PROCEDINGS OF

Fifth Annual

Caribbean Water Engineers Conference

AT

FORT YOUNG HOTEL

8—10th July, 1974

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ROSEAU, DOMINICA.

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INTRODUCTION

Fourteen countries were represented at The Fifth Annual Caribbean Water Engineers' Conference which was held in Dominica from 8th—10th July 1974. But for the absence of Antigua, The Bahamas, Bermuda and The United States Virgin Islands all English-Speaking Countries, the major development agencies and The University of The West Indies assembled to listen to Technical Papers, to discuss and to seek solutions to the common problems affecting The Water Works Industry in the Region.

Once again, we express/gratitude to the Pan American Health /our Organisation/World Health Organisation, the Canadian International Development Agency and the host country for sponsoring the Joint-Venture.

Financial support for future conferences is now in doubt and the coming months will be most important ones, since during this time it will be necessary to evaluate the relative importance of the annual meeting, the justification for it and the future financial responsibility.

It is felt in some quarters that, considering the cost, it could not be unreasonable to ask each Unit Government to pay the bill for its delegate. This may be one way of spreading the idea of a *Caribbean* Conference and accentuating the usefulness of the Conference to the region as a whole and to each territory in particular.

It is also conceivable that the Council of Caribbean Engineering Organisations could through a "Standing Committee" take an active part in organising future activities in Water Engineering in the region. Individual engineers must take an active part in advising on this crucial decision.

PROGRAMME

Sunday 7th:		Arrival and Registration
Monday 8th:	9.30—10.00	Official opening and address by Honourable E.A. Leslie Minister of Communications and Works.
	10.00—10.20	BREAK
	10.25—10.50	Proceedings of Previous Meeting. Matters arising out of Previous Proceedings.
	10.50—11.35	Water Supplies in the Host Country by Eng. E.P.Munro. Discussion
	11.35—12.20	Paper on Pesticides in water derived from Rivers by Dr. R.G. Gibbs. (C.C.P.C.U) Discussion
	12.30—2.00	LUNCH
	2.00—2.00	Paper on Water Quality Control-Protection of catchment Areas by Eng. R. Reid (PAHO/WHO) Discussion
	2.45—3.05	BREAK
	3.15—3.50	Paper on use of PVC in Water Systems by Eng. E.T. Tsai Meu Chong (Surinam) Discussion
	4.00—4.30	Demonstration and talk on PVC pipes under difficult laying conditions by Century Elson Limited. Use of P.V.C—P.C. in High Pressure Water Systems (Plastics Engineering Inc.)
	6.30—8.00	Government Hosted Cocktail Party at the Anchorage Hotel.
Tuesday 9th:	9.00—9.45	Paper on Performance of Trickling Filters in Tropical Countries by Eng. V.A. Nembhard
	9.45—10.05	BREAK
	10.05—11.50	Paper on Financing of Water and Sewerage Projects by Eng. J.N. Freedman (I.B.R.D./I.A.D.B.) Discussion

11.50—12.50 WASA Training Centre Activities-Panel Discussion by Professor Salvatore Grasso (PAHO/WHO)/Eng.M. Sankeralli/Eng. A. Johnson.

1.00—2.30 LUNCH

2.30—3.15 Business Session

3.15—3.35 BREAK

3.35—5.00 Continuation of Business Session

6.30—8.00 Century Eslon Hosted Cocktail Party at Sisserou Hotel

Wednesday 10*th*: 9.00—5.40 Tour of Water Installations and of part of host country.

8.30—12.00 Farewell after Dinner. Function hosted by The Dominica Association of Technical Professionals.

Thursday 11*th*: Delegates depart.

OPENING CEREMONY

On the morning of Monday 8th July 1974, the Conference began at 9.30 a.m. The Chairman, Mr. E.P. Munro, Chief Engineer, Central Water Authority Dominica, welcomed the delegates from the neighbouring territories, and introduced the Honourable E.A. Leslie, Minister of Communications and Works who formally declared the Conference open.

In his address, the Honourable Minister further welcomed the delegates and wished them a pleasant stay in Dominica.

At the end of the opening ceremony there was a short adjournment after which the next item on the programme followed.

MATTERS ARISING OUT OF PREVIOUS PROCEEDINGS

(*a*) *Participation of U.W.I*

In accordance with a decision taken at the last meeting that the University of the West Indies be informed that the Conference did not consider the reasons given sufficient justification for its failure to send at least one delegate to the Conference, the last Chairman, Mr. A.S. Persram reported that he had done so, and noted that on this occasion Dr. H.O. Phelps, Assistant Dean of the University was able to attend.

(*b*) *Water Works Personnel Inventory*

The non-submission of tabulated data on Water Works Personnel--present and anticipated needs, by four (4) countries was discussed and the delegates from the countries concerned were asked to submit the information as soon as possible to the P.A.H.O office in Barbados to permit the full tabulation of the regional data.

(*c*) *Resolution*

In connection with a resolution passed at the last Conference recommending that the Unit Governments take all the necessary steps to have the Caribbean Development Bank relax its requirements laid down for loan purposes, Mr. Yhap pointed out that the Bank had given some consideration to the request, and in the case of one of the countries now negotiating a loan with the Bank the requirements referred to in the resolution had in fact been relaxed.

WATER ENGINEERS' CONFERENCE

OPENING REMARKS BY: E.P. MUNRO, *Chairman*

Hon. Minister of Communications & Works, other Ministers of Government, delegates, observers, ladies and gentlemen.

It is my pleasant duty on behalf of the Commissioners of The Central Water Authority to welcome all present, particularly delegates and their wives from overseas, to the formal opening of this The Fifth Caribbean Water Engineers' Conference.

Many of those present with us this morning have made considerable sacrifices in time to be here to discuss current problems and to exchange ideas on one of the most essential ingredients to the development of The Caribbean viz—Water Supplies. There are others who have been unable to make the journey for one reason or another but whose hearts, I am certain are with us.

In particular, I have been asked to convey to the Conference regrets and best wishes for success from:—

The Bahamas,
and, The U.S. Virgin Islands.

Participation of the latter country's delegation of two was cancelled due to unforeseen circumstances, at the last stages of preparation.

On the local scene, H. E. The Governor and Lady Cools-Lartigue have expressed regrets for not being able to attend this morning.

This meeting is not an annual exercise in crystal-ball gazing. Responsible persons all over the world have long recognised water supplies as an area of real concern. The United Nations Food and Agricultural Organisation forecasts an inadequate global supply by the year 2000. The U.S. National Water Commission predicts that at that same point in time there will be enough water for essential needs, but not enough for waste. At that time also, it is predicted for others among us that although we will be able to meet future demands by conventional means, it will be necessary to pay for water at its market value; in the same way as food, shelter and energy.

The Cynics among us may well express doubts about the realization of these predictions and consider anyone uttering them as mentally unbalanced. Time alone will tell!

The future, not the past, is therefore our prime concern today.

Ladies and gentlemen, I now wish to introduce the Hon. Earl Leslie, Minister for Communications and Works in our gorevnment under whose portfolio the subject of water falls, and whose responsibility it is to appoint the Commissioners of the Authority. Mr. Leslie is deeply conscious of the key water holds not only for the health of our people, but also to development opportunities. He has kindly consented to deliver the keynote address and to declare the conference open.

FIFTH WATER ENGINEERS' CONFERENCE

ADDRESS BY: The Honourable E.A. Leslie, Minister for Communications & Works.

Mr. Chairman, Delegates, Hon. Ministers of Government, Ladies and Gentlemen.

On behalf of the Government of Dominica, I wish to extend a hearty welcome to the Delegates, Advisers and Observers of this Conference who have come from almost all countries of the Caribbean.

In addition to those representing their respective countries, I am happy to welcome persons from the Financing Institutions. We have here with us a speaker from the Inter-American Development Bank/International Bank for Development and Reconstruction, and two Delegates from the Caribbean Development Bank. There are here also Delegates from the Pan American Health Organisation/World Health Organisation, The Canadian International Development Agency and the British Development Division.

For the first time too there are Delegates from Belize, the Turks and Caicos Islands and from the Commonwealth Caribbean Pesticide Control Unit, and I wish to extend to them a special welcome.

This is the 5th Annual Caribbean Water Engineers' Conference and it is Dominica's turn to be host. I sincerely hope that your stay here will be enjoyable and that you will take away with you happy memories of this island.

The Conference is sponsored jointly by the Pan American Health Organisation and World Health Organisation, the Canadian International Development Agency,the British Development Division and Dominica. I wish to take this opportunity to place on record my appreciation of the assistance which these organisations have given making it possible for this very important Conference to be held here.

The theme of this Conference is Water: Key to the future of the Caribbean: Water is one of the essentials of life. It is not only a must for domestic purposes but also for Industrial and Agricultural needs and for Tourist Development and hence it plays a leading role in the development of any country. I understand that this is the only forum in which people in the Water Industry can meet to thresh out and discuss the many problems which confront the Industry and also to exchange information on mutual topics such as Water Quality, Standardization of Equipment and Training. One would expect to see great emphasis on training since in the absence of adequately trained engineers and supporting technicians it is impossible to even commence the process of planning a water system.

With the assistance of the Pan American Health Organisation/World Heatlh Organisation many training opportunities have been provided for personnel in the Water Industry over the past 5 years in this country and elsewhere and it is hoped that the rate of training will be accelerated in the current five year period.

The policy of my Government is to provide pipe-borne water to all the people of this State and we are steadfastly working towards this end. A considerable amount of work has been done in the last 5 years, and revised Rate Schedules have been introduced. We fully realize that when services are provided the consumers must be expected to pay for them. There have been many delegations within recent months protesting the increased rates, but this Government is endeavouring to explain to all concerned that this most important commodity must be paid for if we are to realize the necessary income to pay for operating the systems, to pay the persons administering them and to effect improvement in the standard of service rendered to the consumers.

Gentlemen, it is my hope that your discussions will be very fruitful that you will arrive at solutions to some of the many problems that confront us and that you will find the time to enjoy some of the pleasures of Dominica. I understand that there is to be a tour of part of the Island and this will provide the opportunity for you to see some of our beautiful scenery.

It gives me great pleasure in declaring The Fifth Annual Caribbean Water Engineers' Conference open.

TECHNICAL PAPERS PRESENTED

AN INTRODUCTION TO THE WATER SUPPLIES OF DOMINICA

by

E.P. MUNRO

Location, Size, Population and Physical Features

Dominica lies roughly mid-way in the chain of West Indian Islands known as the lesser Antilles and is situated between the two French Islands of Martinique and Guadeloupe. It is 29.5 miles long from north to south, 17 miles wide from east to west, has an area of 289.8 square miles and a coast line approximately 120 miles long. It extends from latitude 15° 10' 36" north to latitude 15° 35' 42" north and from longitude 61° 15' 00" west to longitude 61° 30' 30" west.

The island is perhaps the most ruggedly beautiful of all the islands but is poorly developed because of its mountainous terrain and the difficulty in establishing communications. It rises virtually sheer from the sea and has an almost continuous range of high mountains some of which exceed 4,000 feet extending the whole lenght of the island in a north-south direction with lateral spines almost enclosing well watered valleys. (See Figure 1)

The country's 72,000 inhabitants live mainly in two towns and in some 76 villages located on the coastal strip and in the valleys. Approximately 75% of the population live below the 500 foot contour (See Figure 2). Some 18,000 persons live in Roseau and its surroundings. Villages range in population from 100 to 3,800.

Climate

The temperature seldom exceeds 90° F. in the lowlands and 80° F. in the highlands. During the period from November to February temperatures drop about 20° F. Temperatures drop with increased elevation at the rate of 2° F. per 1,000 foot and in the highlands temperatures in the fifties have been experienced.

Quoting from 34 years of available record the lowest recorded relative humidity is 54% at 9.00 a. m. and the highest 87% at 3.00 p.m. in the months of May and June respectively.

Prevailing winds are the north-east trades and the island is subject to hurricanes between the months of June and December with a frequency of one in 33 years.

Geology

The soil is largely of volcanic formation and evidence of the island's volcanic origin is supplied by several hot streams and a boiling lake.

According to Earle the geological character of the island is very similar to that of St. Kitts— the differences being chiefly due to topography and to atmospheric conditions.

Shown at Figure 3 is a Geological Map with legend based on the work of Dr. Martin Kaye. Unfortunately the report supporting this map is not available and consequently correlation between it and the work of Earle, persents some difficulty. It is presented as the only available geological map of Dominica, solely for purposes of information.

Rainfall

Rainfall in Dominica is high in the central and upland regions and lower in the coastal areas. So abundant is the rainfall that were it not for the island's forest cover there would be considerable and disastrous problems of soil erosion.

The average rainfall on an aereal basis is 175 inches per year and ranges in value from 50 inches per year on the west coast to 330 inches per year in the mountain regions. The highest annual rainfall recorded is 360 inches at Lakeside in 1921.

The isohyetal map attached at Figure 4 shows the locations of all rain guages. It will be observed from the map that the rainfall on the east coast is higher than on the west. This appears to be due to the trade winds. Seasonal rainfall also varies from east to west with the west or leeward coast having a longer dry spell.

Presented hereunder is a table showing the aereal distribuation in which it will be noted that 84% of Dominica's surface receives an annual rainfall of 100 inches and greater.

Rainfall — Aereal Distribution

Range in inches	Area sq.Miles	%
< 50	5.4	1.9
50—100	41.9	14.5
100—150	70.0	24.2
150—200	61.6	21.2
200—250	57.7	19.9
> 250	53.2	18.3
Total	289.8	100.0

An indication of intensities is obtained from a recent two-year study at Brantridge located at an elevation of 1430 feet above mean sea level, carried out by The Ministry of Transport/ Canadian International Development Agency.

The greatest rainfall recorded in 5 minutes was 0.60 in., that in 30 minutes 2.19 inches and that in 60 minutes was 2.76 in.

Plotting the information provided in the above-named report confirms graphically that here, as well as elsewhere, the intensest rains are the shortest (See Figure 5).

Hydrology

The island is well watered and the capacity of its resources is adequate for domestic and industrial use within the foreseeable future. The demand for electricity on the other hand, has outpaced the development of hydro-power resources and capacity of the existing hydro-power stations (2880KW) are understood to be only 30% of the peak load during the driest months.

So important are these resources to our economic future, particularly in the face of an energy crisis, that early and proper investigations appear most essential.

Apart from gaugings of two water sources for a period of one year and spot gaugings of others, there is little organized information either in this field or in that of Groundwater Investigations.

History

The development of water supplies on this island began in the period 1875 to 1879 during which time the Roseau system was constructed to serve 3,000 persons. In 1903 the Portsmouth system, for the only other town, was constructed: followed 10

FIGURE 2

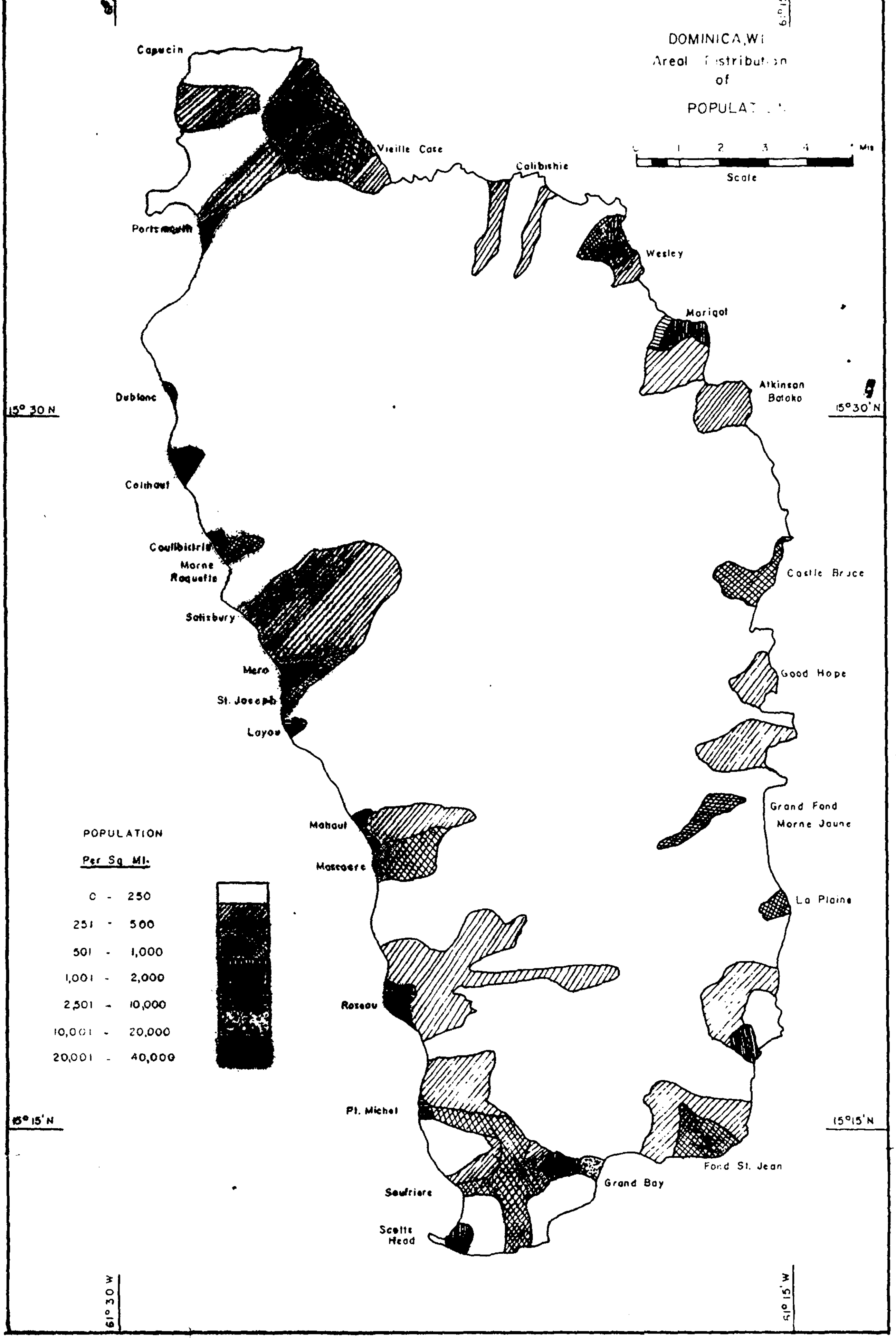
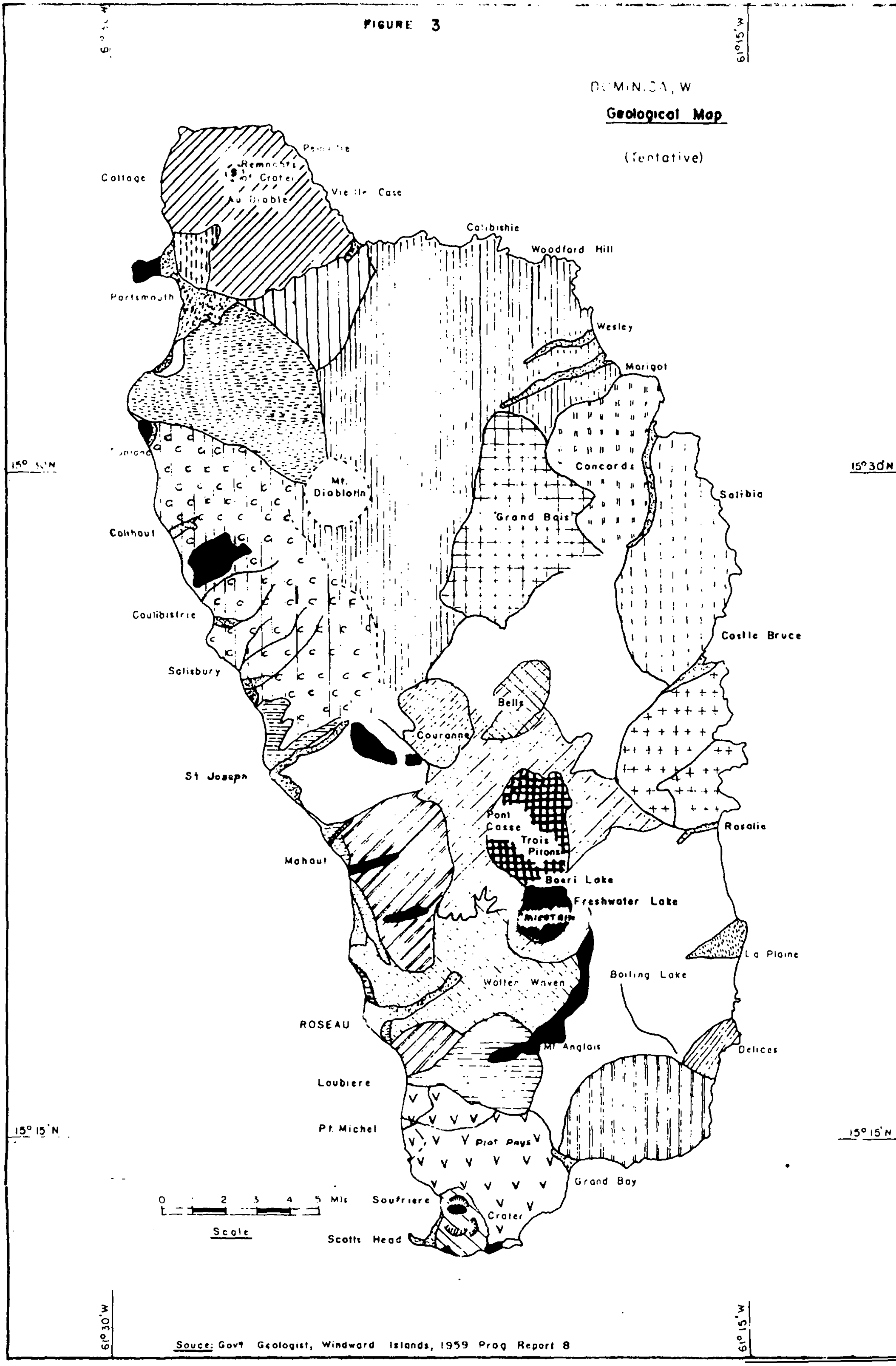
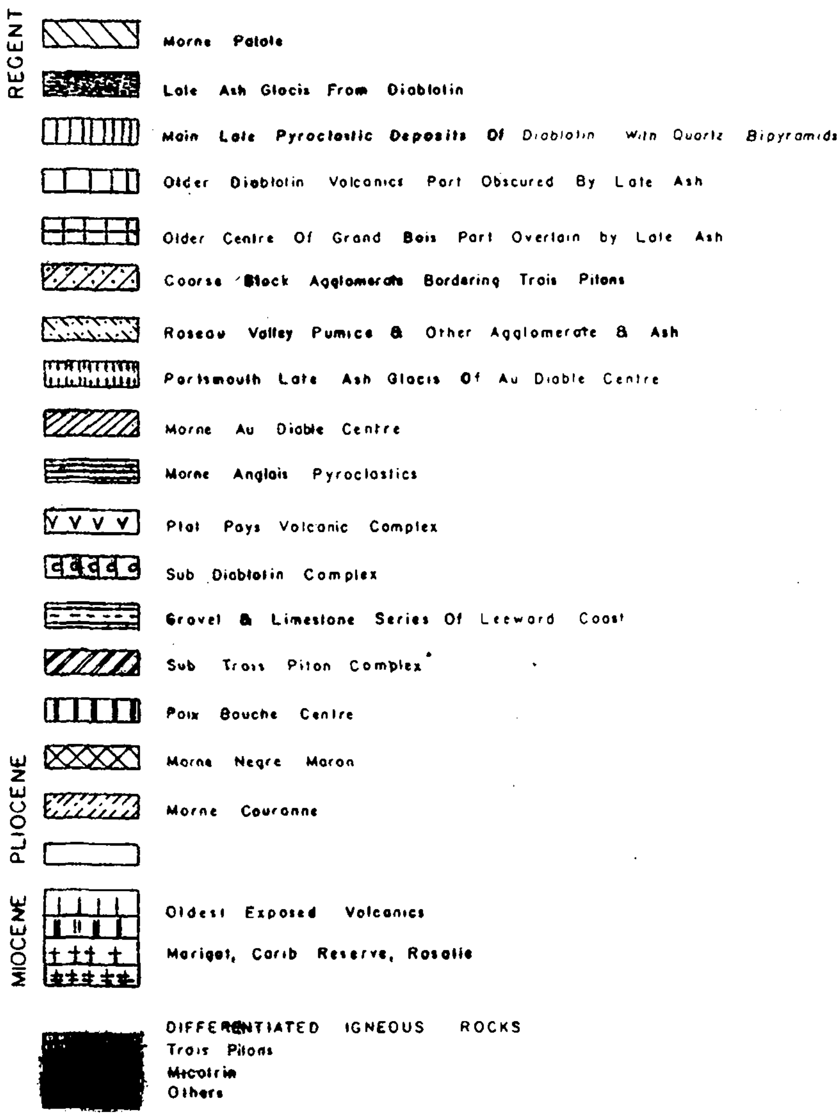

DOMINICA,WI
Areal
of
Scale
Capucin
Vieille Case
Calibishie
Portsmouth
Wesley
Marigot
Atkinson
Batoka
Dublanc
Colihaut
Coulibistrie
Morne Raquette
Salisbury
Mero
St. Joseph
Layou
Castle Bruce
Good Hope
Grand Fond
Morne Jaune
La Plaine
Mahaut
Massacre
Roseau
Pt. Michel
Soufriere
Scotts Head
Grand Bay
Fond St. Jean
15° 30 N
15°30'N
15° 15' N
15°15'N
61° 30 W
61°15'W
POPULATION
Per Sq Mi.
0 - 250
251 - 500
501 - 1,000
1,001 - 2,000
2,501 - 10,000
10,001 - 20,000
20,001 - 40,000

FIGURE 3



Souce: Govt Geologist, Windward Islands, 1959 Prog Report 8



LEGEND

GEOLOGICAL MAP OF DOMINICA - W.I.

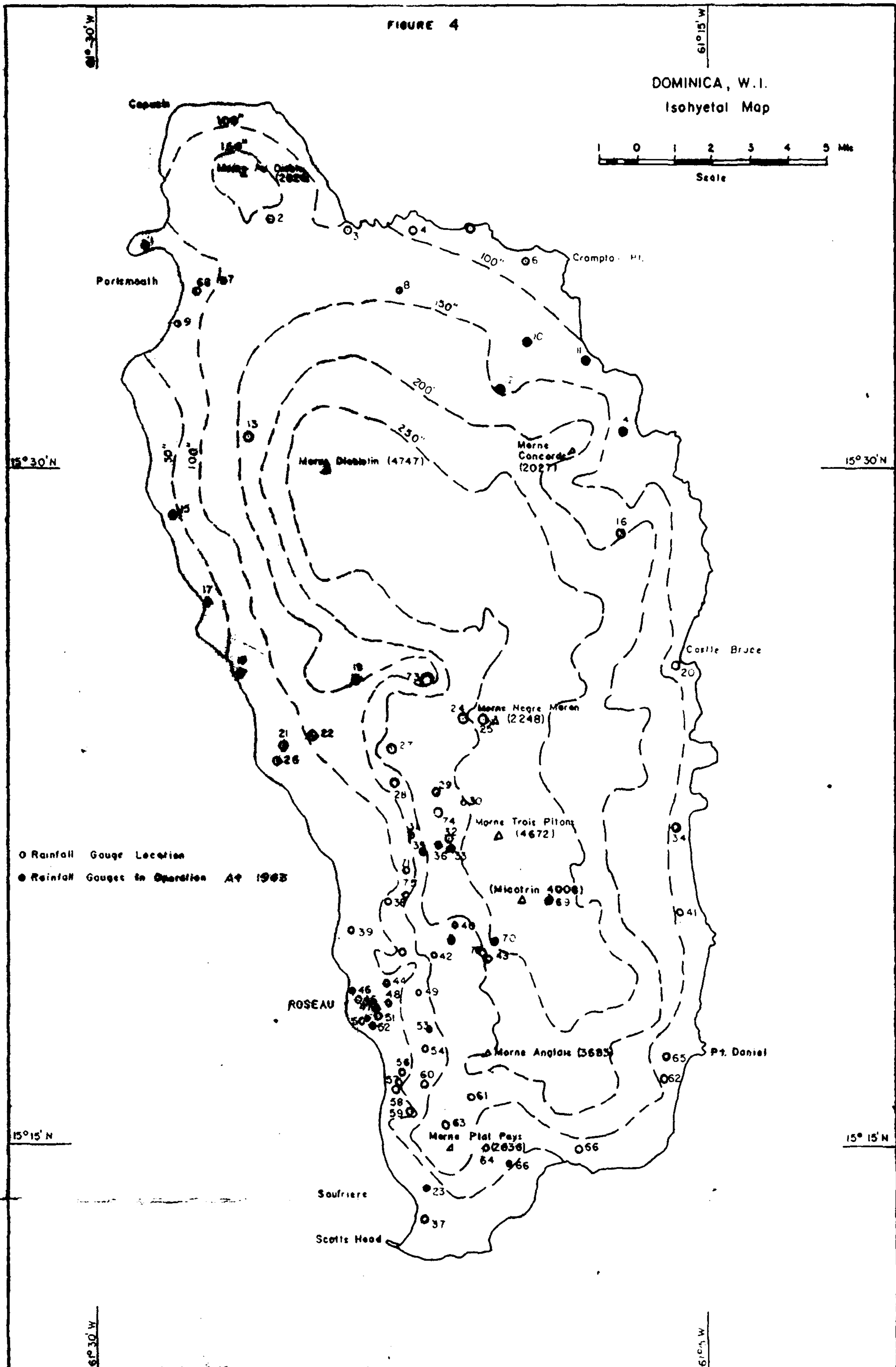

DOMINICA, W.I.
Isohyetal Map
Scale
Portsmouth
Crompton Pt.
Morne Diablotin (4747)
Morne Concord (2027)
15°30'N
61°30'W
61°15'W
15°15'N
Castle Bruce
Morne Negre Maron (2248)
Morne Trois Pitons (4672)
Micotrin 4006
Morne Anglais (3683)
Pt. Daniel
Morne Plat Pays (2836)
ROSEAU
Soufriere
Scotts Head
O Rainfall Gauge Location
● Rainfall Gauges in Operation At 1968
100"
150"
200"
250"

FIGURE 4

years after by the Soufriere system; in 1931, by the Marigot, Grandbay and Point Michel ones and in 1946 by the Vieille Case one. Fifteen other systems were constructed in the period 1947—1968.

PRESENT WATER SUPPLY SITUATION.

General

At the present time there are 36 separate water supply systems in operation; (See Figure 6). Some of these are inadequate to meet future needs. The size of the communities served vary from 230 to 22,265 persons. Six of the supplies are derived from protected springs and the remainder from upland surface sources. A classification according to abstraction methods indicates that only 3 employ pumps, the remainder being entirely dependent on gravity.

For the small surfaces systems, intake arrangements consist of small concrete or masonry dams in conjunction with strainers located in some cases 2 miles upstream from the areas supplied. Since sediment yield and concentration are both high, silt deposits at intakes can rarely be prevented, and, in some cases, there are operational difficulties, when flash floods occur.

The water being supplied through these systems to approximately 60,000 persons or 83% of the total population amounts to 3.6 mgd. Of this quantity, 84% or 3.0 mgd. is chlorinated.

Service reservoirs were rarely provided on the old systems and the present available storage amounts to only 1,019,110 U.S. gallons. An additional 980,000 are scheduled to be provided within the next year.

Persons not supplied with pipe borne water (17% of the population), collect rain water from house roofs or carry their water buckets from nearby rivers and open springs.

Of the population provided with pipe borne water, 30% are served by private service connections into their houses or yards and 70% have easy access to public stand pipes. Put in other terms, 1 building in every 3 in areas served or 1 in every 4 in the State has a connection, or 25.5% of the total population are served by private service connections, 57.5% have easy access to public stand pipes and 17% are not supplied with pipe-borne water.

Water Quality.

Throughout approximately 90% of the year the appearance of all sources is excellent. Turbidities run over a two year period on the largest of our sources indicate a range of 3.8 to 9.2 Jackson Units during these periods. Higher turbidities are however encountered. Chemical analyses are carried out on all proposed sources at the investigational stage and, at the present time, bacteriological analyses are carried out on a minimum of 50 samples per month. Results of the former set of analyses indicate acceptability of the sources; but results of the latter, as would be expected, show that there is need for chlorination of all sources. Chlorine residual tests on the chlorinated systems are carried out as a routine measure. Unfortunately the "policing" action expected from the Ministry of Health is not being carried out mainly, it is believed because of a shortage of equipment and personnel. For a poor developing country, however, the question of duplicating services and expenses is one which must of necessity receive very careful consideration.

Catchment Areas.

There has been much concern about safeguarding the potability of the new water sources being developed and some effort has been made to protect catchment areas first by directing attention to the activites of human and animals on them.

In addition to the question of potability, a most important factor is forest cover, since this will cause stream runoff to be shed slowly and make for higher dry weather flows. One case in our experience is the drop in dwf. of the River Douce from 1.9 mgd to 1.0 mgd between 1943 and 1963. This is thought to be attributable to deforestation due to agricultural activity.

Over the past three years a study has been carried out on the WAI Catchment Area and a look has been taken at the incidence of Pesticides. I will not dwell on these details since comments are to be made by later speakers on them.

A decision has been taken to declare all water catchment areas "Protected Forest" under the provisions of The Forest Ordinance and draft rules to regulate activities in these areas have been formulated. Unfortunately no legal status has yet been given to them.

Since most of our water supplies are derived from surface sources tree cover to regulate run-off and reduce soil erosion, turbidities and flooding is essential.

Some 9,860 acres or 15.5 square miles are required for the protection of all potable water catchment areas. (See Figure 8) Use of these areas could conceivably be combined with our Forest Reserves, proposed National Park and certain types of agricultural tree crops, which are considered compatible.

The question posed is this:— can we afford not to take the necessary safeguards or protective steps by applying restrictive uses to 5% of our total land area for the future welfare of all?

Water Treatment

The largest of the existing systems, —Springfield, has facilities for plain settling and chlorination. There the twin-compartment unit presently has an overflow rate of 680 gpd/ft2 and a retention time of two hours. Very small doses of copper sulphate are also applied, as required, to control algal growths. Facilities for coagulation, floculation and rapid gravity filtration are planned for the next stage of development.

Sixteen of the other systems are chlorinated only. The decision to chlorinate and the phasing of it being based on water quality and the size of the communities involved.

Water consumption

Indiscipline in the use of water is widespread and consumption figures are quite alarming in some areas. From metering tests it has been found that reral domestic consumption amounts to 25—40 gpcd and urban as high as 120gpcd. Urban stand pipe consumption is not known but experiments have shown that rural stand pipe consumption can be cut to 15 gpcd by installing Fordilla Faucets.

Measured hotel consumption amounts to 280 gpbpd.

Of the total present consumption, wastage and outright misuse are estimated to be excessive. Repairs to system leakage does not solve much of the problem while consumer wastage remains entrenched.

Water Production and Cost

At the present time it is possible to pipe 8¼ million gallons of water per day to 60,000 persons living in the areas served. This amounts to a per capita availability of 137 gallons.

FIGURE 5

RAINFALL INTENSITY CURVE.

BRANTRIDGE STATION

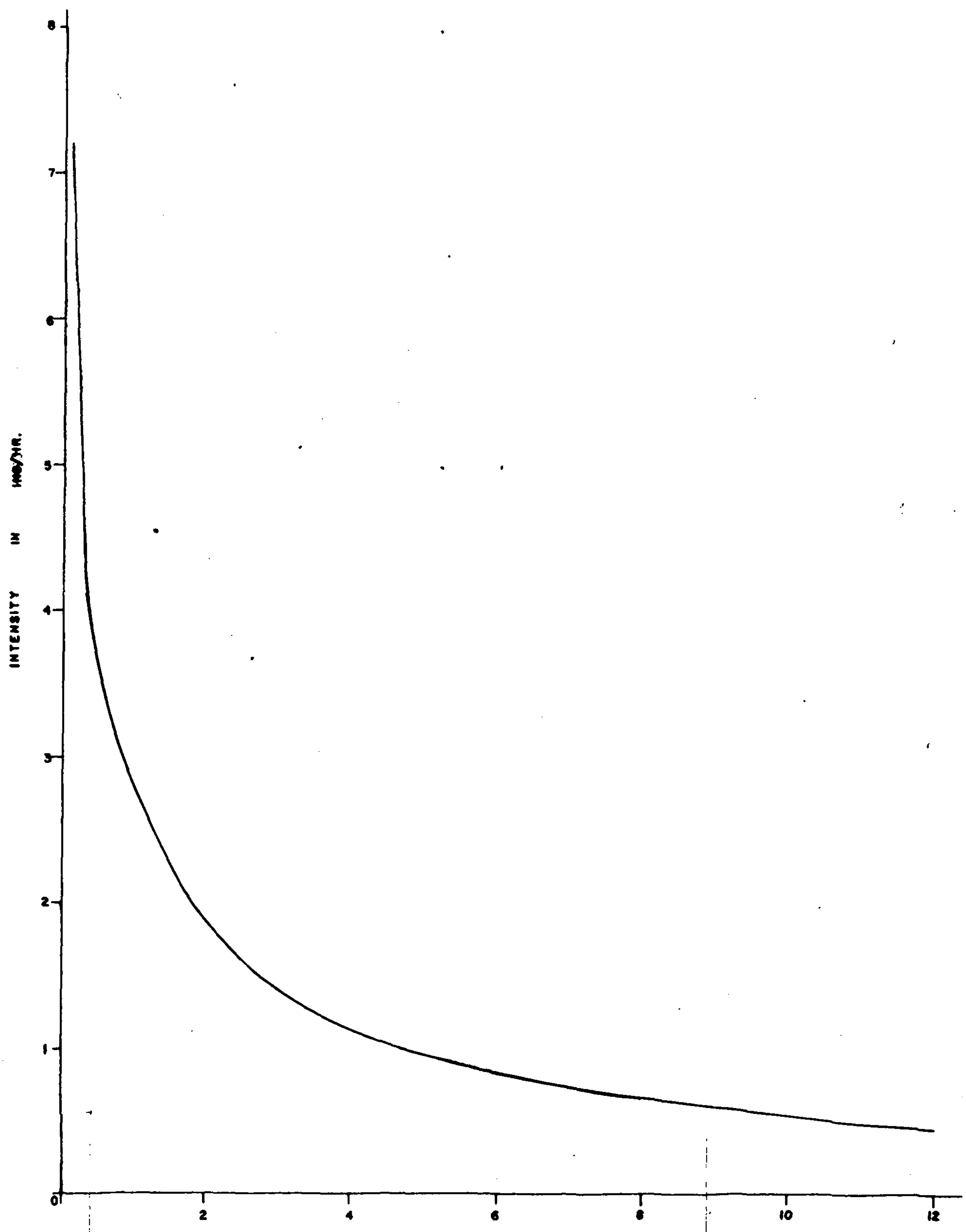
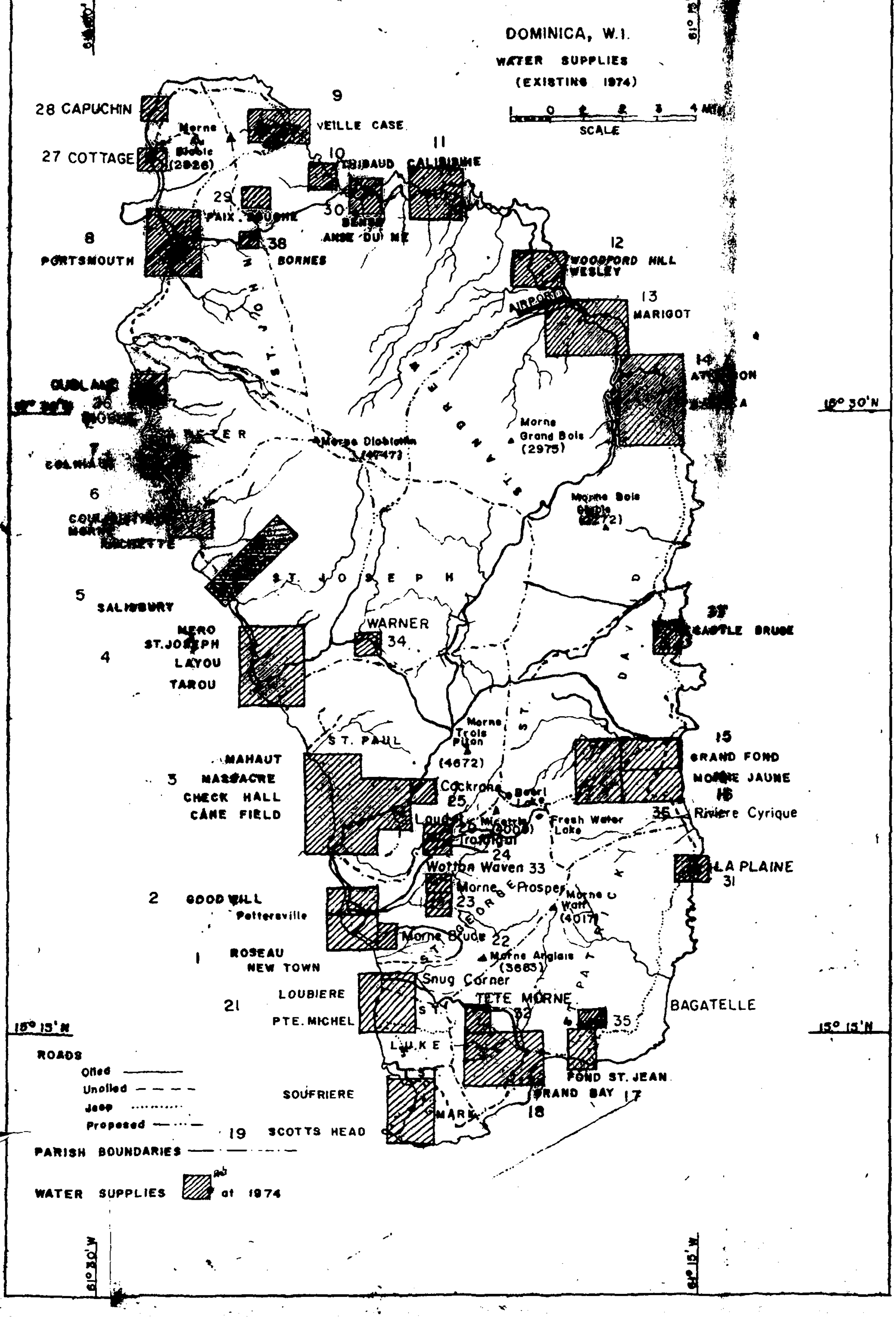


FIGURE 6


DOMINICA, W.I.
WATER SUPPLIES
(EXISTING 1974)
SCALE
28 CAPUCHIN
27 COTTAGE
9
VEILLE CASE
10
11
CALIBISHIE
29
30
8
PORTSMOUTH
38
BORNES
ANSE DU ME
12
WOODFORD HILL
WESLEY
AIRPORT
13
MARIGOT
Morne Grand Bois (2975)
Morne Diablotin (4747)
6
5
SALISBURY
4
ST. JOSEPH
LAYOU
TAROU
WARNER
34
CASTLE BRUCE
ST. PAUL
Morne Trois Piton (4672)
15
GRAND FOND
MORNE JAUNE
MAHAUT
3 MASSACRE
CHECK HALL
CANE FIELD
Cockrane
25
Fresh Water Lake
36 Riviere Cyrique
24
Wotton Waven 33
LA PLAINE
31
Morne Prosper
23
2 GOOD WILL
Pottersville
Morne Bruce
22
Morne Anglais (3683)
1 ROSEAU
NEW TOWN
Snug Corner
LOUBIERE
21
PTE. MICHEL
TETE MORNE
32
35
BAGATELLE
15° 15'N
ROADS
Oiled
Unoiled
Jeep
Proposed
SOUFRIERE
FOND ST. JEAN
GRAND BAY
17
18
19 SCOTTS HEAD
PARISH BOUNDARIES
WATER SUPPLIES at 1974
15° 30'N
61° 30'W
61° 15'W

Present cost of production based on the best information available is approximately 50 cents/1000 gallons, including administrative expenses but excluding provision for debt service and reserves to provide for improvements and extensions.

Development Proposals

General

In 1964, as part of a joint PAHO/WHO—Government study of the island's water supplies, a development plan was formulated. The plan was later accepted in principle by Government.

It provided for adequate island-wide coverage to 97% of the 30 year projected population of 115, 000 through 9 major water systems, each designed to serve a number of communities with the possibility of intergartion; and some 13 other Miscellaneous Minor Systems to serve small isolated communities, the majority of these in inland areas and located at high elevations with serious topographical constraints. (See Figure 7)

A study of the population distribution had indicated that where development of supplies to be continued on a localized basis, this would result in an increase in the number of systems to 51 with corresponding multiplication in cost problems of administration, supervision, maintenance and operation. It was also evident that such an approach, based invariably on smaller sources would severely limit adjustments for rapidly changing land use patterns. Emphasis was therefore placed on the larger rivers.

A Central Water Authority was established to implement these proposals in 1969 and is presently engaged on this task;—updating the proposals wherever necessary.

Estimated Cost

The 1964 estimated cost of the programme was six million dollars with a per capita cost of $54 based on the design population. These figures together with the projected estimated average demand of 3.8 mgd are now considered unrealistic. The 1964 figures did not allow for changes in price levels, labour efficiencies or consumption patterns. At the present time, an estimate of eighteen million dollars is considered conservative.

Phasing

With a programme of this magnitude, bearing in mind financial commitments for operation and maintenance, it has been necessary to establish priorities. The rate of development will however be largely regulated by our ability to obtain further grants and to service the loans required for meeting the matching local costs; since money is the crucial problem and its supply is limited.

Actual Costs/Systems Constructed

With assistance from the United Nations Children's Fund for the Miscellaneous Systems, it has been possible to construct 12 new supplies to serve 15 villages (present population 7,000) during the period 1969—74. Total cost of this work has been $413,030; approximately 35% of this having been contributed by Unicef in the form of materials.

With Canadian assistance during the same period, work has been taken to a rather advanced stage in Water Area No.1 with some work done also in W.A.5. Benefitting from this has been Roseau and its surroundings and 8 villages in the coastal areas. Work on a new system for W.A.8 is about to commence and allocations have been made under phase 3 for new systems in W.A.3 and W.A.5. Total estimated cost of the work being executed under phases 1 and 2 is approximately $4,855,740; 55% of the cost being met by Canada. Work contemplated under phase 3 is estimated at $4,248,480; without considering recent escalation.

Extent of New Systems

As a matter of interset, 46 miles of pipe have been laid since the programme began in 1969: this is equivalent to 76% of the pipe laid between 1875 and 1969. Capacity of the systems has also increased from 1. 08 mgd to 8. 25 mgd in the decade 1964—1974.

Work thus far under phases 1 and 2 has been executed by direct labour under the supervision of C.W.A. staff and with the help of equipment supplied by C.I.D.A. Since the projected works are expected to increase sharply, it is proposed to employ consultants and contractors in the future.

On completion of proposals for W.A.1, W.A.3, W.A.5, W.A.8 and W.A.9 under phase 3 of the development programme, eighteen of the present 36 systems will be fed from five new regional sources rather than from individual systems most of which are rudimentary in character and have been developed on a local basis.

Design Criteria

Criteria used in design of new systems are presented at Appendix 1. Specifications for consumption are considered adequate except for waste and leakage in large quantities.

Water Rates

A new water rate structure was introduced as part of the Authority's Regulations on 1st July, 1973 in some areas, and on 1st January, 1974 in others. There are four schedules:— one providing for a General Water Rate, one for an unmetered supply rate based on the number of fixtures on the premises, one for a metered supply rate and yet another specifying connection and reconnection charges. The second schedule or flat rate is perferred by most wasteful users.

The General Water Rate is presently ½% of the annual assessed value of the premises served. The unmetered rate may be as low as $15.00 per half year. Under the metered rate, domestic consumers are required to pay 70 cents/1000 gallons rising by increments of 10 cents to $1.00/1000 gallons. Non-domestic supplies range from $1.00/10,000 gallons to $1.10/1000 gallons. In order to provide incentive to industry, the rate for industries is 80 cents/1000 gallons rising to 90cents/1000 gallons.

Central Government pays a rate of $15.00 per month for each public fountain or stand pipe. This works out to approximately $1.54/year per person served by these facilities.

The new rates represent an increase, in many instances of 1,000% on the old ones and there has been widespread protest. It is a little too early to predict their full effect, but the success of the venture will depend on the firm application of sound business principles.

Government's and the Authority's present policy is that all commercial and industrial premises and suspected large domestic consumers be metered. Any domestic consumer may however request to be metered and charged under the third schedule.

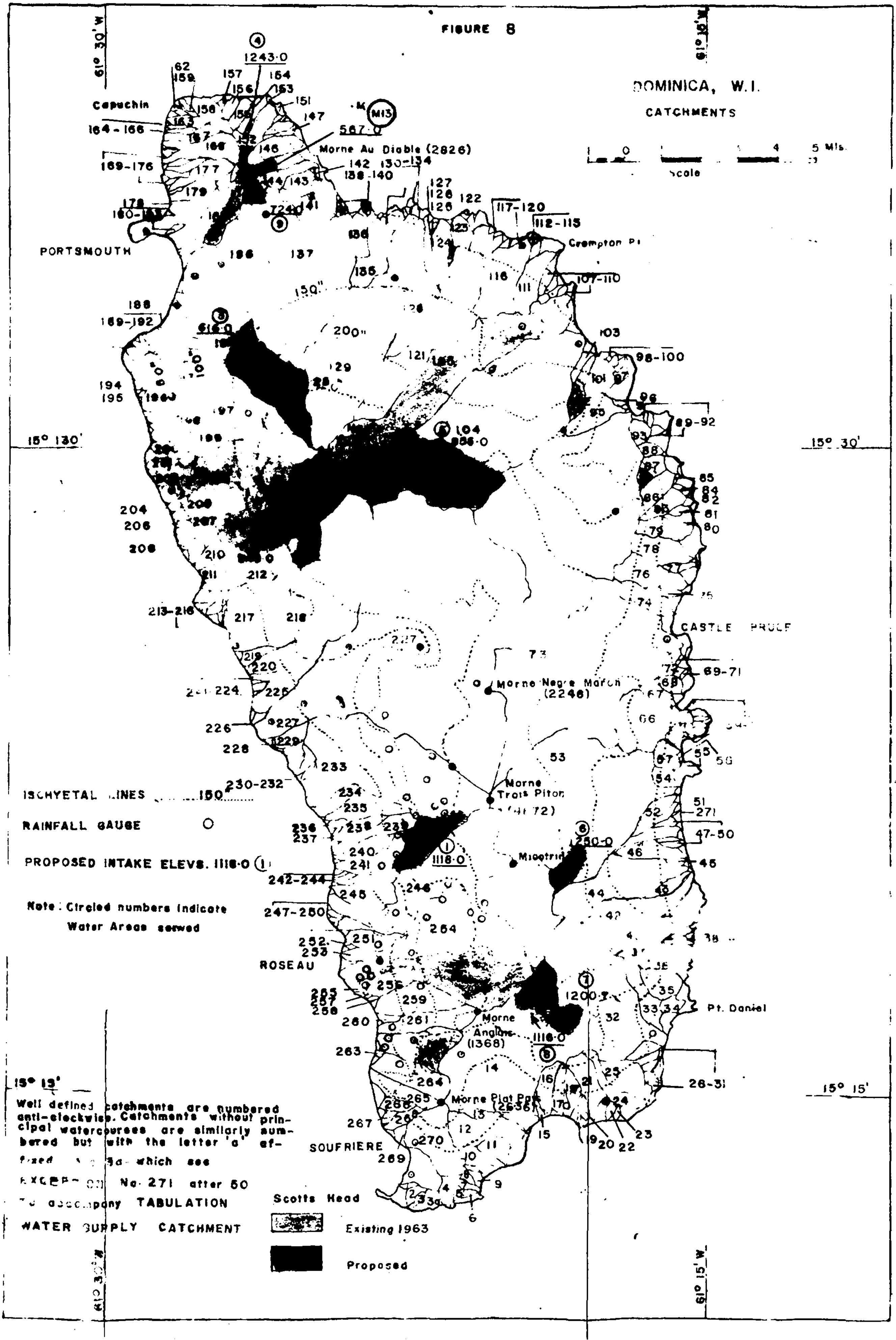
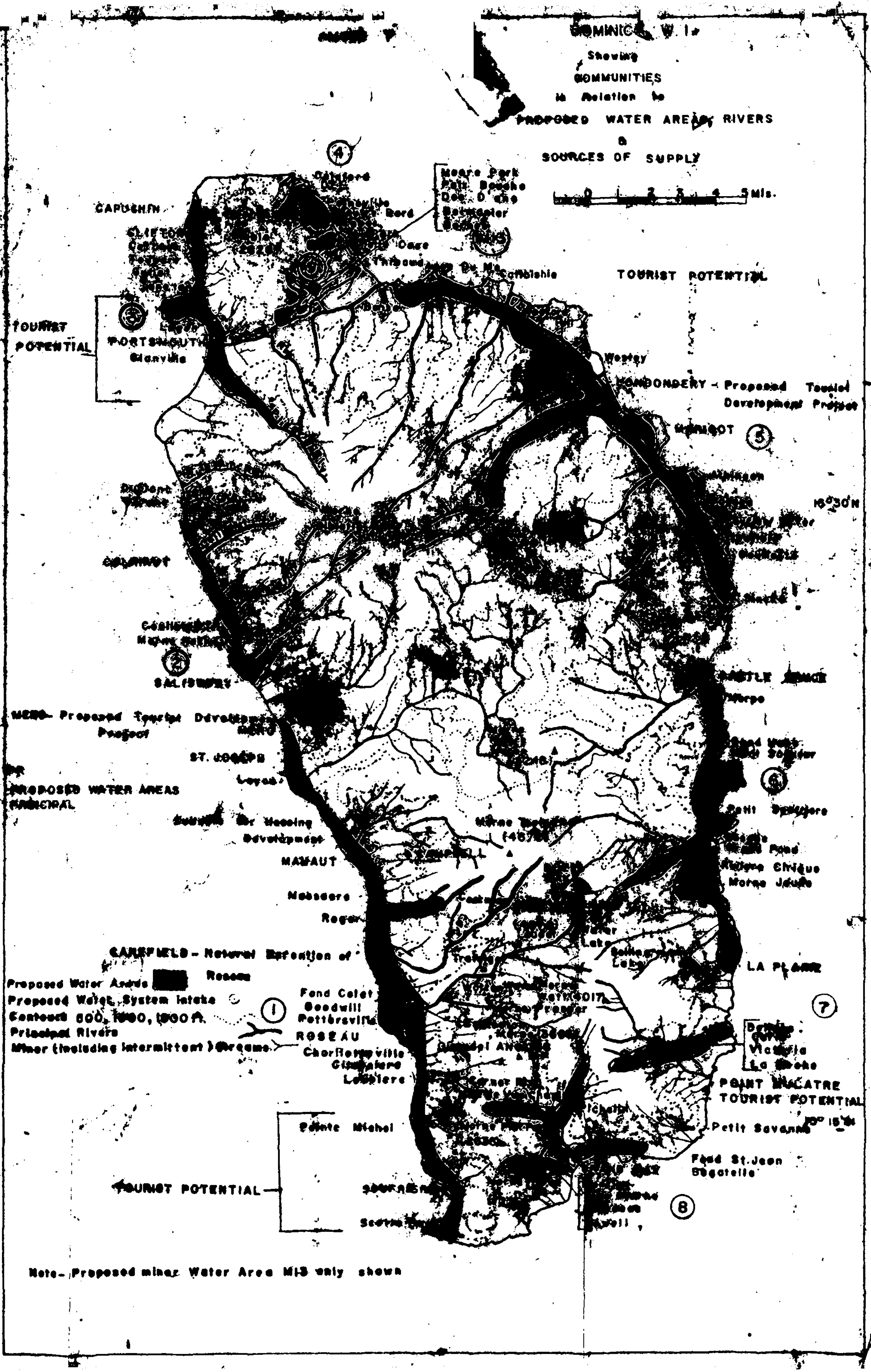


FIGURE 8
DOMINICA, W.I.
CATCHMENTS
Scale
5 Mls.
Capuchin
PORTSMOUTH
Morne Au Diable (2826)
Crompton Pt
CASTLE BRUCE
Morne Negre Maron (2246)
Morne Trois Piton (4672)
ROSEAU
Morne Anglais (1368)
Morne Plat Pays
SOUFRIERE
Scotts Head
Pt. Daniel
ISCHYETAL LINES 150"
RAINFALL GAUGE
PROPOSED INTAKE ELEVS. 1118·0 (1)
Note: Circled numbers indicate Water Areas served
Well defined catchments are numbered anti-clockwise. Catchments without principal watercourses are similarly numbered but with the letter 'a' affixed
EXCEPT No. 271 after 50
To accompany TABULATION
WATER SUPPLY CATCHMENT
Existing 1963
Proposed
15° 30'
15° 15'
61° 30' W
61° 15' W



DOMINICA, W. I.
Showing
COMMUNITIES
in Relation to
PROPOSED WATER AREAS, RIVERS
&
SOURCES OF SUPPLY
0 1 2 3 4 5 Mls.
TOURIST POTENTIAL
CAPUCHIN
TOURIST POTENTIAL
PORTSMOUTH
Calibishie
Wesley
LONDONDERY - Proposed Tourist Development Project
MARIGOT
SALISBURY
Proposed Tourist Development Project
ST. JOSEPH
PROPOSED WATER AREAS
CASTLE BRUCE
MAHAUT
Morne Jaune
LA PLAINE
CANEFIELD - Natural Retention of
Proposed Water Areas
Proposed Water System Intake
Contours 500, 1000, 1500 ft.
Principal Rivers
Minor (including intermittent) Streams
ROSEAU
Fond Colet
Goodwill
Pottersville
Victoria
POINT MACATRE
TOURIST POTENTIAL
Petit Savanne
Pointe Michel
Fond St. Jean
Bagatelle
TOURIST POTENTIAL
Note- Proposed minor Water Area MI3 only shown

There are 4,340 service connections and 360 public taps. Of the total number of service connections, 140 or 3.2 % are metered.

Personnel and Recurrent Budget

Currently, the Authority has 55 monthly paid employees and 29 part-time Caretakers. The number of daily paid workers fluctuates, dependent mainly on the construction programme. Presently, "direct labour" construction is being phased out and the figure is 135. The ratio of the total labour force to the population served is roughly 1 to 275 and the labour force engaged on operating systems is 1 to 450.

For the size of the island, topography and the number of sources, the existing staff is inadequate for proper administration, operation, maintenance and construction of water supplies; and hence, specialized functions such as leak detection and hydrological studies, so necessary for efficient operation and planning, are addmittedly being neglected.

Based on the 1971 employment figure there has been a turn over of 39% of monthly paid staff between 1969 and 1974.

The operating budget of the Authority for 1974 is $335,153 and its capital budget $1,186,478. Government subsidy is 41 % without rates from Government Buildings and 9 % with Government Rates.

Conclusion

This is the present state of the Water Supplies of Dominica. Considerable investment in material and human resources are required to achieve further improvements.

It is hoped that with your assistance and our united endeavours; at least The Minimum Regional Goals of the 10 year Health Plan for the Americas will be met.

APPENDIX I

WATER SUPPLY *DESIGN SPECIFICATIONS DOMINICA, W.I.*

1. *Design Period:* 30 years.

2. *Av. Daily Consumption:*

   Rural

   For system as a whole—min. 25 gpcd.
   For public taps — min. 15 gpcd.
   For service connections—min. 40gpcd.

   Urban

   For system as a whole—min. 60 gpcd.
   For public taps—min. 15 gpcd.
   For service connection—min. 60—90 gpcd.
   Tourist bed—min. 200 gal. ea.

3. *Max. Daily Consumption:*

   For populations 1,000 and less 3 times average.
   For populations 1,001—20,000 3 times average.
   For populations over 20,000 1.5 times average.

4. *Max. Hourly Consumption*:

For populations 1,000 and less 4 times average.
For populations 1,001—20,000 3 times average.
For populations over 20,000 2 times average.

5. *Fire Flow:* *Rural Small Villages.*

Population	Fire Flow	Duration
No.	U.S. galls./min	hrs.
1,000	150	1.50
2,000	300	1.50
4,000	600	1.50
6,000	900	1.50
10,000	1,500	1.50

Towns: Roseau—8 streams at 250 gpm Duration—5 hrs.
Goodwill—6 streams at 250 gpm Duration—5 hrs.

6. *Distribution Pressures*:

Rural

Minimum—No fire hydrants 35.0 ft. or 15 lbs/sq. in.
With fire hydrants 80.5 ft. or 35 lbs/sq. in.
Desirable— 115 ft. or 50 lbs/sq. in.
Maximum— 200 ft. or 86 lbs/sq. in.

Urban

Minimum— 80.5 ft. or 35 lbs/sq. in.
Desirable— 139 ft. or 60 lbs/sq. in.
Maximum— 200 ft. or 86 lbs/sq. in.

7. *Supply Main*

Minimum diameter 2 inches
Maximum velocity at max. day demand $6\frac{1}{2}$ft/sec.

8. *Distribution Mains:*

Minimum diameter 2 inches

Maximum velocity 3 ft/sec.

9. *Service Connections:*

Pipe size not less than $\frac{1}{2}$ in. diameter.

PESTICIDES IN WATER DERIVED FROM RIVERS

by

R.G. GIBBS, Technical Adviser C.C.P.C.U.

1. *Introductory Note*

The Commonwealth Caribbean Pesticide Control Unit was set up as a regional U.K. Technical Assistance scheme in 1971, with the aim of assisting regional Governments in controlling the use of pesticides. The Technical Adviser aids Governments in drawing up relevant legislation and advises on practical aspects of pesticide control, while two Chemists in the Unit's laboratory in the Chemistry Department, U.W.I. Trinidad, analyse pesticide residues in food, water, etc. These samples are drawn from the whole region, and some analyses of Dominica river water are described in this paper.

The regional Governments have agreed to take over the Unit from the end of August 1974, when the Caribbean Community Secretariat will become responsible for the future administration of the Unit.

2. *Pesticides in Water*

The general term "pesticides" includes insecticides, nematicides, fungicides and herbicides. (see Table 1). These may enter natural waters by direct application (e.g. to kill aquatic weeds and insect pests such as Simulium larvae); by percolation and run-off from agricultural land: by drift from aerial and land application, and by discharge of waste waters from cleaning of equipment used for pesticide formulation and application. An additional source of pollution in more developed countries is the effluent from manufacturing plants.

Some important properties of pesticides which affect their importance as water pollutants are considered below. It should be recognised that there is considerable variation in properties within each class of pesticide considered, and so these generalisations may not hold strictly for all compounds.

(*a*) *Solubility* The organochlorine insecticides have the lowest solubilities in water mostly in the range 0.01—0.3 mg/l (ppm) at 20—25°. Organophosphate solubilities are mostly in the range 1—100 mg/l at the same temperature. Some insecticides (especially the organochlorines) are thus so insoluble that if present in water they must be absorbed onto suspended solids such as clay and silt. This implies that they would be largely removed by filtration process.

(*b*) *Mobility in soil* Both organochlorine and organophosphorus insectcides tend to be adsorbed onto organic lipophilic ("fat-loving") materials in soil, and are therefore not readily leached out by water. Other types of pesticide tend to be less firmly bound to the lipophilic materials in soil, but some (e.g. Gramoxone) may be bound by ionic charges to other soil components.

(*c*) *Toxicity to man* Insecticides as a group are more acutely toxic to man than the other groups of pesticides, and most organophosphates are more acutely toxic than the organochlorines. However constant exposure to the latter causes residues to accumulate in fat, while small residues of organophosphates are readily broken down and excreted.

(*d*) *Toxicity to fish* The organochlorines are the most toxic group to fish. Endosulphan is regarded as the most toxic of all, killing some freshwater fish at 0.01ug/l (p.p. thousand million), while the corresponding figures for DDT and endrin lie in the range 0.1—1ug/l. By contrast, organophosphates are generally less toxic to fish, with only one or two producing lethal effects below 10ug/l.

(*e*) *Removal of pesticides from water* Laboratory and pilot plant studies indicate that organic pesticide concentrations can be reduced most effectively by an activated carbon treatment. Furthermore carbon dosages are within normal amounts, 10 to 30 mg/l, that are applied at most water treatment plants (in the U.S.A.) for control of taste and odour levels. Chemical oxidation and chemical coagulation followed by sedimentation and filtration are not efficient processes. (quoted from Faust and Suffet 1966)

3. *ACCEPTABLE LEVELS OF PESTICIDES IN WATER*

The following criteria for pesticides in water have been established as guidelines in the U.S.A.

(*a*) *Permissible criteria for public water supplies and farmstead uses.* These are from the Report of the Federal Committee on Water Quality Criteria, and are shown in Table 2. These permissible limits are derived as being safe if ingested over extensive periods. The limits for four of the pesticides (aldrin, heptachlor, chlordane and parathion) were set at even lower values because of their organoleptic properties.

(*b*) *Maximum reasonable stream allowance* These were suggested by Ettinger and Mount, and are shown in Table 2. These are the levels considered hazardous in waters from which fish are harvested for human consumption. The allowances are quoted for organochlorines only, since these are the only residues which are taken up from the water by fish and stored.

(*c*) *Levels considered directly toxic to fish* The Federal Committee on Water Quality Criteria recommended that the levels of organochlorines in water should not be permitted to rise above 0.05ug/l

4. *RESULTS OF WATER ANALYSES FROM DOMINICA*

Reid (1971) stated that two samples out of seven drawn from the Check Hall catchment in 1970 showed positive for aldrin and/or dieldrin, and that the concentration was thought to be about 1ug/l.

The C.C.P.C.U. has now analysed a further fifteen samples drawn from the same catchment in 1972 and 1973, and found aldrin in one sample (0.01ug/l.) Aldrin was also found at a higher level (0.5ug/l) in a sample taken from the Petite Savanne river shortly after a fish-kill had taken place. Most of the samples from Check Hall were also analysed for the carbamate insecticide, Sevin, and the weedkiller Gramoxone. No Gromoxone was found but three samples contained Sevin up to 8ug/l. This is very low compared to the permissible criteria for organophosphates and carbamates shown in Table 2.

The normal method of analysis adopted is the extraction of insecticides from a 2½ litre sample into hexane, which is then concentrated down to a small volume. Samples of the hexane extract are then analysed by gas-liquid chromatography (GLC). This routine method detects all organochlorine insecticides and most organophosphates, but special methods have to be adopted to detect other compounds (e.g. Sevin and Gramoxone).

5. *LOCAL EXAMPLES OF INCIDENTS INVOLVING PESTICIDES IN WATER*

(*a*) *Fish-kills in Belize.* A large number of fish were killed in a creek in the Stann Creek area in 1973, following the aerial application of the fungicide Ortho Difolatan (captafol) to citrus. This was presumably due to direct drift onto the creek. This chemical kills fish after 4-day exposure to 0.5 ppm (rainbow trout).

(*b*) *Fish-kills in Winward Islands.* There have been a number of reports of fish-kills in the Winward Islands following intensive application of organochlorine insecticides for banana borer control. It is not clear whether the cause is run-off from treated areas or the discharge of contaminated water used for cleaning sprayers and other equipment. The C.C.P.C.U. has already issued simple guidelines to Banana Growers' Associations to prevent these incidents.

(*c*) *Incident in St. Lucia caused by DBCP.* An incident involving the contamination of water by the nematicide DBCP (Nemagon Jebagon etc.) was reported in St. Lucia in 1972. Information on the safe handling of the compound was sent to the Medical Officer of Health in St. Lucia by the Director of Research, WINBAN. Exposure of fish to concentrations of more than 1 ppm may be fatal.

6. *CONCLUSIONS.*

Levels of pesticides in local rivers are known to cause fish-kills on occasion. However, analysis of water samples from the Check Hall Catchment in Dominica in 1972 and 1973 has not provided evidence for serious contamination. Nevertheless, control of pesticide use in the Catchment would still be worthwhile as a preventative measure. The most likely cause of high pesticide levels in rivers would be persons washing out spraying equipment in the river, or disposal of empty containers. Every effort should be made to prevent these malpractices.

7. *REFERENCES.*

Faust, S.D. and Suffet, I.H. (1966)—*Residue Reviews* 15, 44. Title: "Recovery, Separation and Identification of organic pesticides from natural and potable waters."

"Report of the Committee on Water Quality Criteria"—report by the National Technical Advisory Committee to the U.S. Department of the Interior, Federal Water Pollution Control Administration, 1968

Ettinger, M.B. and Mount, D.I. (1967)—*Environ. Sci. Technol.* 1, 203—205. Title: "A wild fish should be safe to eat."

Report by Raymond Reid, PAHO/WHO Sanitary Engineer, on "Water Quality, Check Hall River Water Catchment, Dominica, West Indies", August 1971.

Suggestion for further reading: "Pesticides and Pollution" by K. Mellanby (Collins, New Naturalist Series and Fontana paperback).

TABLE 1

SOME PESTICIDES COMMONLY USED IN THE COMMONWEALTH CARIBBEAN

NOTE: all shown by common names except those with an initial capital letter which are trade names. .

ORGANOCHLORINE INSECTICIDES	ORGANOPHOSPHATE INSECTICIDES	CARBAMATE INSECTICIDES
aldrin	malathion	Sevin
dieldrin	parathion	Lannate
heptachlor	diazinon	Baygon
endrin	(= Basudin)	
		FUNGICIDES
chlordane	Dipterex	
toxaphene	dichlorvos	Benlate
DDT	dimethoate	Captain

ORGANOCHLORINE INSECTICIDES	ORGANOPHOSPHATE INSECTICIDES	FUNGICIDES
lindane	Phosdrin	Cupravit
BHC	phosphamidon	Dithane
endosulphan	Rogor	Maneb
	Perfekthion	Zineb
HERBICIDES		Kocide
2,4—D	NEMATICIDES	Perenox
2,4,5—T		Thiram
MSMA	D D Mixture	Antracol
DSMA	DBCP	Capatfol
dalapon	(=Nemagon,	(=Difolatan)
paraquat	Jebagon etc.)	
(=Gramoxone)	Nemacur	
diuron		
(=Karmex		
Gesaprin		
Gesapaz		
propanil		

TABLE 2

PERMISSIBLE PESTICIDE LEVELS IN WATER SUPPLY (ug/litre)

(blanks = criteria not given)

PESTICIDE	PERMISSIBLE CRITERIA *	MAXIMUM REASONABLE STREAM ALLOWANCE **
Dieldrin	17	0.25
Endrin	1	0.1
DDT	42	0.5
Heptachlor	18	1.0
Heptachlor epoxide	18	1.0
Aldrin	17	0.25
Lindane (BHC)	56	5.0
Chlordane	3	0.25
Methoxychlor	35	20.0
Toxaphene	5	2.5
Organophosphates plus Carbamates	100	—
Herbicides: 2,4—D plus 2,4,5—T and 2,4,5—TP	100	—
Phenols	1	—

*From the "Report of the Committee on Water Quality Criteria".

**Suggested by Ettinger and Mount (1967)

WATER QUALITY

AND

CATCHMENT AREA CONTROL

By

RAYMOND REID, Sanitary Engineer, Pan American Health Organisation/WHO
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presented at the

Caribbean Water Engineers' Conference, Dominica, W. I.

7—10 July, 1974

WATER QUALITY AND CATCHMENT AREA CONTROL

by Raymond Reid

Introduction

The quality of water from a community supply may be looked as the summation of all the factors that may affect its physical, chemical and bacteriological composition during the planning, production, distribution and operation process.

Water quality as organization may have its cultural setting and reflects the level of technology in the country the level of managerial and operational competence, the level of economic development in the country.

During the past decade all governments of the Caribbean have incurred considerable expenses in water supplies bringing improvement to larger number of communities. Community water supply loans and grants made by the Canadian International Development Agency (CIDA) to the Eastern Caribbean alone sums up to 8.7 million Canadian Dollars for the period 1966—72. However, the problem of water quality both in the more developed countries (MDC) and the lesser developed territories remain a crucial one. All countries in the Caribbean acknowledge that W.H.O. standards as goals from water quality even though few have officially adopted them or have reduced them to a written policy. If these standards were effectively applied now many supplies would have met them one hundred percent (100%) of the time.

This paper reviews the various problems associated with water catchment and quality control as it applies to the Caribbean area.

Water Quality

Water supplies in the Caribbean exhibit a high degree of positivity with regard to the number of samples collected and analysed for coliform counts. This is particularly true of medium size and small size community supplies. Table 1 shows the summary of bacteriological examinations of water supplies in one of the lesser developed countries in the Caribbean. Table 2 shows the same data for supplies outside the metropolitan area in a more developed country.

The percent of positive samples runs as high as one hundred percent (100%) in one case for a month. These figures are significant if one considers that numbers of community water supplies consist of an intake or a pumping station from a river, a spring or other natural bodies of water feeding directly into a distribution system. Chlorination is in some cases provided as the only means of treatment thus the differenciation between treated and untreated supplies. Treated supplies in other instances mean that more elaborate treatment is provided. It is therefore not surprising that untreated supplies show a higher degree of positive counts than treated supplies.

Catchment areas or watersheds under normal conditions and particularly during the rainy seasons produce water with higher bacteria content than those recommended for disinfection as the sole method of treatment or even in some cases exceeds the limits recommended by most standards and guidelines for conventional treatment. Chlorination alone is considered adequate when the coliform MPN is less than 50/100ml. This limit has in many cases been exceeded. Table 3 summarises the ranges of standards for raw water sources for domestic supplies.

The heavy reliance on chlorination alone as methods of treatment poses a lot of problems and has in many instances been responsible for outbreak of waterborne diseases due to chlorination failure.

TABLE 1

* BACTERIOLOGICAL ANALYSIS OF WATER SAMPLES FROM SUPPLIES IN A LESSER DEVELOPED COUNTRY

Month	*Negative*	*Positive*	*Total Samples*	*Positive %*	*Samples Taken %100 — 88*
JAN.	—	—	—	—	—
FEB.	25	30	55	55	62.5
MAR.	35	23	58	39	66
APR.	27	16	43	37.5	49
MAY	34	27	61	44	69
JUNE	58	12	70	17	79.5
JULY	29	19	48	4o	54.5
AUG.	52	23	75	31	84
SEPT.	60	16	75	21	68
OCT.	44	11	55	25	62.5
NOV.	64	10	74	13.5	84
DEC.	54	16	70	23.0	70

* for samples collected from distribution system

TABLE 2

* BACTERIOLOGICAL ANALYSIS OF WATER SAMPLES FROM SAMPLES IN A MORE DEVELOPED COUNTRY

Month	*Untreated Supplies*	*Nos. Pos.*	*%Positive*	*Treated Supplies*	*Nos. Pos.*	*%Positive*
JAN.	48	35	73	219	43	20
FEB.	35	27	77	175	36	21
MAR.	77	69	90	221	49	22
APR.	46	30	65	222	41	18
MAY.	40	21	52	269	60	22
JUNE	35	30	86	217	45	21
JULY	57	47	82	245	59	24
AUG.	27	24	89	100	28	28
SEPT.	23	18	78	260	75	29
OCT.	51	48	98	214	76	35
NOV.	47	44	94	303	77	25
DEC.	14	14	100	184	44	24

* for samples collected from distribution system.

TABLE 3

RANGES OF PROMULGATED STANDARDS FOR RAW WATER SOURCES OF DOMESTIC WATER SUPPLY

Constituent	Excellent source of water supply, requiring disinfection only, as treatment	Good source of water supply, requiring usual treatment such as filtration and disinfection	Poor source of water supply, requiring special or auxiliary treatment and disinfection
BOD (5—day) mg/l monthly average:	0.75—1.5	1.5—2.5	Over 2.5
Max. day, or sample:	1.0—3.0	3.0—4.0	Over 4.0
Coliform MPN per 100 ml Monthly average	50—100	50—5,000	Over 5,000
Max. day, or sample:	Less than 5% over 100	Less than 20% over 5,000	Less than 5% over 20,000
Dissolved Oxygen mg/l average	4.0—7.5	4.0—6.5	4.0
% saturation:	75% or better	60% or better	—
Ph Average:	6.0—8.5	5.0—9.0	3.8—10.5
Chlorides, max.mg/l	50 or less	50—250	Over 250
Florides, mg/l	Less than 1.5	1.5—3.0	Over 3.0
Phenolic compounds, max. mg/l	None	0.005	Over 0.005
Color, units	0—20	20—150	Over 150
Turbidity, units	0—10	10—250	Over 250

Water Catchment Problems

Most water catchment are privately owned. Municipalities and communities have not in practise considered it necessary to acquire any water catchment or part of catchment area albeit some areas belong to central Governments. The ownership distribution varies between a large number of owners possessing a few acres of land to a few large plantations known as estates.

With the type of plantation economy common to the Caribbean area most water catchment areas are cultivated. Plantations of bananas, citrus, cocoa and ground provision may be found flourishing as part of the economy of the areas. Modern practices in agriculture require the use of pest control agents to ensure proper yield and quality of the product.

Pesticides are known to have reached certain water supplies. Preliminary investigations in one of the lesser developed territories of the Caribbean carried out by the writer had indicated that aldrin, dieldrin and nemagon, a nematocide were present in the only source of Water Supply for the Capital City.

Pesticides may reach a body of water through leaching from the soil, by direct spraying of the area being treated or by percolation into the ground water. The same investigations revealed gross misuse of pesticides used per arces compared to the recommended dosage by the manufacturers. Pesticides residue may go undetected in a water supply for a long time and the long term effects of these materials are not well known.

With ownership goes the right to live in the water catchment. Sanitary facilities consist of pit privies and septic tank systems.

Septic tanks are considered more harmful in this regard because of the constant danger of direct discharge of contaminated effluent to the receiving waters, however, where possibilities of flooding exist the danger is just as great with privies. In a certain country the resettling of persons who represented a threat of contamination for a community water supply was being considered following an outbreak of waterborne diseases.

In another Catchment Area an organized housing scheme was proposed overlooking the water supply intake as a tourist resort and a haven for retired foreigners. The potential for a timber industry development in some water catchment is great particularly where the catchment consists of forest lands. The steep slope of certain of the mountains areas may create some operational problem unless methods of logging and decomposition are properly controlled.

Water Catchment Management

Water Catchment Management falls the wide realm of water resources management. The question of what uses and what level of use is compatible with water quality has always been a puzzling one. Originally most water catchment or reservoirs were planned developed with a single purpose in view. In more recent times the concept of river basis planning has lead to the consideration of multiple uses of river systems.

The socioeconomics factors involved in multiple use of water catchment need to be carefully evaluated and a stringent cost-benefit analysis between various alternates carried out, before an appropriate solution is arrived at. However, one should not loose sight that in a situation where surface water is the only source of water of a community the primary obligation and benefit is to provide a safe water to the community. The pollution generated by each use need to be carefully examined vis a vis of the water quality standards taking into account capital and operating costs.

New management techniques such as mathematical modeling can be used to the benefit of decision makers. Water quality of catchment area will deteriorate with increase population and urbanization in the area. We have also seen that agricultural practices may have a deleterious effect on water quality, therefore any water resources plan involving catchment areas must be integrated with an overall land use planning.

Some legislations and regulations exist in most countries for water resources management and protection of catchment areas disguised under other legislations such as the Public Health Act or Forest Regulations. However these acts were designed to regulate simple problems. As the pressure for development is translated into more extensive plantation, growing tourist centres and resorts and housing complexes new direction is needed for more protection and more coordinated approach forward managing the water resources of these countries. Few countries have passed a water resources act *perse*.

Caribbean countries have not yet made use of new management concepts such as river basin planning for water resources management. There is need to train engineers, scientists, managers and planners in the techniques of programming and modeling as operational tools toward solving problems affecting the region.

Most Caribbean Islands are faced with a *fiat accompli* of multiple uses of water catchment areas which did not arise from any systematic planning. Tne pressure to develop water catchment areas will increase due to relative scarcity of land. One needs to consider some corrective actions and some guidelines for adequate water catchment management where this situation exists.

Guidelines for Water Catchment Management

The need for proper legislations and codes covering land use in the catchment area cannot be overemphasized. Special attention should be paid to the disposal of domestic waste in the catchment. There should not be any direct discharge to the river or reservoir. When this is not possible domestic waste should receive the highest degree of treatment possible including disinfection prior to discharge.

Septic tanks and privies need to be properly designed and constructed. It is advantageous to consider an approved and standard type of these facilities. Frequent inspections of same must be carried out.

Agricultural land uses and practices need to be evaluated with regard to water quality in the catchment areas. Where certain agricultural land uses are found incompatible with water quality it might be advisable to consider change in crops or in agricultural practices. A project can be written for consideration by the World Food Programme (WFP) to compensate the farmers for loss of income during the crop change. A similar programme has been carried out in Jamaica with the objective of supplementing the diet of some 3,000 farmers engaged in reforestation, terracing and construction and pasture development to rehabilitate some 10,000 hectares of ruinate land.

The need for proper pesticide control and the education of the farmers in the use and technique of pesticide application need to be considered for minimizing the dangers of pesticide contamination. Forestry practices need also be evaluated. Table 4 shows the maximum recommended concentration for most commonly used organochlorine pesticides.

The use of marginal and critical land in the water catchment needs to be adequately controlled by the water or other regulatory agencies. In this regard the two hundred feet ('200') adjacent to the body of water and the immediate area of the water supply intake are considered the most critical. Where the possibility of flooding exists the flood elevation should be considered critical for control. Leasing of these adjacent and other marginal lands may be considered if the agency finds it necessary for protection from pollution or other injury to the water sources by promoting forestation or other desirable improvements.

Some degree of control needs to be exercised over contributory water courses in the catchment area with regard to pollution control or in a case of reservoir the water authority may by ordinance prevent the pollution of the water feeding its reservoirs over a certain distance upstream from the headwaters of its reservoir and abate pollution within that area.

Control needs to be established for solid waste disposal in the catchment where it is inhabited. The movement of population in the catchment must be watched with specific regard of picnics and other outing and sporting activities. Swimming in the immediate area of the intake must be prohibited. Where it applies, water crafts, boats must be carefully controlled. The same caution applies to the movement and raising of animals in the catchment.

With the assistance of the public health department the water authority need to carry out frequent sanitary surveys of the conditions in the water catchment. A continuous water quality surveillance programme needs also to be implemented to support sanitary control measures.

TABLE 4

Recommended Maximum Concentrations of Organochlorine Pesticides in Whole (Unfiltered) Water Sampled at any Time and Any Place.*

Organochlorine Pesticides	Permissible maximum Concentration (ug/l)
Aldrin	0.01
DDT	0.002
TDE	0.006
Dieldrin	0.005
Chlordane	0.04
Endosulfan	0.003
Endrin	0.002
Heptachlor	0.01
Lindane	0.02
Methoxychlor	0.005
Toxaphene	0.01

* Concentrations were determined by multiplying the acute toxicity values for the sensitive species by an application factor of 0.01.

Laboratory Analysis

The type and frequency of analysis to be carried out varies with the sources of supplies and the degree of control exercised in the catchment area. The surveillance programme must aim at giving a picture of the water quality detecting trends in the change of quality if any. For a well protected catchment the frequency of analysis may be reduced to a minimum while where some degree of pollution is to be expected constant surveillance is necessary.

Common tests performed for water quality surveillance are bacteriological examination, chloride ammonia, nitrate, nitrite, PH, iron and sulphate. Colour, odor and microscopic examination would be more appropriate for reservoir supplies. Detergent should be determined where there is a possibility of contamination. Pesticides determination needs to be performed where pesticides are used in the catchment area. Continuous monitoring of pesticides require sophisticated equipment for sampling such as carbon samplers and for analysis such as atomic absorption units which are not readily available to small countries.

The need for laboratory evaluation in the Caribbean area need to be considered. In the absence of any official agency for carrying out laboratory evaluation, and monitoring, interchange of samples and ideas between various laboratories in the region might serve the same purpose.

Other Factors Affecting Water Quality

In the previous exposé one may have given the wrong impression that water quality is a function of raw water quality alone.

Design, management and operations and maintenance are responsible for a major share. Time will not allow to go into details in all these factors but we wish to summarize few of some typical problems. The list is by no mean exhaustive but will suffice to illustrate the point—

(*a*) Design

Large number of supplies are designed without elevated storage as a cost saving factor, posing a constant threat to contamination in case of power failure. The lack of residual pressure in the distribution will facilitate contamination by introduction of pollutants through faulty joints, leakage in the distribution network or back-syphoning of contaminated waters.

(*b*) *Management*

This point can be better illustrated by quoting from the medical officer of health report from which Table 1 was extracted "In May Chlorine stocks became very low and effort was made to obtain supplies from Trinidad. The danger of this situation was emphasized later in the year around August when outbreaks of cholera had to be considered".

Conclusions

The provision and delivery of high quality water is a team effort relying on the competence of the water resources planners the design engineers, the managerial capability of the agency and the skill of the operators and technicians in the field. It can be postulated that where all these factors have been properly considered positive samples will be randomly distributed maybe a direct cause-effect relationship. In the contrary some definite pattern of positivity will be developed regarding the occurrence of coliform bacteria. The pattern may be seasonal relating to the rainy season or otherwise.

We wish that this hasty view of the question of water quality and water catchment control will stimulate action toward improving water quality in the region.

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THE USE OF P.V.C. IN WATER SYSTEMS

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HISTORICAL DEVELOPMENT

The economical and efficient transportation of water for personal and household needs from distant sources to convenient use points has been a continuing challenge to the ingenuity of man since they first started to live in communities. In the beginning it was the open trench and then the hollowed log, masonry channels, pierced stones cemented together, tunnels, aqueducts, followed by the baked clay pipe and lead pipe.

The development of cast iron pipe in the 17th century was a break-through in the transportation of water and in 1914 the asbestos cement pipe was developed.

In 1931 P.V.C. (Polyvinyl Chloride) compounds were developed by German seientists who proceeded to produce millions of pounds, some of it for pipes.

In 1950 P.V.C. entered the world market and is being used and recommended today in countries all over the world.

In 1955 P.V.C. was introduced in Surinam and in its traditional role as guardian cf the public health, the water authorities have been extremely cautious about accepting new materials, until reports and other documents from Test institutions abroad led to the acceptance of P.V.C.

Nowadays, P.V.C. has come into widespread use throughout the country, almost 95% (plus or minus 200 km) of the distribution system of the Rural Water Supplies Division is constructed with P.V.C.

It is being used in nearly every part of the system, from the well or raw-water intake to the tap.

Of course there have been some failures in the use of P.V.C., some caused by the use of the materials under conditions beyond their designed capabilities, other by unproper installation.

However, with more experience in the use of P.V.C., an "improved image" is emerging.

ADVANTAGES OF P.V.C.

1. *Non Corrosion.*

The material is resistant against aggressive ground water, diluted acids, diluted alkalis, bencine and mineral oils.

2. *Sanitary.*

The chemical properties allow for all common chemical and mechanical procedures of waterwell regeneration, including acidification, and it will not release any organic substances to the water. It is non toxic and will not effect the taste, odor or colour of water.

3. *Friction.*

Because of its mirror smooth inside surface, P.V.C. pipes minimise flow loss and impede the build-up of deposits and corrosive scales, permitting greater flows through a particular pipe size.

4. *Weight.*

P.V.C. is incredibly light, in comparison with A.C. or steel pipes. This cuts down transportation and handling costs.

5. *Installation.*

Installation is quick and easy with a complete line of fittings.

In maintanance work, pipe can be readily repaired with a minimum of complication or cost.

6. *Mechanical Strength.*

P.V.C. has great tensile strength yet flexible enough to withstand displacement in the pipe line. It will not dent or flatten under pressure.

7. *Dielectric Properties.*

Because it is itself an integral insulator, it eliminates the possibility of electrolytic corrosion which so often destroys underground metal piping.

Mechanical				
Specific Gravity	A.S.T.M.	D 792	1.43	
Tensile Strength (PSI at 78 °F	"	D 638	7000	— 7500
Izod Impact lbs/in./notched	"	D 256	0.8	
Flexural Strength (PSI)	"	D 650	13500	
Compressive Strength (PSI)	"	D 695	9600	
Hardness (Durometer D)	"	D 676	83	
Thermal Properties.				
Coefficient of Thermal Expansion in./in./°C	"	D 696	5.2 x 10–5	
Coefficient of Thermal Expansion in./in./°F (properties at 73.4)	"	D 696	2.9 x 10–5	
Heat Distortion °F at 264 PSI	"	D 648	165	
Thermal Conductivity BTU/sqft.2/hr. °F/in.			1.0	
Electrical Propertities.				
Dieclectric Strength volts/mil	"	D 149	1400	
Dielectric Constant 60 CPS at 30 °C	"	D 150	3.70	
Power Factor 60 CPS at 30	"	D 150	1.255	
Other Properties.				
Water Absorption % in 24 hrs.at 75 °F	"	D 570	.12	
Flammability	Will not support combustion.			

Light Weight

Platic pipe has a tremendous advantage weight-wise which is particularly important in transportation cost and ease of handling to job sites which are often remote in the rural areas of Surinam. A mile of 4-inch 130 psi PVC pipe weigh 4.3 tons compared with 18 tons for asbestos cement pipe and 55 tons for cast iron. One man could easily carry two 20-foot lengths of 4-inch PVC pipe but with the same effort could carry less than 5 feet of 4-inch cast iron pipe. This extremely light weight makes it easier to install the plastic pipe, particular in the larger sizes which can be installed without the use of tripods or lowering equipment.

Installation

P.V.C. pipe comes in lengths up to 40 feet. This reduces the number of joints very materially from the number required on other types of pipes. Pipes may also be joined at the trench side and then lowered into the trench with ropes making it possible to use a much narrower trench. For instance, a 4-inch plastic pipe can be laid in a 6-inch trench, whereas, an asbestos cement pipe will require from 18 to 25 inches.

Joining the ends of plastic pipe has been improved and simplified.

P.V.C. pipe can be joined by insert fittings, by flarring, by solvent cementing, by threading, by mechanical joints, by a combination of cemented adaptors and overshot steel flanges and by bell-end couplings. A good advantage of mechanical joints or joints with a rubber seal is that after installation the line can be immediately tested and placed into service. For water wells, threaded or solvent cemented joints are to be preferred.

For service lines and connections, a P.V.C saddle and a self drilling P V.C. corporation stop is one of the easiest solutions.

Lower Coefficient of Friction.

The relatively high value of "C" (150 for plastic pipe versus 120 for galvanized iron) for the Hazen-Williams formula used in calculating the flow of various types of pipes indicates the advantage in using plastic pipe because of its lower coefficient of friction. Because of its nonscaling, hydrophobic surface and resistance to corrosion and tuberculation, plastic pipe maintains its high "C" whereas the "C" of some of the other materials is reduced in time as evidenced by the very appreciable reduction between new and old unlined steel pipe.

Resistance to Corrosion.

This characteristic is important both on the inside and outside of plastic pipe. Its resistance to corrosive soils is of great value in many areas where the soil is aggressive. Long range burial tests have shown practically no effect on the plastic pipe. Experiments carried out to determine the susceptibility of plastic pipe to bacterial growth have shown that the number of bacteria adhering to the internal surfaces of plastic pipe is no greater than that adhering to other pipe. In fact disinfection experiments with very high doses of chlorine showed that plastic pipe could be disinfected comparatively better than old and new steel or A.C. pipe.

Good Chemical Resistance.

PVC has outstanding resistance to a wide range of chemical reagents in temperatures up to 140°F. Normally P.V.C. pipe is resistant to all chemicals found or used in homes but for industrial applications a special study should be made of the short and long-term effects of the fluid being transported. PVC pipe is being used with outstanding savings in cost and maintenance time in water treatment plants for alum solution lines, sodium silicoflouride lines, prechlorination and postchlorination lines, and to carry carbon dioxide and highly corrosive carbon slurry.

Local Production of Plastic Pipe.

The principal potential advantage of use of plastic pipe is favourable costs. In developing countries, costs have two significant components: local currency and foreign exchange. Local manufacteur of plastic pipe is relatively easily and inexpensively established, in comparison to other forms of pipe. POLVA SURINAM is a good example.

Large Diameter (12" nominal) P.V.C. for well casings.

The problem of corrosion of steel casting inserted in production wells located in certain areas in Surinam, is acute. So much so, that the life of such boreholes, i.e. the time taken for corrosion to eat through the steel casting, is as low as 5 years.

Although PVC was introduced for small diameter (3" — 4") production and observation wells in 1968 with depths ranging from 80 — 130 m. But due to several incertion facts in the performance of PVC casting, U.N. and local staff, at their numerous meetings and discussions on the subject, viewed with favour the possibility of using larger diameter PVC pipe. Consequently ,arrangements were made to drill a test well, in a proposed well field for Paramaribo at RIJSDIKWEG, designated TW 14/72 specifically for the UN Drilling Superintendant to demonstrate for the first time in Surinam, the use of large diameter PVC pipe to case a production well. A well of shallow depth was choosen in the first instance, but it was intended to use PVC pipes for wells of 90 m depth and greater.

Accessories.

The PVC pipes had preformed sockets on one end; the other end being plain. Apart from cleaning and jointing fluid (plastic cement) to secure a joint between two pipes, there were no accessories or fittings supplied by the manufacturing company suitable for water-well work.

Therefore the following items were fabricated locally:

a. Re-inforcing for the bottom of the string of PVC pipes to form a shoe.

b. Centralizers around the bottom near the shoe.

c. A pressure head to fit in the top of the string of PVC.

d. Lugs around the top but lower down than the pressure head.

e. A cement plug.

Pipe specification:

"Chemidus 3000" according to British Standard No. 3505 : 1968.

Nominal size	O.D.	Wall thickness	Class
12"	12.732"	0.453"	C 300 ft Head.

Details.

a. It was considered necessary to re-inforce the bottom of the string of pipe to form a shoe in order tc maintain a true circular orifice, particularly in view of the differential pressures which are exerted on the wall of the pipe during the cementing process. Also to distribute more evenly round the circumference of the pipe any pressure imposed by the centralizers due to the string of pipe bearing heavily to one side of the borehole. Fig. I.

b. Centralizers were attached to the outside of the shoe piece to keep the bottom of the string of pipe in the centre of the borehole, thus ensuring an even distribution of cement slurry round about the shoe.

c. In order to circulate mud through the annular space when the string of pipe was positioned, also to place the cement slurry at the appropriate time, a pressure heau was designed and fabricated. The body was of hard wood, with a 2" pipe running through the centre. Rubber insertion was wrapped round the outside of the body of the pressure head for ease of withdrawing and re-positioning in the top of the PVC pipe. A rubber seal ring was attached to the bottom edge or the body to prevent fluid escaping by back-pressure.

A steel plate with angle-iron extensions was attached to the top of the pressure head to facilitate handling and for securing the pressure head to clamps to casing maintain its position while pumping. The 2" pipe through the centre carried a spreader on the of lower end for distributing the cement slurry on the lower end, and supported with pipe fittings and a valve on the upper end. Fig. II.

d. Lugs were attached to the upper end of the string of pipe but clear of the area occupied by the pressure head. The purpose of the lugs was to keep the casing clamps in position, thereby forming an anchor to which the angle iron extentions of the pressure head could be secured.

e. As is normal procedure in cementing the annulus, a plug was used to separate the cement slurry from the following fluid. In this case, the plug was constructed of plywood, 6mm thick with a rubber diaphram on top. In order to make the plug more easily drillable when the cleaning out process commenced, numerous holes of 1" diameter were cut out of the plywood.

Site Preparation and Layout.

The site was prepared in the normal manner, using a one metre diameter concrete pipe which is usual for the cellar. The orifice in the concrete base of the celler was enlarged a little so as to take the 18 ins. O.D. surface casing.

A truck mounted Failing rotary rig model 1250 Combination, although not entirely suitable for this type of work was used for this job. This rig was set up on sub-base and base sections as is regular practice.

An 8⅝" O.D. steel conductor box was cemented in the bottom of the cellar; steel channel was arranged from the top of the conductor box to the mud pits for mud circulation.

The Borehole TW 14/72 *Rijsdijkweg.*

Regular bentonite mud was prepared to complete the circulation from conductor box to the suction pit via the settling pit.

Spudding in was with a 5⅞" diameter wing bit. Drilling progressed cautiously to 32m, taking formation samples continously and labelling them every one metre of depth until the top of the sand proper was established, (the water bearing horizon). An electric log was run using the gamma ray only. Formation samples and the log correlated which indicated that there should be a positive shutoff with casing from ground level to approx. 32 m depth.

The 8⅝" conductor box was removed; the top part of the borehole reamed; 3 metres of 18" O.D. steel casing was squeezed in to shut off the sand and sandy clay in the top 2 metres of the borehole and an 18" conductor box connected to the casing. Reaming was carried out to 32 m BCL, first with an 11½" diameter 3 wing bit and finally with a 16½" diameter pilot bit.

Casing Insertion.

As previously prepared and described, the 12" nominal bore PVC pipes were run in the borehole; the shoe piece first with centralizers on the outside, followed by plain pipes and lastly the special top piece. The pipes were run male end upwards and hoisted by means of a rope sling attached to steel clamps, tightened to the pipes. The joint of each pipe was made with cleaning fluid followed by tha application of plastic cement. As an additional safeguard to permit the pipes to be run in the hole immediately a joint was made, stainless steel self-tapping screws were inserted into the joint (three screws spaced equidistant but at different horizontal lines round the circumference of the joint). Fig.I.

The annulus was circulated with mud by attaching the pressure head in the top of the pipe and the string of pipe surged from approx. 23m to the final depth of 31.27m BCL. This was to ensure that the annulus was open and free enough to accept the cement slurry round the full circumference of the pipe. With the string of pipe in position, the piece supported on clamps at collar level and the annulus being circulated with mud, a drill collar weighing approx. ¾ ton was stood on the steel plate on top of the pressure head.

Cementing.

Seventeen bags of Portland cement was mixed into 400 litres of fresh water in a tank, giving 620 litres of cement slurry at 1.80 S.G. This mixture was immediately pumped into the string of pipe through the pressure head. After this, the drill collar was lifted, the pressure) head removed, a cement plug inserted on top of the cement slurry in the string of pipe,, the pressure head re-inserted and the drill collar re-posi tioned on top of the pressure head. 2000 litres of following fluid in this case it was water was pumped into the string of pipe sending the cement plug towards the bottom of the string of pipe; the cement slurry then having displaced the mud in the lower half of the annulus and a little remaining in the bottom of the pipe. Immediately the pumping of the measured amount of following fluid was completed, the 2" valve on top of the pressure head was closed. The cementing operation was then completed.

After the borehole had been closed-in for 20 hours, the plug and cement in the bottom of the PVC pipe was drilled out, using rock roller bits; first with a 7 7/8" diameter, then with an 11 3/8" diameter. The cement had set but was not hard. This condition was considered ideal, because the bottom section of the pipe was not subjected to harsh vibration or hard blows from the bit, as would have been the case had the cement been drilled out when it was hardened. A further 48 hours was given for the cement in the annulus to harden.

During this period, the 18" conductor box and 3m piece of 18" casing were pulled out of the top of the borehole. The top of the PVC pipe was lined up vertically, the annulus infilled with gravel to within 2m of the bottom of the cellar, then concreted to cellar floor level.

Completion of Well.

The cement contaminated mud in the borehole was displaced with fresh bentonite mud. Then a 5⅞" diameter wing bit was centered in the bottom of the borehole and a pilot hole drilled through the water bearing sand, to an underliyng clay band at 52m BCL, taking continuous formation samples as before. The section of hole from 32 to 52m was electric logged (single point resistivity, self-potential and gamma ray) and correlated with the samples. On the basis of data thus obtained, a screen string was designed, using 3 Johnson stainless steel screens 15 ft. long x 6 ins. I.D., 40 slot, interspaced with 6 ins. I.D. plain s/s pipe, a plastic reducer with rubber packing ring, 6 ins. I.D. sump and washdown bottom (non-return valve) ; in all a total of 24.16 m. 79.25' Fig.I.

The pilot hole was reamed out with a 9⅞" diameter bit and the screen string positioned in the borehole using the string of drill pipes with a left hand threaded back-off joint attached to the top of the wash-down bottom. The screen section was jetted and the borehole developed using the jetting and circulating tool. The same operation had been repeated in a proposed well-field for La Vigilantia and Smalkalden, T.W. 32/72, using the two plug-method for grouting the annulus, with almost the same results but a couple minutes longer, to drill-out the second plug. So far the deepest insertion of P.V.C. casing (3") is in borehole T.W. 25/72 with a total depth of 187 meter (613.36').

Some Recommendations

1. Use only standardized and approved P.V.C. pipes, fittings and solvent cement.
2. Cut pipe square, using a hand saw and miter box, a mechanical cut off saw, or a plastic pipe cutter which does not raise a burr on the end of the pipe.
3. Don't use a standard wheel cutter. It will raise a flare on the end of the pipe. The flare will scrape the cement from the joint and create a leak.
4. Remove all burrs from the end of the pipe with a file or knife. If all the burrs are not removed they may scrape lines in the cement and create leaks.
5. Clean and dry the pipe and fitting socket of all dirt, moisture, and grease. Use a clean dry rag.
6. Use only PVC cement for PVC products. Unapproved or unkown brands of cement may contain substances that can damage the pipe & fittings.
7. Don't use thinner to dilute the solvent cement. Discard the cement if it thickens very much in the can. Keeping the cement can closed as much as possible while working will help to prevent thickening.

8. Dry fit the pipe into the fitting socket. It should enter at least 1/3 of the socket.

9. First coat the inside of the fitting socket, then coat the outside of the pipe. Flow the cement on with a full brush. Assemble the parts immediately with a quarter turn to spread the cement evenly.

10. Use only approved thread tape or thread lubricant specifically intended for making up threaded joints.

11. Don't use convential pipe thread compounds, putty, linseed oil base products or unknown mixtures. They can cause cracking of the parts.

12. Threaded connections should be made up one turn past hand tight, using a strap wrench. Overtightening may damage the parts.

13. Don't pull or force pipe into line when assembling. This stresses both pipe and fittings and can lead to future trouble.

14. Allow for thermal expansion in all installations by allowing freedom for the pipe to move with temperature changes. Leave the pipe free to move longitudinally at changes in directions and on long straight runs, but support it at four foot maximum intervals.

15. Use threaded transition fittings when connecting to copper systems.

16. Don't lay or backfill a P.V.C. pipe on sharp objects such as stones and rocks.

17. Always thrust blocking the pipe at points where the line changes direction, e.g. tees, elbows, wyes, caps, valves and hydrants. The trust blocks must have adequate bearing surface.

18. Don't lay P.V.C. pipe near root of trees.

FORMULA FOR WALL THICKNESS IN METRIC UNITS:

$$S \frac{P \, x D}{2G}$$

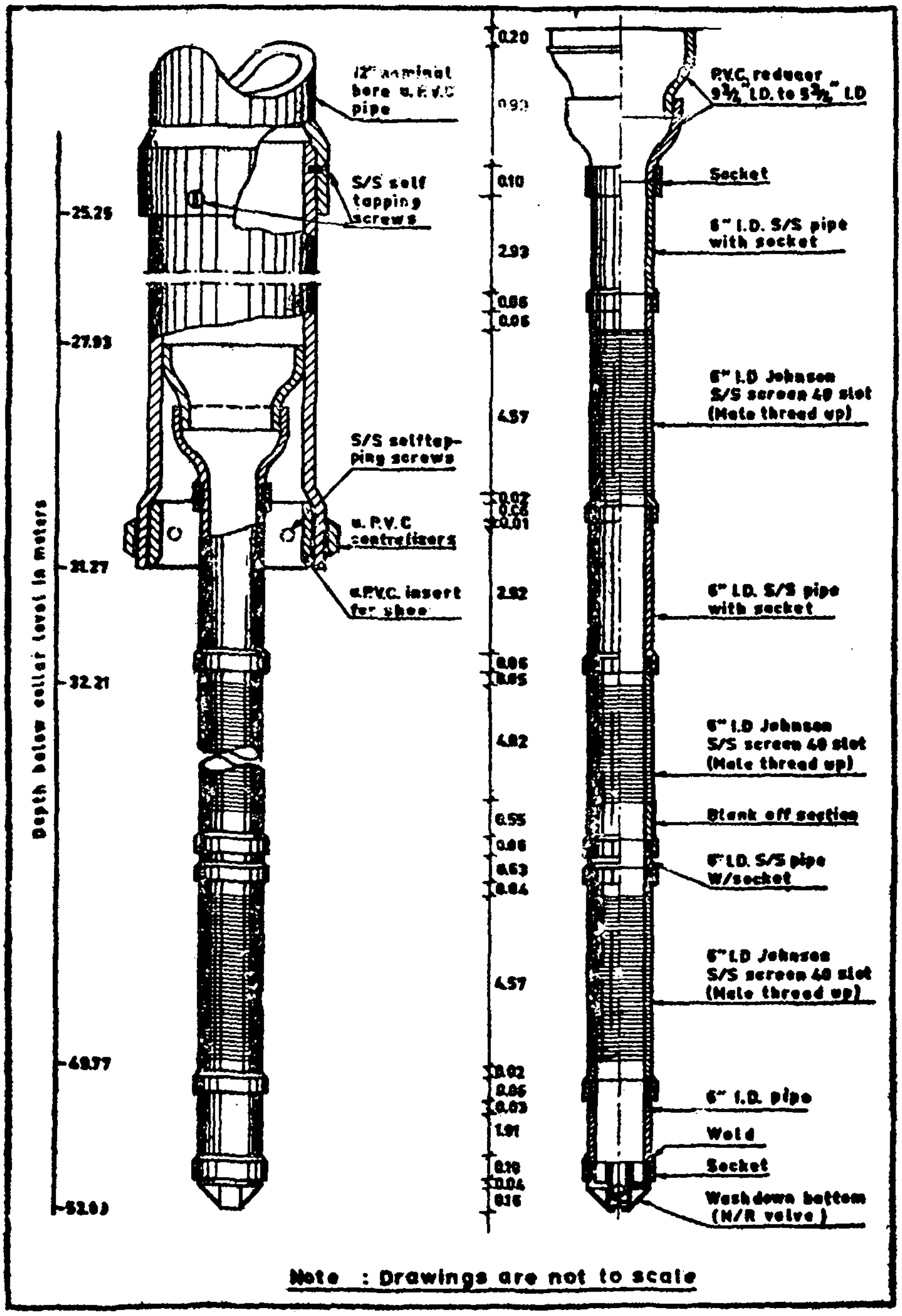
Where:

S — Wall thickness in c.m.

D — Outer diameter in c.m.

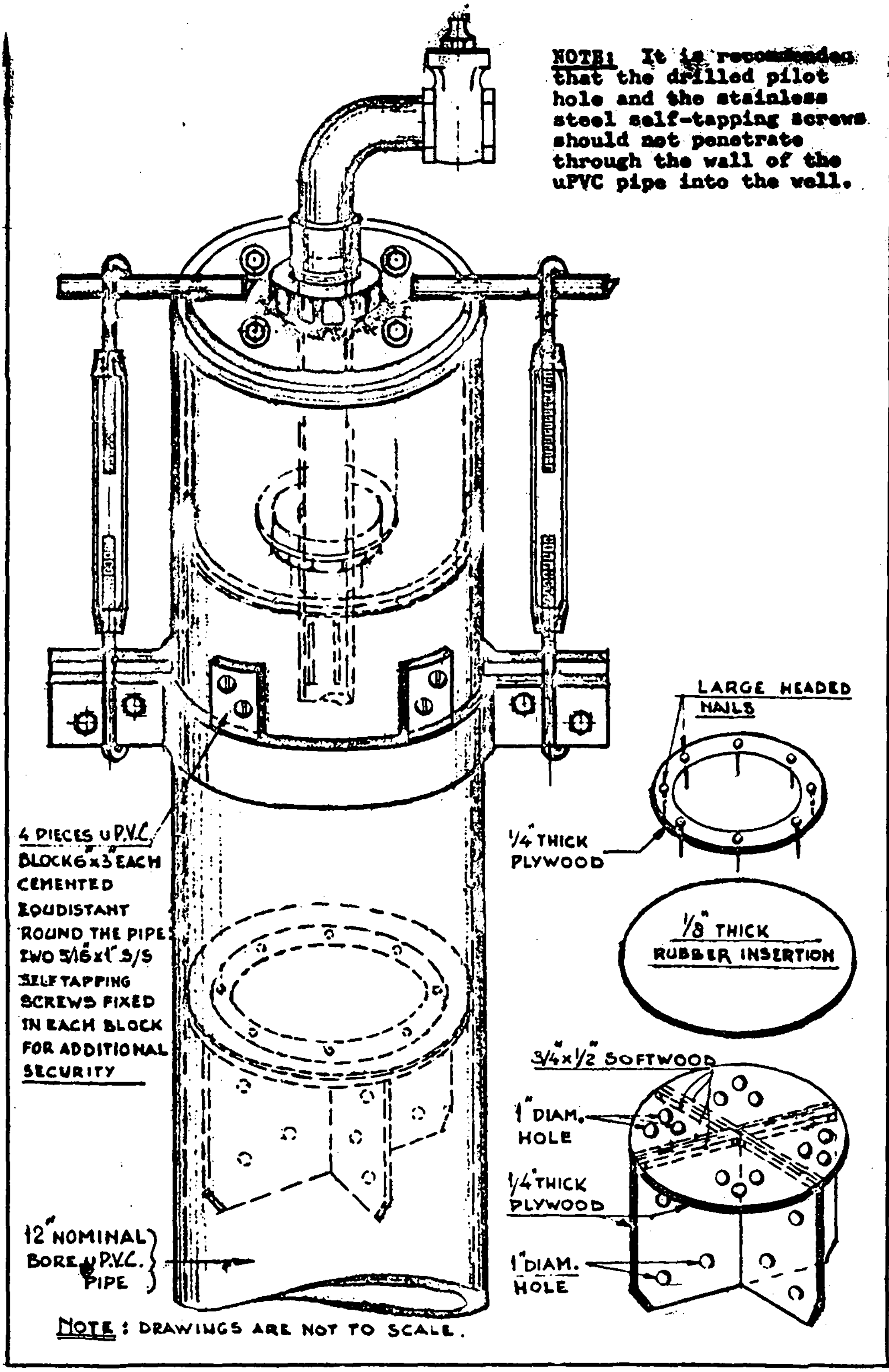
P — Internal pressure in kg/cm2

G — Compressive strenght in kg/ cm2

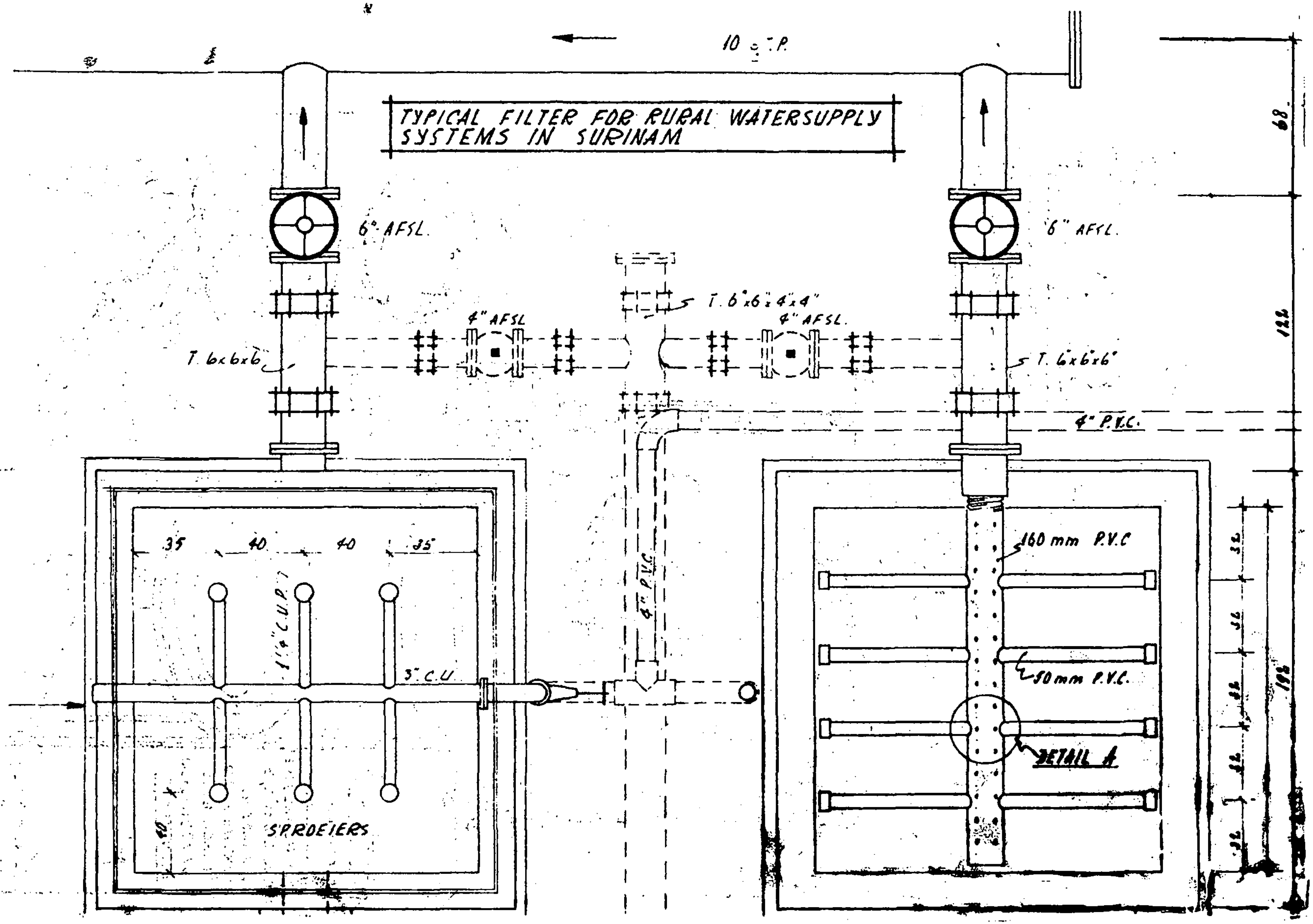


Construction details of Well 14/72, Rijsdijk

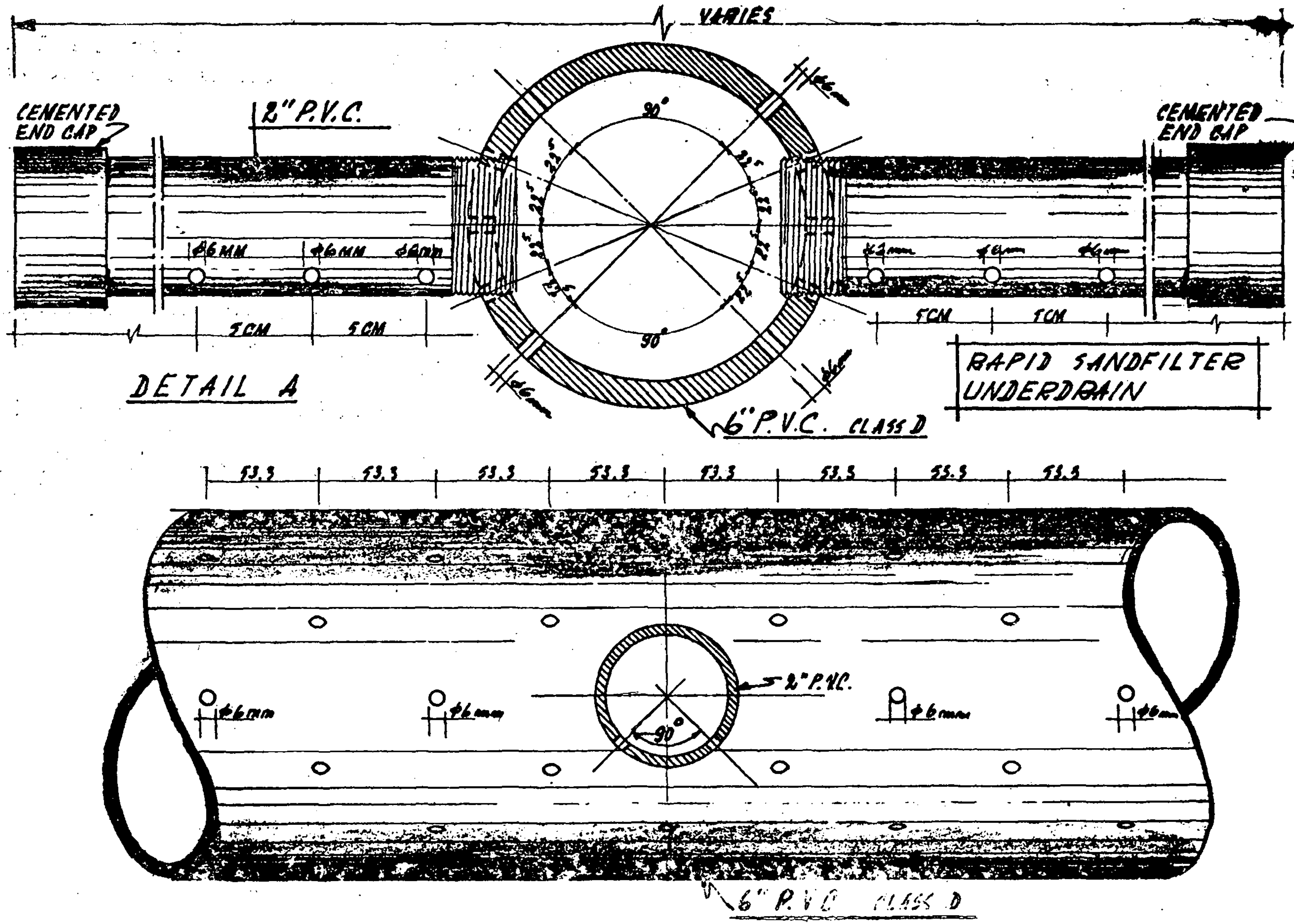
NOTE: It is recommended that the drilled pilot hole and the stainless steel self-tapping screws should not penetrate through the wall of the uPVC pipe into the well.



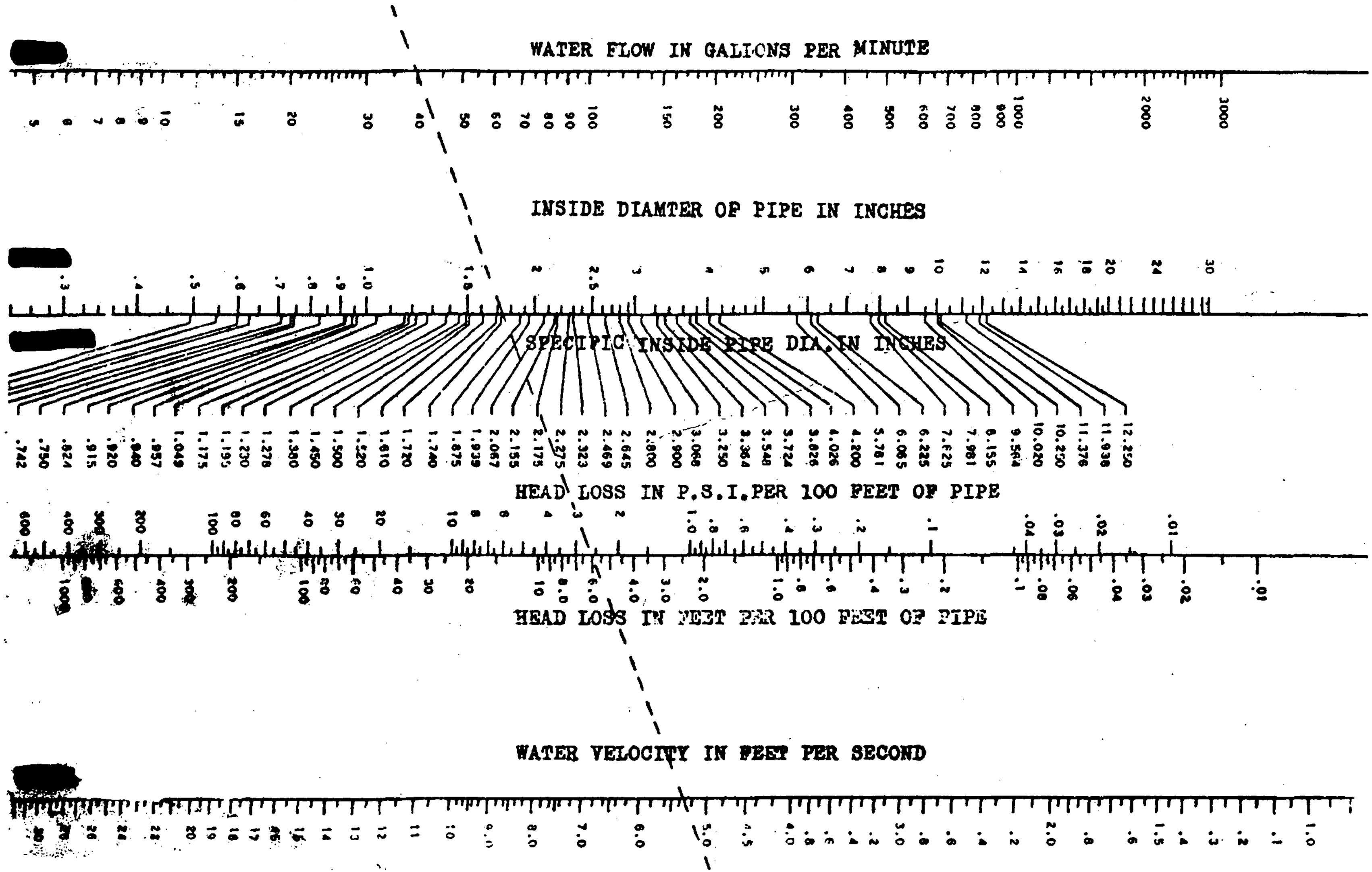
NOTE: DRAWINGS ARE NOT TO SCALE.



TYPICAL FILTER FOR RURAL WATERSUPPLY SYSTEMS IN SURINAM
6" AFSL.
6" AFSL.
T. 6"x6"x4"x4"
4" AFSL
4" AFSL.
T. 6x6x6
T. 6"x6"x6"
4" P.V.C.
68
122
35
40
40
35
1 1/4" C.U.P.
3" C.U
4" P.V.C
160 mm P.V.C
50 mm P.V.C.
DETAIL A
SPROEIERS
40


VARIES
CEMENTED END CAP
2" P.V.C.
CEMENTED END CAP
90°
90°
5CM
5CM
5CM
5CM
DETAIL A
6" P.V.C. CLASS D
RAPID SANDFILTER UNDERDRAIN
53.3
2" P.V.C.
90°
6" P.V.C. CLASS D

[redacted] LOSS C[redacted]RACTERISTICS OF WATER FLOW THROUGH RIGID PLASTIC PIPE



ENGINEERING INFORMATION

Definitions of Common Expressions Used in Describing Properties of Plastic Materials:

Compressive Strength is the crushing load at failure applied to a specimen per unit area of the resistance surface of the specimen.

Density is the weight of a substance per unit volume.

Dielectric Constant is the ratio between the capacity of a condenser with a given dielectric and the same capacity with a vacuum as a dialectric.

Dielectric Strength is the voltage that will rupture or puncture the material in question when placed between electrodes of a given size.

Flammability is the time a specimen will support a flame after having been exposed to a flame for a given period.

Flexural Strength is the force a specimen will withstand when loaded at its centre and supported at its ends.

Graves Tear Strength is the force required to rupture a specimen by pulling a prepared notched sample.

Hardness is the resistance to indentation of the specimen surface by a penetrator applied to the surface for a given time.

Heat Distortion is the temperature at which a specimen will deflect a given distance at a given load.

Izod Impact Strength is the resistance a prepared specimen has to a sharp blow from a pendulum hammer.

Light Transmission is the degree to which a specimen will permit light to pass through it

Modulus of Elasticity is the ratio of the stress per square inch to the elongation per inch due to this stress.

Moisture Absorption is the percentage of water absorbed by a specimen immersed in water for a given time.

Specific Gravity is the ratio of the density (weight per unit volume) of a material to the density of water at the same conditions.

Specific Heat is the ratio of the heat capacity of a body to the heat capacity of an equal weight of water.

Tensile Strength is the pulling force necessary to break a specimen divided by the cross-sectional area at the point of failure.

Thermal Conductivity is the time rate of transferring heat by conduction through a material of a given thickness and area for a given temperature difference.

Equivalents and Conversion Factors:

Temperature:

Centegrade (°C) to Fahrenheit (°F)

9/5 x °C : 32 °F

(°F-32) x 5/9 °C

Length:

1 inch — 2.54 centimeters

1 rod — 16.5 feet

1 meter — 3.28 feet — 39.37 inches

1 mile — 5280 feet — 1.61 kilometers

Area:

1 sq. inch — 6.452 sq. centimeters   1 sq. foot — 144 sq. inches
1 acre — 43.560 sq. ft.

Volume:

1 U.S. Gal. — 231 cu. in. — 0.137 cu. ft. — 3.785 litres — .00379 cu. meters 0.833 imp. gal. — .0238 barrel (42 gal. bl.)
1 cu. ft. — 1728 cu. in. — 7.48 U.S. gal. — 0.0283 cu. meter
1 barrel (oil) — 42 U.S. gal.
1 litre — 0.2642 U.S. gal.
1 acre foot (i.e., 1 acre filled with 1 ft. water)—43,560 cu. ft.—325,829 U.S. gal.
1 acre inch (i.e., 1 acre filled with 1 in. water)—3,630 cu. ft—27,100 U.S. gal.

Capacity:

1 cu. ft. per second — 449 Gal. per min.
1 acre ft. per day — 227 Gal. per min.
1 acre inch per hour — 454 Gal. per min.

Pressure (Head)

1 pound per sq inch (p.s.i.) — 2.31 ft. head of water — 2.04 in. mercury 0.07 kg. per sq. cm.
1 ft of water — 0.433 lb. per sq. in. — .885 in. mercury
1 atmosphere (at sea level) — 14.7 p.s.i. — 34.0ft. water — 10.35 meters of water 30 in. mercury — 769 mm mercury

Weight:

1 cu. ft. water — 62.35 lbs.
1 U.S. gal. water — 8.33 lbs.
1 imperial gal. — 10.0 lbs.
1 kilogram — 1 litre water — 2.2 lbs.
1 lb. — 454 g.

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PERFORMANCE OF TRICKLING FILTERS IN A TROPICAL COUNTRY

by

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Presented at the Fifth Annual Caribbean Water Engineers, Conference, Dominica.
July 9, 1974.

PERFORMANCE OF TRICKLING FILTERS IN A TROPICAL COUNTRY

INTRODUCTION

The Sewage Treatment Plant is located in Montego Bay, a resort town on the North Coast of Jamaica, where the mean monthly temperature varies between 87°F 67°F. Construction of the plant together with the sewers and five pumping stations commenced in 1965.

On the night of December 15, 1968 starting at about midnight, seven hotels were connected to the system and at 9.30 a.m. on the 16th, sewage entered the treatment plant for the first time. By the 21st, with a total of nine hotels connected, daily flows ranged between 100,000 and 150,000 gallons.

In March 1974 with 58 connections the daily flows varied between 234,000 and 510,000 gallons. The premises served include 21 Hotels, an International Airport and a 400 bed Hospital which was connected toward the end of March 1974 with 200 beds occupied.

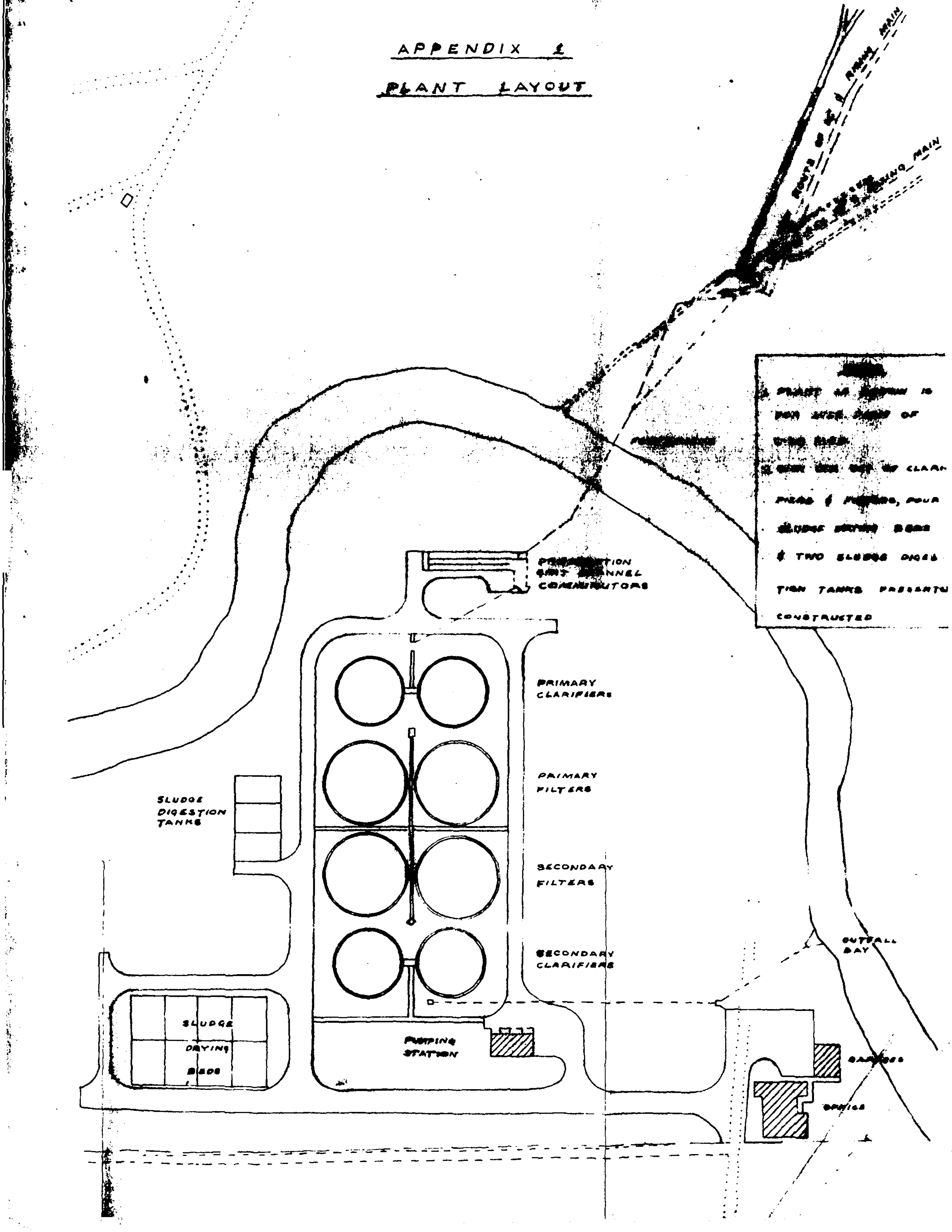
DESCRIPTION OF PLANT

The plant is a two-stage high-rate Trickling-Filter (see layout at Appendix I). The main components are as follows:—

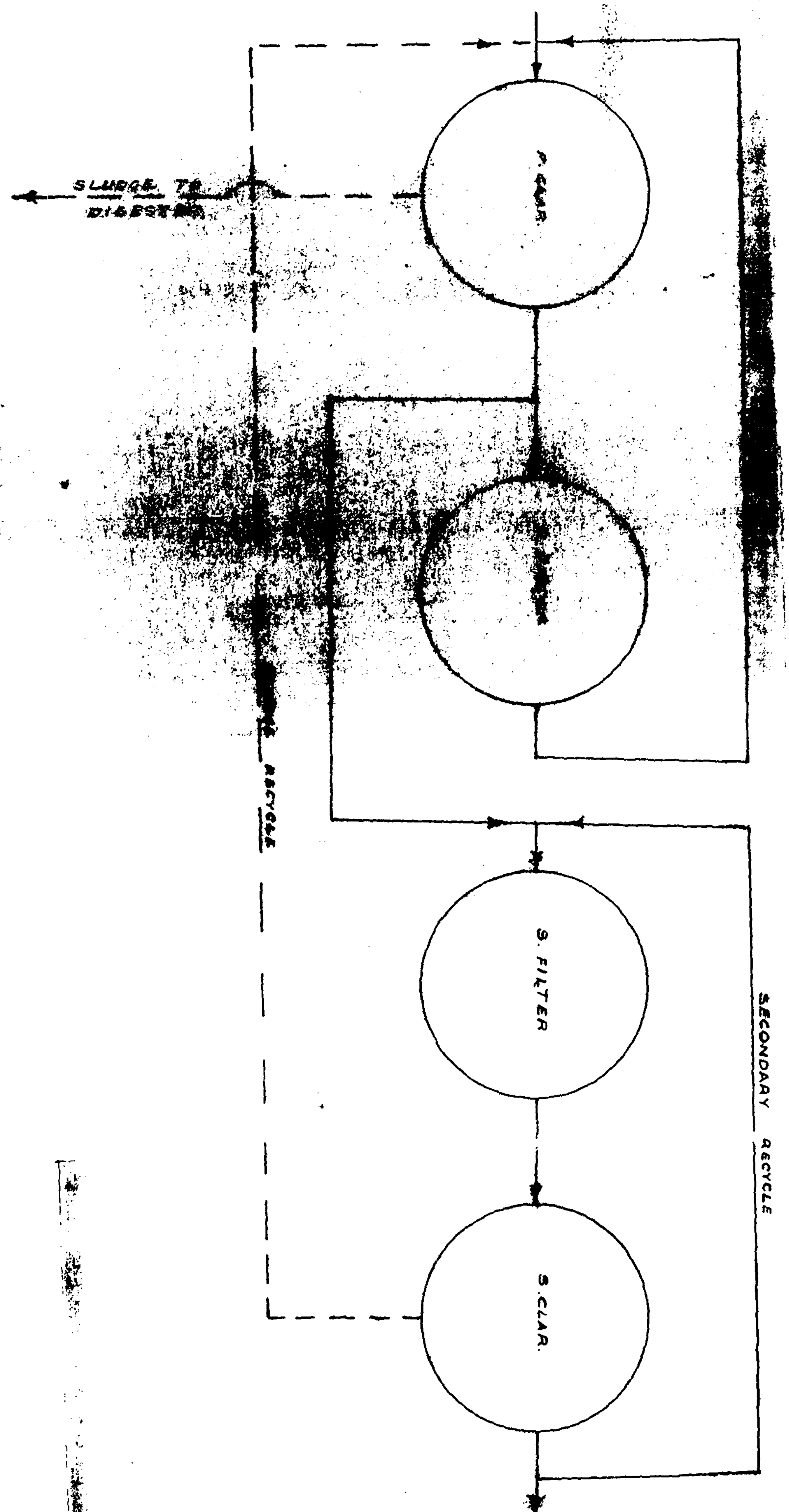
1. *Pre-aeration Channel*		
Capacity:		5,600 gallons
Detention Time		10 mins
2. *Grit Channel* (2 No.)		
Velocity		1.5 f. p. s
3. *Comminutor* (2 No.)		
Max. capacity		2.54 m. g. d. each
4. *Primary Clarifier*		
Dimensions		60' dia. x 8'
Overflow Rate.		
	Max.	705 g. p. d. /ft^2
	Average	406 " "
Detention Time:		
	Min.	1.87 hours
	Average	3.27"
5. *Primary Filter*		
Dimensions :70' dia. x 5' (media depth)		
Hydraulic Load: 8.2 m.g.d. /acre		
6. *Secondary Filter*		
Dimensions: 70' dia. x 5' (media depth)		
Hydraulic Load:		
	Average	13.m.g.d/acre
	Max.	22.6 m.g.d/acre
7. *Secondary Clarifier*		
Dimensions:		60' dia. x 8'
Overflow Rate		
	Max.	705 g.p.d./ft^2
	Average	406 " "
Detention Time:		
	Min.	1.87 hours
	Average	3.27 hours

APPENDIX 1

PLANT LAYOUT



APPENDIX II — FLOW DIAGRAM



8. *Primary and Secondary Recycle Pumps* (one each)
Capacity 500 g.p.m. each

9. *Primary and Secondary Sludge Pumps* (one each)
Capacity 150 g.p.m. each

10. *Digester* (2 No.)
Capacity 18,500 cu. ft. each

11. *Sludge Drying Beds* (4 No.)
Capacity 1,200 sq. ft. each

DESCRIPTION OF THE PROCESS

(see Flow Pattern at Appendix II)

Raw sewage enters the intake works where it is pre-aerated to "freshen" it, having been pumped through five pumping stations, each with varying detention times.

The steps through the Plant are outlined as follows:—

1. From Pre-aeration it flows through a Girt Channel and Comminutor to the Primary Clarifier.
2. Part of the primary clarifier effluent goes to the Primary Filter and part to the secondary Filter.
3. The secondary filter effluent goes to the Secondary Clarifier.
4. The secondary clarifier effluent is discharged to an adjoining stream which enters the sea about mile away.
5. In addition to the basic flow pattern the following recycling takes place:—
   (*a*) All the primary filter effluent is recycled to the primary clarifier influent
   (*b*) Part of the secondary clarifier effluent is recycled to the secondary filter influent.
   (*c*) Secondary sludge is recycled to the primary clarifier influent.
6. Sludge from the primary clarifier is pumped to the Digester.
7. Digested sludge is drained to the Sludge Drying Beds.
8. Digester liquor together with that from the drying beds is returned with the primary filter effluent to the primary clarifier.

DESIGN CAPACITY

The Plant as constructed, is designed for an average flow of 0.85 m.g.d., with exception of the Filters and Clarifiers which should be duplicated when the flow reaches 0.425 m.g.d. At that time also the impellers of the Recycle Pumps will be increased from the present 500 g.p.m to 1,000 g.p.m. The Plant will then be capable of passing peak flows up to 2.55 m.g.d.

The design proposal also provides for increased capacity up to an average flow of 1.7 m.g.d. and peak flow of 5.1 m.g.d. This would be accomplished by adding additional sets of clarifiers and filters when each increment of 0.435 m.g.d. is reached, and doubling the size of the remainder of the plant as presently constructed to serve a population of 44,600.

Based on the above criterion a look at the flow data indicates that the second set of filters and clarifiers should be presently under construction.

PLANT PERFORMANCE

When the Plant was put into operation, it was the hope of the writer that samples would be taken at specific points to permit a rigorous analysis of its performance.

The view was that formulas and design loads for the various components would then be modified for applicability to countries which enjoy high temperatures throughout the year, such as Jamaica and the other countries in the Caribbean.

Unfortunately the sampling that is actually done does not permit this.

The data at Appendix III, however, does show a high level of B.O.D removal, in fact much higher than would be expected in the other countries. One example is the sample taken in May 1972 which indicated a removal of 96%.

Another unfortunate result of the method of sampling is that the percent B.O.D. removal cannot be related to increase inflows as the plant approaches its design capacity. The only relative conclusion that can be drawn from the data available is that during a particular month in which the daily flows varied, between X and Y m.g.d. samples were taken which indicated a certain B.O.D. removal. Because of this deficiency, the quality of the plant's performance can be questioned by the sceptics.

DEFICIENCIES IN PLANT DESIGN

Because of the flow pattern, the plant does not operate strictly as a two-stage plant. This is so because the flow to the primary filter is fixed at 0.72 m.g.d., and flows in excess of this quantity enter the secondary filter. The result is that several times during the day the quality of the plant effiuent is lowered. Since the performance data given are based on grab rather than composite samples, it follows that some of the results which indicate B. O. D removals of 90% or less could be from samples taken when the flow exceeded 0.72 m.g.d.

Another problem also is that the capacity of the plant could be increased without providing additional filters and clarifiers, however this cannot be accomplished because of hydraulic limitations in terms of available head.

POWER CONSUMPTION

The installed horse power for all units is 54. A typical package plant of the Contract-Stabilization type for the same capacity has installed horsepower of 70 for the Blower alone. Since the blower opreates continously, this amounts to monthly power consumption of over 37,000 Kwh/compared to the maximum of 20,000 Kwh consumed by the Trickling Filter Plant under discussion. It must be borne in mind also that the Montego Bay Plant with the same installed horsepower is capable of treating an average flow of twice the present flows.

It may be argued that there are other types of aeration equipment than blowers The fact is however, that blowers are used, particularly in package plants.

DIGESTER

The digesters installed at present are two in number. The proposal is that if the plant is expanded as originally conceived, when the flow approchaes 1.7 m.g.d. a third w,ll be added.

They are the anaerobic type and are uncovered. In the colder climates not only would the anaerobic digesters be covered but they would have to be heated.

The only records of digester performance that are kept, are temperature and ph, and these are given at Appendix II. It may seem suspicious that for every month except one, the figures are identical. The writer was not able to determine whether they are correct-certainly a temperature of 86 °F in January 1974 as against 78 °F in August 1973 does seem odd.

In spite of this apparent contradiction however, the digester produces a very stable sludge and is odour free. The only operational functions involving digester are sludge withdrawal to the Drying Beds and an occasional recycling of sludge within the tank presently in use.

SUMMARY

In spite of the deficiency in data collection which prevents a rigorous analysis, the case has been clearly established at the Montego Bay Plant for Trickling Filters, in preference to Aeration for the treatment of domestic sewage in the tropics.

Capital cost of course is higher than comparable aeration plants, however this is far outweighed when power requirements, trouble-free operation and simplicity of operation are considered.

The following quotes are taken from SEWAGE TREATMENT PLANT DESIGN pubished by the Water Pollution Control Federation of the United States of America,

> "Trickling filters are applicable for secondary treatment of domestic sewage and mixtures of domestic and industrial wastes which are susceptible to aerobic biological processes. They are capable of providing adequate treatment of such wastes where the production of a plant effluent of 20 to 30 milligrams per litre of B.O.D. is acceptable, or where partial treatment is applicable. Proberly no other biological treatment process is so versatile in its applications and so dependable in its performance". A further quote from the same source, They have the ability to recover from shock loads and to provide good performance with a minimum of skilled technical supervision".

In North America, because of higher pollution control standards introduced in recent years, and due to the limitation that climatic conditions place on its performance, the trickling filter is becoming unacceptable. At the Montego Bay Trickling Filter Plant, effluent B.O.D. of less than 20 mg/l and BOD removal of greater than 90% are constantly produced.

It is the writer's opinion that contrary to current North American trend, in the Caribbean trickling filters are "the way to go".

NOTE: All flows given in Imperial Gallons.

APPENDIX III

PLANT PERFORMANCE DATA

(Based on Grab Samples)

Date	*Daily Flows (m. g. d)*			*B. O. D. (mg/1)*		*Suspended Sol. (mg/1)*		*Digester*	
	Max.	*Min.*	*Aver.*	*Infl. (max)*	*Effl. (Max.)*	*Infl.*	*Effl.*	*Tem. of*	*ph*
Dec. '71	0.37	0.20	0.26	142	3.8	84	3	78	7.4
Jan. '72	0.32	0.32	0.28	180	5.3	81	3	—	—
Feb.	0.37	0.32	0.32	121	3.9	152	5	78	7.4
May	0.40	0.25	0.30	92	3.6	92	—	78	7.4
June	0.30	0.20	0.26	144	5.0	152	—	78	7.4
August	0.32	0.22	0.28	166	2.4	176	7	78	7.4
Sept.	0.30	0.17	0.23	88	1.7	108	12	78	7.4
Oct.	0.52	0.15	0.25	134	5.8	90	7	78	7.4
Jan. '73	0.30	0.20	0.24	155	5.7	204	3	78	7.4
March	0.34	0.20	0.28	126	7.8	108	10	78	7.4
May	0.35	0.20	0.27	138	10.0	138	2	78	7.4
June	0.39	0.13	0.28	145	21.0	246	12	78	7.4
August	0.80	0.23	0.42	111	8.0	93	19	78	7.4
Jan. '74	0.51	0.23	0.34	264	30.0	180	31	86	7.4

BANK FINANCING

OF

WATER SUPPLY AND SEWERAGE PROJECTS

by

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Roseau, Dominica
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BANK FINANCING OF WATER SUPPLY AND SEWERAGE PROJECTS*

Introduction

The International Bank for Reconstruction and Development (the World Bank) has now completed nearly 28 years of activity. During that time it has made loans for reconstruction, electric power, transportation, communications, agriculture industry, development finance companies, general development and industrial imports, water supply and sewerage systems, education, population, tourism, urban development, project preparation, and technical assistance.

Its first loan for water supply was made in 1961 for the Taipei water system. Since then in Latin America and the Caribbean region alone 14 loans and credits for water supply and sewerage have been made. These amount to US $354 million for projects totalling US $767 million.

Water Supply and Sewerage Projects Identification

These projects are identified or originate in several ways. A member country may propose a project to the Bank; a Bank mission supervising an earlier project may suggest a new one that flows naturally from an earlier one; the Bank may send out a mission specifically to identify suitable projects; Bank resident representatives or resident mission may identify projects; and projects may be identified through other United Nations agencies such as UNDP and WHO/PAHO working in the sector.

Because basic knowledge of this sector of the country's economy is important for the identification of projects and the determination of investment priorities, the Bank has been carrying out a joint programme of sector surveys with WHO in several countries.

Loan Application

There is no formal "application form" for a Bank loan or an IDA credit. Loan proposals usually arise from discussions between the Bank and the prospective borrower. A country might request Bank help in financing a much needed water supply system. After discussions in the field by loan officers and engineers with officials from the country concerned, provisonal plans for the project — if it were found to be useful would be agreed upon. If a feasibility study were not available, the Bank would recommend to the potential borrower that private engineers and consultants be hired to prepare plans, cost estimates, and a financial analysis of the proposed project. After the preparatory work is completed, the Bank makes a thorough on-site appraisal of all aspects of the project with the borrower.

Appraisal

The appraisal of the project is carried out by a team from the Bank: engineer, economist, and financial analyst. Occasionally, when highly specialised knowledge is required, such as for the analysis of hydrogeological data or tunnel design, consultants may form part of the team.

The appraisal of the project usually involves the investigation of six different aspects: economic, technical, organizational, managerial, operational, and financial. The relative importance of the different aspects vary according to the type of the project.

1* These are the views of a member of the Bank's staff but do not necessarily reflect Bank policy.

1. *Economic*

The economic aspect is fundamental since the Bank will not finance a project unless it can be demonstrated that the project represents a high-priority use of the country's resources. An economic or social analysis looks at the project from the viewpoint of the whole economy, asking whether the latter will show benefits sufficiently greater than project costs to justify investment in it.

In the large majority of cases it is possible to quantify project costs and benefits and to construct a rate of return. Streams of future costs and benefits are calculated, using either market or shadow prices as appropriate. These cost and benefit streams are discounted to arrive at the project's estimated rate of return; the latter is then compared with the minimum earning power of capital judged appropriate for each country.

2. *Technical*

The appraisal of the technical aspects involves the investigation of the detailed engineering and other plans for its construction, implementation, and operation. The main items coming under this heading include the proposed scale of the project, the source of water and equipment to be used, the location of the project, its layout and design, environmental consequences, and the availability of labour, power, and materials. The technical staff available to the borrower for carrying out and operating the project is evaluated and a judgement is reached whether outside help is needed.

When the Bank considers that the assistance of consulting engineers or other experts is needed by those responsible for the project, the Bank often assists the borrower to prepare detailed terms of reference. The choice of consultant is made by the borrower, but the Bank satisfies itself that the consultant chosen is suitably qualified to perform the work. The selection should be made on this basis and not on price. If the chosen consulting firm is owned by or associated with a contractor or manufacturer, the firm is required to limit its role on the project to providing consulting services and disqualify itself and its associates from construction work or supply of equipment.

The investigation of the assumptions on which the cost estimates have been calculated is an important party of the appraisal. This includes a detailed review of cost estimates and contingency allowances and the proposed arrangements for buying materials and contracting construction work. The Bank is concerned that the borrower shall obtain the best value for the money spent and normally requires international competitive bidding.

3. *Institutional, Managerial and Organizational*

During appraisal, the suitability of the organization and the adequacy and competence of the management are examined. If one or the other is found wanting, remedial steps are recommended to the government and may be conditions for the Bank's assistance. These measures could include short-term remedies such as the recruitment of individuals to assist in running the organization at least during the initial phase, or long term remedies such as a management study, a reorganization, or the creation of a new autonomous agency to run the project. The need for training local staff to fill positions at all levels is examined and training programmes may well be included as part of the project. The objective of this aspcet of the appraisal is to make sure the project is adequately carried out and that a locally-staffed institution capable of contributing effectively to the development of the sector in question is created.

4. *Procurement*

As previously mentioned, borrowers are generally required to obtain goods and services financed by the Bank by means of international competitive bidding on the part of suppliers. These suppliers may be located in any of the Bank's member countries, or in Switzerland (which, though not a member, has opened its capital market to the sale of Bank bonds and notes).

In some cases, to ensure that maximum benefit is obtained from this system of procurement, borrowers are requested to employ qualified consultants to assist in preparing the specifications, determining the qualifications of the bidders and the analysis of the bids where, in addition to the price, such considerations as delivery dates, quality and performance must be taken into consideration.

The Bank may, in suitable cases, permit a margin of preference for domestic manufacturers of goods when comparing domestic bids with those of foreign manufacturers. When a preference is agreed upon, bidding documents should refer to it and specify the manner in which it will be applied. In the cases of construction work no such margin is allowed. In all cases where protection is allowed, the degree of protection to be taken into account in comparing bids from domestic and foreign suppliers is agreed before bidding arrangements for a project are approved.

Circumstances sometimes arise where although the goods are to be imported, international competition may not be appropriate. This may be because of the desirability of matching existing equipment to avoid complications and expense in maintenance and spare parts, experience with certain types of equipment, and the availability of dealer's maintenance and service facilities for certain types of equipment. There might be also the exceptional cases in which the equipment required may be available in one market only.

The Bank satisfies itself that requests for exemption from international competition are justified, that the equipment to be purchased is suitable for the project, and the terms of the purchase are reasonable. Bidding procedures and the recommendation for the award of the bid are the responsibility of the borrower subject only to review by the Bank or IDA with regard to the suitability of the goods and services and the reasonableness of the terms of the purchase.

5. *Financial*

The purpose of the appraisal of the financial aspects of the project is to ensure that the financial conditions for sound implementation and efficient operation of the project are met. This includes an assessment of the funds needed during the project implementation and their source, and of the projects operating costs, revenues, and prospective liquidity after completion. The Bank usually provides only a part or whole of the foreign exchange component of a project's total cost and arrangements for the provision of the remaining finance are examined.

Negotiations

When agreement is reached by the two parties on the details of the proposed loan, formal negotiations take place in Washington between borrower and lender. Since most of the problems should have been settled during the course of the economic analysis and project appraisal, it is usually possible to complete these negotiations within a few days.

Upon satisfactory conclusion of the negotiations, the loan or credit agreement and all supporting documents are presented to the Executive Directors, together with the recommendation of the President, for their approval. After approval of the Executive Directors and the signing of the loan or credit agreement, a further period usually elapses before the agreement becomes effective and funds can be disbursed. The coming into effect of the agreement depends upon the fulfillment of certain conditions.

Types of Expenditure Financed

Normally, a Bank loan or IDA credit provides foreign cexhange for expenditures on imported goods and services required for the project. These include the foreign exchange element represented by the imported component of domestically produced goods and foreign expenditures under civil works contracts with local contractors. Under special circumstances the foreign exchange lent may be used to finance local expenditures. The circumstances justifying this kind of lending are typically those in which a country needs more funds for its development that it can provide from its own savings or from bans from external sources other than the Bank, and where these additional funds cannot be provided without neglecting other projects of higher priority which involve mainly local expenditure. A decision whether to finance local expenditure and to what extent is made in the light of the special circumstances prevailing in the country and the nature of the project to be financed.

Supervision and Disbursement

In order to ensure the timely and effective execution of the project, the Bank carries out a supervision of the project.

This is achieved by requiring that careful records be kept and regular progress reports be submitted. These reports contain information on physical progress, purchasing, costs of the works and equipment, financial condition of the operating agency, and any problems encountered.

Reports from the borrower are supplemented by periodic visits to the project by staff members. During these visits, the staff members examine the work being done, the accounts of the borrower, and the use and maintenance of goods and equipment. They also satisfy themselves that the management and administration of the project are satisfactory.

Problems and necessary changes in the project are discussed and resolved.

Funds are disbursed by the Bank and IDA only as expenditures are incurred for specific goods and services. Each item for the project is followed from the determination of specifications, placing of the order, delivery, and its actual use in the project. Disbursements are made on the receipt of satisfactory documentation and in the currency of the supplier. If the currency is supplied from the Bank's funds, the loan is repayable in that currency. If the Bank purchases the currency, the loan is repayable in the Bank currency used to purchase the currency furnished to the borrower.

In the case of IDA, a credit is repayable in a convertible currency agreed with the borrower in an amount equivalent to that originally provided.

Terms of Lending

Water supply and sewerage projects have been financed with funds from Bank loans and IDA credits.

The Bank loans are medium and long term, with the principal repayments beginning at the end of a period of grace and thereafter spread over the remainder of the life of the loan. The grace period is designed to run until the project becomes operational and starts to yield economic benefits, while the amortization period takes into account the estimated useful life of the project.

The rate of interest charged by the Bank on its loans is kept as low as possible as is compatible with the need to maintain its financial strength and reputation. The current rate for Bank loans at June 30, 1974 is $7\frac{1}{4}\%$

Interest on Bank loans is charged only on that part of a loan which has actually been disbursed. To compensate the Bank for the cost of holding funds pending their disbursement, and to encourage borrowers to draw loans promptly, a commitment charge is normally made on the undisbursed portion of the loan. This charge is $\frac{3}{4}$ of 1 per cent and accrues from a date 60 days after the date of the loan agreement.

In 1960 the International Development Association, known as IDA, was established to provide financial assistance for developing countries that were either so poor or had such balance of payments problems that they could not borrow on commercial or near commercial terms the money for furthering their economic development. IDA credits (so-called to distinguish them from Bank loans) differ from the Bank loans in the rate of interest and terms provided. IDA projects have to satisfy the same rigorous criteria as Bank loans.

IDA's credits have generally been for terms of 50 years, interest free, and with no commitment charge. A service charge of $\frac{3}{4}$ of 1 per cent per annum to meet IDA's administrative costs is payable on the principal amount withdrawn and outstanding. The credits have carried grace periods of 10 years before repayment has to begin. Thereafter 1 per cent of the credit is repayable annually for 10 years and 3 percent annually for the final 30 years.

It was not intended that the concessionary terms of IDA's financing should result in the extension of financial subsidies to the actual projects on which IDA funds were employed, or be used for projects that could not satisfy normal criteria for financial and economic viability. Accordingly, when IDA financies a revenue producing project, the credit is extended to the government, which then relends it for the project on terms adapted to the circumstances.

Most IDA credits are generally made to those of its members whose per capita Gross National Product is below a level of about US $375 equivalent.

Under certain circumstances, low-income countries may receive a "blend" of conventional World Bank loans and IDA credits. "Blending" of Bank and IDA lending may be undertaken when a country's per capita GNP is marginally above the IDA limit, but where the problem of debt servicing is nevertheless serious. Blend countries typically receive IDA credits for some projects and Bank loans for others; but sometimes a single project will be assisted with an IDA credit for part of the costs which the Bank Group is willing to finance and a Bank loan for the rest.

In Latin America and the Caribbean there are several countries with per capita incomes substantially above US $375 equivalent and Jamaica, Uruguay, and Venezuela are not members. Attached is Annex 1 showing that as of June 1974, 11 loans and one credit had been made for water supply and sewerage projects in Latin America and the Caribbean.

ANNEX I

IBRD LOANS AND CREDITS

Water and Sewerage Projects in Latin America

Loan or Credit No.		Amount in US$ Project	Loan	Year of Loan
BRAZIL				
757	Sao Paulo Water Supply and Pollution Control	59.8	22.0	1971
758	Sao Paulo Water Supply and Sewerage	81.5	15.0	1971
1009	Minas Gerais Water Supply	92.0	36.0	1974
COLOMBIA				
536	Bogota I Water Supply	48.2	14.0	1968
682	Cali Water Supply and Sewerage	37.5	18.5	1970
738	Palmira Water Supply and Sewerage.	3.8	2.0	1971
741	Bogota II Water Supply	118.0	88.0	1971
860	Medium Cities W.S. & S.	15.9	9.1	1973
ECUADOR				
	Guayaquil Water Supply	38.3	23.2	1974
JAMAICA				
598	Kingston I Water Supply	9.1	5.0	1968
NICARAGUA				
Cr 26	Managua Water Supply	4.8	3.3	1962
808	Managua Water Supply	10.0	6.9	1972
MEXICO				
909	Mexico City Water Supply	194.0	90.0	1973
VENEZUELA				
444	Caracas Water Supply	54.1	21.3	1966
Totals:	14 loans and one credit	767.0	354.0	1962 to July 1974

OTHER TECHNICAL PAPERS CIRCULATED

WATER WORKS TRAINING PROGRAMMES IN THE EASTERN CARIBBEAN

by

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The purpose of this paper is to review the water works training programmes that have been taking place in the Eastern Caribbean. It is aimed at generating beneficial discussion during its session of the conference.

The First Caribbean Water Engineers Conference held in Trinidad in February of 1970, addressed it self to the training needs in the Eastern Caribbean. This conference not only identified the need for training — but — it also demonstrated the worthiness of holding annual conference — which —in reality are a training technique.

The major factor that influenced the unanimous decision that a broad and comprehensive training programme was necessary — was the 1971 tabulation of each country's waterworks staff and anticipated staff needs over the next five years. This tabulation was updated annually by Engineer Neil Carefoot of PAHO/WHO who at that time was Water Supplies Adviser to five Eastern Caribbean governments. Attached to this paper, as Annex 1, is the 1973 tabulation.

One of the objectives of this conference is to further update the tabulation during this session with information I understand you have brought with you.

The initial tabulation (1969) brought the larger number of water works employees involved in the Caribbean into sharp focus and this in turn called attention to the impossibility of training all of these people outside of the Caribbean area on a fellowship basis. Impossible, that is, — in terms of getting the job done, as well as being neither a practical nor an economical solution to the problem.

Having reached a unanimous agreement — that a training programme was needed — the conference identified fifteen job classifications and decided to have training courses designed specifically for Caribbean water works employees.

During the latter part of 1970, the Water and Sewerage Authority of Trinidad and Tobago, — WASA — stimulated by the conference requested the services of four PAHO/WHO short-term consultants to work with their training officer and chief engineers on the development of training course outlines for their employees and for use throughout the Caribbean area.

WASA was established in 1965. It brought together all of the individual water and sewerage agencies to function under one rule. This consolidation generated problems in the areas of organizational structure, unification, leadership, and morale which were quickly recognised and which led to a request in 1968, for PAHO/WHO to evaluate the situation and make recommendations for improvement.

Implementation of the recommendations of that study began in 1970. At the same time — WASA recognised the need for training, and in 1969, identified a training officer to handle the training function. A training centre was established with its initial thrust directed to the technical aspects of water works activities. Its purpose has been to develop knowledge, skills, and attitudes of employees — and to improve efficiency and relationships by increasing general water works knowledge — as well as — specific job knowledge through properly designed training courses.

The in-service training courses at WASA began during January 1970. Prior to that date, physical facilities had not been ready — however, ad-hoc training activities were organised and conducted with provisions for employees of the organization to attend external seminars and conferences.

Participation at one of these seminars by WASA representatives — namely, the First Caribbean Water Engineers Conference in 1970 on the training needs in the Eastern Caribbean — broadened their vision of the training need and emphasised its importance to the Caribbean area.

Consequently — in November of 1970 —WASA made its request for assistance in the preparation of appropriate course outlines. One of the references used as a guide by the consultants was the proceedings of the 1970 Caribbean Water Engineers Conference.

Course outlines for thirteen job classifications — Annex 2 — were completed and printed during early 1972 and distributed to water utility authorities throughout the Caribbean.

Meanwhile — the committee of Chief Engineers at WASA reviewed the outline and examined the overall approach to the training programme. Both the urgency and the magnitude of the task were considered in the light of the physical and human resources available to conduct and complete the training within the time frame desired. It was quickly recognised that the limited resources made it impossible to implement the programme rapidly and effectively. Therefore — after considerable discussion and assistance from PAHO/WHO — an application for assistance in the special field of educators, supplies, and equipment, under the United Nations Development Programme — UNDP — was completed and forwarded for action in December of 1972. The target date for UNDP implementation was January 1974.

In addition to initiating the UNDP application, the committee of WASA Chief Engineers established training priorities — and as an interim measure — it proposed to utilise the limited resources available to conduct a staff development programme over the period June 1972 — January 1974.

The objective of the interim Training Programme was to pave the way for the broader and more comprehensive programme proposed to start during January 1974 under UNDP sponsorship. The ultimate objective of staff development programme is to improve the job knowledge of each and every employee who is exposed to training.

It was at this time — May 1972 — that the writer was assigned as a PAHO/WHO short-term consultant to implement the WASA Interim Training Programme, to assist in developing trainers from the cadre of supervisors, and to advise generally on the organization of the programme. Planning for the training programme, which was sufficiently advanced for immediate implementation was thoroughly reviewed with Mr. David Massiah, the WASA Training Officer, and further reviewed with the committee of Chief Engineers. Because the need for training personnel was deemed urgent and critical, it was imperative to start the programmes as quickly as possible, and the objectives established were:

1. To prepare for an easier transition to the broader programme anticipated under UNDP sponsorship.

2. To accomplish as much training as possible.

3. To test the WASA resources for conducting a training programme.

It was also considered advisable to include a basic course in the programme, to serve as an introduction and foundation to the specialised courses for which outlines had already been prepared. Such a course would provide an opportuinty to observe and select trainees for the specialised course, and motivate employees. Thus, it was planned to be a module common and pre-requisite to the specialised courses.

It was designed to develop a better understanding of the functions and responsibilities of the Authority, the organizational structure, and the lines of responsibility as well as providing basic information in the areas of water and sewage works, water pollution, and environmental concerns.

Additional benefits were considered to be the opportunity for employees to get to know each other better, for them to acquire a better understanding of where to refer problems encountered outside of their jurisdiction, and to develop a more efficient relationship both inside and outside of the organization. It was also intended that the basic course would be open to people from all areas of responsibility within the organization, and to employees of governmental departments and statutory boards.

A major concern was the desire to start the training as quickly as possible — within the limitations imposed by the major confining conditions —namely —

1. The utilization of WASA staff personnel for lecturing. They would still perform their normal work duties.

2. The utilization of the existing facilities at the training centre which consisted of one classroom and an assembly room.

The availability of lecturers was recognized as a controlling factor in the scheduling — so the approach to the interim programme attempted to minimize interference with job responsibilities and proposed a system of having backup lecturers available to fill in as required.

The guidelines adopted for the Interim Training Programme were:

1. That all trainees commence their training with the basic course entitled, "The Introduction to the Functions and Responsibilities of the Water and Sewerage Authority."

2. That the order of priority for the specialized courses be:

a. Water and Sewage Works Foreman and Distribution System Supervisors — Course Outline Number 7 — approximately 120 to be trained.

b. Water Works and Sewage Works Operators II and III —Course Outline Number 4 — approximately 100 to be trained.

c. Water and Sewage Works Operators I. Course Outline No. 3 — approximately 270 to be trained.

The course outlines call for heavy demands in terms of class hours — ranging from 30 to 530 hours per course. It was quickly recognised that implementation of these courses as outlined could have disastrous effects on the work programme of the authority. For this reason — it was decided to present these courses in units of 60 hours — 2 weeks — making it necessary to revise the outlines to fit this requirement.

The first special course offering — Water and Sewage Works Foreman and Distribution System Supervisors requires 90 hours. This had to be revised to 60 hours and provision made to complete the remaining 30 hours, if deemed necessary.

The second course for Water and Sewerage Works Operators II and III requires 250 hours. The proposed training programme divided it into 4 parts — A, B, C, and D of 60 hours each and suggests that all trainees complete Part A before Part B is presented.

3. That the courses be of two weeks duration scheduled for 6 hours per day 30 hours per week (5 days each 6 hours) and 60 hours per course.

This time schedule was intended to be moderate and realistic rather than an attempt to achieve a rigorous training schedule. The reasons for this were to provide ample time for preparation, organization, and evaluation.

4. That the lecturers be drawn from the staff of the Authority and that this duty eventually become a part of their assigned job responsibilities. Each scheduled lecturer would have a backup lecturer prepared and scheduled to take over the class should an emergency on job responsibility conflict with the scheduled class time.

5. That the participants attending the classes be relieved of any work responsibilities during the period of enrollment in the courses.

6. That the course enrollment be limited to a maximum of 20.

Several ideas for achieving maximum utilization of the physical and human resources were discussed and evaluated. What finally emerged was the inauguration of the first basic course on June 5, 1972, and a time schedule covering the period July 1972 to January 1974 — Annex 3.

WASA has approximately 3,000 employees and the course outlines cover job descriptions involving more than 900 employees from the Technical Section. Added to WASA's needs were those of the remainder of the Eastern Caribbean as evidenced by the Inventory of Water Works Personnel — Annex 1.

The philosophy behind the time schedule prepared was that the Basic Course would be run continually on a 2-week basis, with breaks for holidays, reassessment, evaluation, and readjustment — and that the specialised courses be redesigned for two-week offerings, and programmed into the schedule as often as practicable.

One of the most pressing considerations for the preparation of such a calendar was to have it available for circulation throughout the Eastern Caribbean— and Engineer Carefoot did circulate it — so that water works personnel from other countries could participate in the project. Among the first countries to take advantage of this opportunity, was Barbados. However, because of the large number of water works personnel in Barbados, about 1,000 — it is not economically feasible to send them all to Trinidad for training. Therefore — the possibilities of a Barbados Training programme were discussed at meetings which PAHO/WHO Engineer Carefoot, the writer H. A. Sealy, Chief Engineer of the Barbados Water Department, and his staff. Consequently, a plan for a training programme in Barbados was developed with Mr. William A. Johnson, Mechanical Engineer and Acting Training Director of the Barbados Water Department.

The fundamental objectives of the WASA basic course were adopted; namely, to acquaint the employees with the functions and responsibilities of the Water Department — the organizational structure, and the existing facilities, — and — to provide a foundation for specialised courses, as well as providing an opportunity to improve working relationships by association with each other at classes.

The 1973 Training Programme in Barbados — which officially began June 18, 1973 — included nine basic course offerings and one specialised course for pump operators. The specialised course offering was restricted to one so as to permit time for the programme to get underway and to test and evaluate the capabilities of the human and physical resources before expanding with specialised courses.

The training time schedule for 1974 includes plans to again offer the Pump Operators Course.

In January 1974, the writer was assigned to review, appraise, and assist in the training programmes in progress at WASA and in Barbados.

In Trinidad — the 22nd Basic Course opened on January 14, 1974. The number of trainees who had completed courses as of that date were:

Basic Course 322 Remaining to be trained, about 1,300

Distribution Area Supervisors 65

Water Works Operators 49
(Part A)

The number of Water Works Operators completing Part A of the specialised course reached 49 in September of 1973 when the course was stopped to develop a new approach which was to completely train much needed water works operators.

It was decided to have 23 operators complete the entire specialised course (TRT-2100-06-71) over a six-month period rather than continuing the attempt to serve a larger number over a longer period as orginally proposed. This new approach started on January 14, 1974, with the selected trainees taking the 22nd Basic Course and the remaining time to the scheduled completion date of June 16, 1974, was broken down into three parts:

1. Allocation to treatment plants for practical work experience.
2. Instruction in theory at the Training Centre.
3. Rotation to various treatment plants to further practical training in different treatment processes.

Undoubtedly, David Massiah, the AWSA Training Officer, can tell us about this and the number of people from other islands who have attended WASA courses during the discussion period.

Antigua and Dominica also offered short courses during 1973. Antigua had a Public Health Inspectors course for 17 trainees, and in Domimica, a course for water Pipe Fitters was given twice to a total of 27 people.

In Barbados, 173 people had completed the 7th Basic Course when the 1973 programme ended on November 26, 1973. Eight of the participants were from other islands. A total of 17 trainees took the Pump Operators Course. Three of these were from other islands.

The 1974 Training Time schedule includes 13 Basic Courses, one specialised course for Pump Operators, and one Basic Supervisors Course.

The contents and time table for the Basic Course were reviewed with Engineers William A. Johnson, Training Director, and Mr. John Halley, Administrator of PAHO/WHO office in Barbados, and its objectives were re-established. It was agreed that the objectives could be summarised — not in the order of their importance as follows:—

1. Teach the language of Water Works and Sewerage.
2. Provide introduction to specialised courses.
3. Induction of new employees.
4. Develop better communications between employees.
5. Develop aspiration for further knowledge.
6. Acquaint employees with functions and responsibilities of Water Works Department.
7. Create appreciation for the public health aspects of the Water Department.
8. Develop the necessity for working together as a team.

Generally, the results of both the WASA and Barbados training experiences are about the same:

The need, desire, and ability to conduct the training programmes appears to have been well established and both should be able to complete the courses proposed for 1974.

Feed-back, from trainees, at the completion of each course supports the conclusion that the courses are well accepted and successful.

There has been involvement — in the Basic Course — by employees from areas other than those of technical responsibilities.

Participants show a continuing enthusiasm and interest in training and suggestions for more training and greater depth and longer courses seem to dominate the feedback. Adverse criticism and comments were scattered and mimimal.

There appears to be a constant demand for greater depth in the Basic Courses, especially in the Technical Subjects. The creation of this desire — by the intentional "Quick-brush" approach is one of the objectives, and the depth is intended to be provided in the Specialised Courses.

There also appears to be an interest in expanding specialised training into areas other than the technical sections of the water works industry as evidenced by the proposed supervisory basic course in Barbados and the interest for courses to serve needs of the Administrative and Financial Divisions at WASA.

A greater understanding and appreciation of obligations to follow employees in terms of responsibilities, understanding, communications, duties, and social relationships seems to be emerging as a benefit that cannot be measured at this time.

Evaluation of the benefits brought about by training is a matter of concern to everyone in such programmes. At this time, a positive, valid, and workable means of measurement for the programmes discussed has not been developed and their successes have been judged on the basis of classroom critiques and feedback from trainees and supervisors.

This matter has not been overlooked, it has been considered and momentarily set aside in the interest of getting the programmes off the ground and rolling. However, the time has come, to give this matter of evaluation considerable thought — and this group — that identified the needs for training at the first conference can be most helpful in establishing criteria for examining results. Just what are the results to be looking for? The objective has been clearly stated —to improve the efficiency and effectiveness of the personnel by increasing job knowledge through training courses designed to upgrade performance levels. How is the improvement to be measured?

Should pre and post examinations be given to measure assimilation and retention of course material?

Should evaluation be on the basis of trainee comments and critiques?

Should a questionnaire or examination be developed? Or should the measurement be on the basis of indicators?

For example:

Does a noticeable over-all reduction in overtime hours indicate increased job efficiency or improved performance?

Would a reduction in operating costs be an indicator?

How about public relations — social relationships — teamwork — promotions — sense of responsibility — sense of belonging — job interest — satisfaction in the job — or recalls on work performed — can these be measured?

Certainly, you people in attendance have valuable input as to the expectations that should be developed and how to evaluate the training efforts. Think about this for the discussion period.

It should be noted at this point that training in Trinidad and Barbados is not intended to be restricted strictly to local undertakings, but rather include an effort to assist in serving the needs of the Eastern Caribbean. It is realistically impossible for any one country to implement all thirteen courses. Even the limited efforts of Trinidad and Barbados place burdensome demands on these organizations and expansion to broaden coverage would severely tax their available resources and hamper day to day operations. Both have needed and used qualified instructors from the private sector to round off their programmes. This situation was recognised by Engineer Carefoot, and he initiated discussions of a regional concept with various agencies. The concept received favorable consideration.

For example, in addition to the Basic Course, Barbados has tried and demonstrated that it can handle the Pump Operators Course. WASA's programme has included three specialised courses, and possibly will add more after the broadened programme scheduled to start later this year under UNDP sponsorship is underway.

These efforts account for only 4 of the 13 specialised courses, thus leaving 9 that are neither offered nor proposed at this point in time. This situation emphasises the need for expanding the regional concept. It also shows the opportunity for other countries to take an active part. Possibly your country or organization has the resources to implement one of the remaining courses — thus — spreading the burden and widening the opportunity for training.

People from other islands have participated in Trinidad and Barbados, and everyone profits by this intermingling of trainees. There are real advantages offered by spreading the training load throughout the area and everyone profits.

It now appears that the Basic Course has proven itself and developed into the proper introduction to Specialised Courses. Because it includes organizational structure and existing facilities, it seems advisable to make this offering locally wherever possible. For instance, the WASA basic course outline was revised for use in Barbados.

It was mentioned earlier that the UNDP involvement at WASA — a 3-year programme — begins later this year. Its immediate objectives are to develop training instructors from the existing staff who could carry out the training programmes on a continuing basis and to develop and implement a comprehensive training programme that should become an integral part of the day-to-day operations of the organization.

Being the largest Water and Sewer Authority in the Caribbean, — WASA acts as a training base for the other smaller island water utilities. Yet, regardless of its size, it obviously cannot implement all of the training courses. This is where you come into the picture, — the outlines are available — can you implement one of these courses — thus continuing to spread the burden as initiated by Barbados — and to assist in building a consolidated, co-operative, training complex within and possibly outside of the Carbibean area.

It can be readily appreciated that there are many concepts concerning the determination of training needs, the organization of training activities, and the evaluation training results. It is these matters that conferences such as this one can provide valuable input. The need is no longer questionable, the value of training is well accepted, and the training programmes in Trinidad and Barbados are well underway.

Some of the other Caribbean countries have also run training programmes in the form of seminars, workshops, and short courses. One of the objectives of this session is to determine and tabulate what has been done, and it is to this end that the reporting sheets — Annex 4 — have been handed you for completion. If time permits, we can summarise this data on the blackboard for discussion.

The training programmes as developed and now underway are not the only solution. It is more than likely that changes based on experiences encountered will occur with the passage of time. What is evident is that training plays a vital role in achieving the prime responsibility of any water works organization — to provide safe and adequate water. Achievement of this objective requires a sound organizational structure, staffed with trained personnel for planning, design, management, operation, and maintenance of the water works system; the facilities necessary to supply consumers with potable water that conforms to International Standards of quality and adequate quantities of water at adequate pressure 24 hours each day. Success in attaining these requirements contributes to the health, social, and economical well being of the people.

In closing let me sincerely thank you for this opportunity to again meet with you and congratulate you Caribbean engineers for providing this excellent conference to exchange ideas and information.

FIFTH CARIBBEAN ENGINEERS WATER CONFERENCE

July 8 — 10, 1974 Dominica, West Indies

REPORT ON STAFF AND TRAINING ACTIVITIES

Country:——————————————Date:——————

Water Works Personnel

	Now Employed	Unfilled Positions	Potential Trainees
1. Engineers			
2. Supervisory Staff			
3. Technicians			
4. Skilled Labonr			
Totals:			

TRAINING COURSES COMPLETED, IN PROGRESS, OR PROPOSED

Course Title	Dates	Number of Trainees		Sponsor
		National	Other Countries	

Report Prepared By: ——————

Title: ——————

TABULATION OF TECHNICAL WATER WORKS PERSONNEL — PRESENT AND ANTICIPATED STAFF (MAY 1973)

Country	Code	Engineers: Water	Engineers: Mechanical	Engineers: Electrical	Chemists	Surveyors	WTP Operators	Supervisory Staff: Water Inspectors	Supervisory Staff: Drilling Supervisor	Supervisory Staff: Construction Foreman	Supervisory Staff: Plumber and/or Fitter	Supervisory Staff: Shop Supervisor	Supervisory Staff: Engineering Assistant	Technicians: Laboratory	Technicians: Dratfsman	Technicians: Technical Records	Technicians: Instrument	Skilled Labour: Drilling Crews	Skilled Labour: Mechanics	Skilled Labour: Electrician	Skilled Labour: Plumber and Fitter	Supplemental Data – Labour Force: Monthly Paid	Labour Force: Daily Paid	Labour Force: Total Staff	Coverage: Population Served*
Barbados	P	3	2					3	1	2	8	2	1		2			2	2	2	28	71	987	1,058	240,000
	F	1	1	1	1	1		1	1	2	2	1	2		1	1	1		2	4	8				
	I										2	1	1		1		1		2	2	2				
Br. Virgin Islands	P					1	1														3	2	4	6	3,000
	F	1						1		1			1								3				
	I																								
Dominica	P	2				21		3		3				11	11		6		1		12	78	210	288	60,000
	F	1				1	10	4		1	2		2	1	1	1	2		2	1	6				
	I	1				1	4	2			1		1	1		1	1		1	1	4				
Grenada	P	1				1	25	4		1	4	1		1	2		2		2		48	40	140	180	96,000
	F	2	1		1	2	12	1	1	2	4	1	2	2	4	2	3	1	3	1	24				
	I	1	1					1		1	2	1	1	2	1	1		2	1		12				
Montserrat	P																					6	15	21	12,000
	F										1			1			1								
	I																								
St. Kitts	P					1		11			3		1		2		1					14	54	68	35,578
	F																								
	I																								
Saint Lucia	P	1					10	6	1		5	1		1	1				6	1	8	59	200	259	42,000
	F	2		1		1	10	4		2	2	2	2	1	2	1	1		4	2	7				
	I	1				1	5	2		1	1	1	1		1	1	1			1	3				

TABULATION OF TECHNICAL WATER WORKS PERSONNEL — PRESENT AND ANTICIPATED STAFF (MAY 1973) (*Cont'd*)

		Engineers						Supervisory Staff						Technicians			Skilled Labour					Supplemental Data: Labour Force			Supplemental Data: Coverage
Country	Code	Water	Mechanical	Electrical	Chemists	Surveyors	WTP Operators	Water Inspectors	Drilling Supervisor	Construction Foreman	Plumber and/or Fitter	Shop Supervisor	Engineering Assistant	Laboratory	Draftsman	Technical Records	Instrument	Drilling Crews	Mechanic	Electrician	Plumber and Fitter	Monthly Paid	Daily Paid	Total Staff	Population Served*
Saint Vincent	P	1					3	28		2	2	1	5	2		2		1	1	1	1	54	201	255	90,000
	F	1			1	1	3	7	1	2	2	1	1	1	1	1	2		2	1	14				
	I					1		7		2	2	1	1	1	1	1		1			6				
Surinam	P																					230	340	570	267,000
	F																								
	I																								
Trinidad and Tobago	P	19	2	2	3	3	297	35		31	102	25	27	8	16	5	6		34	20	418	1121	2591	3,712	990,000
	F					4	18	6		6	15		8	3	15	3			5	4	3				
	I					1	18	6			15				11	2				4	3				
Present Staff	P	28	4	2	3	7	318	91	2	39	124	30	34	13	24	6	0	3	46	23	535	1675	4742	6,417	1,835,578
Personnel Requirements	F	8	2	2	3	10	53	24	3	16	28	5	18	9	24	9	0	1	18	13	65				
	I	3	1	0	0	4	72	18	0	6	23	4	5	3	16	5	0	0	5	9	30				

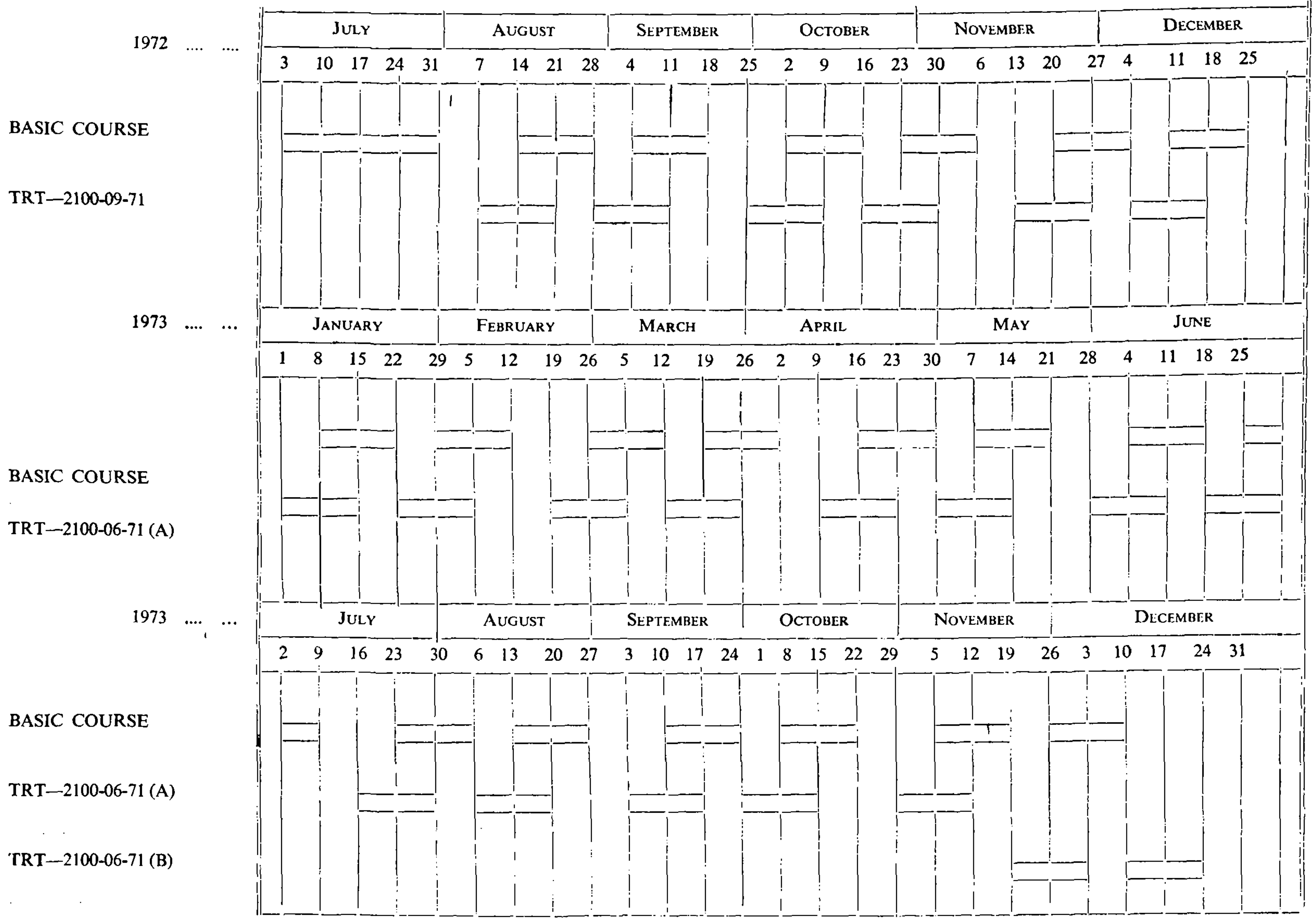
CODE: P — Present Staff
F — Additional Staff Required over next 5 years (including I)
I — Staff Required immediately
T — Trainee
* — Easy Access and House Connections

NOTE: The following Personnel were also listed:

	P	F	I
Heavy Equipment Op. (Dom.)	2	1	
" " (St. V)	2		

INTERIM TRAINING PROGRAMME

WATER AND SEWERAGE AUTHORITY OF TRINIDAD AND TOBAGO



NOTE: ▭ = A Class of twenty (20)

TRT—2100-09-71 = Course for "Water Foreman and Distribution System Supervisions".

TRT—2100-06-71 = Course for "Water Works and Sewage Works Operators II and III" — Course is divided into four parts (A), (B), (C) and (D)

5 July 1972

TYPICAL TIMETABLE — BASIC COURSE

INTRODUCTION TO THE FUNCTIONS AND RESPONSIBILITIES OF WASA

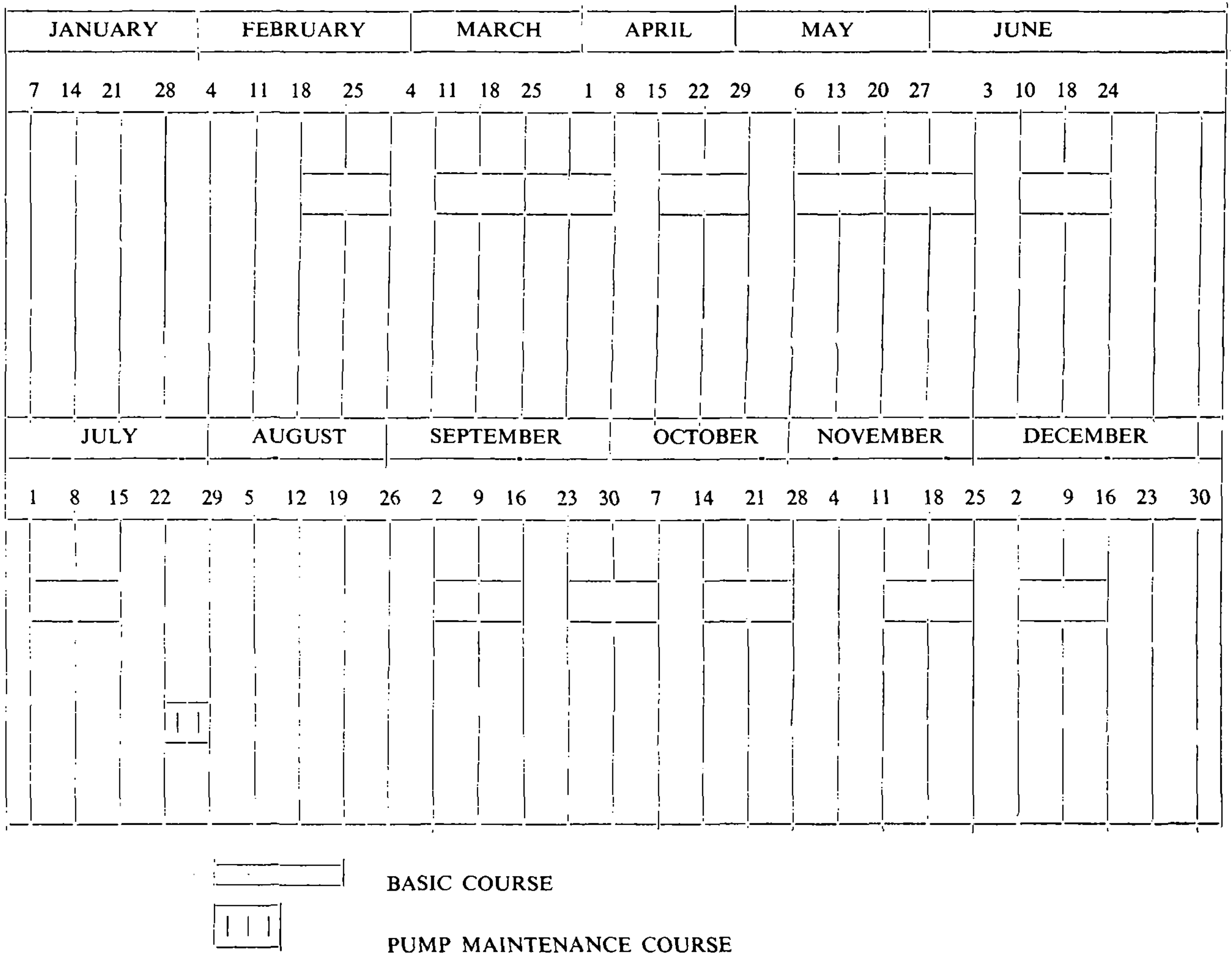
WEEK	TIME	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
1ST	8:30 a.m. — 10:00 a.m.	1 Orientation	5 Organization Structure (Technical Division)	9 Sources of Water and Their Characteristics	13 Basic Hydraulics	17 Water Suply Field Trip
	COFFEE BREAK					
	10:30 a.m. — 11:45 a.m.	2 Organization Structure (General and Administration)	6 Public Health Aspects	10 Sources of Water and their Characteristics	14 Basic Hydraulics	18 Water Supply Field Trip
	LUNCH BREAK					
	1:00 p.m. — 2:15 p.m.	3 Organization Structure (Financial)	7 General Description of Water Systems	11 Water Quality Analysis	15 Water Distribution Pumps and Storage	19 Water Supply Field Trip
	COFFEE BREAK					
	2:45 p.m. — 4:00 p.m.	4 Organization Structure (Financial)	8 Description of Existing Water Systems	12 Methods of Water Treatment and Disinfection	16 Water Distribution Pumps and Storage	20 Water Supply Field Trip
2ND	8:30 a.m. — 10 a.m.	21 General Description of Sewerage Systems	25 Operation and Maintenance of Water Systems	29 Sewage Plant Field Trip	33 Sewerage Operation and Maintenance	39 Public Relations
	COFFEE BREAK					
	10:30 a.m. — 11:45 a.m.	22 Description of Existing Sewerage Systems	26 Operation and Maintenance of Water Systems	30 Sewage Plant Field Trip	34 Sewerage Operation and Maintenance	38 Records and Reports
	LUNCH BREAK					
	1:00 p.m. — 2:15 p.m.	23 Water Use and Consumption	27 Sewage Pumping Station Analysis and Treatment	31 Sewage Plant Field Trip	35 Customer Service and WASA Act	39 Evaluation
	COFFEE BREAK					
	2:45 p.m. — 4:00 p.m.	24 Sewage Quantity and Collection	28 Sewage Pumping Station Analysis and Treatment	32 Sewage Plant Field Trip	36 Customer Service and WASA Act	40 Closure

NOTE: ☐ INDICATES PERIOD NUMBER

BARBADOS

TRAINING PROGRAMME 1974

WATERWORKS DEPARTMENT



ANNEX 1

TABULATION OF WATER WORKS PERSONNEL

PRESENT AND ANTICIPATED STAFF (DECEMBER 1971)

COUNTRY	CODE	ENGINEERS						SUPERVISORY STAFF						TECHNICIANS				SKILLED LABOUR			
		Water	Mechanical	Electrical	Chemists	Surveyors	WTP Operators	Water Inspectors	Drilling Supervisor	Construction Foreman	Plumber and/or Fitter	Shop Supervisor	Engineering Assistant	Laboratory	Draftsman	Technical Records	Isntrument	Drilling Crews	Mechanic	Electrician	Plumber and Filter
Antigua	P	1	1					4		1								2	2	2	20
	F	1	1			1	3	3	1	1		1	2	2	1	1	1	1	2	2	10
	I	1	1			1	1	2	1	1			1	2	1	1	1		1	1	3
Barbados	P	2	1					3	1	2	8	1	1		2			2		2	26
	F	1	1	1	1	1		1		2	2	2	3		4	2	3		4	4	8
	I	1	1	1						2	2	2	2		2	1	1		2	4	
Br. Virgin Islands	P	1						1		1											3
	F							1			1										
	I																				
Dominica	P	2				1		3		2			0		1						4
	F	1				1	8	4		2	2		2	1	1	1	2		2	1	8
	I					1	2	4		2	1		1	1	1	1	1		1	1	4
Grenada	P	2				1	25	4		1	4	1		1	2		2		2		48
	F	4	1		1	4	12	1	1	2	4	1	2	2	4	2	3	1	3	1	26
	I	2	1			2		1		1	2	1	1	1	2	1	1		2	1	12
Montserrat	P	1					2	2			1			1					1	1	4
	F														1						2
	I																				
St. Kitts	P	1									4					1	1				9
	F	1			1	2	1		1					1	2	2	2	1			1
	I	1			1											2	2				1
St. Lucia	P	2					10	6	1		5	1		1	1	0	1		6	1	8
	F	2		1		1	10	4		2	2	2	2	1	2	1	1		4	2	7
	I	1				1	4	2		1	1	1	1		1	1				1	3
St. Vincent	P	1						16			2	1		1		1	1	1	1		12
	F	1			1	1	3	18	1	1	6	2	1	3	2	2	3		2	1	20
	I					1	3	7		1	4	1	1	1	1	1	1		1	1	8
Surinam	P	3	1			1	6	3	1					1	4	1		6	4		9
	F	2	1	1		1	12	12	1		10			1	4	1			2	1	18
	I																				
Trinidad and Tobago	P	18	1	2	1	3	266	27		31	101	25	21	8	16	5	6		34	20	418
	F	2	0	0	1	4	28	14		6	14	0	1	3	15	3	0		5	4	3
	I	2	0	0	0	1	27	14		0	10	0	0	0	8	2	0		0	4	3
Present Staff	P	34	4	2	1	6	309	68	3	37	125	30	22	13	26	8	11	11	50	26	461
Personnel	F	16	4	3	4	16	87	58	5	16	41	8	13	16	36	15	15	3	26	16	101
Requirements	I	8	3	1	1	7	37	30	1	8	20	5	7	5	16	10	7		7	13	34

CODE: P = Present Staff
F = Additional Staff ERequired over next 5 years (including I)
I = Staff Required Immediately
I = Trainee

Note: The following Personnel Requirements were also listed:

	P	F	I
Assistant Surveyors (Grenada)	1	2	0
Water Supervisors "	2	2	1
Heavy Equipment Op. "	2	42	2
Construction Eng. (Surinam)	0	3	0
Surveyor Helpers "	4	6	0
Well Pulling Supervisors (I & I)	5	0	0
Riggers (Wells) (I & I)	18	0	0

LIST OF TRAINING COURSES

DESIGNED FOR

W.A.S.A. OF TRINIDAD AND TOBAGO

COURSE	*DURATION*
1. Water Pipe Fitters	90 hrs.
2. Sewer Pipe Fitters	90 "
3. Water Works and Sewage Works Operators I	210 "
4. Water Works and Sewage Works Operators II and III	250 "
5. Water Works and Sewage Works Supervisors	330 "
6. Water Systens Investigators	150"
7. Water Foremen and Distribution System Supervisors	90 "
8. Pump Operators	30 "
9. Construction Foremen	288 "
10. Water Works and Sewage Works Electrical Tcehnicians	270 "
11. Water Works and Sewage Works Instrumemt Technicans	512 "
12. Water Works and Sewage Works Electrical Supervisors	276 "
13. Water Works and Sewage Works Instrument Supervisors	530 "

COURSE EVALUATION

PERSONNEL SUPERVISION, APRIL 30th — JULY 2nd, 1974

BARBADOS WATERWORKS DEPARTMENT

At the conclusion of the first supervisors' course, participants were asked to respond to a series of questions comparing their impressions concerning their work groups and themselves with the period preceding the course. The results of this analysis suggest that the course has been very beneficial to both the organization and the individuals.

The course was held two mornings per week for ten weeks which allowed time for assimilation and experimentation with the ideas presented. This was particularly important as much of the material was focused on attitudinal and behavioural changes which cannot be fully engendered in a "block" course of study, be it six months or two days. The evaluation therefore, although subjective, reflects not so much the enthusiasm of a course participant filled with new ideas eager to be put into practice, but the collective responses of a group of people who have been testing the ideas over a period of ten weeks. Enthusiasm is high, but given the structure of the course, it appears to rest on relatively solid ground.

One of the basic hypotheses of the course was that job satisfaction is at least in part related to the opportunity of the individual to experience personal growth and express him/herself creatively on the job. This was certainly a result of the course: nearly all participants felt they had a much better understanding of themselves. Coupled with a similar feeling that their competence as supervisors is much improved, it is not surprising that 76% reported that they were more satisfied with their work, 65% much more.

Seventy-one percent of the participants reported that their groups were showing more *interest* in their work. The result of that increased interest is that 65% reported that the quality of work had increased and 41% said that the *productivity* of their work groups had increased. In addition, thirty-four percent felt that there was more concern for elimination of waste and reduction of costs. All of these factors represent positive advances for any organization.

In order to achieve the reported increases in performance, supervisors attempted through improved interpersonal communications to develop and utilize the human potential of their work groups. Fifty-eight percent felt that the confidence and trust among their group members was higher, 22% much higher. Subordinates were encouraged to make suggestions for improving their own work methods, and 60% of the participants said that the number of suggestions had risen.

As a method of developing a sense of teamwork and responsibility within the work group, it was suggested that supervisors hold "problem solving" meetings with their groups. In fact several supervisors have held meetings with good results, and a number of others intend to hold them in the near future. Seventy-one percent reported that the ability of their work groups to deal with its own problems was higher and 47% said that group participation in problem solving was higher. This suggests that future decisions regarding localized problems will not only be of higher quality, but will be more likely to be accepted and implemented as all people involved will feel they have a voice in the decision.

In addition, this added responsibility for each employee will augment the job satisfaction of each. Supervisors were also encouraged to delegate tasks to their subordinates for the joint purposes of freeing the supervisor to deal specifically with planning and supervising his/her work, and to allow opportunities for subordinates to learn and develop their own capacities, and therefore increase job satisfaction. Nearly all participants felt that their ability to delegate tasks was higher, 59% much higher. Several had attempted delegation of specific tasks and others indicated the intention to do so.

Despite increased group participation in decision-making and increased delegation, 89 % of the course participants felt that they had more *influence* in carrying out thier work, 48 % much more. This seems to indicate a higher capacity for *accepting responsibility* for their own departments. This change represents a radical departure from the historical "buck-'passing" so prevalent in the Caribbean countries. Not only will operational decisions be made quicker and performance improved, but morale of both the supervisor and his/her people will improve. The retention of trained and dedicated people is an invaluable asset to any organization. It should be added that 83 % of the course participants felt that their usefulness to the organization was higher, 48 % much higher. It is now a question of the organization allowing these and other personnel to work to their full capacity.

One further by product should be mentioned: 60 % reported that co-operation with other sections was higher, 29 % much higher. Whether this was due to improved communication skills or to the contacts made on the course and the use of the course as a forum is not certain. Nevertheless, the improvement in co-ordination is evident and will hopefully continue.

Finally, the course participants were asked to state commitments that they had made as a result of this course. The following statements were representative:

> "I have committed (*sic*) myself to the understanding of people, so that I'll be able to delegate with more confidence."
>
> "To have staff meetings at least once per quarter to know the opinions of others."
>
> "I will try not to forget that the people who I deal with have feelings too and that I will always be nice to them no matter how tiring it may seem at times."
>
> "To get the interest of my group for the work to be of a higher standard."
>
> "The confidence and trust among members of my group to be much higher, and co-operation with other sections too."
>
> "The morale of the group to be much higher."
>
> "Display the P.A.C. system (human relations) with my supervisors and subordinates."

These and many other comments both written and verbal indicate that the Barbados Waterworks Department has at least one group of people interested in both their work and the people who work with them. In the final analysis the hypothesis that satisfied employees can also produce better work seems to hold out.

This course is intended to be repeated for other members of the supervisory personnel. In addition, members of this first group are intending to come together periodically to discuss progress and problems, and have expressed interest in working with other similar groups in the future.

DESCRIPTION OF THE PERSONNEL SUPERVISION COURSE OF THE BARBADOS WATERWORKS DEPARTMENT

The Personnel Supervision Course of the Barbados Waterworks Department has grown out of a series of conclusions derived from the Basic Orientation Course. The increased awareness by each Basic Course participant of the goals, structure, and functioning of the Waterworks Department has created a sense of awareness on the part of many individuals that they could potentially contribute more to the organization than is currently the case. It is the view of the Waterworks Department that this potential can be positively channelled toward fulfilment of the institutional goals by *encouraging individual initiative*, and thus simultaneously creating greater job satisfaction. Employees are invited to upgrade their technical skills through various training mechanisms in order to maintain high quality performance. The very existence of these training programmes also tends to foster individual growth and fulfilment which increases *job satisfaction and motivation.*

Management believes, however, that not only must an individual be technically competent at his or her job, but must be given the opportunity to utilize and expand on that competence which will enhance the value of each individual to the organization. This calls for effective leadership at all levels, responsive to the needs and capabilities of each employee. The responsibility to provide such leadership rests on all persons who directly supervise the activities of others. Not only must these persons be skilled in their respective field, but they must also be *technically capable leaders.* The course in Personnel Supervision is an attempt to upgrade Supervisory personnel in this critical area. By increasing the leadership capabilities of its personnel, individual expression of all personnel will be encouraged, augmenting *both personal job satisfaction* and *productivity.*

The course seeks first to awaken an appreciation for the capabilities, needs, and poteniatl of each person through an analysis of human behaviour. Much emphasis is then placed on interpersonal communications skills as a means of locating and satisfying both organizational and personal needs. And, finally, the course deals with specific techniques for improving leadership capabilities.

In every sense of the expression, the course is designed as an "in-service" training programme. Just as the demands, responsibilities, and requirements of different jobs vary, so do the training needs and the capacity of each individual to learn. For this reason, the *onus* for *learning* lies with the participant. Specific ideas are presented, but each individual is expected to take the initiative in applying those general principles to his or her own job-setting. This methodology provides a means for self-expression and growth among supervisory personnel which should lead to greater job satisfaction and increased motivation.

The sessions include lectures, films, group discussions, role plays, and other devices geared to help the individual maximize his or her potential to learn and apply these learning experiences to the job. Because examples are drawn principally from the work experiences of each group, the level and depth of the material and course content will vary somewhat from group to group. To insure some degree of continuity, each group is composed of individuals having approximately the same immediate potential capabilities.

The sessions are held two mornings each week for eight to ten weeks (again depending on the needs of each particular group). Each session is intended to build on and reinforce the prior sessions, and participants are encouraged to begin trying out new ideas on their jobs immediately. A follow-up one day session for each group at six-month intervals is anticipated to answer questions, discuss progress, etc.

It is also hoped that this course will provide a vehicle for the strengthening of the training capacity in Barbados through increased *co-ordinator* and *co-operation* between the different training units. This could well provide the first opportunity for collaboration between the Central Training/Unit of the Government, The Waterworks Training Division, BIMAP and Diverse Intertnational Agencies.

Finally, it should be noted that a dynamic *evaluation* process is undertaken within each course session as well as an attempted evaluation as to the overall success of the programme. The results of this evaluation should point the way toward further improvements in meeting the needs of the people and institutions of Barbados.

PERSONNEL SUPERVISION COURSE SYLLABUS

Barbados Water Department

The topics listed below suggest the focus of each respective session, but as the emphasis lies with meeting the needs and desires of the participants, tangential issues are the rule rather than the exception. Each session is designed to build on the material of the previous sessions, often exploring similar ideas from slightly varied foci. This we feel is especially important as many of the ideas are attitudinal and require considerable reflexion and time to assimilate.

The Course is subdivided into Three Sections

I Appreciation of Human Behaviour

Session

1. *Introduction to Supervisory Techniques*

   Explore various questions relating to the worker, his/her job, and his/her supervisor. Designed to introduce many of the topics to be discussed in further depth during the course.

2. *Human Needs:* Examines human needs as the basis for motivation.

3. *Individual Interaction and Comportation:*

   Explore some of the ideas of personality and human behaviour which affect personal interaction.

4. *Supervisory Behaviour:* A film and discussion centered on the modes of behaviour on the job and how different types of behaviour affect people.

5. *Introduction to Groups:* A brief look at how groups affect the behaviour of individuals.

II Interpersonal Communications

6. *Introduction to Interpersonal Communications:*

   Establish some of the ground rules with respect to communications. Identify some problem areas, begin seeking means of improvement.

7. *Barriers to Communications:* Identify the barriers which hinder interpersonal communications and seek the means for overcoming those barriers.

8. *Awareness:* A series of exercise designed to sharpen the perceptions of the supervisor.

9. *Active Listening:* Techniques for dealing with problems of all kinds. Perhaps the most important techniques of effective communication.

III SUPERVISORY TECHNIQUES

10. *Leadership Styles:* The different possibilities of leadership styles are examined.

11. *Group Participation in Problem Solving:* Methods for using group participation are analysed.

12. *Improving Leadership:* Exploring different specific ways of becoming more effective leaders.

13. *Delegation:* Problem, benefits and putting it into practice.

14. *Control:* Setting standards and comparing the actual performance with the standards as a means of affecting delegation.

15. *Corrective Action:* Methods of handling discipline.

16–20. The subject of each session is to be determined by the group itself. Materials may supplement previous sessions or may be entirely new depending upon the group. If the group decides it would prefer to stop at any point, then the course will end. Part of the last session will be used for a course evaluation.

PERSONNEL SUPERVISION

COURSE EVALUATION

I. We could like to ask you if you feel the work of *your section* has changed since the beginning of the course about two months ago. After each statement, please tick the box which best describes your feeling about the statement.

	Lower (L)	About the same (ATS)	A little higher (LH)	Much higher (MH)
1. The quality of work is				
2. The quantity of work during an average week is	L	ATS	LH	MH
3. The interest of your group for the work is	L	ATS	LH	MH
4. The number of suggestions from your group to improve their own work method is	L	ATS	LH	MH
5. The amount of confidence and trust among members of your work group is	L	ATS	LH	MH

	Lower	About the same	A little higher	Much higher
6. The amount of teamwork within your group is	L	ATS	LH	MH
7. Co-operation with other sections is	L	ATS	LH	MH
8. Concern for elimination of waste and reduction of costs in your department is	L	ATS	LH	MH
9. The ability of your work group to deal with its own problems is	(L)	(ATS)	(LH)	(MH)
10. The morale of your group is	L	ATS	LH	MH
11. Your understanding of yourself is	L	ATS	LH	MH
12. Your understanding of other people is	L	ATS	LH	MH
13. Your ability to communicate with your work group is	L	ATS	LH	MH
14. Your competence as a supervisor is	L	ATS	LH	MH
15. Your own usefulness to the organization is	L	ATS	LH	MH
16. Your own leadership ability is	L	ATS	LH	MH
17. Your own ability to delegate tasks to your work group is	L	ATS	LH	MH
18. Your respect for the people in your group as individuals is	L	ATS	LH	MH

	Lower	About the same	A little higher	Much higher
19. The amount of influence you have in the carrying out of your work is	L	(ATS)	(LH)	(MH)
20. The amount of group participation in problem-solving is	L	ATS	LH	MH
21. My own satisfaction in my work is	L	ATS	LH	MH

II. Please answer the following questions as completely as you can.

1. Do you think that most of the changes you noted above come as a result of this course? Yes No
2. Have you been able to delegate any tasks to others in you group recently?

   Yes No

   If so, what were those tasks and what are the results?
3. Have you attempted any group problem-solving meetings? Yes No

   If yes, what were the results? If no, do you intend to try this in the future?
4. As a result of the course, are you more aware of your own potential as an individual? Yes No

   If so, in what way?

III. We would also like to know your feelings about the course.

1. The length was too long

   about right

   too short
2. The number of topics covered were too many

   about right

   not enough
3. If you ticked "too many", what would you suggest eliminating?
4. How would you suggest improving the course?
5. Are there topics which you would like to see covered in more detail at a later date? Yes No

   If so, what are they?
6. Would you be interested in taking similar courses in the future?

   Yes No

7. Do you think it would be useful for your group to get together for a day every few months to review some of the material on the course?

Yes No

IV. We would like to ask you to state one to four *commitments* which you have decided to take as a result of this course.

1.

2.

3.

4.

Thank you very much for your co-operation. Best of luck in the future.

REPORT ON TRAINING PROGRAMME OF THE CENTRAL WATER AUTHORITY DOMINICA, W.I. 1969-1974

OLIVER T. GEOROES, ENG. C.W.A. JUNE 1972.

Introduction

The Central Water Authority has been always very conscious of the need for trained personnel in the water Industry, and has placed great emphasis on the training of water works personnel at all levels. In keeping with this objective, the Authority has made maximum use of the training facilities and opportunities provided by the PAHO/WHO and to a lesser extent the Canadian Training Programme.

TRAINING ACCOMPLISHMENTS 1969-74

The Authority formally went into operation in 1969. At that time, with the exception of the Chief Engineer, the staff for all practical purposes, had little or no formal, specific training in the operation and maintenance of water supplies.

The emphasis therefore, was on the immediate training of supporting technical and supervisory staff, and in the period September 1969 — September 1971, four PAHO fellowships were taken up, one being a post graduate course in Sanitary Engineering at Purdue University and three others for Water Treatment Plant Operators at Neosho and The Texas State Technical Institute. In addition, a candidate received an award under the Canadian Technical Assistance Programme to pursue a two year course leading to a Diploma in Civil Engineering. The candidate now holds the post of Engineering Assistant in the Authority.

In 1970 the Authority embarked on a major water supply construction programme, namely, Phase I of Water Area No. 1 — the largest single system in the Regional Water Supply Schemes, and it was at this stage that the deficiencies of the local "Pipe Fitter" became most apparent. As a consequence, the Authority, with the assistance of CIDA arranged for on the job training of pipefitters conducted by CIDA Personnel over a four month period. This programme was very successful.

In March 1971 as a part of its in-service training programme, the first annual seminar was held. It was of a general nature, and was designed to familiarise water personnel with the operation of the Authority and included lectures on the basics of water treatment, pipe laying, construction methods, and simple accounting and financial procedures. The course was also attended by Public Health personnel. A similar course was repeated in 1972

The Authority strongly supports the establishment of regional training programmes conducted by WASA of Trinidad and the Barbados Water Works Department. Two candidates have attended WASA training programmes. A senior pipefitter was attached to WASA for six weeks early this year and an assistant Laboratory Technician has just returned from a 6 week course in Water Bacteriology.

In October 1972 two candidates attended a two week Chlorinator Operators Course conducted in St. Vincent, and sponsored jointly by the CWA, St. Vincent BDD, CIDA and PAHO/WHO.

As previously mentioned on the construction side, the capacity of the Authority has been severely restricted by the limited number of local trained pipefitters. Unfortunately, the two year Plumber and Fitter's Course conducted by the Local Technical College, (based on the City of Guildes London Institute with emphasis on house and building plumbing) is not geared to the immediate requirements of the C.W.A. To overcome this problem, a one month crash training programme for pipefitters was conducted from July — August 1973. The course was jointly sponsored by the Authority and the Pan American Health Organisation who provided the services of an Instructor. The course was based on TRT — 2100 — 03 — 71 "Suggested Course Outlined for Water Pipefitter", and was attended by 18 pipefitters and other water works personnel including Caretakers, Pump Operators and Meter Readers.

A Construction Foreman and a Water Area Supervisor are currently undergoing training at Canadian Institutions under the Canadian Technical Assistance Programme. The former is on an attachment and the latter is pursuing a two year course leading to a Diploma in Civil Engineering Technology with emphasis on Water Supply Systems.

Surveyors and Draughtsmen are being trained internally. Other than attendance at courses conducted by the Land and Survey Division, no formal training has yet been arranged for Surveyors and Draughtsmen.

In March 1972, a small Laboratory was set up in the office of the Central Water Authority to undertake routine bacteriological sampling and testing. A one week initial training of the Laboratory Technician and an assistant Technician for the Laboratory was conducted under a joint venture of The Central Water Authority, PAHO and CIDA. This was followed by a three month attachment for the Laboratory Technician at the Ontario Water Research Laboratory. The Laboratory Assistant has also just returned from a six week course at WASA, Trinidad, in Water Bacteriology. Both fellowships were sponsored by PAHO/WHO.

PERSONNEL DEVELOPMENT PROGRAMME

In keeping with a decision made at the 4th Annual Water Engineers' Conference, the Authority has prepared a programme for the training of its staff over the period 1974-1977, (*see Table I*) and has requested the assistance of PAHO/WHO in developing the programme.

ASSESSMENT OF TRAINING PROGRAMME

Area Water Supervisors have been trained at U.S. Institutions. The courses offered are, naturally, oriented towards the needs of the U.S. water utilities. Furthermore, the courses are structured to the Institutions' sylabi. It is difficult under these circumstances to adjust to the needs of foreign studies. As a result, the student is forced to pursue courses that are not really relevant to his needs.

The solution of the above problem seems to lie in the development of regional training programmes at the undergraduate and graduate level. The Authority, therefore, is eagerly looking forward to the opportunity of participating in the Public Health Engineering Programme of the University of Guyana.

It has been observed that the course offered at Neosho and The Texas State Technical Institute are heavily weighted in favour of waste water treatment, with little emphasis on water distribution. It has been further observed that candidates with a sound educational background seem to benefit a lot more from the programme than those with a relatively weak background.

The two year Diploma Programme in Civil Engineering Technology is a very good academic course. It is not specifically oriented to Water Engineering. In spite of this it appears that it provides the candidate with a good background, for further development at the level of an Engineering Assistant. It has been found that with this background, the candidate can be very readily adapted to the operations Division. This is not so with the one year Neosho programme.

The greatest problem is in the training of pipefitters/plumbers, and the difficulty arises because of the miserably weak educational background of the people available for this type of work. As a short term measure, in-service training and attachment to regional water utilities appear to be the best solution. The four week in-service programme conducted in 1973, although reasonably successful, was far too theoretical for the majority of the participants. There was far greater interest in the practical aspects of the training.

CONCLUSION

In the Engineering and middle Supervisory Division, (technical) the Authority's training efforts have been successful. There is however, need for further development in the training of pipefitters at the Junior and Foreman's level. Very little has been done in the Accounting and Clerical Sections. The 1974-77 development programme has taken this deficiency into account.

WATER WORKS PERSONNEL DEVELOPMENT PLAN (TENTATIVE) DOMINICA, 1974.

Employee	POSITION		*Training Desired*	*Venue*	*Duration*
	Present	*Proposed*			
P. J. Henderson	Accountant	ditto	"Basic" & Attachment.	WASA & U.S.	12 weeks
—	Water Repairer	ditto	"Basic" & Attachment	WASA	4 weeks
—	—	Operator	"Basic" & WTP OP. Course	WASA	10 weeks
—	—	Operator	"Basic" & WTP OP.	WASA	10 weeks
Engineer E. P. Munro	Chief Engineer	ditto	Management Analysis	U.S., Connecticut	5 months
H. Sampson	Mechanic	Senior Mechanic	"Basic" & Pump Op.& Attach .	Barbados Water Works	8 weeks
R. Jehmot	Storekeeper	ditto	"Basic" & Attachment.	WASA	4 weeks
				1975	
S. Pacquette	Secretary	ditto	"Basic" & Middle Management & Attachment	Barbados & U.S.	10 weeks
I. Clarendon	Pipe Fitter	Water Foreman	"Basic" & Foreman—& Super	WASA	5 weeks
—	—	Operator	"Basic" & WTP Op.	WASA	10 weeks
—	—	Operator	"Basic" & " " Course	WASA	10 weeks
—	Accounts Clerk	Senior Accounts Clerk	"Basic" & Middle Management Attachment	WASA	10 weeks
—	Draftsman	Draftsman Trainee	"Basic"& Draftsman course	WASA & Trinidad	16 weeks
—	—	Design Engineer	Bachelor Technology, P.H.E. Course	Guyana	12 months

Table I.

WATER WORKS PERSONNEL DEVELOPMENT PLAN (TENTATIVE) DOMINICA, 1976

Employee	Position		*Training Desired*	*Venue*	*Duration*
	Present	*Proposed*			
—	Surveyors Asst.	Surveyor	"Basic" & Surveying	Trinidad	4 months
—	—	Operator	"Basic" & WTP OP. Course	WASA	10 weeks
	—	"	"Basic" & " " Course	WASA	10 weeks
—	—	Laboratory Technician	"Basic" & Attachment	Barbados & Canada	3 months
—	—	Foreman	"Basic" & Foreman Super	WASA	5 weeks
				1977	
—	—	Plumber/Super	"Basic" & Attachment	Barbados Water Works	8 weeks
—	—	Electrician	"Basic" & Electrical Technician	Barbados Water Works	11 weeks
—	—	Investigator	"Basic" & Investigator	WASA	7 weeks

DEMONSTRATIONS AND TALKS ON PVC/PE PIPES

The talk and mini exhibition on PVC pipes manufactured by Century Eslon Ltd. of Trinidad were conducted by Mr. M.J. Williams and were most interesting and at question time there were some searching enquiries.

The talk on PE pipe by Mr. Calvin Sides was more of an advertising nature.

WASA TRAINING CENTRE ACTIVITIES

This took the form of a panel discussion led by Professor Grasso, other members of the panel being Eng. Sankeralli and Eng. Johnson.

A broad outline of the activities of the training centre for the 1973/74 period was given, and Mr. Sankeralli pointed out that the participation from the other countries in these courses was very poor. Mr. Johnson stated that there was an Electrical Technicians Training Course to be held in Barbados in August 1974 and invited all interested countries to attend.

Engineer Sealy emphasized the need for Regional training.

Dr. Gibson supported Eng. Sealy on this but felt that Guyana was always being left out when training programmes are being developed. He informed participants of the Pump Operators' Course held in Guyana during October 1973 which was attended by trainees from St. Lucia and St. Kitts.

Dr. Gibson also asked for indications of interest in the Course in Public Health Engineering to be held at The University of Guyana in the Academic Year 1975—76.

BUSINESS SESSION

(*a*) *Training*

The first point for discussion was the need for coordinating training. Mr. Chinchilla suggested that a committee be appointed to look into this. Mr. Sealy felt that the Caribbean Development Bank be asked to assist in this, but Mr. Yhap said that the Bank would be unable to do so at the present time. Mr. Sealy further suggested that PAHO be asked to replace Mr. Carefoot whose absence had adversely affected the progress made in this area. Dr. Gogan then advised that the Governments would have to approach PAHO and stress the need for the replacement. Mr. Pagan then suggested that the following resolution be passed and forwarded to PAHO.

"That this conference shall elect a standing committee on training which shall be authorised to approach C.D.B. and Caricom for the necessary support of co-ordinated training and in due course to act executively on such co-ordination".

This was seconded by Mr. M.E. Durham. The motion carried.

The members of the standing committee were elected as follows:—

Barbados—Mr. Johnson

PAHO/WHO—Mr. Holly

C.I.D.A—A nominee from C.H.C.

Any two of the three to form a quorum.

(*b*) *Financing of Future Conferences*

The withdrawal of C.I.D.A. support from future conferences was discussed. Engineer Sealy suggested that PAHO be requested to continue to finance the dependent countries and the independent ones pay their own way.

A proposal by Dr. Gibson that the Caricom Secretariat be approached for its support of the Conference did not find favour with the majority present.

It was finally decided that PAHO/WHO and CIDA be approached and asked to continue their support of the Conference.

(*c*) *Standardization of Material*

Mr. M. Williams offered the suggestion that C.I.D.A. be asked to reconsider their policy with regard to the supply of materials from Canada as some materials were being manufactured within the region at competitive prices. Mr. Durham thought that this was not advisable.

Mr. Wheatley said that C.C.C. was trying its best to standardise materials and equipment and gave the assurance that the point made by Mr. Williams will be taken up with the Canadian authorities, particularly with regard to the materials manufactured by the Company Mr. Williams represents.

(*d*) *Association of Water Engineers in the Caribbean Region*

Conference considered a proposal by Engineer Reid for the formation of an Association for water and Water Engineers for the Caribbean together with information forwarded by Engineer Carefoot on the formation of a section of The American Water Works Association.

The majority present thought a Caribbean Organization would be more meaningful and did not recommend direct links with either AWWA or The Institution of Water Engineers (U.K.) but supported the idea of an Association under the umbrella of the Council of Caribbean Engineering Organizations.

The Chairman was delegated to pursue the matter with the Secretary General CCEO.

(*e*) 1975 *Conference*

It was agreed that Grenada, subject to that Government's approval, should host the next conference to be held some time in July 1975.

(*f*) *Tentative Programme for* 1975 *Conference*

The following topics were decided upon for discussion at the next conference:

(1) Paper on host country

(2) Care for Water Resources Institution planning by Dr. Phelps

(3) Selection and installation of water meters by a speaker from PAHO

(4) Updating of training requirements by A. Johnson

(5) Management by a speaker from PAHO

(6) Preventative maintenance by M. Sankeralli

(7) *Report on catchment protection* project by a speaker from PAHO

(g) *Vote of Thanks*

A formal vote of thanks to the Chairman and to the Government of Dominica for hosting the Conference was moved by Eng. H.A. Sealy.

The Chairman thanked delegates for attending and expressed pleasure at seeing The University of the West Indies represented.

ANNEX 1

PERSONS IN ATTENDANCE

at

FIFTH ANNUAL CARIBBEAN WATER ENGINEERS' CONFERENCE
8th—10th July, 1974

Names	*Territory or Organisation*	*Position*
CARIBBEAN GOVERNMENTS		
Mr. H.A. Sealy	Barbados	Chief Engineer, W.W.D.
Mr. A. Johnson	Barbados	Mechanical Engineer, W.W.D.
Mr. D.O. Gonguez	Belize	Sanitary Engineer, W.A.
Mr. S.A. Persram	British Virgin Islands	Supervisor, Water and Sewerage P.W.D.
Mr. E.P. Munro	Dominica	Chief Engineer, C.W.A.
Mr. O.T. Georges	Dominica	Engineer, C.W.A
Mr. H. McNab	"	Engineer, (C.I.D.A)
Mr. A. Williams	Grenada	Acting Manager, C.W.C.
Dr. U.P. Gibson	Guyana	General Manager, G.W.A.
Mr. V.A. Nembhard	Jamaica	Asst. Chief Engineer, N.W.A.
Mr. E.L. Beswick	"	Chief Lab. Chemist N.W.A
Mr. O.G. Vernon	"	Engineer Designs T.W.C.
Mr. T.B. Kennedy	Monserrat	Engineer/Manager N.W.A.
Mr. G.A. Chandler	St.Kitts	Acting. Manager, Water Engineer, W.S.D. (C.I.D.A.)
Mr. H.M. Sanchez	St. Lucia	Chief Engineer, C.W.A.
Mr. R. Bailey	St. Vincent	Manager, C.W.A.
Mr. E.T. Tsai-Meu-Chong	Surinam	Engineer, W.S.D.
Mr. M.A. Sankeralli	Trinidad & Tobago	Deputy Technical Director, W.A.S.A.
Mr. K.F. Sparks	Turks & Caicos Island	Water Engineer, (Hydrologist)

NATIONAL AND INTERNATIONAL ORGANIZATION/AGENCIES

Names	*Territory or Organisation*	*Position*
Mr. D. Pagan	British Development Division	Engineering Adviser
Mr. J.M. Murray	C.I.D.A.	Project Officer, Eastern Caribbean
Mr. C.A. Wheatley	"	Engineering Resources Division
Mr. M.E. Durham	C.I.D.A.	First Secretary Development
Mr. E. Valmonte	C.D.B.	Engineer
Mr. O.K. Yhap	"	Engineer
Dr. R.G. Gibbs	Caribbean Pesticide Control Unit	Technical Adviser
Mr. J.N. Freedman	I.A.D.B.	Sanitary Engineer
Dr. I. Gogan	PAHO/WHO	Country Representative
Prof. S.P. Grasso	PAHO/WHO	Short Term Consultant
Mr. R. Chinchilla	"	Zone Engineer
Mr. R. Ried	"	Sanitary Engineer
Mr. Z.S. Ansari	"	Sanitary Engineer
Mr. H. Chiroboga	"	Sanitary Engineer
Mr. J. Holly	"	Administration & Methods Officer
Dr. H.O. Phelps	University of the West Indies	Assistant Dean

OBSERVERS

Mr. M.J. Williams	Century Eslon Ltd.	Managing Director
Mr. Ron Irwin	" " "	Sales Engineer
Mr. Fitzroy Baptiste	" " "	Field Technician
Mr. C.E. Sides	Plastics Engineering Inc.	President
Mr. D.M.MacQuarrie	Keith Consulting Engineers	Project Manager

OFFICERS OF THE CONFERENCE

Conference Chairman — E.P. Munro

Rapporteur — A.M. Williams

Editing Committee — Dr. U.P. Gibson

R. Bailey

J. Holly

ANNEX 2

WATER ENGINEERS' CONFERENCE 8TH—10TH JULY, 1974.

ADMINISTRATIVE ARRANGEMENTS

Place of Meeting	Fort Young Hotel, Roseau. Telephone 2251.
Opening	There will be a formal opening at 9.30 a.m. on Monday 8th July. Delegates and observers are required to be in the dining room at 9.20 a.m. The official opening and address will be by the Honourable E. A. Leslie, *Minister of Communications and Works.*
List of Delegates	A list of delegates, advisers and observers will be produced as soon as all information is received.
Transportation	All delegates and wives who have notified their date of arrival and flight number will be met at the airport and conveyed to their hotel. Vehicles will be made available for the return journey to the Airport, for conveying delegates to and from official functions and for the tour of the host country.
Liaison Officer	Mr. G.M. Clarke will be available at the hotel to take care of airline reservations, provide advice on shopping and to assist delegates generally.
Typing Services	Request for typing services should be made through the Liaison Officer. There will be an office on the Ramparts.
Refreshments	Coffee/Tea/Juices will be served during the morning and afternoon breaks.
Transport Officer	Mr. S. Ferreira will co-ordinate all transporation of delegates. He will be available through out the Sessions at the Hotel.
Tour	Proposed route with approximate times are as follows:— Roseau*(9.00 a.m.)— Antrim* — Springfield* — Castle Bruce*(11.40) — Arr. Camp Londonderry*(1.10) — Leave Camp Londonderry*(2.25) — Portsmouth-Cabrits*(3.45)— Dominica Distilleries*(5.40)— Roseau 6.30).
Social Programme	The Government of Dominica will host a cocktail party on Monday 8th at 6.30 p.m. for delegates and their wives at the Anchorage Hotel. The firm of Century Eslon Ltd. will host a cocktail party on Tuesday 9th at 6.30 p.m. at the Sisserou Hotel. The Dominica Association of Technical Professionals will host an "After Dinner Farewell Function" on Wednesday 10th at 8.30 p.m.

*Indicates stops.