quality applicable to disinfection treatment only	0-50	0-20
(ii)	Bacterial quality requiring conventional methods of treatment (coagulation, filtration, disinfection)	50-5,000	20-2,000
(iii)	Heavy pollution requiring extensive types of treatment	5,000-50,000	2,000-20,000
(iv)	Very heavy pollution, unacceptable.	50,000 >	20,000 >

2. Drinking Water Standard (Physical and Chemical)

The most widely used standards before 1983 were the WHO International Standards for drinking water first published in 1958 and revised in 1963, 1968 and 1971. These have been further revised and were reissued in a new form in 1983, now entitled Guidelines for Drinking Water Quality. These WHO 1983 Guidelines are summarized in Table 2, but the 1971 International Standards are also reproduced since they have formed the basis for many national standards.

The WHO also published European Standards, the latest in 1970, but these no longer apply as they are merged into the 1983 Guidelines.

Other standards of importance are those used in the USA formerly issued by the US Pacific Health Service, now superseded by the Drinking Water Regulations published by the US Environmental Protection Authority (EPA) in 1977. The old US Public Health Service Standards were first issued in 1913 and the 1962 update version of them was reflected in many of the provisions of the second issue of the WHO International Standards in 1963.

Many other countries have their own national standards, most of which are based upon the WHO International Standards of 1958, 1963, 1968 or 1971, with only slight modifications to allow for local in-country conditions.

3. Swimming Water and Water for Shellfish Culture Standard

(a) Standard for suitability for swimming

In assessing the suitability of water for recreational use, clearly it is important to define the type of recreational activity that would be involved. The microbiological quality of water is of little importance in relation to fishing or boating activities and it is only where there is intimate human contact with water, as in swimming, that the health hazard can be serious.

There have been several studies since the 1950; particularly in the USA demonstrating that appreciably higher rates of illness can be expected in swimmers than nonswimmers. The illness can be grouped into eye, ear, nose and throat, gastro -intestinal, skin irritations and other illness.

Bathing water quality is judged on the content of coliform or faecal coliform organisms an assessment which is only likely to be related to the incidence of gastro -intestinal infections. There is no WHO standard for bathing waters but the EEC standard is shown in Table 3.

(b) Standard for suitability for shellfish culture

The microbiological criterion for shellfish water quality has been accepted by international agreement to be a median MPN for total coliforms of not more than 70/100 mls and not more than 10% samples normally exceeding an MPN 230/1000 ml sample for the 5-test tube.

This standard has proved to be reasonably satisfactory. However, recent investigations proved that the criteria should be changed and the median faecal coliform value should not exceed MPN 14/100 and not more than 10% samples should exceed an MPN 43/100 ml.

Tables 4 and 5 show shellfish standards for USA and UK. In the UK water quality standards are not used, since it is considered that the relationship between the bacteriological water quality and the quality of the shellfish is variable. Instead shellfish is judged on the bacteriological content of the flesh.

Table 2: Summary of WHO drinking water standards (revised 1983).

			1983 Guidelines 1971 Internatonal Standards		WHO EC Directive 1980 relating to the qualitly of water intended for human consumption		
Substances or characteristic		**Unit**	**Guidelines value**	**Upper limit of concentration (tentative)**		**Guide level (GL)**	**Maximum admissible concentration (MAC)**
Inorganic constituents of health significance							
* Antimony	Sb	)					0.01
* Arsenic	As	)	0.05	0.05			0.05
* Cadmium	Cd	)	0.005	0.01			0.005
* Chromium	Cr	)	0.05				0.05
* Cyanide	CN	)	0.10	0.05			0.05
* Fluoride	F	)	1.5	0.9-1.7(b)			1.5(b)
		) mg/l		0.6-0.8(c)			0.7(c)
* Lead	Pb	)	0.05	0.10			0.05(d)
* Mercury	Hg	)	0.001	0.001			0.001
* Nickel	Hi	)					0.05
Nitrates		)	10 (as N)	45 9as NO3)		25 (as NO3)	50 (as NO3)
* Selenium	Se	)		0.01			0.01
Organic constituents of health significance							
* Pesticides and related products		)					
individually in		)					0.0001
total		)					0.0005
* PAH - six refrence substancea		) mg/l					0.0002
Other organochlorine compounds additional to pesticides etc.		)				0.001	Haloform concentration must be as low as possible
				Highest desirable level	Maximum permissible level		
Other characteristics or substances							
Colour		Hazen	15	5	5-	1	20
Odour			Inoffensive	Unobjectionable			2 or 3 TON(f)
Taste			Inoffensive	Unobjectionable			2 or 3 TON(f)
Suspended Solids						None	
Turbidity		JTU	5	5	25	0.4	4
pH			6.5-8.5	7.0-8.5	6.5-9.2	6.5-9.2	9.5 (maximum value)
Temperature		°C				12	25
Aluminium	Al	)	0.20			0.05	0.20
Ammonium	NH4	)				0.05	0.50
Barium	Ba	)				0.10	
Boron	B	)				1.0	
Calucium	Ca	)		75	200	100	
Chloride	Cl	)	250	200	600	25	
Copper	Cu	)		0.05		0.10	
Hydrogen		)					
Sulphide	H2S	)	Not detectable				Not detectable
Iron	Fe	)	0.30	0.10	1.0	0.05	0.20
Magnesium	Mg	)		30(h)	150	30	50
Manganese	Mn	) mg/l	0.10	0.05	0.50	0.02	0.05
Nitrite	NO2	)					0.10
Phosphorus		)					
Pentoxide	P2O5	)				0.40	5.0
Potassium	K	)				10	12
Silver	Ag	)					0.01
Sodium	Na	)	200			20	175(i)
Sulphate	SO4	)	400	200	400	25	250
Zinc	zn	)		5.0	15	0.10(g)	
Anionic detergents		)		0.2	1.0		0.20(j)
Mineral oil		)		0.01	0.30		0.01(k)
Phenolic compounds		)		0.001	0.002		0.0005(l)
Total dissolved solids		)	1000	500	1500		1500
Conductivity		uS/cm				400	
Total ahrdness as CaCO3		mg/l	500	100	500		- (m)

Substances or characteristic		Unit	1983 Guidelines 1971 Internatonal Standards: Guidelines value	1983 Guidelines 1971 Internatonal Standards: Upper limit of concentration (tentative)	WHO: Guide level (GL)	EC Directive 1980 relating to the quality of water intended for human consumption: Maximum admissible concentration (MAC)
Inorganic constituents of health significance						
* Antimony	Sb	)				0.01
* Arsenic	As	)	0.05	0.05		0.05
* Cadmium	Cd	)	0.005	0.01		0.005
* Chromium	Cr	)	0.05			0.05
* Cyanide	CN	)	0.10	0.05		0.05
* Fluoride	F	)	1.5	0.9-1.7(b)		1.5(b)
		) mg/l		0.6-0.8(c)		0.7(c)
* Lead	Pb	)	0.05	0.10		0.05(d)
* Mercury	Hg	)	0.001	0.001		0.001
* Nickel	Hi	)				0.05
Nitrates		)	10 (as N)	45 9as NO3)	25 (as NO3)	50 (as NO3)
* Selenium	Se	)		0.01		0.01
Organic constituents of health significance						
* Pesticides and related products		)				
individually in		)				0.0001
total		)				0.0005
* PAH - six refrence substancea		) mg/l				0.0002
Other organochlorine compounds additional to pesticides etc.		)			0.001	Haloform concentration must be as low as possible
			Highest desirable level		Maximum permissible level	
Other characteristics or substances						
Colour		Hazen	15	5	5-	1	20
Odour			Inoffensive	Unobjectionable			2 or 3 TON(f)
Taste			Inoffensive	Unobjectionable			2 or 3 TON(f)
Suspended Solids						None	
Turbidity		JTU	5	5	25	0.4	4
pH			6.5-8.5	7.0-8.5	6.5-9.2	6.5-9.2	9.5 (maximum value)
Temperature		°C				12	25
Aluminium	Al	)	0.20			0.05	0.20
Ammonium	NH4	)				0.05	0.50
Barium	Ba	)				0.10	
Boron	B	)				1.0	
Calucium	Ca	)		75	200	100	
Chloride	Cl	)	250	200	600	25	
Copper	Cu	)		0.05		0.10	
Hydrogen		)					
Sulphide	H2S	)	Not detectable				Not detectable
Iron	Fe	)	0.30	0.10	1.0	0.05	0.20
Magnesium	Mg	)		30(h)	150	30	50
Manganese	Mn	) mg/l	0.10	0.05	0.50	0.02	0.05
Nitrite	NO2	)					0.10
Phosphorus		)					
Pentoxide	P2O5	)				0.40	5.0
Potassium	K	)				10	12
Silver	Ag	)					0.01
Sodium	Na	)	200			20	175(i)
Sulphate	SO4	)	400	200	400	25	250
Zinc	zn	)		5.0	15	0.10(g)	
Anionic detergents		)		0.2	1.0		0.20(j)
Mineral oil		)		0.01	0.30		0.01(k)
Phenolic compounds		)		0.001	0.002		0.0005(l)
Total dissolved solids		)	1000	500	1500		1500
Conductivity		uS/cm				400	
Total ahrdness as CaCO3		mg/l	500	100	500		- (m)

Table 3: EEC stardard guidelines for bathing waters.

Measurement	*Guidelines*	*Imperative*
Total coliform / 100 ml	500 (80% sample)	10,000 (95% sample)
Faecal coliform / 100 ml	100 (80% sample)	2,000 (95% sample)
Faecal Streptococci / 100 ml	100 (90% sample)	
Enteroviruses	PFu / 10 litres	

Table 4: US standards for shellfish growing (culturing) waters.

Status	*Median Faecal Coliform count (no. E.coli / 100 ml water)*	*with 10% (no. / 100 ml)*
Approved	>14	43
Restricted	>140	430 (/ 100 sample)

Table 5: UK standards for shellfish flesh.

Coliform count (*E. coli* / ml flesh)	*% clean*	*Comments*
0-5	100-80	Satisfactory
6-15	70	Suspicious
16+	<60	Unsatisfactory - scale prohibited or consumption not recommended.

Handout 8: Incidence of Water-related Disease in Niue

Water is very important to life and certainly a matter of Public Health importance. The human body requires 70 to 75mls of water per kilogram for 24 hours. If you can work out the average daily requirement of an average -build person it will come to 2 1/2 litres in 24 hours. This recovers the loss from urine, sweating, faeces and breathe.

Water can cause certain diseases if it is contaminated with certain types of germs. It is therefore important that the constituents harmful to health are eliminated for the safety of the consumer and the well- being ofthe community.

The consumer relies on his senses to tell whether the water is good or bad to drink by appearance, smell and taste. These do not, however, guarantee that the water is safe to drink.

The water must be subject to special laboratory tests to ensure there is no harmful bacteria present at regular intervals. There are other aspects related to the protection of water quality such as the selection of the bore site, the restriction of animal farming, housing and industrial development but I will leave those areas to the Civil Engineers, the Sanitary Engineers and the Health Inspector.

Water borne diseases are diseases caused by drinking water that is contaminated bacteria. Some well known diseases are:

- Cholera;
- Typhoid;
- Dysentery; and,
- Gastro-enteritis, causing diarrhoea and vomitting.

Niue is fortunate that the first two most serious diseases are not prevalent. However, with the speed of travel and the freedom of movement and the fact that these diseases are prevalent in some countries of the region, there is danger of their introduction. As we have only one water source we must always be vigilant. The Health Department must follow the accepted international procedures to ensure that the quality of our drinking water is maintained at the safety level.

Gastro-enteritis is prevalent in Niue affecting all age groups, but mostly infants on bottle feed and the very elderly. Because ofthe early intervention of health care there has been no mortality for several years. **Dysentery** is less common.

The most common bacteria the laboratory has identified are:

- *coli*;
- *Shigella sonnei*; and,
- Rotovirus.

All these can contaminate water if they have access to it.

In 1991 there was a sudden increase in the number of cases of gastro -enteritis reported. The Health Department was very concerned, especially when it coincided with the high coliform bacterial count of water samples tested. The Government was notified and the public was advised to boil all drinking water.

World Health Organisation assistance was requested and a consultant visited. He supported the water boiling as a cheap and very effective measure. The latest tests, as revealed by the Health Inspector, are satisfactory.

The underground water is our only water source. The public, the private sector and the government departments must be aware of this matter of Public Health importance. Economic Development must be carefully planned and implemented in a way that it does not cause any harmful effect on the only water source of the country.

The Public Works Department and the Health Services must continue to work together to maintain the quality of our drinking water with support from SPREP.

Information on Suitable Water Filters

1. BACFREE British Berkefeld Bacteria-Free Water Filters

The following information and prices for BACFREE British Berkefeld Bacteria-Free Water Filters was obtained from Bacteria Free Water Filters (M) San. Bhd. (Fax 03 - 7331785), the Malaysian supplier.

According to the information provided, the models described would be acceptable on United Kingdom registered ships in lieu of automatic chlorination for the treatment of water intended for drinking and cooking. The price per unit is M$325 to M$380 (US$ 130 to US$ 150). No information on shipping charges is available.

Larger versions are available for commercial, industrial and institutional use ranging in price from M$1 650 to M$1 925 (US$ 660 to US$ 770). The latter are rated up to a maximum of 1 500 litres per hour. They are designed with 1/2" inlet and outlet. No information on throughput and inlet dimensions was provided for the smaller units.

2. PWT Doulton Filter

This is a new product from one of the world's most respected producers of ceramic water filters, being introduced to the New Zealand market. These new filters remove:

- Giardia
- Bacteria
- Sediment
- Taste and Odour
- Chlorine
- Organic Chemicals

The main market application is as a giardia filter. This nasty little cyst has created a lot of attention recently. However, the sterilising properties of the Doulton Filter make it ideal for domestic use from tank or bore water supplies. Tank water (from roof collection) is particularly susceptable to contamination from bird droppings, possums, lead (from lead head roofing nails), zinc from galvanised roofing and tank sides, decaying leaves from spoutings etc. Doulton filters are also very effective in removing chlorine and taste from treated water supplies. A glass of water certainly tastes better from a Doulton Filter.

Most domestic filters being marketed in New Zealand at present are simply carbon filters with a limited filtering capacity. The unique Carbosyl element in the PWT Doulton will filter down to one micron such sterlising due to the silver compound incorporated with activated carbon in the ceramic core and is cleanable. Most sandard activated carbon filters do not have this protection and become a breading ground for bacteria.

Filters (1991 retail prices)

Item	Prices (NZ$)
Domestic capacity	219.00 - 354.00
Replacement filters	49.00 - 65.00
Large scale capacity	1,600.00

Handout 9: Introduction to Water Pollution

All domestic, industrial and agricultural wastes affect in some way the normal life of a river, lake orunderground source ofwater. Whenthe influence is sufficientto render the water unacceptable for its best usage, it is said to be pollution. The principal sources of water pollution are shown in Fig. 1 and following is a discussion of the common types of pollutants.

Oxygen Consuming Matter

Deoxygenation can be caused by reducing agents that have an immediate oxygen demand, or by biological decomposition of waste organic matter. The latter is a relatively slow reaction, gradually depleting the dissolved oxygen in a river as the water flows downstream. Oxygen is replaced by aeration at the surface and photosynthetic activity of green plants.

The maximum oxygen deficit depends on the interrelationship of biological oxygen utilization and reaeration. Fisheries and most aquatic life are stifled by a lack of oxygen, and unpleasant tastes and odours are produced if the content is sufficiently reduced. Settleable organic solids can create sludge deposits that decompose, causing regions of high oxygen demand and intensified odours. Floating solids are unsightly and obstruct passage of light vital to plant growth. Thin films of oil can also reduce the rate of reoxygenation.

Inorganic Solids

Inert suspended solids, such as silt and mine slurries, produce turbidity that reduces light penetration and, therefore, interferes with photosynthesis. Solids that settle out of solutions blanket the streambed, smothering bottom organisms and hindering the reproduction cycle of fish.

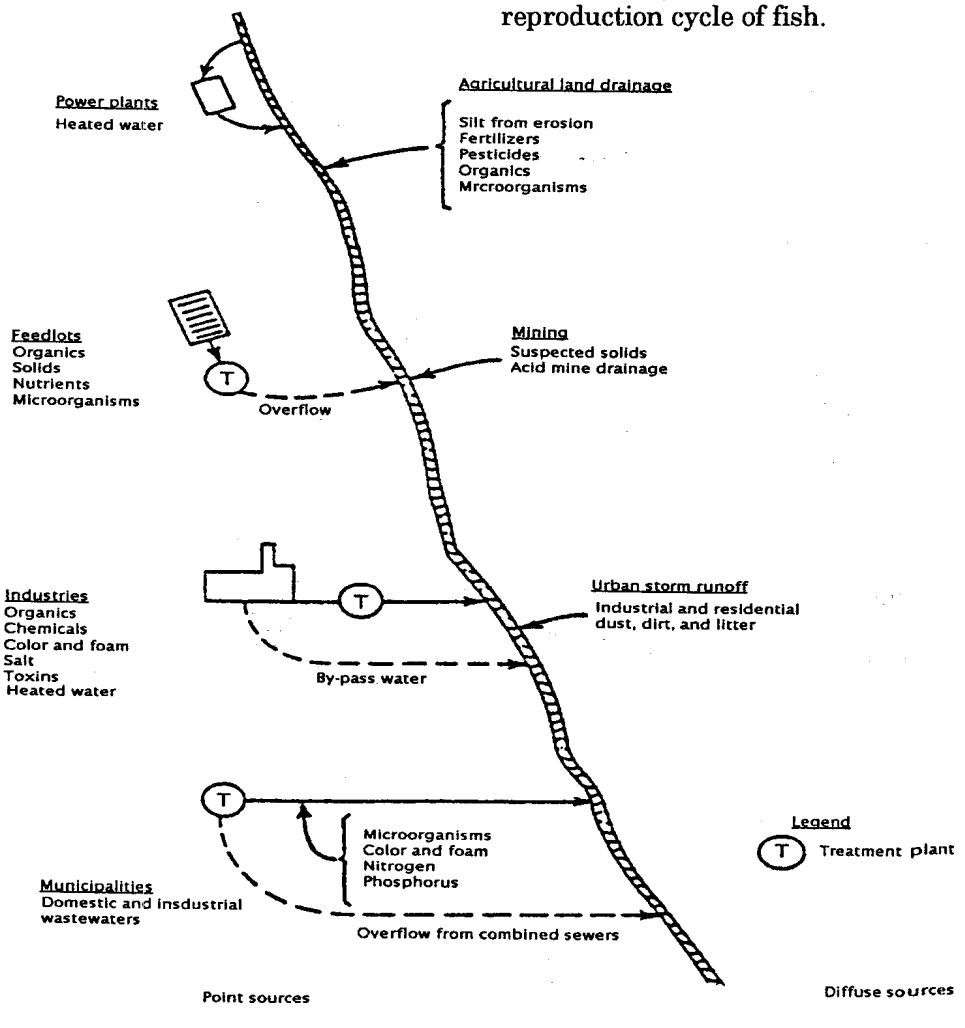

Fig. 1: Principal sources of water pollution.

Poisons

Acids, alkalis, and toxic chemicals adversely affect aquatic life and impair recreational water uses. Sharp changes in pH at the point of discharge into a river or lake eliminate less tolerant animal and plant species, and considerably influence the toxicity of some poisons. For example, ammonia is more toxic in alkaline water than acid because free ammonia (NH_3) is more inhibiting than the ionized form (NH_4^+).

Some chemicals are poisonous to human and aquatic life, rendering the water unsuitable for domestic supplies. Heavy metals, such as mercury, are serious pollutants, as they are stable persistent compounds in nature and concentrate in the aquatic food chain. The fishing industry has sustained economic losses recently because of unacceptable levels of mercury and other heavy metals in fish from contaminated waters, resulting in government condemnation of the affected catches.

Nontoxic Salts

Build-up of salts from domestic wastewaters and waste brines can interfere with water reuse by municipalities, industries manufacturing textiles, paper, and food products, and agriculture for irrigation water. Salts like sodium chloride and potassium sulphate pass through conventional water and wastewater treatment plants unaffected.

Inorganic phosphorus and nitrogen salts induce the growth of algae and aquatic weeds in surface waters. The majority of phosphates originate from fertilizer washed from agricultural land and phosphate builders used in synthetic detergents. The latter source contributes approximately 60 percent of the phosphorous in domestic wastewater, and often the majority found in industrial wastewaters.

Ammonia nitrogen is extremely soluble and is readily transported by surface runoff from cultivated farmland. In wastewater treatment, the nitrogen in organic compounds is released as soluble inorgainc nitrogen. Removal of nitrogen and phosphorous in conventional biological wastewater treatment is generally only 30 to 50 percent.

Unaesthetic Wastes

Foam-producing matter and colour, although often not harmful, lend an undesirable appearance to receiving streams; they are considered indicators of contamination.

Taste- and odour-producing compounds interfere with the palatability of drinking water. These may come from industrial wastewater discharge, or from blooms of algae encouraged by nutrient enrichment from waste disposal. An increase in water temperature often magnifies the offensiveness of polluted water. Discharging heated water, such as cooling water from power plants, accelerates dissolved oxygen depletion, promotes the growth of blue-green algae, intensifies tastes and odours, and can stress fishes and other aquatic life.

Table 1: Categories of pollutants found in water

Acids and alkalis
Anions (eg. sulphide, sulphite, cynide)
Detergent
Domestic sewage and farm manures
Food processing wastes (including processes taking place on the farm)
Gases (eg. chlorine, ammonia)
Heat
Metals (eg. calcium, zincs, lead)
Nutrients (eg. phosphate and nitrates)
Oil and dispersants
Organic toxic wastes (eg. formaldehyde, phenols)
Pathogens
Pesticides
Polychrinated biphenyls
Radioactives

Whether compounds will effect a community depends on the concentration of these and the time of exposure to the component (ie the dose). The effect of a pollutant on a target organism may be either acute or chronic. **Acute** effects occur rapidly, are clearly defined, often fatal and rarely reversible. **Chronic** effects develop after long exposure to low doses or long after exposure and may ultimately cause death, sub-lethal doses result in the impairment of the physiological or behavioural processes of the organism (eg. may grow poorly, or fail to reproduce). Its overall fitness is reduced.

At the community or ecosystem level it is unlikely that pollution will cause irreversible effects, except possibly for radioactive pollution. Pollution effects are recorded in the loss of some species, with possible gain in others, generally a reduction in diversity, but not necessarily numbers of individual species, and a change in the balance of such processes as predictions, competition and materials cycling.

Handout 10: Designing a Water Pollution Control and Monitoring Programme

Preventing Pollution

1. The putting into place of development and land use control mechanisms such as the Town and Country Planning Scheme Programme, Sub-division of Land Scheme Programme.
   - where areas and zones are marked for specific development purposes only;
   - where any development to be carried out within such zones must comply with certain conditions;
   - where prior consent is obtained before development; and,
   - where EIA is used as a tool for assessing likely impacts.
2. The putting into place of a reliable and satisfactory solid waste/ hazardous waste management policy and programme both for towns and villages which allows for:
   - proper collection of refuse from homes i.e. provision of rubbish bins or recepticles for each home;
   - efficient carry away of refuse to final disposal ground; and,
   - efficient method of final disposal, land burial, (pit or otherwise).
3. Puttting into place a reliable, potable water supply system free of contamination for all domestic purposes.
4. The putting into place of a reliable and appropriate waste water collection and carriage way system in the form of:
   - provision of sewerage system - in populated areas;
   - promotion of septic tanks in villages; and,
   - promotion of water seal in developed areas.
5. The promotion of a programme addressing the waste minimization at source through:
   - recovery;
   - recycling;
   - promotion of bi-product sale;
   - burning of importation of products in plastic containers and getting bulk supply whole;
   - promotion of the use of available local resources in place of plastic wares;
   - coconut baskets as a replacement for plastic carry bags, etc.; and,
   - through teaching of handicrafts.
6. Putting into place a reliable air pollution management and control programme.
7. Putting into place a good land conservation and coastal management programme.
8. Putting into place a good monitoring and evaluation programme.
9. Putting into place appropriate legislation and ensuring its implementation:
   - appropriate sub-division of Land Act
   - appropriate Town & Country Planning Act
   - appropriate Sanitary Refuse Colllection and Disposal Act
   - appropriate Environmental Health and Environmental Acts
   - appropriate Land Conservation and Coastal Management Act
10. Putting into place a well maintained and trained team of officers to implement the programme.
11. Putting into place a well co-ordinated environmental awareness and education programme for schools and the public.

Monitoring Pollution

Many times studies and reviews have pointed out that to effectively manage an environment receiving polluting substances we need to have information concerning:

- The substances entering the environment and their quantity source and distribution.
- The effects of these substances within the environment .
- Trends in concentration and effect, and the causes of these changes.
- How far these inputs, concentration effects and trends can be modified and by what means and at what cost.

The **first stage** in this management is to carry out a **survey**, which is a programme of measurements that defines a pattern of variations of a parameter in space. As an example, we may be concerned about the output of zinc into a river from a rubbber-processing factory.

Our initial survey may involve measuring the concentrations of zinc in the river sediments at a number of stations downstream from the factory, together with sampling the fauna and flora at these stations. The survey will only inform us of the situation at one point in time.

The next stage will be **surveillance** and **research** which will enable us to learn more about a problem before any policy decisions are made.

Surveillance is defined as the repeated measurement of a variable in order that a trend may be detected. In our example we may measure the concentration of zinc in the sediments, at three-monthly intervals to see how sedimentary loading varies. Similarly the animals and plants will be sampled to see if the original observations are repeated.

The **research** function will be to examine the pollution process in more detail, using experimental and analytical techniques. For instance, the survival of fish in concentrations of zinc flowing from the rubber processing factory could be studied in the laboratory, or experimental streams might be used to study whole commmunities. Furthermore, the tolerance of organisms to concentration of zinc lower than that in the effluent might be studied as a guide to fixing a standard for the zinc level.

From the surveillance and research progr-mme, and taking into account economic considerations, a policy for managing the pollution might be decided. For example the level of zinc in the effluent might be reduced by 75% by installing a treatment plant in the factory. It will be necessary to see that this reduction has the desired effect, an improvement in the state of the receiving river or water and also to ensure that the effluent quality is maintained. These observations on performance in relation to standards are known as **monitoring**.

It should be noted that these terms are used rather loosely and the boundaries between them are indistinct. Furthermore there is not necessarily an order sequence in the procedure. The **monitoring** programme set up might produce useful research data which can be used to redefine the policy, which may then require modifications in monitoring strategy.

Both approaches have their disadvantages. The experimental simulation does not take into account the complexity of the normal pollution situation in which a variety of factors influence the way a pollutant affects its targets. This very complexity, however, makes the interpretation of observational data exceedingly difficult.

The Complexity of Pollution

It must be stressed that it is rare that a single pollutant is present in a watercourse. Normally an effluent will consist of a variety of potentially harmful substances and most watercourses will receive a number of effluent discharges and so the effects of these will often be difficult or impossible to disentangle.

Pollutants occuring together may act completely independently on a target and the one exerting the greatest effect would then be the most important. One would not, for example, worry unduly about high levels of zinc in an effluent if the oxygen demand was so high that all life in the receiving stream was suffocated. However if the organic loading in the effluent was reduced such that the stream could support life, the concentration of zinc might then become inportant.

Handout 11: People and the Environment in Niue

Bradley Punu, Environment Officer.

Introduction

During this week we have covered many areas related to water and more specifically to pollution awareness. With the topic that I have been asked to cover this morning, I would like to begin by substituting the word public with people although their reference on this paper are the same. The topic and focus therefore is on "people and environment".

For so many years we have enjoyed and continued to co-exist in a system that is capable of meeting our basic needs. In broad terms we need food, shelter, clothes and water in order to survive. We have seen on television and read in papers about people who died in the desert for lack of water, and the same with those who were lost at sea. We have had many experiences during the past from droughts and cyclones. Life therefore was hard.

Today the introduction of new technologies has made it possible for us to meet our needs from underground sources. This supply should not be taken for granted nor seen as unlimited and totally protected from likely means of pollutants. It is from this perspective that this workshop is being organized for all of us. We certainly don't want to see a repeat of the hard times nor do we want to forget that the risk is always there.

Once this source is unsafe for human consumption then it is a question of going back to the past. Our role therefore is to try and prevent this from happening. So in receiving this training it is important that we train others like your family, friends and relatives.

People and environment are one. That is the philosophy of our ancestors. It is therefore important for us to be cautious of what nature provides for us. At the present time the focus and aspirations of the people of Niue is to go all out for growth and of course in this drive there is a lack of balance between what people do and what nature can provide. There is no doubt that we want to improve our standard of living, however, it is equally important that we recognize that a clean and healthy environment is part of this standard.

Overall, since our focus this week is on water pollution the reality of what we are talking about today is part of our life line so it is important to keep our water system reliable and safe for everyone.

Problem Areas

Littering

The general public is still not fully aware and appreciative of living in a clean environment. Rubbish such as beer, soda cans and empty plastic bags can be seen on the road side and all public places like the airport, sports field and scenic sites. The problem is also seen at home and many gathering places in villages. It is for this reason that public education and awareness campaigns should be carried out.

Water

A cautionary measure issued by the Health Authorities is still in place on village bores for domestic use. This problem may be long term, however, preventative measures are being taken to avoid further contamination of the main watershed areas. Villages may resort to water treatment in future if the extent of the problem is considered high risk and no longer safe for human consumption. This problem was investigated by the WHO Sanitation Engineer.

Other government policies on potential pollutants i.e. fertilisers and pesticides should be carefully monitored and controlled.

Other means of water storage, for example water tanks or household and village water tanks should be re-established. If these are not properly sealed they could become potential breeding places for mosquitoes.

Waste Disposal Systems

Human Waste

Refer to the report by the Sanitation Engineer from the World Health Organization :

- to include livestock that are under confinement and in large numbers, e.g. pigs, cattle, goats and poultry.
- impact on watershed areas.

Dumping Sites

- To establish some criteria on how to determine these sites. Note that the Health Department may have a policy that is sufficient or relevant for the present time.
- What methods are presently being carried out. The recycling of aluminium cans is now being carried out by members of the Catholic Mission.

To be able to contain the degree of the problem at present, there is a need to design an improved waste management system for Niue.

Land Use Systems

Heavy Machines

- To raise public awareness and provide training for machine operators.

Forest Areas

Need to investigate impact on primary forest and buffer areas due to land clearing for cropping and logging.

Replanting programme

This is now being carried out by the Forestry Division, Department of Agriculture.

Cropping Systems

More careful attention to be paid to land clearing and choice of crops.

Indiscriminate Excavation of Coral Sand for Construction Purposes

To set proper criteria for site selection of coral sand for construction purposes.

Chemicals

Weedicides, fertilizers and pesticides. Consider regulation.

Other Developments

Clearing of areas with heavy machines for house sites and other industrial purposes. Needs careful consideration.

Coastal Areas

Wharf Development

Several problem areas ranging from siltation to erosion, and plastic rubbish dumping during loading and offloading of cargoes from vessels. Visiting yachts pose a different problem.

Small Boat Landing

Appears to have siltation problem due to materials used for construction work and poor drainage system. Rubbish and fish guts pose a problem.

Scenic Sites

Provision of containers for rubbish and toilet and shower facilities if water is available.

Village Sea Tracks

Expected the same problem as for landing facilities. The track may lead to other problems such as easy access and over-use by people.

Fish Poisoning and use of Explosives

Awareness needs to be raised relating to environmental destruction associated with these fishing techniques.

Traditional Reserves and Fono's

This practice is to be encouraged to allow rejuvenation of the soil and marine life. The establishment of other conservation areas (other than Huvalu forest) is to be encouraged at Hakupu and Liku.

Cultural/Historical Sites

Places of significance to Niuean culture to be declared as historical sites as a means of reviving cultural appreciation.

Broad Overview on Areas for Medium and Long Term Management Plan

- Focus will be on how to sustain the effort in the problem areas already identified.
- How to involve village participation in dealing with conservation issues, especially reserves and protected areas.
- Preservation and protection of wildlife and the process of enforcement.
- On-going development pressure and conflicting use of resources especially land and fresh water.

Annex 7: Results from the Awareness Workshop Evaluation Forms

Questions for participants:

What do you think about the following?

1. Programme

(Day-to-day activities in general)

100% Good

0% Needs improvement

Comments: none

2. Choice of Topic/Issue

88% Good

12% Needs improvement

Comment:

Drilling problems (plus Question 7)

The issue of drilling could also have been included.

3. Presentation/Lecture

45% Too technical - hard to understand

55% Good, easy to understand

Comment:

Too Technical/Terminology beyond understanding to some

4. Method of Presentation:

60% Good

40% More discussion

0% More demonstration

Comments: none

5. Field Visit

60% Good

40% Need Improvement

Comments:

Other places of interest not visited: eg. Bulldozing sites / Burning sites / Sewage Dump Site

6. Your general comments about workshop - any specific comment for future workshops?

- More slides and videos from the Pacific Region of similar condition to Niue
- Approaches and strategies need to be polished - to take back to the people
- More protection and prevention rather than cure
- Choices of participants: Have two separate groups: Technical people together: villagers, youth, church.
- Emphasis on awareness rather than technical
- More community input/developers eg. Mining company/Youth council, etc

7. Content of Future Workshops:

What other subject would you like to be included?

Comments

- Environmental Health;
- Marine Pollution;
- Air & Noise Pollution;
- Case studies from other Pacific Countries;
- Simple topics (ways to avoid water pollution on the island).

8. General Comments

- Follow-up workshop;
- Still need room for public education;
- Allowance appreciated;
- Further assistance from SPREP would be appreciated.