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UNITED STATES INTERNATIONAL DEVELOPMENT COOPERATION AGENCY
AGENCY FOR INTERNATIONAL DEVELOPMENT
Washington, D. C. 20523

CARIBBEAN REGIONAL

PROJECT PAPER

ANTIGUA WATER SUPPLY

AID/LAC/P-131

Loan Number: 538-K-023
Project Number: 538-0098

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AGENCY FOR INTERNATIONAL DEVELOPMENT PROJECT DATA SHEET		1. TRANSACTION CODE A = Add C = Change D = Delete <input type="checkbox"/> A	Amendment Number	DOCUMENT CODE 3
2. COUNTRY/ENTITY Regional Development Office/Caribbean		3. PROJECT NUMBER 538-0098		5. PROJECT TITLE (maximum 40 characters) Antigua Water Supply
4. BUREAU/OFFICE Latin America and the Caribbean <input type="checkbox"/> 05				
6. PROJECT ASSISTANCE COMPLETION DATE (PACD) MM DD YY 03 31 86		7. ESTIMATED DATE OF OBLIGATION (Under "B" below, enter 1, 2, 3, or 4) A. Initial FY <input type="checkbox"/> 83 B. Quarter <input type="checkbox"/> 2 C. Final FY <input type="checkbox"/> 83		

8. COSTS (\$000 OR EQUIVALENT \$1 =)						
A. FUNDING SOURCE	FIRST FY			LIFE OF PROJECT		
	B. FX	C. L/C	D. Total	E. FX	F. L/C	G. Total
AID Appropriated Total						
(Grant)	(3,045)	(30)	(3,075)	(3,005)	(70)	(3,075)
(Loan)	(6,405)	(220)	(6,625)	(5,770)	(855)	(6,625)
Other U.S.						
1.						
2.						
Host Country		1600			4,750	4,750
Other Donor(s)						
TOTALS	9,445	1850	9,700	8,775	5,675	14,450

9. SCHEDULE OF AID FUNDING (\$000)									
A. APPRO- PRIATION	B. PRIMARY PURPOSE CODE	C. PRIMARY TECH. CODE		D. OBLIGATIONS TO DATE		E. AMOUNT APPROVED THIS ACTION		F. LIFE OF PROJECT	
		1. Grant	2. Loan	1. Grant	2. Loan	1. Grant	2. Loan	1. Grant	2. Loan
(1) ESF	701	826	826	0	0	3,075	6,625	3,075	6,625
(2)									
(3)									
(4)									
TOTALS				0	0	3,075	6,625	3,075	6,625

10. SECONDARY TECHNICAL CODES (maximum 6 codes of 3 positions each) 545	11. SECONDARY PURPOSE CODE
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12. SPECIAL CONCERNS CODES (maximum 7 codes of 4 positions each)	
A. Code	
B. Amount	

13. PROJECT PURPOSE (maximum 480 characters)

To assist Antigua in meeting the current potable water demands of the tourism industrial and domestic sectors, and assure that the water authority operates on a self-sustaining basis.

14. SCHEDULED EVALUATIONS	15. SOURCE/ORIGIN OF GOODS AND SERVICES
Interim MM YY MM YY Final MM YY 1 0 8 4 0 3 8 6	<input checked="" type="checkbox"/> 000 <input type="checkbox"/> 941 <input checked="" type="checkbox"/> Local <input type="checkbox"/> Other (Specify)

16. AMENDMENTS/NATURE OF CHANGE PROPOSED (This is page 1 of a _____ page PP Amendment.)

17. APPROVED BY	Signature <i>William B. Wheeler</i>	Date Signed MM DD YY 03 24 83	18. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCU- MENTS, DATE OF DISTRIBUTION MM DD YY
	Title William B. Wheeler Director		

ANTIGUA WATER SUPPLY PROJECT

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EXECUTIVE SUMMARY

Antigua differs from most other Eastern Caribbean Islands in that it does not enjoy abundant and reliable supplies of fresh water. The present water supply is little more than two imperial million gallons per day (imgd) while the unconstrained demand is estimated at three imgd, increasing to 5.6 imgd by the year 2000. Water rationing has practically become an annual occurrence, and the limited data available indicate bacterial contamination throughout much of the supply system. This shortage is a major constraint to growth in nearly every sector of Antigua's economy, but poses a particular constraint on tourism, the island's main source of foreign exchange earnings. The quality of water, while not a current threat, could become a problem in the future if steps are not taken now to improve water treatment and transmission. In addition to water quantity and quality problems, the Water Division of the Antigua Public Utilities Authority (APUA) is technically and financially weak and not able to respond to the problems it faces.

In order to assist Antigua in meeting current potable water demands of the tourism, industrial and domestic sectors, and assure that the Water Division operates on a self-sustaining basis, AID will provide \$9,700,000 to finance the following activities over a three year period:

1. Ground Water Development: Through a well rehabilitation program, 32 inoperative wells will be replaced or rehabilitated, increasing total water production by 1.22 imgd.
2. Transmission and Storage: Priority facilities will be upgraded through the installation of 5.9 miles of new pipeline, a storage tank and new pump station equipment.
3. Restoration of the Potworks-Delaps Water Treatment Works: This facility treats water from Antigua's single largest source, the Potworks reservoir.
4. Water Treatment Improvement: The replacement/restoration of three filtration treatment plants will upgrade the quality of water provided and enable the supply of an additional 0.36 imgd. (0.11 from Collins Plant replacement and 0.25 from Body Ponds Pump Station rehabilitation).
5. Institutional Development: This component will provide the technical assistance, training and equipment necessary to assure that the APUA can manage Antigua's meet domestic water needs on a self-sustaining basis. The assistance also will produce fundamental changes in the Water Division of APUA by putting it on a sound financial footing thereby insuring that it can meet all recurrent costs of operation and contribute to its future capital expansion requirements.

It is estimated that the Project will increase potable water production capacity from the present 2.06 imgd to approximately 3.64 imgd by project completion in 1986.

AID financing will include a loan of \$6,625,000 for infrastructure and a grant of \$3,075,000 for technical assistance, training and limited support equipment. The Government of Antigua will provide an in-kind contribution of personnel, overhead and land rights totalling approximately \$4.4 million.

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I. PROJECT AUTHORIZATION

Name of Country: Antigua and Barbuda

Name of Project: Antigua Water Supply
Number of Project: 538-0098
Number of Loan: 538-K-023

Pursuant to Section 531 of the Foreign Assistance Act of 1961, as amended, I hereby authorize the Antigua Water Supply Project for Antigua and Barbuda involving planned obligations of not to exceed \$6,625,000 in loan funds and \$3,075,000 in grant funds until March 31, 1983, subject to the availability of funds in accordance with the AID OYB/allotment process, to help in financing foreign exchange and local currency costs for the Project. The planned life of the Project is 3 years from the date of initial obligation.

The Project will assist the Cooperating Country in the establishment of a viable water supply system and in meeting current potable water demands by financing engineering, technical and construction services and necessary commodities and training.

The Project Agreement which may be negotiated and executed by the officer(s) to whom such authority is delegated in accordance with AID regulations and Delegations of Authority shall be subject to the following essential terms and covenants and major conditions, together with such other terms and conditions as AID may deem appropriate.

A. Interest Rate and Terms of Repayment

The Cooperating Country shall repay the Loan to AID in U.S. Dollars within forty (40) years from the date of first disbursement of the Loan including a grace period of not to exceed ten (10) years. The Cooperating Country shall pay to AID in U.S. Dollars interest from the date of first disbursement of the Loan at the rate of (a) two percent (2%) per annum during the first ten (10) years; and (b) three percent (3%) per annum thereafter, on the outstanding disbursed balance of the Loan and on any due and unpaid interest accrued thereon.

B. Source and Origin of Commodities, Nationality of Services

Commodities financed by AID under the Project shall have their source and origin in the Cooperating Country or in the United States except as A.I.D. may otherwise agree in writing. Except for ocean shipping, the suppliers of commodities or services shall have the Cooperating Country or the United States as their place of nationality, except as AID may otherwise agree in writing.

Ocean shipping financed by AID under the Project shall, except as A.I.D. may otherwise agree in writing, be financed only on flag vessels of United States.

C. Conditions Precedent to Disbursement

1. First Disbursement. Prior to the first disbursement under the Agreement, or to the issuance by AID of documentation pursuant to which disbursement will be made, the Cooperating Country will, except as the Parties may otherwise agree in writing, furnish to AID in form and substance satisfactory to AID:

(a) An opinion of counsel acceptable to AID that this Agreement has been duly authorized and/or ratified by, and executed on behalf of, the Cooperating Country, and that it constitutes a valid and legally binding obligation of the Cooperating Country in accordance with all of its terms;

(b) A statement of the name of the person or persons holding or acting as representatives of the Cooperating Country and of any additional representatives, together with a specimen signature of each person specified in such statement; and

(c) Evidence that a first payment has been made by the Cooperating Country to the United States Export-Import Bank of outstanding indebtedness to that institution in accordance with an agreement of payment between the United States Export-Import Bank and the Cooperating Country pertaining to payment of that indebtedness and acceptable to both parties.

2. Professional Services or Equipment: Prior to any disbursement for professional services or equipment, or to the issuance by AID of documentation pursuant to which disbursement will be made, the Cooperating Country and APUA will, except as the Parties may otherwise agree in writing, furnish to AID in form and substance satisfactorily to AID:

(a) Evidence of the establishment of a Governing Board of APUA.

(b) Evidence that the Cooperating Country has made a valid commitment which permits and enables APUA to operate on a technically and financially self-sustaining basis including a commitment enabling APUA to acquire all required trainable personnel and that necessary steps will be taken to encourage them to remain with APUA once training is completed.

3. Construction Services After One Year. Prior to any disbursement for construction services for which invitations for bids are issued one year after the date of this Agreement or the issuance by AID of documentation pursuant to which disbursement will be made, the Cooperating Country and APUA will, except as the Parties may otherwise agree in writing, furnish to AID in form and substance satisfactory to AID:

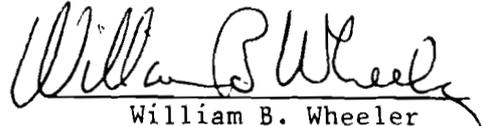
(a) Evidence that APUA has adopted and is following essential operating regulations, including but not limited to those dealing with water supply conditions, extension of the water systems, personnel administration and financial management;

(b) Evidence that APUA has substantially achieved the financial performance targets establishing in the Project's time-phased implementation plan.

D. Special Covenants

Financial Viability. The Cooperating Country and APUA covenant to maintain the financial viability of APUA through such collection measures and other steps including rate increases if necessary which will assure that the Water Division of APUA can amortize its debts, pay all staff, operating and maintenance costs, depreciate its facilities and contribute to future capital

expansion. Diversion of cash surpluses to other divisions of APUA or elsewhere which the Water Division may realize in the future will require prior consultation with AID.



William B. Wheeler
Director

3/24/83

March 24, 1983

II. PROJECT RATIONALE AND DESCRIPTION

A. Rationale

1. Background

Antigua differs from most other Eastern Caribbean islands in that it does not enjoy abundant and reliable supplies of fresh water. In fact, the shortage of water is one of the major constraints to growth in nearly every sector of Antigua's economy. Rainfall is unevenly distributed throughout the year, and droughts, generally severe, occur periodically. There are no perennial streams or permanent water courses in Antigua. During the drier months of January-April, water rationing has become an almost annual occurrence. Although water rationing in recent years has never been as severe as the drought of 1948 (where only one hour's supply of water could be provided every three days), less than a year ago the capital of St. John's had water supplied for only eight hours each day.

Antigua faces several climatic and geological constraints in identifying additional water sources and increasing its supply of potable water to meet the present unconstrained demand of approximately 3 imgd:

- 1) Climate conditions of variable rainfall and extremely high evaporation rates;
- 2) Lack of favorable watersheds, reservoir and dam sites;
- 3) Limited storage capacity in groundwater aquifers;
- 4) Difficulty and expense in locating production well sites due to geologic structures.

2. Current Water Supply

The country's public water system serves about 95% of Antigua's population of approximately 78,000. The network consists of 300 miles of distribution lines and 110 miles of trunk mains.

Supplying the distribution system is a series of groundwater (wells) and surface water (reservoirs) sources which in total have the capacity to produce approximately two imperial million gallons per day (imgd)*. Table 1 shows current water production. It should be noted, however, that no annual source production records are available and the data used in this section are based on best estimates. More than 75% of total supply is derived from surface water resources. While historically a number of small reservoirs were built, the large majority are now unutilized. The major reservoir in operation, Potworks, was completed in the mid-1970's and provides approximately 80% of all surface water, or nearly 66% of Antigua's entire domestic water supply. The balance of water supply is provided by ground water from 22 producing wells.

* 1.0 imperial gallon = 1.2 U.S. gallons = 4.5 litres

TABLE 1

Water Production

<u>Source</u>	<u>Estimated Production (imgd)</u>
<u>Surface Water</u>	
a) Upper Creekside Catchment	0.23
b) Potworks	<u>0.90</u>
	1.13
<u>Ground Water</u>	
a) Bendals	0.14
b) Christian Valley	0.14
c) Cades Bay	0.13
d) Clairmont	0.13
e) Follies	0.17
f) Long Lane Bristol	<u>0.22</u>
	0.93
Total Average Daily Production	2.06

In terms of domestic use, it was estimated in 1980 that approximately 58 percent of the population was served by residential connections and 43 percent by standpipe. Hotel consumption was estimated at 100 imperial gallons per tourist-bed night. Table 2 below provides a breakdown of total average daily use of potable water.

TABLE 2

Average Daily Use

<u>Type of Connection</u>	<u>Consumption (imgd)</u>	<u>Percentage of Total Production</u>
Domestic	0.61	29.6
Standpipe	0.29	15.3
Commercial	0.07	3.5
Hotel	0.22	10.7
Industrial	0.10	4.8
Government/Bulk	<u>0.38</u>	<u>18.5</u>
Sub-Total	1.66	82.4
Unaccounted for	<u>0.39</u>	<u>18.9</u>
Total Average Daily Production	2.06	100%

The reported existing 19 percent unaccounted for water estimate (including leakage, wastage, service reservoir overflow and other unmetered losses) is considered low. Transmission and distribution line breakages and other leaks are reported to be frequent, and overflows of service reservoirs are not uncommon. It is considered that actual unaccounted for water is probably over 30 percent.

The problem of current water supply is therefore complicated by problems with the management of the water transmission and distribution system. One critical problem is the substandard and undersized transmission line from the Potworks Reservoir to St. John's. Others, including poor communications between water treatment plants and reservoirs, mean frequent service reservoir overflows. Therefore, the existing system cannot be managed with efficiency to maximize delivery of even the current level of water production.

3. Water Demand

The Antigua Public Utilities Authority estimates that there is a current unconstrained demand for potable water of approximately 3 imgd. Based on estimated population growth and increased tourist activity as projected in Tables 3 and 4 below, the unconstrained demand is estimated to reach some 5.6 imgd by the year 2000. With production now standing at the 2 imgd level, it will require a considerable increase to meet the projected domestic water needs.

TABLE 3

Population Served by APUA

<u>Year</u>	<u>Population</u>	<u>Connection</u>	<u>Standpipe</u>
1982	76,050	45,600	30,400
1985	78,975	49,750	29,225
1990	84,240	57,280	26,960
1995	89,860	65,600	24,260
2000	95,850	74,760	21,090

The tourism growth rate is more difficult to predict as the market is influenced by many outside factors, causing the number of visitors to fluctuate greatly in any given year. However, past studies indicate that the number of tourist bed nights should increase from 580,000 in 1980 to 950,000 by the year 2000.

TABLE 4

Estimated Average Daily Demand
(imgd)

<u>Year</u>	<u>Domestic</u>	<u>Standpipe</u>	<u>Tourist</u>	<u>Subtotal</u>	<u>Losses</u>	<u>Total</u>
1982	1.73	0.34	0.24	2.31	0.99	3.30
1985	1.99	0.29	0.27	2.55	1.09	3.64
1990	2.58	0.27	0.41	3.26	1.09	4.35
1995	3.28	0.24	0.27	3.79	1.26	5.05
2000	3.74	0.21	0.52	4.47	1.13	5.60

The projected unconstrained demand of 3.3 imgd in 1982 understates total water production requirements to maintain a fully pressurized system 24 hours a day. A peak load factor of up to an additional 30 percent may be necessary to reach this objective. However, it is also anticipated that the percentage of losses will decrease as improvements in the transmission and distribution system take place, and the leak detection program is more fully underway.

4. Water Quality and Quantity

There is cause for serious concern with respect to both water quality and water quantity. Limited bacteriological analyses have revealed positive coliform counts in delivered water supplies and in freshly treated water coming from all but the largest water treatment facility. Although there is no evidence of significant transmission of water-borne diseases such as typhoid, the demonstrated levels of contamination within the existing water system point to the possibility of such an occurrence and thus makes water quality a public health concern. Also, although it is impossible to quantify, some percentage of the reported cases of gastroenteritis must be water-borne.

Although diarrhoeas of unknown cause are often water-borne the more direct transmission route is from faeces to mouth or by way of dirty food. Termed water-washed, these infections may be reduced by the provision of more abundant or more accessible water of unimproved quality. The most thorough studies, of shigella infections in the southern, U.S., have shown that simply making water more available tends to roughly halve the frequency of infection.

The usual reported incidence of water-washed gastroenteritis in children under five is not remarkably high. (It should be noted, however, that the only health facility in Antigua which turns in routine reports is the hospital in St. John's). The rates per 1,000 children in 1979, 1980 and 1981 were 27, 25 and 37 respectively. The fact that the usual low rates (in the 20's and 30's) can rise so sharply (83% of the 1,698 reported cases in 1980 occurred over a two month period, February-March, the driest months of the year), demonstrates that conditions exist which will allow epidemics of gastroenteritis. Both improved quality and increased quantity of water should help ameliorate this situation.

In-house connections have been shown to be one of the most powerful influences on reducing levels of water associated disease. This project does not directly influence the rate at which individual homes are connected to the main system as the current rate with which APUA is providing new connections is considered the maximum of which the system is capable.

5. Institutional Framework

The government authority which administers the country's water supply system is the Antigua Public Utilities Authority (APUA). The Antigua Public Utilities Authority was created in 1963 at which time all the properties of the Government that dealt with electrical, telephone and water supply were assigned to it. The APUA is responsible for all electrical, telephone and water supply facilities and services in the country. The Telephone Division has been separated from the Electrical and Water Divisions and has its own accounting and support groups whereas the Electrical and Water Divisions share accounting, billing, collections, meter reading, vehicle maintenance and repair, and purchasing.

The APUA was structured to operate as an autonomous public entity, with a Board of nine Commissioners appointed by the Minister of Public Works and a General Manager who would be appointed by the Board to manage the operations of the Authority. The Commissioners also have the authority to appoint a Chief Accountant. The APUA is not currently operated as stipulated in the Act; instead, the Minister has appointed a Permanent Secretary, who in effect is serving the function of the Board of Commissioners. Most of the responsibilities of the General Manager are now being carried out by the respective Managers of the Electrical and Water Divisions. Recently, however (February, 1983), the Cabinet officially reinstated the Board of Commissioners, although members have not yet been appointed. (See Section VI.E. below).

The Water Division is headed by a manager who has one superintendent and six supervisors reporting to him. It lacks fully qualified personnel throughout. The Manager, the Electrical and Mechanical Supervisor, and Chief Accountant are all CFTC (Commonwealth Fund for Technical Cooperation) contractors and only the Chief Accountant has a local counterpart. With few exceptions, generally within the accounting group, most personnel have limited training, and learn their trade through actual on-the-job experience from people not properly trained, and who pass on bad as well as good skills. No formal training program exists and there are no job descriptions, although plans for both exist. The accounting group is common to both the Water and Electrical Divisions, but each have a cashiering and billing staff and have separate ledger and bank accounts. Ledger-keeping and cash control are common to both Divisions.

In terms of maintenance and repair, the Water Division has a pump repair shop, but almost no spare parts, and pumps brought in for repairs are generally added to the piles of other inoperative pumps. Once a pump goes out of service, it usually ends up as scrap. All the well pumps are the submersible type and the main failures have been the motors which cannot be repaired locally. The vehicle maintenance and repair facility is an open metal corrugated shed surrounded by numerous vehicles of all types that have been cannibalized for parts needed to repair the few functioning vehicles. The repair facilities are poorly equipped, have no stock or spare parts, and provide poor working conditions.

The financial situation of the APUA Water Division is poor. Collections have started to improve somewhat, but their cash flow situation is still at the point where it is difficult to meet the payroll. The turn around time from meter reading to payment is three to four months. The present water collection program only collects some 39% of the revenue due for water supplied. An estimated 50% of current billings are lost by not enforcing water bill collections, and an additional 28% is lost due to inoperative and unread water meters.

All service connections with the exception of standpipes have meters. It has been estimated that about 31% of these meters not functioning properly, are lost or have been removed. The APUA has begun a program to locate all of these lost and defective meters and replace them with new or rebuilt meters. Meters are read at monthly intervals by a team of 18 people who read both the water and electric meters. Because of inadequate mail service the meter readers also hand deliver the previous month's bill.

The APUA water quality laboratory is presently beset with many problems. It has only one employee and receives little financial assistance from the Authority. The lab has few chemicals and is not equipped to do any bacteriological/coliform analyses. Similarly, the laboratory is also not equipped to run either coliform fermentation tube or standard plate counts, so samples are taken to Holverton hospital for positive or negative determinations. At present, the lab is only performing chlorine residuals on the effluents from the water treatment plants and from selected points in the distribution system. The lab is in immediate need of the standard lab equipment required to perform routine water analyses.

Clearly, APUA faces severe institutional constraints. In general terms, it is not being operated on a technically or financially sound basis. There is an urgent need for training of APUA personnel in a wide scope of technical and administrative aspects of water supply; there is a lack of basic water data, due in large part to an all but non-functioning meter system; and there are institutional/legal constraints inhibiting the effective operation of the APUA.

6. Water Sector Strategy

a. Project Strategy

To meet current and anticipated future demands for potable water, APUA must resolve the wide spectrum of constraints discussed above. These include: changes in the policy framework within which APUA must operate; institutional improvements in APUA to put it on a sound technical and financial footing; capital improvements in the water supply and transmission; and water resources management planning to identify and undertake future expansion of the system in anticipation of demand.

As a first major step toward resolving these constraints, APUA and RDO/C have collaborated to define an assistance strategy which will make the most significant impact on the array of constraints within reasonable time, financing, and institutional limits.

By rehabilitating the existing, known ground water resources, the Project will increase total water production from 2.06 mgd to

3.64 mgd by project completion in 1986; an increase of over 77%. In addition to this substantial increase in water supply, the Project will contribute significantly to improving water transmission and resource management by constructing a large-volume pipeline from All-Saints to Scotts Hill reservoir (linking St. John's with Potworks reservoir). This pipeline will permit APUA to maximize the total effective yield of the Potworks reservoir. Water quality also will be improved by upgrading and/or replacing selected treatment plants.

Finally and most importantly, the policy framework within which APUA will function and APUA's institutional capability will be significantly enhanced. A series of conditions precedent and covenants have been negotiated with the Government of Antigua and Barbuda (GOAB) to restore APUA to its status as a semi-autonomous statutory agency operating under a Board of Governors. In addition, clear policy statements on water collection procedures and commitment to the financial and technical viability of APUA will be made by the GOAB. Finally, the Government itself will undertake to keep its account with APUA current.

Institutionally, a significant technical assistance component, including training and essential commodities, will be provided to the Water Division of APUA to strengthen its overall capabilities. By the end of the Project, APUA's Water Division will be able to manage overall water supply and distribution, maintain its facilities and equipment, effectively bill and collect for water sales and plan future expansion in its system.

b. Other Donor Assistance

As discussed above, the AID project will enable the APUA to meet current demands in 1986 and establish an institutional base from which to address the next generation of water programs, which will include limestone exploration and development, and installation of a sewerage system. In furtherance of these long range programs, AID has carried out a series of discussions with other donors to coordinate and encourage support in these areas. The Canadian International Development Agency (CIDA) has for some time expressed an interest in a limestone harvesting program and recently sent a team to Antigua to gather more information before proceeding further. The British Development Division (BDD) recently finished a pre-feasibility study for institutional assistance to the APUA, although it now appears that that program may not go forward in the near future. The European Investment Bank is also financing a feasibility study for a desalination plant at Friar's Hill, and Trinidad and Tobago has recently signed an agreement to finance \$5.0 million in pipeline and reservoir installation. RDO/C has also discussed possible assistance to the APUA in the installation of a sewerage system with the World Bank.

In sum, there is considerable interest on the part of the international donor community to participate in the development of Antigua's water sector. AID will continue to encourage this interest and make available to these donors the master plan and other studies generated under the Project which will be useful in other water programs.

7. Conformity with Antigua's Development Strategy

Antigua has assigned the highest priority to an immediate expansion in the supply of potable water and is actively seeking donor

assistance for projects which will address identified deficiencies in this area. The World Bank has also identified the water sector as the most critical area for assistance in Antigua. At the fifth meeting of the Caribbean Group for Cooperation in Economic Development held in June 1982, the representative of the GOAB emphasized that in order to support productive activities and promote investment in his country, improvements in its economic infrastructure were essential. Foremost among the areas described was the need to rehabilitate and expand the present water supply system. The Government's concern is based on a demonstrated need to increase immediately its potable water supply by one million imperial gallons per day and 3.6 mgd by the year 2000. Providing an increased supply of water would also require improved monitoring of usage and expansion of the Water Authority's transmission, distribution and treatment facilities.

8. Relationship to Mission Strategy

The Mission fully supports Antigua's efforts to improve its basic infrastructure, and in particular its domestic water supply. That demand outstrips supply is clearly evidenced by rationing, which now occurs annually during the dry season. There is, however, no single, simple input which can be added to the present system to meet the identified needs of safe water. The assistance required goes beyond a quick-fix injection of hardware and equipment, but rather requires a comprehensive program incorporating organizational and structural reforms within the Antigua Public Utilities Authority; including restructuring of APUA collection and fiscal policies; a ground water development program; increased storage, transmission and treatment capacity; and a series of institutional development activities to include training, upgrading of maintenance and water analysis capabilities, and completion of a master plan for the island's entire water supply system, and waste water.

The proposed project is also reflective of USAID's strategy to combine more focused bilateral programs with longer term assistance through regional institutions. A direct agreement with Antigua, in this instance, will more quickly and selectively address deficiencies in that country's public water system, and leverage key policy and institutional reforms which are difficult to influence through regional intermediaries. The combination of policy and institutional reforms linked with critical immediate infrastructure development needs makes the proposed project ideal in terms of RDO/C's bilateral assistance strategy.

The Antigua Water Supply project design has incorporated AID policy guidelines set forth in both the Institutional Development and Domestic Water and Sanitation Assistance Policy Papers. In order to achieve the desired objective of financial viability for Antigua's Water Authority, the Project includes necessary organizational and policy reforms to address constraints which have impeded the APUA's effectiveness. Various steps will be taken by the host country to establish a technically and financially viable water utility able to serve the long-term needs of the country.

AID has a long history of support for water and sanitation programs as a fundamental component for broad based economic growth. Certainly Antigua is an appropriate recipient for this type of assistance; demand for water exceeds supply as evidenced by rationing; the current water supply shows evidence of contamination beyond standards acceptable to the World Health Organization; consumers have demonstrated a willingness to support recurrent costs of expanded service; and the country's transportation

and communication facilities will provide sufficient support for an improved water system. In health terms, an adequate supply of potable water is a sine qua non for physical well-being, and hence for the realization of full development potential of the people of Antigua.

The proposed project is supportive of the Caribbean Basin Initiative. Economic growth in Antigua is dependent upon the presence of minimal, but basic, economic infrastructure and it appears certain that the present water supply system will have to be upgraded if it is to provide support commensurate with projected population and economic growth. The Mission's CBI Implementation Plan has identified an insufficient water supply in Antigua as a serious constraint to further development, especially in tourism. The proposed program of activities is designed to more effectively manage one of the island's most critical resources, and provide a water supply adequate to meet Antigua's development needs.

Finally, bilateral ESF assistance to the Government of Antigua and Barbuda is seen by the Country Team as an essential element in our political support for this newly independent nation. By responding to the GOAB's highest development priority, we are underscoring our support for its democratic institutions and free enterprise economy.

B. Objectives

The goal of the proposed project is to establish the physical productive infrastructure essential to achieve a self-sustaining level of economic growth for Antigua.

The purpose of the Project is to assist Antigua in meeting the current potable water demands of the tourism, industrial and domestic sectors, and to assure that the water authority continues to operate on a self-sustaining basis. This will be achieved through a program of activities that will: (1) expand water production; (2) increase transmission and storage capacity; (3) improve water quality; and (4) establish a financially viable Water Authority capable of satisfying water demands of the economy over the long term.

C. Project Elements

The Project will finance the following activities:

1. Water Supply Expansion

In terms of supply, it is estimated that by the end of the Project, the total production capacity will have increased from the present 2.06 imgd to approximately 3.54 imgd. The additional production will derive from ground water development (1.22 imgd), rehabilitation of the Collins Treatment Plant (0.11 imgd) and restoration of the Body Ponds Pump Station (0.25 imgd).

a. Ground Water Development

The ground water development program consists of the rehabilitation of existing and inoperative wells, and the redrilling of wells where necessary. It is estimated that this program will add approximately 1.22 imgd to the present water supply. There are a total of 61 APUA-owned and

five privately-owned water wells located in Antigua, 24 of which are operating, 34 inoperative and 8 that are plugged or collapsed. Operating well discharges reportedly range from 13 to 40 igpm, with a total estimated capacity of 550 igpm for producing APUA wells. The estimated potential capacity of the inoperative APUA-owned wells, is 1.2 imgd once they have been rehabilitated or redrilled and are fitted with new submersible pumps.

Although corrosion is doubtless occurring in Antiguan wells, no extensive instances of well corrosion or collapse are apparent. The principal well problem appears to be the difficult redevelopment of the torch-slotted casing in non-screened wells. Rehabilitation will include pump removal, wire brushing, scrubbing, bailing, air-lift pumping and turbine pump discharge and aquifer tests. Additionally, ten piezometers will be installed near the seaward end of Christian and Bendals Valleys in order to monitor possible sea water intrusion. During the period of time it takes to rehabilitate 32 inoperative wells, it is probable that some currently producing wells will become inoperative and require redrilling. The Project thus allows for construction of 20 new replacement wells at sites where rehabilitation proves ineffective or insufficient.

Construction time for the well rehabilitation program is estimated at 26 months, with AID financing totalling \$1,650,000.

The original project design included two additional ground water development activities: recharge of Bendals Valley aquifers and limestone harvesting. The Bendals Valley activity was deleted when recent tests at the proposed recharge area showed soil conditions non-conducive for percolation. The limestone exploration/development activity was also deleted because costs of its implementation were increased significantly in the final consultant report, including the potential need for a water treatment (reverse osmosis) plant. (See more detailed description in Technical Summary, Section VI.A).

b. Other Sources

Two other minor potential sources of water were identified: increased yield from the Collins Reservoir by rehabilitating its associated treatment plant and utilizing water from Body Ponds by restoring a pumping station. These sources are discussed in sections 4a and 2d below.

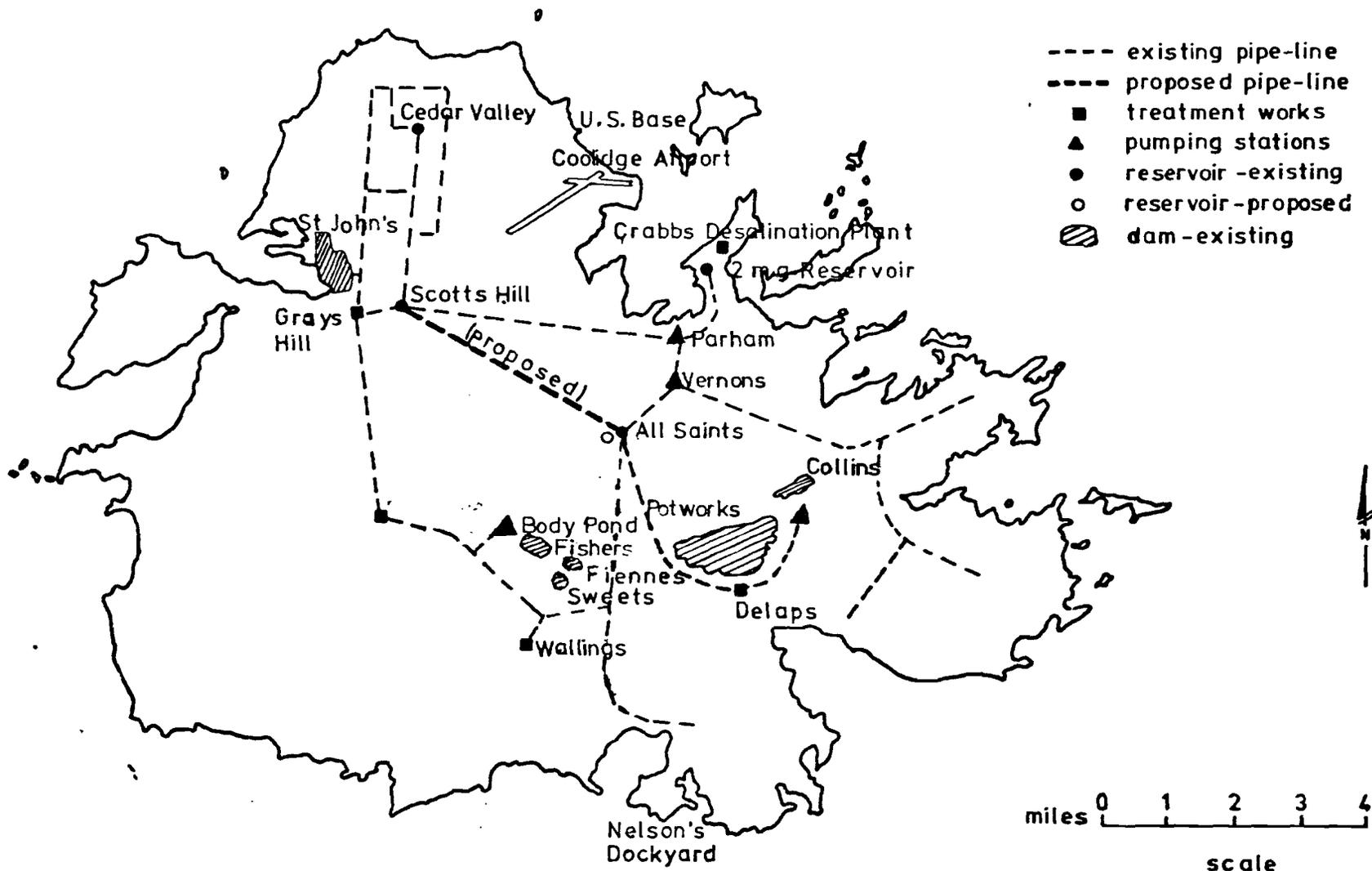
2. Transmission and Storage

In addition to developing new sources of water, some parts of the present distribution system, will have to be restored in order to operate at rated capacity and others upgraded to handle the increase in water supply. This component includes four separate activities which will increase delivery capabilities of the APUA water supply system:

a. Pipeline from All Saints to Scotts Hill

The Delaps Plant which treats all water supplied from Potworks Reservoir, has a rated capacity of 201 imgd and currently delivers 0.9 imgd of treated water to the All Saints Reservoir. Water then flows from this reservoir, which has a capacity of 400,000 imperial million gallons, by gravity via a 12-inch main to a booster pump station at Parham where it is

ANTIGUA POTABLE WATER SUPPLY SYSTEM



transmitted by a continuing 12-inch main to Scotts Hill and Cedar Valley reservoirs (see map). Each of these reservoirs has a capacity of 400,000 igal and supply the distribution system of the capital city, St. John's. Scotts Hill water can also be delivered by gravity via an 8-inch pipeline to the 2.64 imgd Grays Hill reservoir, another source of supply for the St. John's area.

Due to the capacity limitation of the All Saints-Parham-Scotts Hill pipeline (less than 1.0 imgd), the requirement for an in-line booster station, and the badly corroded condition of some pipeline sections, it is imperative that an alternative pipeline be constructed between All Saints and Scotts Hills reservoirs. Under the proposed project a new pipeline between these two reservoirs will be laid largely within an existing 40 foot right-of-way following the All Saints Road. The pipeline would be approximately 5.4 miles in length and permit all gravity flow between the two reservoirs. It is also proposed to size this pipeline to permit a flow of 2.1 imgd so that Delaps Water Treatment Works can operate at rated capacity. This will require an 18-inch diameter pipeline. The long-term yield of Potworks Reservoir is approximately 0.9 imgd but seasonal variations would allow the Delaps Water Treatment works to be operated over periods of time at its rated capacity, and this should be taken advantage of whenever possible.

The estimated cost of the All Saints-Scotts Hill pipeline activity is \$1,650,000.

b. Additional Storage at All Saints

Existing reservoir storage at All Saints consists of one circular reinforced concrete tank, volume 400,000 igal. Additional storage is needed at All Saints to enable more effective operation of the Delaps Water Treatment Works and also provide year 2000 storage requirements for all areas served by pipeline from All Saints. The total requirements for this storage is approximately 2.0 mil igal which would be met by the addition of 1.6 mil igal of storage to the existing 0.4 mil igal reservoir. An alternative would be to relocate the 2.08 mil igal circular welded steel tank at the Crabbs Peninsula Seawater Desalination plant site which is not currently being used. The 2.08 mil igal steel tank was constructed in conjunction with the Crabbs Peninsula Seawater Desalination Plant in 1970, which has now been abandoned. The reservoir and associated facilities would occupy approximately one acre.

Loan funds of approximately \$700,000 are budgeted under the proposed project for the installation of a new 1.6 mil igal storage tank at All Saints or the relocation of the Crabbs Peninsula tank, whichever proves most economically feasible."

c. Sea View Farm Pipeline

The village of Sea View Farm is a community of some 1,000 persons, consisting of low to moderate income housing and lying approximately half way between All Saints and St. John's, just off the main road connecting these two cities. It's water supply is currently provided by a 4-inch cast iron pipeline, 10,000 ft. in length, from All Saints. Service pressures are very low. Since the existing streets of Sea View Farm are all concrete paved and very narrow, the project will finance a shorter transmission main from the 18-inch All Saints-Scotts Hill pipeline (described above) to the edge of town where it will interconnect with the existing 4-inch

distribution main. The new 2000 foot transmission pipeline into Sea View Farm will be 6" PVC, and will enable delivery of water adequate to meet the year 2000 maximum day demand estimated at 40,000 igal. The estimated cost of the Sea View Farm pipeline is \$60,000.

d. Rehabilitation of Body Ponds Pump Station

The Body Ponds catchment area consists of approximately 2,200 acres located in the central southeast area of the island. This catchment area receives some of the highest rainfall in Antigua with runoff conditions generally favorable for both quality and quantity of surface flows. Body Ponds includes the Fishers, Fiennes and Sweets reservoirs which have a total storage volume of approximately 100 acre feet.

Water from these three reservoirs is collected in the Body Ponds sump and transmitted to Grays Hill via an alternately a 6-inch and 8-inch cast iron and asbestos cement main. The main also collects impounded water from four dams west of the Body Ponds area. Raw water is pumped from all the reservoirs to Grays Hill where it is treated and then passed into service reservoirs. The long-term yield of these combined sources is estimated at 0.25 imgd.

The existing Body Ponds Pump station is located at Body Ponds sump. It was previously equipped with two diesel driven pumps with a total capacity of about 0.27 imgd. An electrically driven submersible pump rated at 0.12 imgd was installed in recent years. The diesel driven pumps are no longer usable and the pump station is in need of rehabilitation for sustained usage.

Under the proposed project, a new Body Pond Pump Station will be constructed at the present site with the capacity to provide an average flow of 0.29 imgd and intermittent flows of 0.43 imgd. A floating surface intake and 700 ft. of 6-inch pipe will be installed from Fishers Dam to the new pump station. The Body Pond sump generally contains heavy growth and stagnant water, and Fishers Dam would be a more suitable location for the intake. The pump station design will contain provision for four pumps, including one standby, each of 100 gpm capacity. This will result in an average addition of approximately 0.2 imgd to the present water supply. In terms of conjunctive use, the operation of Body Ponds at peak capacity during periods when reservoir water is abundant, will allow APUA to decrease use of ground water sources and permit the recharge of these aquifers.

The estimated AID financing for this activity is \$250,000.

3. Potworks/Delaps Restoration

Following the five year drought which ended in 1969, Potworks dam was constructed for the purpose of increasing the public water supply. Potworks Reservoir is now the largest impoundment in the APUA system and accounts for 80% of the total island surface water storage. It has a total volume capacity of 1000 mil igal and a rated supply capacity of 2.1 imgd.

Water is drawn from Potworks Reservoir through pipes in the dam to a pumping station on the downstream side of the dam. From there the

water is pumped to the Delaps Water Treatment Works where it is coagulated, settled, filtered and chlorinated. Treated effluent is then pumped through a 15-inch main to All Saints Reservoir which has 400,000 gal capacity. From All Saints the water flows by gravity through a 12-inch main to Parham Pumping Station. From Parham, the water is pumped to Scotts Hill Reservoir which also has a capacity of 400,000 gal. An 8-inch main then transports the water by gravity to Grays Hill Reservoir, from which point it enters the St. John's distribution system.

The Potworks draw-off structure has three 8-inch draw-off pipes that pass through the dam and discharge water through a valve structure immediately downstream which controls discharge into the 15-inch suction pipe to Potworks Pumping Station. These downstream pumps have been clogged with fish and debris from the reservoir, prompting APUA personnel to install perforated plates in the suction lines of each pump. The situation is highly problematical as each pump is rated at 1 mgd, and the loss of any one of the three would be significant.

To prevent clogging and help ensure uninterrupted operation of the pumps, stainless steel screens will be installed over the three 8-inch draw-off pipes. To provide the pumping station operator with access for cleaning the screens, a permanent walkway from the dam to the draw-off structure will be constructed. The walkway will be provided with a gate to prevent access to the draw-off structure, and chains and padlocks provided for each sluice valve and gate, as well as for the screens, to prevent their unauthorized operation.

The U.K. financed construction of the Delaps Water Treatment Works was completed in 1975. It has a rated plant capacity of 2.1 mgd, but routinely operates at half that flow rate. The designed treatment sequence proceeds from aeration, to flash mixing, sedimentation, filtration, disinfection and finally storage of the treated water. Three turbine pumps lift water from the clear water tank through a 15" pipeline to All Saints Reservoir 3.7 miles to the west.

There are various problems and deficiencies with the present treatment process for which the Project will finance the following:

- . installation of a flash mixer unit to optimize initial mixing;
- . replacement of filter media;
- . installation of new chlorine manifold piping and new automatic switchover unit;
- . installation of new chemical feeders;
- . installation of chlorine gas leak detectors;
- . re-equipment of the laboratory for basic analyses of plant performance and operation requirements;
- . installation of on-line turbidimeters;

- . re-establishment of pumps and lines for collection of samples;
- . recalibration of plant flow rate and level of monitoring;
- . replacement of pump flow rate indicators and pressure gauges on pumps as necessary.

These improvements will provide the Delaps Treatment Plant with the capability of operating at its design capacity of 2.1 mgd.

The estimated cost of this component is \$270,000 of which \$75,000 is for the construction costs of improvements to the Potworks Reservoir facility.

4. Water Treatment Improvements

In addition to the Delaps Water Treatment Works, the APUA operates three other plants that provide filtration and treatment of surface water. These require replacement or rehabilitation to restore their operating efficiency and water treatment effectiveness.

a. Collins Water Treatment Works

The Collins Reservoir was constructed in 1966 and is located immediately northeast of Potworks Reservoir. The 906 ft long earth fill dam now impounds a maximum of 330 ac. ft. following modifications in 1967 to raise the dam and spillway elevation. Two 16 inch draw-off pipes extend from the reservoir's intake tower to the valve box on the downstream face of the dam adjacent to the treatment plant. The exact age of the Collins treatment plant is not known, except that it is at least 13 years old.

The Collins Water Treatment Works is supplied from Collins Reservoir by the two 16 inch pipes referred to above. The long-term safe yield of Collins Reservoir is reported by PAHO to be 150,000 igpd. The original Collins plant has been out of service for a number of years. The inactivity of the facility is clearly apparent by the weeds growing through the filters and the generally poor condition of the sedimentation basins. Originally the plant provided alum addition at the influent, three basins for sedimentation, and filtration and chlorination. There appear to have been three sand filters with a total area of 178 sq. ft., although presently only two are equipped with media. The third filter is now used as a sump for collecting the dam's underflow. In order for the reservoir to operate at its safe yield of 0.15 mgd, the sedimentation basins would have had to operate at an overflow rate of 1,463 igpd/sq. ft. The filters, in turn, would have had to operate at a filtration rate of 864 igpd/sq.ft. These rates are too high for this facility; without any equipment for backwashing (which Collins does not appear to have), the plant would have to operate a slow sand filter process, which commonly has a rate between 14-173 igpd/sq. ft. In short, the process capacity of the original Collins plant was probably in the range of 10,000 igpd to 25,000 igpd.

There is also a leak at the valve structure where the two 16-inch pipes terminate, and the water now flows into a ditch where it crosses the road a half mile below the dam. The APUA has placed a shallow-set

submersible pump in the ditch in an effort to try and recover some of the flow, discharging it into what was formerly the No. 3 filter.

These and other broken or inoperable elements of the Collins Water Treatment Works make it evident that the plant is beyond restoration and needs complete replacement. The basins and gravity filters are all too small to extract the safe yield from the reservoir. The pressure filters, in addition to being too small, may be of little value in the future during times of high influent turbidity without upstream sedimentation basins.

The Project will finance the purchase and installation of a new package treatment plant with a rated average capacity of 0.15 imgd and a peak capacity of 0.30 imgd. The package plant includes chemical storage and feeding, flash mixing, flocculation and sedimentation units. This will enable the treatment of the safe yield from Collins Reservoir and additional water at times when it is more abundant in supply, which will enable APUA to rest and recharge ground water sources. The plant's chlorination system will be sized to disinfect not only the effluent from the treatment plant, but also the water from Collins and Bristol Springs well (about 0.35 imgd).

b. Grays Hill Water Treatment Works

The Grays Hill plant is located immediately south of St. Johns, and is one of the primary facilities for providing potable water to the capital area. It has a rated capacity of 300,000 igpd and, by 8-inch main, receives water from several impoundments - Body Ponds, Hamiltons Dam, Diamond Hole, Bendals Pool, Dunnings Dam and the two Brecknocks dams.

Alum is mixed by hand at the plant inlet; there is no rapid mixed nor any flocculation basins. The water flows into two sedimentation basins and then through two slow sand filters, and on into the lower Grays Hill Reservoir. Chlorination takes place in the Reservoir by blending the effluent from the treatment plant with the chlorinated well water from Bendals and Christian Valleys. Although there are two chlorinator units at Grays Hill, both are inoperative, so that disinfection takes place by the manual addition of calcium hypochlorite.

The Grays Hill Water Treatment Works is very old and in need of many improvements. In a 1965 report, PAHO reported "the filter walls leak, the filter sand is beach sand. On a trial run, samples of raw and filtered water showed no change in the B. (sic) Coli count. The surface water, when available is so muddy that 20 percent is wasted when the settling tanks are blown down every hour."

To upgrade the capacity for water treatment at Grays Hill, the Project will finance the installation of a new package plant which will include flash mixing, flocculation, sedimentation, filtration, chemical coagulant storage and feeding, and instrumentation for controls. The treatment plant is equipped with provision for backwashing of the filters. The package plant will be housed in a new facility which will include a chlorine contact tank and clearwell, flow metering for both raw surface and well waters and a chlorination system.

The Grays Hill WTW is important to the overall water supply of Antigua. Properly upgraded, it will have the capacity to treat 20%

of the island's total existing water production. AID-financed improvements to this facility will increase the rated plant capacity to 0.5 imgd, with a maximum hydraulic capacity of 1.0 imgd which will enable treatment of additional surface water captured when abundant. In addition, the treatment plant's chlorination system will be sized to disinfect not only the plant effluent but also the numerous well waters which converge at Upper Grays Hill Reservoir. These well water long-term yields are estimated at 1.4 imgd, and together with the surface water yield of 1.0 imgd, will provide Grays Hill with the capacity to produce 2.4 imgd of chlorinated water.

c. Wallings Water Treatment Works

The Wallings WTW receives its raw water from Wallings Dam, which was constructed in 1980, and has an estimated safe yield of 150,000 igpd. The 13 mil igal reservoir also stores raw water pumped up from Fig Tree Dam (0.6 mil igal).

As at Grays Hill, influent at Wallings Treatment Plant receives alum addition by hand, then flocculation, sedimentation and filtration, passing into an underground clearwell where chlorine is added.

Project-financed improvements to the Wallings facility will include new chemical storage and feeding system, rapid mixing, complete rehabilitation of the sedimentation basins and filters, new filter backwashing and air scour equipment, new chlorination system, new roof for the building, hatch cover to prevent contamination of filtered water in the clear well, construction of handrails at miscellaneous locations for operator safety, provision for water meters and pressure gauges, and other miscellaneous piping, valving, electrical, and structural improvements. A pH correction feeding system (i.e. lime) will also be installed to adjust the acidic water received from Wallings Dam caused by the collection of leaves and humic debris at the gate structure. The rated capacities of the restored Wallings Water Treatment Works will remain at 0.15 imgd. The installation of a new chlorinator system, however, will increase this capacity from 0.30 imgd to 0.40 imgd, and permit chlorination of any well water which may be pumped into the system.

The estimated total cost for the Water Treatment Improvement component is \$1,191; \$450,000 for replacement of the Collins Treatment Plant; \$550,000 for the replacement of the Grays Hill Facility; and \$191,000 for the restoration of the Wallings WTW.

5. Institutional Development

The above four components will address increased production in Antigua's water supply system and the physical capacity to deliver safe water to consumers. The fifth component will address the institutional capabilities of the Antigua Public Utilities Authority and the laws, regulations and policies that govern its operations. The activities financed under this component will enable the APUA to operate as a self-sustaining authority at the end of project assistance, and at the same time to administer a potable water system which will have increased supply by 77%.

a. Powers, Laws and Regulations

Of foremost importance are certain basic institutional reforms which will have to take place in order for project inputs of technical assistance, training and equipment to produce any meaningful or lasting improvements. Accordingly, the Project will encourage and support the following, either by conditions and covenants contained in the Project Agreement (see section VII) or directly through technical assistance:

- . Develop comprehensive regulations applicable to APUA and its customers and applicants for service, which will be presented to the Board of Commissioners and the Minister for review and official approval.
- . Develop detailed regulations for extending the water supply system to serve new developments and customers. These will be designed to protect APUA from undue future financial obligations and water service problems and would require the same approval authorization as the utility regulations.
- . Develop comprehensive rules dealing with personnel administration. The rules will include conditions of employment, a description of fringe benefits, disciplinary and grievance procedures, salary administration program, union regulations and other procedures pertinent to personnel administration. These rules will also be submitted to the Board of Commissioners for review and approval.
- . Analyze and evaluate establishing a formal entity to control the utilization of the country's water resources and to monitor the quality of water resources. Consideration will be given to establishing a water resource control committee within the APUA with representation from APUA, the Ministry of Agriculture and the industrial commercial sectors. The enabling act permits such committees in Section 10 of the First Schedule of the 1973 Act.
- . Review Act No. 10 of 1973 with the purpose of strengthening and clarifying its conditions, and also, examine the ramifications of Section 26.9 regarding the majority vote requirements (See Annex F.5). Any proposed changes in the act would be presented to government for consideration.

The above activities all relate to the existing APUA enabling legislation, the "Public Utilities Act, 1973". The proposed improvements are required within the terms and provisions of the Act, or are a discretionary power provided by the Act.

b. Technical Assistance

Approximately 78 person months of technical assistance will be provided for development of the Water Division's institutional skills. (Additional assistance will be provided under the construction management activity). At least seven long and short-term specialists will assist APUA personnel in the following areas of operation (See Annex F.10 for detailed list of technical assistance):

(1) Organization and Management

Institutional advisors will offer assistance on a wide array of organization and management procedures. The chart in Annex F.6 shows the present organizational structure, which is at variance with the organization as described in the enabling legislation. The advisors will assist management in developing the most workable and practical organization plan for the Water Division and its support units within APUA. The advisors will evaluate the sufficiency of all internal systems, procedures and controls. Areas of assistance will include general administrative activities, board action files, personnel administration, procurement, storekeeping, general accounting, and billing and collecting and complaint processing.

Technical advisors will assist in preparing detailed job descriptions for each job classification involved in water utility activities showing specific functions and duties within the organizational structure. The advisors will assist in analyzing salary range programs for salaried and weekly-paid staff in order to develop salary structures that are compatible with respective responsibilities and technical skills. Special attention will be given to any inequities that may exist between weekly-paid and salaried staff, and salary scales that are not competitive in the local labor market. Various incentive plans will also be studied and analyzed to determine their applicability. The proposed program includes various training components designed to provide the broadest possible training exposure throughout the organization. During the two-year institutional assistance program, the advisors will continually provide training plus help to establish a permanent APUA training program.

Advisors will assist in the planning and design of information systems geared toward providing timely and essential data for management review, decision-making and planning purposes. Meaningful management information may include: classification of water services, production and loss calculations, water costs, financial statements and budget comparisons, leak and maintenance reports, staffing reports, construction progress, and cash flow reports. A system to provide monthly progress reports to the Board of Commissioners capsulizing this information will be developed.

Advisors will assist in developing a program to fill middle management positions with qualified personnel in order to strengthen the division's management, control and productivity. A public sector advisor will develop an affordable and structured program to promote public information dissemination and improvement of the APUA image throughout all public sectors.

Improvement of employee morale and elimination of other low motivating forces will pay big dividends to APUA in improved service and reduced costs. The public and internal relations programs will assist in

improving morale, and generate better productivity and higher efficiency.

(2) Revenue Collecting

The full realization of all revenues due APUA is essential to the implementation of institutional improvements and to allow movement towards financial viability and a true semi-autonomous operation.

Precedent to any viable collection enforcement program is the establishment of a clearly-stated policy by APUA and the Government of its intention to collect all legitimate bills for water service. Very few exceptions should be allowed in the collection enforcement policy and, if exceptions are necessary, they should be clearly described and defined. If long-overdue accounts or disputed accounts are to be forgiven, an itemized compilation of the exemptions should be prepared and submitted for approval.

Advisors will assist in the development of a workable enforcement program that will achieve the desired results in an acceptable time frame. It is estimated that all water accounts could be brought to a current basis within 12 to 24 months after commencing the planned program. The advisors will analyze the benefits of using special meter valve locking devices over the present system of removing meters and plugging service lines.

It is estimated that about 50 percent of the installed water meters are inoperative or are estimated due to meter-reading problems. The advisor will assist in a thorough analysis of the problem and will develop a planned program to correct the deficiencies within a reasonable time frame. This will include a corrective metering program budget and projection of increased revenue benefits. The 2,000 standard Kent meters furnished by the BDD and the 4,000 meters included in this program will be utilized to implement the corrective program. A controlled monitoring program for the collection enforcement and metering activities will be developed to:

Assure that disconnection orders are fully implemented;

Make sure that disconnected customers do not illegally reconnect;

Determine if customers are illegally selling water to disconnected users; and

Make sure that all inoperative meters are included in the corrective program, and that operating meters are recorded accurately.

Other acceptable sources of revenue, including higher reconnect charges, adjusted meter rental fees and connection charges, or "buy in" assessments, for new service connections will also be evaluated.

(3) Records and Planning

Sufficient and accurate engineering and system data are essential to the planning and operational activities of the Water Division.

Many basic data are unavailable and are being permanently lost through lack of adequate recording systems. Consequently, advisors will directly assist in developing a basic, uniformly-scaled mapping system of the underground and above-ground water facilities. Transfers will be made of all data available on existing "as-built" drawings and from information developed through field investigations and discussions with knowledgeable present and past APUA staff. A program of mapping will be established identifying labor needs, costs, mapping techniques, target dates, and map up-dating procedures.

A coded work order system will be developed for all construction activity involved with the water utility plant as will systems to provide complete information on project construction activity. Advisors will also develop procedures to process and properly record all new service applications. Accurate records will be maintained on all installed water connections for engineering statistical reasons, maintenance and relocation work, and as controls for water billing procedures.

A master plan of the APUA water system will be developed. The engineering master planning advisor will review the existing reports, maps and data on the distribution system and evaluate key facilities within the system to determine their condition and functional capability. Existing water use data will be reviewed along with past and projected population and land use plans to determine future water requirements. An operational study will be conducted of sources of supply, treatment facilities, transmission lines, pump stations, and service reservoirs to determine deficiencies and develop an overall operational guideline for APUA. Engineering and hydraulic analyses will be conducted of existing water transmission, distribution and storage systems to determine capability to serve present and future demands. Future facility requirements, together with phased improvement programs, will be developed.

(4) Operations and Maintenance

The advisors will provide assistance in all areas of water system operations, including water treatment plants, well stations, booster pumping stations, storage facilities and the use of controls and special operating devices. Besides these overall activities, assistance will be provided in: developing daily demand requirements and the scheduling of production from the various supply resources and establishing methods to evaluate total production costs per unit of water produced from the various sources.

Recording and reporting systems detailing essential operating information will be developed and will be used for analyzing operating costs and efficiencies and for management decision making. Logistics support needs will be analyzed and identified.

A water quality specialist will assist in establishing the equipment, supplies and structural needs to provide an adequate water quality laboratory at APUA, and train the Laboratory Technician in the use of equipment and in the systems and procedures needed to monitor water supply quality.

The advisors will provide assistance in all areas of water system maintenance, and in developing achievable preventive maintenance programs. A thorough analysis and identification of support needs to adequately provide timely emergency maintenance and to carry out preventive maintenance programs will be undertaken. Summary of needs and costs will be prepared and presented to management for consideration.

c. Training Programs

Staff training programs are proposed for all levels of staff and all disciplines required to manage and operate the Water Division. A combined program is proposed using several training approaches as follows:

- . On-The-Job Training: The proposed institutional assistance program is scheduled to span over two full years. During this time, the advisors will be working directly with APUA counterparts and their staff in developing and implementing improved systems and procedures. The entire staff of the Water Division should be exposed to direction and assistance from the advisors during the course of the program implementation. The proposed institutional advisors are selected from six differing disciplines paramount to good water utility management.
- . Outside Observation Tours: The program budget includes funds for observation-type training through visits to modern and efficient overseas water utilities of similar size and complexity. The program would include seven participants for an average tour of seven weeks each.
- . International Conference and Meetings: The budget provides for attendance at appropriate conferences by four top management employees for an average duration of one week.

d. Support Equipment and Supplies

The APUA frequently has to rent backhoes and large trucks from the private sector. As renting equipment causes time delays and the utilization of units without control over their operating condition, the budget includes funds for this type of equipment. Also 4,000 5/8-inch x 3/4-inch meters will be provided under the improvement program. These meters, added to the 2,000 Kent meters in stock, would allow replacement of all defective meters and the retirement of outdated and poorly-designed meters. Approximately \$60,000 will be provided to equip and supply a water testing laboratory at APUA and to make needed building modifications.

At the end of the three year program of technical assistance, training and selected inputs of equipment, the APUA will have strengthened its institutional capabilities in terms of skilled personnel, sufficiency of internal systems and revenue collection. By 1986, it should be

operating on a self-sustaining basis and with the capacity to provide a water supply of approximately 3.6 imgd to a residential population of 80,000 people.

The total AID-financed cost for the institutional development component is \$1,700,000. The Government of Antigua will provide an in-kind contribution of personnel, overhead and related support estimated at \$4,460,000.

6. Energy Demonstration Activity

The Project will produce a modest increase in physical energy consumption, primarily as a result of the new pumping undertaken in the ground water development program. Given the high cost of electricity in Antigua, the proposed project will finance an alternative energy demonstration activity which will take advantage of Antigua's relatively high level of solar radiation through the use of photovoltaic power.

The demonstration project will include a photovoltaic pumping system to be installed at Orange Valley, a ground water site with a potential yield of 0.15 imgd. The photovoltaic array of storage batteries for inverted DC to AC power will provide power on a peak demand basis, over a continuous operation period of 18 hours. The batteries require replacement after 5-6 years; all other system components will last in excess of 20 years.

The second demonstration activity will be a photovoltaic cathodic protection system. Many of the steel pipes and casings in Antigua have deteriorated rapidly because of the corrosive affects of the highly salinic and acidic soils in the area. A solar-powered impressed cathodic protection system, incorporating several small photovoltaic modules, will be installed with five well heads with metallic casings to demonstrate its anti-corrosive affect.

The total cost of the photovoltaic energy demonstration activity is \$60,000 which will be financed with AID grant funds.

III' COST ESTIMATES AND FINANCIAL PLAN

Of the total \$9.7 million provided by AID, \$6,625,000 will be loan funds and \$3,075,000 grant funds. The Loan will be made at the Agency's most concessional terms (2% during a ten year grace period, 3% during a 30 year amortization period). The loan funds will be used to finance the construction costs of the well rehabilitation program and the replacement/restoration of water treatment plant facilities. The grant monies will finance construction management and engineering services, technical assistance, training, support equipment an energy demonstration program and evaluation.

The Government of Antigua contribution of approximately \$4,750,000 will be entirely in-kind. The contribution towards the construction component of the Project will largely be for the acquisition of land or easements required for the installation of transmission pipeline, storage tanks, treatment plants or other water facilities. The \$20,000 for survey and evaluation will be for various bacteriological analyses that will be carried out by the Ministry of Health during the course of the Project. The rest of the counterpart contribution will be the operating expenses of the APUA Water Division over the life of the Project (a three year period).

A' Recurrent Cost Financing Capability

Concessional loan terms were granted to Antigua in recognition of the Government's current payment difficulties. While APUA will be able to amortize the AID debt, the GOAB would be hard-pressed to make U.S. dollar payments for debt on terms harder than those proposed.

At year end 1981, the external public and publicly-guaranteed debt of Antigua amounted to \$58 million, or 46 percent of GDP, having increased at an annual rate of almost 30 percent over 1977-81. Nearly 70 percent of the foreign borrowing in the five year period was at commercial terms, principally for the purchase of generators for the Antigua Public Utilities Authority and for the construction of hotel facilities. Consequently, Antigua's debt service has risen from 2.3 percent of export earnings in 1977 to an estimated 7.9 percent in 1981. Also, the country's current account deficit has jumped from three percent of GDP in 1977 to 45 percent in 1981 with the cumulative balance of payments deficit of \$1.4 million financed entirely by borrowing from the East Caribbean Currency Authority (ECCA).

Antigua is in arrears on loans from the Caribbean Development Bank (CDB), the U.K., and the United States. (See Annex H). In addition, the Government is considering construction of several large hotels that may cost as much as \$200 million. While a good portion of that funding would come at soft terms, some would be provided at hard terms by commercial banks.

In assessing the GOAB's ability to finance recurrent costs of the APUA Water Division, and to pay back the \$6.625 million AID loan, the following were taken into consideration: First, as a precondition for securing the funds to be furnished under this project, Antigua rescheduled its payments on the EXIM Bank loan debt and is committed to commence repayment on that debt. The commitment represents a decision to take the steps required to put the country's finances back in sound order. Second, even though the country's debt-servicing requirements have been increasing, they were still modest as of year end 1981. Third, the manner in which the East Caribbean Currency Authority (the monetary authority for Antigua's currency) operates will help ensure Antigua's financial integrity. ECCA has a cover ratio

requirement which stipulates that it hold foreign assets equal to 60 percent of deposit liabilities, and also imposes limitation on security sales to it by member governments. These requirements will assist the GOAB in improving carrying out fiscal discipline measures. Last, Antigua has strong tourism and manufacturing sectors and the medium-term outlook for these sectors is reasonably bright. Strong performances on the part of these two sectors will have a significantly positive impact on foreign exchange earnings.

On balance, the medium term economic outlook for Antigua together with the recent debt-servicing commitments undertaken by the GOAB, indicate an ability on the part of the Government to finance recurrent costs in the operation of its Water Authority and to repay as scheduled the \$6.625 million AID loan. However, maximum concessionality is recommended.

B. Summary Cost Estimates

All Years \$000

SOURCE	AID		HOST COUNTRY		TOTAL
	FX	LC	FX	LC	
I. <u>Construction</u>¹					
A. <u>Ground Water Development</u>					
Well Rehabilitation Program	1350	300		50	1700
B. <u>Transmission and Storage</u>					
All Saints-Scotts Hill Pipeline	1350	250		-	1600
All Saints Reservoir	650	50		100	800
Sea View Farm Pipeline	50	10		50	110
Body Ponds Rehabilitation	125	125		50	300
C. <u>Potworks/Delaps Restoration</u>					
Potworks Reservoir	75			-	75
Delaps Water Treatment Works	190	5		-	195
D. <u>Water Treatment Improvements</u>					
Collins WTW Replacement	400	50		20	470
Grays Hill WTW Replacement	500	50		20	570
Wallings WTW Restoration	176	15			191
II. <u>Professional Services and Training</u>					
A. Survey & Geotechnical	60	5		-	65
B. Engineering Design	420	-		-	420
C. Construction Management	565	60		-	625
D. Technical Advisory Services	1143	-		-	1143
E. Training	80	-		-	80
III. <u>Equipment</u>					
A. O&M Equipment	160	-		-	160
B. Water Meters	160	-		-	160
C. Laboratory Equipment	60	-		-	60

SOURCE	AID		HOST COUNTRY		TOTAL
	FX	LC	FX	LC	
IV. <u>Personnel & Overhead</u>	-	-		4440	4440
V. <u>Energy Demonstration Program</u>	60	-		-	60
VI. <u>Survey & Evaluation</u>	60	5		20	85
TOTAL CAPITAL COSTS	7634	925		4750	13309
INFLATION	1003	138		-	1141
PROJECT TOTAL	8637	1063		4750	14450

- 1) Construction costs include contractor's overhead and profit (20 percent), contingency (10 percent), and freight and insurance of imported equipment (15 percent). Construction costs are representative of U.S. contractors working in Antigua using local materials and labor, as available. Costs are indexed to March 1983.
- 2) Should the existing steel storage tank presently located at Crabbs Peninsula be used as the new reservoir at All Saints, the GOAB contribution would increase by approximately \$400,000, or the present value of that tank.

C. Projected Disbursements of Loan and Grant Funds

Project Year (\$000)

COMPONENT	1	2	3	TOTAL
<u>I. Construction</u>				
A. Ground Water Development	650	550	450	1650
B. Transmission and Storage				
1. All Saints/Scotts Hill Pipeline	1100	550	-	1600
2. All Saints Reservoir	150	450	100	700
3. Sea View Farm Pipeline	-	-	60	60
4. Body Ponds Pump Station	90	80	80	250
C. Potworks/Delaps Restoration				
1. Reservoir	-	-	75	75
2. Water Treatment Plant	-	195	-	195
D. Water Treatment Improvement				
1. Collins Plant	200	250	-	450
2. Grays Hill Plant	250	300	-	550
3. Wallings Plant	191	-	-	191
LOAN SUBTOTAL	2631	2325	765	5721
<u>II. Professional Services and Training</u>				
A. Survey & Geotechnical	22	22	21	65
B. Engineering Design	420	-	-	420
C. Construction Management	250	190	185	625
D. Technical Advisory Services	760	443	-	1203
E. Training	20	40	20	80
SUB TOTAL	1472	695	226	2393

COMPONENT	1	2	3	TOTAL
III. <u>Equipment</u>				
A. O&M Equipment	160	-	-	160
B. Water Meters	-	160	-	160
D. Laboratory Equipment	60	-	-	60
SUB TOTAL	220	160	-	380
IV. <u>Survey & Evaluation</u>	20	15	30	65
GRANT SUB TOTAL	1712	870	256	2838
TOTAL CAPITAL COSTS	4343	3195	1021	8559
V. INFLATION FACTOR	346	530	265	1141
PROJECT TOTAL	4689	3725	1286	9700

IV. IMPLEMENTATION PLAN

A. Project Schedule

A detailed project implementation plan network is presented below. The overall project will be completed by March, 1986; 36 months following signature of the Project Agreement. While this schedule may appear optimistic, the individual project activities in themselves are not particularly complex. However, management of the number of activities which will occur simultaneously would severely tax the limited current capacity of APUA. Therefore, project funds will be used to augment APUA's absorptive capacity as well as provide technical assistance to that institution. With this additional management assistance, the Project can be completed within the PACD.

The procurement and implementation of each major activity under the Project is discussed below.

B. Implementation and Procurement Plan

1. Professional Services

(a) Project Consultant

Major responsibility for the management of project procurement and construction and the provision of technical assistance will fall upon the overall Project Consultant. Procurement of the consultant will begin immediately following signature of the Project Agreement and will be implemented in conformity with AID procedures for host country contracting. With publication of a prequalification notice in April, 1983, it is anticipated that the consultant team will arrive in Antigua by September, 1983.

The first major activity of the consultant will be to prepare a detailed time-phased implementation plan for the Project and to initiate well-drilling activities. The consultant contract will run to the PACD to assure proper day-to-day monitoring of project activities.

The Project Consultant contract will contain two major elements of work: engineering design and supervision and technical assistance and training. Under engineering services, the consultant will:

- (i) prepare final construction plans, specifications, cost estimates and bid documents for all project funded construction;
- (ii) supervise and coordinate all project funded construction;
- (iii) prepare all necessary reports on construction progress and certify payments;
- (iv) prepare final equipment lists and specifications for project funded equipment to be procured following the arrival of the consultant;

- (v) act as a procurement agent for APUA for AID funded equipment as directed by APUA and RDO/C;
- (vi) provide APUA staff with necessary training in the operation and maintenance of major equipment provided under the project and all rehabilitation on new facilities constructed during the project.

Under the technical assistance component of the project, the consultant will provide long and short term expertise needed to upgrade the management and operations of the Water Division of APUA including assistance in:

(i) Organization and Management: A long-term advisor will work with APUA to develop among other things a revised organizational structure for APUA, assignment of functional responsibilities within the Water Division, development of a management information system, and development of a middle management improvement program.

(ii) Operation and Maintenance: A long-term advisor will assist in improving the day-to-day operation of the Water Division, including: preparation of the operating principles and procedures of the operating principles and procedures for the Water Division, installation of a routine maintenance program, and definition of personnel policies.

(iii) Financial Management: A long-term advisor will work with the accounting department to improve water billing and collection procedures, develop financial information systems, install a cost accounting system with a financial planning component, improve inventory control and procurement procedures.

(iv) System Master Plan: Up to one year of assistance will be provided to develop base-line data and detailed information on the current over all system. These data will then be used to prepare a master plan including a time-phased plan for the continued growth of the water supply, treatment, storage and distribution systems. In addition, the waste water/sewerage situation will be reviewed and recommendations made with regard to the possible development of a sewerage system for Antigua.

(v) Water Quality Testing and Monitoring: A program of water testing (bacteriological and chemical) will be developed and installed, including upgrading of the skills of the current water technician and provision of testing equipment.

(vi) Public Relations: Guidelines will be provided in improving customer relations, including accounts management, handling of complaints, and improving APUA's public image.

(vii) Training: Training will be provided through on-the-job training, in-country seminars, and outside observation tours and seminars.

(b) Project Coordinator

A full-time project coordinator will be contracted under a personal services contract with APUA to augment APUA's management capability

during the Project. It is anticipated that the Caribbean Fund for Technical Cooperation (CFTC) will fund the project coordinator through CY 1983 with the Project funding the individual for the balance of the Project. It should be noted that the current CFTC-funded advisors to the Water Division will continue to provide assistance and will be integrated into the Project.

(c) Well Drilling Services

It is anticipated that one master driller, two mechanics/welders and local assistance will be contracted under the Project (loan-funded) to take the major role in well drilling as well as train Antiguan counterparts. These individuals will be under contract to APUA and will begin work following completion of the definition of the detailed well drilling plan to be prepared under the Project consultant contract (approximately November, 1983).

2. Equipment

(a) Well Drilling Equipment

To permit the critical well drilling element of the Project to begin as soon as possible following the preparation of the well drilling program by the project consultant, the procurement of the well rig, associated equipment, and initial consumable items will be initiated as soon as possible. RDO/C will seek assistance from AID/W to finalize the equipment specifications following which APUA will issue the appropriate Invitation for Bids. IFBs will be issued to permit arrival of the well drilling equipment by October, 1983. In addition to well-drilling equipment, a portion of the equipment necessary to support the institution building aspect of the Project (such as water meters, backhoe, vehicles) may also be included in this initial equipment IFB.

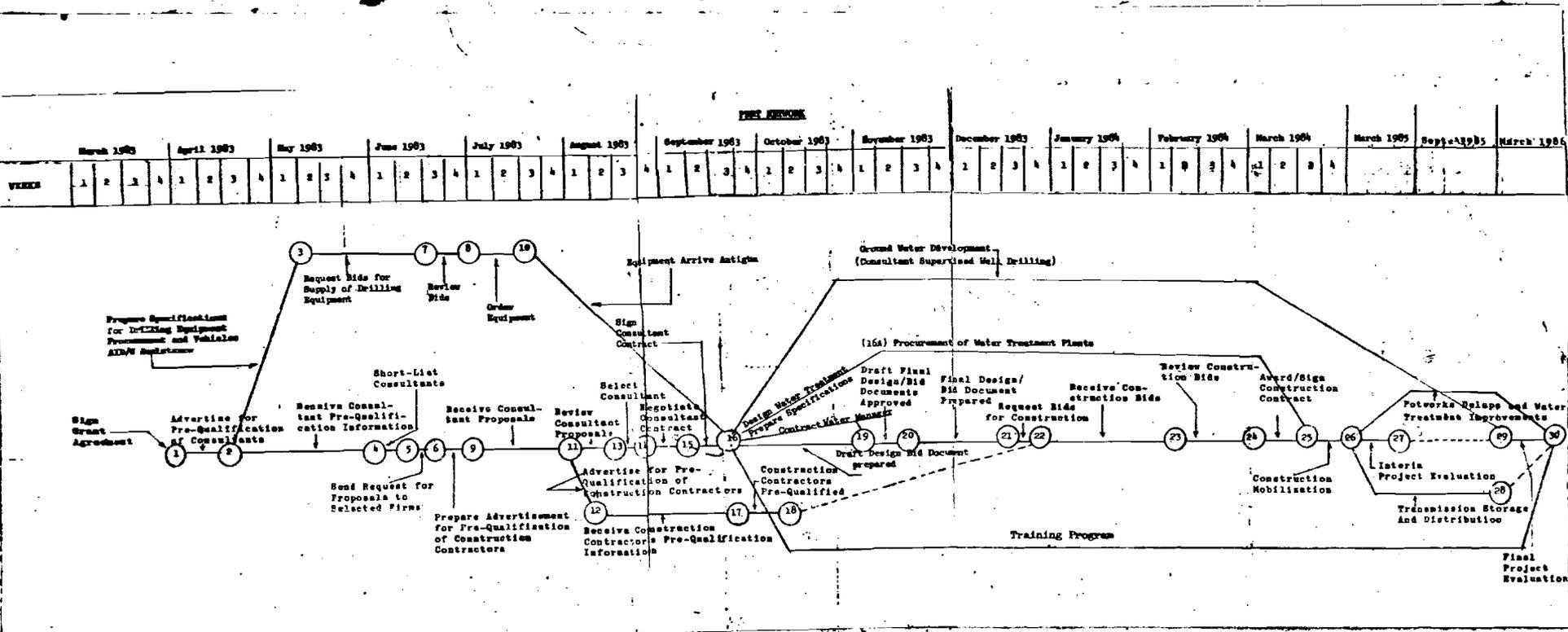
(b) Other Equipment

The Project Consultant will determine whether other major equipment and materials (such as pipe, water treatment package plants, pumps, etc). will be supplied as part of the construction contract or will be procured by APUA and provided to the construction contractor.

The Project Consultant will prepare the necessary specifications and, as appropriate, act as the procurement agent for the acquisition.

3. Construction

Construction work will be contracted to begin in approximately March, 1984 and will include the All Saints-Scotts Hill pipeline, storage tank, water treatment works, improvements to the Potworks Dam and the Body Ponds Pump Stations. It is anticipated that one IFB will be published for all construction activities with bidders able to bid on one or all element of the Project. Minor work, upon the recommendation of the consultant, may be undertaken by force account. Construction work will be completed within two years following award of the contract or contracts.



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V. MONITORING PLAN

A. RDO/C

The RDO/C Office of Engineering and Energy will provide general monitorship of project activities, including periodic trips to project sites in Antigua. During the early months of the Project, prior to the arrival of the contractor, it is expected that the Mission project officer will travel to Antigua bi-weekly to assist the GOAB in meeting conditions precedent, but that travel requirements will decrease once the consultant is on site. The Mission project officer will also coordinate approval of consultants, contracts for the procurement of commodities and services, and satisfactory completion of construction. The Office of Engineering and Energy will also receive backstop assistance from the Capital Project Development Office. Additional monitorship will be provided under the evaluation program. The Grant will finance a mid-term and project completion evaluation which will involve the use of either AID/W TDY assistance or contracting for short-term consultant assistance.

B. Contractor

The overall Consultant contractor will provide a Chief of Party, who will work closely with the APUA General Manager and Manager of the Water Division. The Chief of Party will prepare quarterly reports of progress for submission to the APUA and USAID, and assist as necessary with periodic reports submitted by APUA to USAID.

C. APUA

The APUA will establish a project management system with specific personnel assigned to project implementation responsibilities. A detailed project implementation plan will be drawn up which will include a time-phased schedule for all project activities and projected balance sheets and pro forma cash flows which can be used to measure the financial viability of APUA over time. Based on the implementation plan, the APUA will submit quarterly reports to RDO/C, describing overall progress in relation to time-phased events, and discussing any problem areas that need to be addressed.

VI. SUMMARIES OF ANALYSES

A. Technical

The proposed project as described in the Project Identification Document included five components: (1) Ground water development, consisting of well rehabilitation, limestone development, and Bendals Valley Recharge; (2) transmission and storage improvements through the installation of a new transmission main between All Saints and Scotts Hill, an additional storage tank at All Saints, and a distribution pipeline into Sea View Farm; (a) the replacement/restoration of three water treatment works; (4) the rehabilitation of the Potworks/Delaps facility; and (5) institutional development of the APUA through a program of technical assistance, training and equipment.

Following the feasibility study conducted by J.M. Montgomery and subsequent review by RDO/C, two substantive modifications in the technical design of the Project were made; all other activities remain essentially as originally designed.

The Bendals Recharge activity has been deleted from final project design. During the feasibility study, the JMM team took samples from the four proposed sites for recharge ponds and discovered that the materials consisted primarily of silty clays down to a depth of nine feet. As the low permeability of these soils would not provide adequate percolation of surface waters for the recharge of the proposed site, this activity was deleted from the Project.

The second activity that has been omitted from final project design is the program for exploration/development of the northeast limestone region for new sources of ground water. According to the limited information available at the time of the prefeasibility study, it appeared that a modest program to drill 45 boreholes would result in approximately 30 producing low-discharge wells. Further examination of the conditions in the northeast region, undertaken during the feasibility study, showed that while a limestone exploration program could indeed be carried out at the \$1 million dollar level, the actual development of successful wells would be considerably more. The difference in cost between the previous \$1 million estimate and the more recent \$4.6 million estimate is principally attributable to two factors: the earlier cost estimates were based on a five year project life; to carry out the same amount of drilling in a three year period, two sets of drilling teams and equipment were required which added another \$0.6 million; and (2) provision had to be made for a connector pipeline once the wells had been successfully developed, which would have added another \$1.6 million. The difference in freight and insurance, overhead and contingency costs - which are calculated as a percentage of the cost of construction - added another \$1.1 million.

In sum, what had originally presented itself as a modest sub-project to provide an inexpensive source of new ground water, may now be more accurately described as a large scale and high cost undertaking more appropriately addressed as a separate program worthy of donor interest at some point in the near future. As such, the limestone exploration program was deleted from the final project proposal.

One new activity will be included as a result of the Environmental Assessment, which concluded that an increase in Antigua's water supply offered the potential for problems in disposing of increased wastewater flows. As such, this Project will include as part of the technical assistance program and master plan study, as overview of the impact of project activities on waste water management, the status of plans to introduce a sewerage system into St. John's, and the most critical needs that should be addressed in terms of developing the capability to manage increased water usage.

B. Financial

The APUA Water Division is not currently financially viable as an independent entity. Collections are less than 50% of accrued revenues, and much water actually consumed by the public goes unbilled and does not even show in the revenue figures.

With adoption of the institutional reforms and procedures described in Section II C, the APUA could rapidly become self-sustaining and could show a positive cash flow at some point during the fiscal year ending June 30, 1985.

However, the cash flow available to APUA will be insufficient through the year ending June 30, 1984 to support operations on an independent basis. The Water Division will need external cash financing this year, and Table 7 shows the projected cash flow based on bridge financing in 1983 at commercial terms. Given a short term bridge loan of \$1,100,000 EC to cover the FY 82-83 deficit, the financial position of the APUA Water Division would thereafter show a positive cash flow.

The financial analysis (see Annex F.2) and the cash flow projections included in the analysis, are based on the assumption that the APUA Water Division does make the necessary changes in practice and procedure as recommended. Assuming these changes are made, the proposed project is financially viable and the cash flow needed to support the Project should be available.

All projections are in constant dollars because of the uncertainty involved in predicting inflation rates over the period of time covered in the projections. For this reason, no increases in water rates have been factored into the projections. Realistically, water rates will have to be increased not only to meet inflationary costs in operating expenses, but also for the purpose of financing capital expenditures over the long-term. The GOAB has covenanted to maintain the financial viability of the APUA, which will mean closer financial monitorship of income and expenses and adjusting water rates as necessary. (See Section VII.B).

All financial analysis has been done on the basis of the APUA Water Division operating as an independent entity.

C. Economic

Using a discount rate of 11 percent, a benefit-cost ratio exceeding one was calculated. This suggests that the internal rate of return for the Project exceeds 11 percent, indicating that the Project is economically viable.

TABLE 5

APUA PRO FORMA INCOME & EXPENSE STATEMENT
(EC\$000)

Year Ending June 30

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>
<u>Income</u>											
Domestic	1,556	1,971	2,652	2,803	2,882	2,897	2,942	2,983	3,075	3,111	3,146
Standpipe	805	625	743	744	692	642	597	554	376	348	322
Commercial	391	420	540	595	602	612	624	633	651	659	655
Hotel	1,202	1,055	1,396	1,563	1,617	1,678	1,739	1,798	1,888	1,949	2,012
Industrial	548	587	766	838	856	870	885	879	929	942	955
Government	971	1,042	1,354	1,485	1,512	1,539	1,565	1,588	1,638	1,661	1,683
TOTAL	5,473	5,700	7,451	8,028	8,131	8,238	8,352	8,453	8,557	8,670	8,783
<u>Operating Costs</u>											
Fuel and Oil	45	45	45	45	45	45	45	45	45	45	45
Chemicals	167	167	167	188	207	217	227	237	247	257	267
Salaries and Wages	1,831	1,923	2,015	2,107	2,199	2,291	2,291	2,291	2,291	2,291	2,291
Maintenance	488	498	578	632	637	669	701	733	765	797	829
General	266	266	266	266	266	266	266	266	266	266	266
Transportation	195	195	195	195	195	201	207	213	219	225	231
Electricity	584	720	845	1,135	1,155	1,213	1,271	1,329	1,387	1,445	1,503
Head Office Expenses	426	426	426	426	426	426	426	426	426	426	426
TOTAL	4,002	4,240	4,537	4,994	5,130	5,328	5,434	5,540	5,646	5,752	5,858
Operating Margin	1,471	1,460	2,914	3,034	3,001	2,910	2,918	2,913	2,911	2,918	2,925
<u>Less</u>											
T&T Loan P&I	-	-	-	-	-	-	1,465	1,465	1,465	1,465	1,465
Interest (Old Loans)	291	231	178	134	119	58	18	13	9	5	0
AID Interest	-	155	298	345	345	345	345	345	345	345	345
Depreciation	1,147	1,254	615	726	950	950	950	942	941	941	938
Total	1,438	1,640	1,091	1,205	1,295	1,353	2,778	2,765	2,760	2,757	2,748
Net Profit (Loss)	33	(180)	1,823	1,829	1,706	1,557	140	148	151	161	177

US\$=EC\$2.7

Water supply projects generally provide benefits in three forms: (a) incremental revenues generated by the Project for the Water Authority; (b) additional consumer surplus created; and (c) health benefits. Consumer surplus is defined as what people are willing to pay above what they actually do pay. In this Project, significant additional consumer surplus is likely to be created. The very large premiums that the additional consumer surplus created will be substantial. However, because of difficulties in quantifying consumer surplus, this additional benefit has not been included in the Project's benefit stream. For similar reasons health benefits also have not been included in the benefit stream. While health benefits are normally quite large in a project that is introducing piped water for the first time, they tend to be less significant for a project that is making improvements to an existing water supply system. Nonetheless, in the case of Antigua, they could be important. In sum, the primary economic benefit measured in this project are the incremental revenues that this project generates for APUA.

On one hand, the incremental revenues measured are understated. This project will improve the efficiency with which APUA delivers water. Renovation of the water transmission and distribution system will mean reduced loss of water from leaks and increased pumping and distribution capacity which will, in effect, increase the actual amount of water delivered to the user. While some of the improvements in delivery efficiency are reflected in the Project's benefit stream, some are not because of estimation difficulties. On the other hand, one source of incremental revenues, at least in the Project's early years, derive from improved collection procedures. If the additional revenues generated from improved collection procedures are utilized by APUA to deliver increased water supplies, they should be included in the Project's benefits stream. If these additional revenues, however, are used in a manner that does not enhance APUA's water supply capabilities, they should not be included as a project benefit. Given the substantial institution building that is to take place under this project, we suspect that these revenues, for the most part, will be employed effectively; that is, they will be used to augment APUA's capacity to deliver water and, hence, should be included as a project benefit.

On balance, we feel that the Project's internal rate of return is sharply understated. The Project will produce substantial additional consumer surplus that has not been included in the benefit stream.

The water treatment improvement activities were not included in the economic benefit cost analysis calculations. While water treatment improvement activities are a task that a water authority normally undertakes, these activities do not contribute any benefits as measured by incremental revenues. Although improved water quality provides economic benefits in the form of enhancement of the populace's health, these have not been included in our cost-benefit analysis calculations because of difficulties in their precise specification.

D. Social Soundness

An analysis of the social feasibility of the Antigua Water Supply project concluded that it will have a total positive impact on the population of Antigua. Since the water authority supplies 96% of the population, practically all Antiguan will directly benefit from the Project.

A safe, reliable source of potable water is essential to the tourist and industrial sectors of Antigua as well as for domestic needs. At present, the unconstrained demand for water exceeds the amount that can be safely supplied. Tourism is the principal economic activity in Antigua and a source of jobs for approximately a quarter of the working population. An increase in the quantity, as well as quality, of water supplied will enable the tourist industry and others to continue to grow and to provide increased job opportunities for Antiguans.

The second direct benefit will be in terms of improved health. The Project will finance assistance for improving the quality of water through better treatment. It is expected that this will result in a reduction of the number of water-borne diseases, whereas the increase in the quantity of water supplied will reduce the incidence of water-washed diseases. Both interventions will help to lower the incidence of gastroenteritis which is presently the most widespread disease in the island.

No immediate increases in water rates are foreseen at this time, and the cost of water is affordable to all Antiguans. Standpipe water, which is free (paid for by the GOA), serves the lowest economic groups of the island. Hotels have demonstrated the willingness/capability to pay several times the APUA rate to insure an adequate amount of water to supply tourist demand.

E. Administrative

An evaluation of the present organization and management of the Water Division indicates that many constraints deter the utility from becoming financially viable and efficient. Uncorrected, these constraints could magnify as further investments are made in improving and expanding the water supply systems. Major constraints are in the area of organizational control, changing management, weak middle management, non-realization of full revenues, and lack of formal policies, regulations, systems and procedures. During its 10-year existence, the Water Division has received substantial outside assistance, but internal problems, changing staff, and lack of funds have resulted in very little, or no, institutional improvement. The utility is realizing less than 40 percent of its potential operating revenue. Present water rates are relatively high and equate to US\$2.24 and \$4.81 per 1,000 U.S. gallons for residential and commercial classes, respectively.

Proper development of APUA's institutional capacity has also been hampered by inadequate regulations and policy guidelines and the abrogation of the Board of Commissioners for the Water Authority in order for project-financed inputs to have the desired long-term effect of establishing financial viability and ability to meet current water demands certain institutional reforms would be required. The Government of Antigua has demonstrated its commitment to these reforms by agreeing to: (a) appoint nine members to comprise the APUA Board of Commissioners; (b) issue a clear policy statement on the collection of water bills; (c) appoint all essential managerial and technical staff to the Water Division of the APUA; and (d) pay all GOA water bills as of July, 1982.

In order to be in a position to operate and maintain improved systems and to cover all revenue requirements, the Water Division must make significant institutional improvements. The proposed program is designed to

assist in implementing needed improvements within an acceptable time frame and will include the following:

- . conditions precedent to disbursement requiring certain institutional reforms;
- . a tailored institutional strengthening program based on a wide array of short and long term technical assistance;
- . proposed staff training programs; and
- . essential support equipment and supplies.

F. Environmental

An Environmental Assessment (EA) has been prepared on this project, pursuant to USAID Environmental Procedures (CRF Title 22 Part 216, as amended 1982). Below is a summary of the EA. Copies of the complete Assessment are on file in the LAC/DR Environmental Office and in the Regional Development Office/Caribbean in Barbados.

The EA identified and analyzed the primary (direct) and secondary (indirect) effects with respect to degree of significance, temporal and spatial extend, and reversibility and proposed mitigating measures. The EA treated four groups of proposed projects (plus No Project): ground water development; transmission, storage and distribution facilities; Potworks/Delaps restoration; and water treatment improvements.

There are no significant, long-term adverse primary impacts. Construction impacts (noise, nuisance, safety hazards) will be minor. Less than 2 acres of land total will be needed for facilities. No endangered species or archaeological materials will be affected. Well and treatment plant rehabilitation will increase energy and chemicals consumption, but only to former levels. However, disruption of traffic and access to homes and shops on All Saints Road during pipeline construction will be unavoidable, significant, but localized, and temporary impacts will be partially, but not completely mitigable.

Secondary impacts are more substantial. Well rehabilitation in southwest valleys could reduced agricultural well yields and eliminate double cropping. Rehabilitated wells will need monitoring to prevent seawater intrusion into coastal alluvial valleys. Water treatment plant effluent quantity and quality improvements could reduce the incidence of water-washed diseases; reporting (incomplete) of water-borne diseases shows very low rates. Limited bacterial sampling of water supplies indicates at least occasional fecal contamination of storage and distribution systems and certain treatment plants. Expected increases in per capita water use in areas with individual connections will cause a proportional increase in effluent from failed septic tanks to open drainage ditches. Such drainage is an aesthetic and potential health problem, and pollutes the marine environment, an important tourist source. The Project is not expected to significantly affect the incidence of dengue fever by creating new vector breeding sites. The net effect on public health of the Project cannot be determined, but the sewers long-since planned for portions of St. John's, at least, should be implemented

soon. The integrity of existing water transmission and storage facilities also needs examination.

The No Project Alternative is rejected as less environmentally sound than the Project alternative. Early initiation of ground water development in the limestone area and sewer and water distribution sytem master plans are needed to begin dealing with Antigua's residual water supply and waste management problems.

VII. CONDITIONS PRECEDENT AND COVENANTS

The following conditions and covenants will be included in the Loan/Grant Project Agreement:

A. Conditions Precedent to Disbursement

1. First Disbursement. Prior to the first disbursement of the Assistance, or to the issuance by AID of documentation pursuant to which disbursement will be made, the Cooperating Country will, except as the Parties may otherwise agree in writing, furnish to AID in form and substance satisfactory to AID:

(a) An opinion of counsel acceptable to AID that this Agreement has been duly authorized and/or ratified by, and executed on behalf of, the Cooperating Country, and that it constitutes a valid and legally binding obligation of the Cooperating Country in accordance with all of its terms;

(b) A statement of the name of the person holding or acting in the office of the Cooperating Country specified in Section 9.2, and of any additional representatives, together with a specimen signature of each person specified in such statement; and

(c) Evidence that a first payment has been made by the Cooperating Country to the United States Export-Import Bank of outstanding indebtedness to that institution in accordance with an agreement between the United States Export-Import Bank and the Cooperating Country pertaining to payment of that indebtedness and acceptable to both parties.

2. Professional Services or Equipment. Prior to any disbursement for professional services or equipment, or to the issuance by AID of documentation pursuant to which disbursement will be made, the Cooperating Country and APUA will, except as the parties may otherwise agree in writing, furnish to AID in form and substance satisfactory to AID:

(a) Evidence of the establishment of a Governing Board of APUA which shall include (1) the composition of the Board; and (2) dates for regular Board meetings.

(b) Evidence of establishment of a firm policy by the Cooperating Country and APUA concerning the collection of accounts receivable by the Water Division of APUA and a policy concerning enforcement of payment;

(c) Evidence on the part of the Cooperating Country that it is current on all payments due the Water Division of APUA and evidence of its commitment to remain current on its payments;

(d) Evidence that the Governing Board of APUA has appointed individuals to serve as the permanent General Manager of APUA, permanent Water Division Manager, and Permanent Chief Accountant;

(e) Evidence that the Cooperating Country has made a valid commitment which permits and enables APUA to operate on a technically and financially self-sustaining basis including a commitment enabling APUA to acquire required trainable personnel and that necessary steps will be taken to encourage them to remain with APUA once training is completed;

(f) An executed professional services contract for the Project, including technical assistance to APUA, engineering and construction supervision; and

(g) Evidence of the establishment of a project management system within APUA clearly designating the officials who will be responsible for the Project.

3. Construction Services. Prior to any disbursement for construction services or to the issuance by AID of documentation pursuant to which disbursement will be made, the cooperating country and APUA will, except as the parties may otherwise agree in writing, furnish to AID in form and substance satisfactory to AID:

(a) A time-phased implementation schedule for all equipment procurement, construction services, installation of water meters, training activities, technical and all other activities to be undertaken as part of the Project, including projected balance sheets and pro forma cash flows which can be used to measure the financial viability of APUA over time;

(b) Evidence that APUA has obtained all necessary rights of way to lands where construction and/or rehabilitation activities will take place under the Project; and

(c) A construction contract or contracts acceptable to AID.

4. Construction Services After One Year. Prior to any disbursement for construction services for which invitations for Bids are issued one year after the date of this Agreement or the issuance by AID of documentation pursuant to which disbursement will be made, the cooperating country and APUA will, except as the Parties may otherwise agree in writing, furnish to AID in form and substance satisfactory to AID:

(a) Evidence that APUA has adopted and is following essential operating regulations, including but not limited to those dealing with water supply conditions, extension of the water systems, personnel administration and financial management; and

(b) Evidence that APUA has substantially achieved the financial performance targets established in the Project's time-phased implementation plan.

(c) Evidence that the APUA Governing Board has adopted and is following regulations based upon the Act creating APUA, which explain in detail the responsibilities, composition and operating authorities of the Board.

B. Special Covenants

1. Project Evaluation. The Parties agree to establish an evaluation program as part of the Project. Except as the Parties otherwise agree in writing, the program will include during the implementation of the Project and at one or more points thereafter:

(a) evaluation of progress toward attainment of the objectives of the Project;

(b) identification and evaluation of problem areas of constraints which may inhibit such attainment;

(c) assessment of how such information may be used to help overcome such problems; and

(d) evaluation, to the degree feasible, of the overall development impact of the Project.

2. Maintenance Costs. APUA agrees to provide on a continuing basis adequate funds for the maintenance of facilities and equipment provided, rehabilitated or expanded under the Project.

3. Staffing. The Cooperating Country and APUA covenant to provide and maintain the qualified staffing essential to the financial and technical operation of the Water Division of APUA, including provision of adequate incentives to retain qualified staff.

4. Financial Viability. The Cooperating Country and APUA Covenant to maintain the financial viability of APUA through such collection measures and other steps including rate increases if necessary which will assure that the Water Division of APUA can amortize its debts, pay all staff, operating and maintenance costs, depreciate its facilities and contribute to future capital expansion. Diversion of cash surpluses to other divisions of APUA or elsewhere which the water division may realize in the future will require prior consultation with AID.

5. APUA Governing Authority. Substantive changes in the Act creating APUA or Regulations derived therefrom will require prior consultation with A.I.D.

6. APUA Operating Regulations. The Cooperating Country covenants that it will abide by all of the operating regulations adopted and established pursuant to the Act creating APUA.

VIII. EVALUATION ARRANGEMENTS

Prior to any actual improvements being made in water treatment, transmission, etc, a base-line survey will be conducted for the purpose of determining with reasonable accuracy the present quality of the potable water supply. This will involve the collection of a number of water samples from representative points, including source, storage and delivery points, adequate to insure meaningful results. The analysis will include the full range of routine chemical and bacteriological tests that are necessary to determine the quality of potable water, and will be carried out with the assistance of the Ministry of Health clinical laboratory facilities.

A mid-project evaluation will take place approximately 18 months into the Project, or in October, 1984. Based on the detailed, time-phased implementation plan, this evaluation will examine the progress of project activities in relation to identified objectives and the implementation schedule for achieving them. The continuing validity of the efforts will be assessed and suggestions provided of such modifications as may be required to increase the likelihood that the effort will achieve its objectives within the given time frame.

A final, in-depth evaluation will be carried out at the completion of the Project. This will include another sample survey for analysis of water quality to determine in quantitative terms what effect the Project has had in improving the quality of the potable water supply. The final report will determine whether all required actions have been carried out and if performance to date is consistent with expectations. Achievement of established project objectives will be evaluated and any subsequent findings or recommendations with regard to future development of the water sector that would be appropriate. The evaluation will be carried out by a contracted specialist assisted by AID/W or RDO/C staff. The Grant-financed water quality specialist will also assist in water quality analysis as available.

The estimated cost of the grant-financed baseline survey and evaluation activity is \$65,000. The Government of Antigua will contribute laboratory tests and analyses estimated at \$20,000.

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ACT: AID INFO: AME DCM CHRON

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TOR: 0629

CN: 01512

CLERGE: AID

AIDAC

F.O. 12356: N/A

TAGS:

SUBJECT: ANTIGUA WATER SUPPLY (538-0098) PID

1. THE DAEC REVIEW OF THE SUBJECT PID WAS HELD ON JANUARY 12, 1983. THE PID IS HEREBY APPROVED AND RDO/C IS AUTHORIZED TO DEVELOP AND APPROVE THE PP IN THE FIELD. DURING INTENSIVE REVIEW THE FOLLOWING POINTS SHOULD BE TAKEN INTO CONSIDERATION:

2. TECHNICAL ISSUES AND CONDITIONS:

--A. RDO/C SHOULD IMMEDIATELY INITIATE DISCUSSIONS WITH THE GOA REGARDING THE PROPOSED GOVERNMENT OF TRINIDAD AND TOBAGO (GOTT) ALL SAINTS/SCOTTS HILL TWELVE-INCH PIPELINE. IF THE GOA PROVES UNWILLING TO RELOCATE THE GOTT PIPELINE TO ANOTHER PART OF THE SYSTEM AND ALLOW A.I.D. TO CONSTRUCT THE EIGHTEEN-INCH PIPELINE, THIS RAISES A SERIOUS TECHNICAL ISSUE. IN THIS EVENT RDO/C SHOULD NOTIFY AID/W, EXPLAIN THE SITUATION AND DESCRIBE HOW THE PROJECT WILL BE MODIFIED TO DEAL WITH THE SMALLER DIAMETER PIPELINE.

--2 ITEMS (1) THROUGH (4) BELOW CONCERN CONDITIONS PRECEDENT (CP'S). TO THE EXTENT FEASIBLE THEY SHOULD BE CP'S TO EXECUTION OF THE GRANT/LOAN AGREEMENT. HOWEVER, IF THIS PROVES INFEASIBLE, THEY MAY BE MADE CP'S TO INITIAL DISBURSMENT.

--(1) THE PROJECT AUTHORIZATION SHOULD INCLUDE A CONDITION PRECEDENT (CP) THAT THE GOA HAS AGREED TO RESCHEDULE THE EXIM BANK LOAN AND HAS MADE A FIRST PAYMENT.

--(2) THE PROJECT AUTHORIZATION SHOULD INCLUDE A CP THAT THE GOA HAS PAID THEIR OUTSTANDING WATER BILLS TO APUA FOR A MINIMUM PERIOD (SIX MONTHS SEEMS REASONABLE UNLESS OTHER INFORMATION IS DEVELOPED DURING INTENSIVE REVIEW) AND HAS AGREED IN WRITING TO PROMPTLY PAY FUTURE BILLS IN FULL.

--(3) THE PROJECT AUTHORIZATION SHOULD INCLUDE A CP THAT THE GOA HAS AGREED TO ALLOW APUA TO OPERATE ON A

SELF-SUSTAINING, TECHNICALLY AID FINANCIALLY SOUND BASIS. RDO/C SHOULD USE INTENSIVE REVIEW-GENERATED APUA CASE FLOW AND INSTITUTIONAL ANALYSES TO DETERMINE WHAT CONSTITUTES A "SELF SUSTAINING, TECHNICALLY AND FINANCIALLY SOUND BASIS."

--(4) THE PROJECT AUTHORIZATION SHOULD INCLUDE A CP THAT THE GOA AND APUA HAVE AGREED TO ASSIGN TO THE APUA ALL REQUIRED TRAINABLE ADDITIONAL PERSONNEL AND THAT NECESSARY STEPS HAVE BEEN UNDERTAKEN TO ENCOURAGE THEM TO REMAIN WITH APUA ONCE TRAINING IS COMPLETED (E.G. RAISING THEIR SALARY LEVELS TO BE COMPETATIVE WITH THE PRIVATE SECTOR).

--(5) BEFORE PROJECT AUTHORIZATION IS UNDERTAKEN, RDO/C SHOULD CABLE AID/W THE TEXT OF THE PROPOSED CP'S. HOWEVER, EXPLICIT AID/W APPROVAL IS NOT REQUIRED.

3. OTHER DONOR COORDINATION - THE PID INDICATES THAT THERE ARE OTHER DONORS INVOLVED IN OR CONSIDERING INVOLVEMENT IN THE WATER SECTOR. DURING INTENSIVE REVIEW, RDO/C SHOULD INTERFACE AS MUCH AS PRACTICAL WITH THESE DONORS TO ELICIT PARTICIPATION, COORDINATE ACTIVITIES AND LEARN OF PAST EXPERIENCES. THE EXPERIENCE OF THE CIDA CARIBBEAN BASIN WATER MANAGEMENT PROJECT MAY BE PARTICULARLY USEFUL IN DESIGNING THE APUA TRAINING COMPONENT.

4. PROJECT IMPLEMENTATION STRATEGY - DURING INTENSIVE REVIEW RDO/C SHOULD EXAMINE THE FEASIBILITY OF STRUCTURING IMPLEMENTATION INTO A SERIES OF MEANINGFUL DISCRETE ACTIVITIES. IF THIS PROVES FEASIBLE, CP'S SHOULD BE INCLUDED WHICH ALLOW A.I.D., AT APPROPRIATE INTERVALS, TO EVALUATE PROGRESS IN MEETING PROJECT OBJECTIVES, INCLUDING POLICY AND ADMINISTRATIVE REFORMS.

5. AVOIDING COST OVERRUNS - PARTICULAR ATTENTION SHOULD BE PAID TO ASSURING THAT IMPLEMENTATION COST ESTIMATES AND TIME FRAMES ARE REASONABLE SO THAT OVERRUNS, EXPERIENCED IN THE PAST WITH THIS KIND OF PROJECT, CAN BE AVOIDED.

6. LOAN VS. GRANT - RDO/C SHOULD EXAMINE THE POSSIBILITY OF FINANCING PORTIONS OF THE PROJECT WITH LOAN FUNDS. A RESULTING RECOMMENDATION SHOULD BE CABLED TO AID/W BEFORE PROJECT AUTHORIZATION. IN CONSIDERING THIS ISSUE, RDO/C SHOULD PAY CAREFUL ATTENTION TO THE FACT THAT ANTIGUA IS A SMALL, OPEN ISLAND ECONOMY WHICH IS VULNERABLE TO THE EXTERNAL, WORLD ECONOMIC SITUATION.

7. AID/W SUPPORT DURING INTENSIVE REVIEW:

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--A. ST/FAA DR. JOHN AUSTIN, BEFORE JOINING A.I.D., WAS A PAHO CONSULTANT INVOLVED IN TRAINING AT APJA. HE IS AVAILABLE TO ASSIST IN THE DESIGN OF THE INSTITUTIONAL DEVELOPMENT COMPONENT DURING INTENSIVE REVIEW. RDO/C FINANCING OF TRAVEL AND PER DIEM WILL BE REQUIRED.

--B. AID/W STANDS READY TO OFFER SUPPORT FOR THE ECONOMIC ANALYSIS AND MEETING THE SPECIAL REQUIREMENTS OF FAA SECTION 611(B).

11 e. FYI. ALL IAC PID APPROVALS ARE SUBJECT TO BUREAU REVALIDATION IF THE POST-PID PROJECT DEVELOPMENT PROCESS EXTENDS BEYOND ONE YEAR. END FYI. SHULTZ

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Best Available Document

LOGICAL FRAMEWORK

From FY 83 to FY 86
 Total U.S. Funding 9,700,000
 Date Prepared: _____

Project Title & Number: ANTIGUA WATER SUPPLY 538-0098

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS																																								
<p>Program or Sector Goal: The broader objectives to which this project contributes: To establish the physical productive infrastructure essential to achieve a self-sustaining level of economic growth for Antigua.</p>	<p>Measures of Goal Achievement: Water supply system is able to supply the Island's basic potable water needs.</p>	<p>Annual statistical Government Data</p>	<p>Assumptions for achieving goal targets: . Government will remain stable and pursue economic growth. . No major drought.</p>																																								
<p>Project Purpose: To assist Antigua in meeting the current potable water demands of the tourism, industrial and domestic sectors, and assume that the Water Authority operates on a self-sustaining basis.</p>	<p>Conditions that will indicate purpose has been achieved: End of project status. . Water production capacity increased to 3.6 mgd. . Water quality meets WHO standards. . Water Authority operates on a financially viable basis. -</p>	<p>. APU Reports . MOH Reports . Project evaluation</p>	<p>Assumptions for achieving purpose: . Government makes timely payment of its water bills and enforces revenue collection policy. . Well rehabilitation produces estimated yield.</p>																																								
<p>Outputs: 1. Well rehabilitation. 2. Increased transmission, storage and distribution capacity. 3. Reservoir and water treatment improvements. 4. Improved water authority capabilities</p>	<p>Magnitude of Outputs: 1 Master Plan of Water Supply System 32 wells rehabilitated 5.9 miles of pipeline installed 1 storage tank installed 4 water treatment plants restored/replaced 1 pump station rehabilitated 4000 meters installed 25 APUA personnel trained</p>	<p>. APUA Reports . Project Manager Reports . Project evaluation</p>	<p>Assumptions for achieving outputs: . Counterpart personnel assigned to key positions . Equipment and materials available within time and cost limits</p>																																								
<p>Inputs: 1. Well rehabilitation 2. Transmission, storage & Distribution 3. Water Treatment Improvements 4. Technical Assistance and Training 5. Equipment 6. Evaluation 7. Personnel, office support TOTAL</p>	<table border="1"> <thead> <tr> <th></th> <th colspan="2">(\$000)</th> <th></th> </tr> <tr> <th>AID</th> <th>GOA</th> <th></th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>1855</td> <td>50</td> <td></td> <td>1905</td> </tr> <tr> <td>2940</td> <td>200</td> <td></td> <td>3140</td> </tr> <tr> <td>1830</td> <td>40</td> <td></td> <td>1870</td> </tr> <tr> <td>2630</td> <td>-</td> <td></td> <td>2630</td> </tr> <tr> <td>380</td> <td>-</td> <td></td> <td>380</td> </tr> <tr> <td>65</td> <td>20</td> <td></td> <td>85</td> </tr> <tr> <td>-</td> <td>4440</td> <td></td> <td>4440</td> </tr> <tr> <td>9700</td> <td>4750</td> <td></td> <td>14450</td> </tr> </tbody> </table>		(\$000)			AID	GOA		Total	1855	50		1905	2940	200		3140	1830	40		1870	2630	-		2630	380	-		380	65	20		85	-	4440		4440	9700	4750		14450	<p>. USAID disbursement records . APUA records</p>	<p>Assumptions for providing inputs: . AID funds available as planned . GOA provides counterpart contribution</p>
	(\$000)																																										
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-	4440		4440																																								
9700	4750		14450																																								

ANNEX B

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COUNTRY CHECKLIST

Listed below are statutory criteria applicable generally to FAA funds, and criteria applicable to individual fund sources: Development Assistance and economic Support Fund.

A. GENERAL CRITERIA FOR COUNTRY ELIGIBILITY

1. FAA Sec. 481. Has it been determined that the government of the recipient country has failed to take adequate steps to prevent narcotic drugs and other controlled substances (as defined by the Comprehensive Drug Abuse Prevention and Control Act of 1970) produced or processed, in whole or in part, in such country, or transported through such country, from being sold illegally within the jurisdiction of such country to U.S. Government personnel or their dependents, or from entering the U.S. unlawfully? No.
2. FAA Sec. 620 (c). If assistance is to a government, is the government liable as debtor or unconditional guarantor on any debt to a U.S. citizen for goods or services furnished or ordered where (a) such citizen has exhausted available legal remedies and (b) the debt is not denied or contested by such government? No.
3. FAA Sec. 620(e) (1). If assistance is to a government, has it (including government agencies or subdivisions) taken any action which has the effect of nationalizing, expropriating, or otherwise seizing ownership or control of property of U.S. citizens or entities beneficially owned by them without taking steps to discharge its obligations toward such citizens or entities? No.
4. FAA Sec. 532(c), 620(a), 620(f), 620D; FY 1982 Appropriation Act Secs. 512 and 513
Is recipient country a communist country? Will assistance be provided to Angola, Cambodia, Cuba, Laos, Vietnam, Syria, Libya, Iraq, or South Yemen? Will assistance be provided to Afghanistan or Mozambique without a waiver? No.
5. ISDCA of 1981 Secs. 724, 727 and 730. For specific restrictions on assistance to Nicaragua, see Sec. 724 of the ISDCA N/A

of 1981. For specific restrictions on assistance to El Salvador, see Secs. 727 and 730 of the ISDCA of 1981.

6. FAA Sec 620(j). Has the country permitted, or failed to take adequate measures to prevent, the damage or destruction by mob action of U.S. property? No.
7. FAA Sec. 620(l). Has the country failed to enter into an agreement with OPIC? No.
8. FAA Sec. 620 (o); Fishermen's Protective Act of 1967, as amended, Sec. 5
 - (a) Has the country seized, or imposed any penalty or sanction against, any U.S. fishing activities in international waters? No.
 - (b) If so, has any deduction required by the Fishermen's Protective Act been made? N/A
9. FAA Sec. 620(q); FY 1982 Appropriation Act Sec. 517.
 - (a) Has the government of the recipient country been in default for more than six months on interest or principal of any AID loan to the country? (a) No.
 - (b) Has the country been in default for more than one year on interest or principal on any U.S. loan under a program for which the appropriation bill appropriates funds? (b) No.
10. FAA Sec. 620(s). If contemplated assistance is development loan or from Economic Support Fund, has the Administrator taken into account the amount of foreign exchange or other resources which the country has spent on military equipment? (Reference may be made to the annual "Taking into Consideration" memo: Yes, taken into account by the Administrator at time of approval of Agency OYB." This approval by the Administrator of the Operational Year Budget can be the basis for an affirmative answer during the fiscal year unless significant changes in circumstances occur.) Yes.
11. FAA Sec. 620(t). Has the country severed diplomatic relations with the United States? If so, have they been resumed and have new bilateral assistance agreements been negotiated and entered into since such resumption? N/A

12. FAA Sec. 620(u). What is the payment status of the country's U.N. obligations? If the country is in arrears, were such arrearages taken into account by the AID Administrator in determining the current AID Operational Year Budget? (Reference may be made to the Taking into Consideration memo.) Antigua's payment status is current.
13. FAA Sec. 620A; FY 1982 Appropriation Act Sec. 520. Has the country aided or abetted, by granting sanctuary from prosecution to, any individual or group which has committed an act of international terrorism? Has the country aided or abetted, by granting sanctuary from prosecution to, any individual or group which has committed a war crime? No.
14. FAA Sec. 666. Does the country object, on the basis of race, religion, national origin or sex, to the presence of any officer or employee of the U.S. who is present in such country to carry out economic development programs under the FAA. No.
15. FAA Sec. 669, 670. Has the country, after August 3, 1977, delivered or received nuclear enrichment or reprocessing equipment, materials, or technology, without specified arrangements or safeguards? Has it transferred a nuclear explosive device to a non-nuclear weapon state, or if such a state, either received or detonated a nuclear explosive device, after August 3, 1977? (FAA Sec. 620E permits a special waiver of Sec. 669 for Pakistan.) No.
16. ISDCA of 1981 Sec. 720. Was the country represented at the Meeting of Ministers of Foreign Affairs and Heads of Delegations of the Non-Aligned Countries to the 36th General Session of the General Session of the General Assembly of the U.N. of September 25 and 28, 1981, and failed to disassociate itself from the communique issued? If so, has the President taken it into account? (Reference may be made to the Taking into Consideration memo.) No.

17. ISDCA of 1981 Sec. 721. See Special requirements for assistance to Haiti. N/A.

B. FUNDING SOURCE CRITERIA FOR COUNTRY ELIGIBILITY

1. Development Assistance Country Criteria

- a. FAA Sec. 116. Has the Department of State determined that this government has engaged in a consistent pattern of gross violations of internationally recognized human rights? If so, can it be demonstrated that contemplated assistance will directly benefit the needy? N/A

2. Economic Support Fund Country Criteria

- a. FAA Sec. 502B. Has it been determined that the country has engaged in a consistent pattern of gross violations of internationally recognized human rights? If so, has the country made such significant improvements in its human rights record that furnishing such assistance is in the national interest? No.

- b. ISDCA of 1981, Sec. 725(b). If ESF is to be furnished to Argentina, has the President certified that (1) the Government of Argentina has made significant progress in human rights; and (2) that the provision of such assistance is in the national interests of the U.S.? N/A

- c. ISDCA of 1981, Sec. 726(b). If ESF assistance is to be furnished to Chile, has the President certified that (1) the Government of Chile has made significant progress in human rights; (2) it is in the national interest of the U.S.; and (3) the aiding international terrorism and has taken steps to bring to justice those indicted in connection with the murder of Orlando Letelier? N/A

PROJECT CHECKLIST

Listed below are statutory criteria applicable generally to projects under the FAA and project criteria applicable to individual funding sources: Development Assistance (with a subcategory for criteria applicable only to loans); and Economic Support Funds.

A. GENERAL CRITERIA FOR PROJECT

1. FY 1982 Appropriation Act Sec. 523; FAA Sec. 634A; Sec. 653(b).
 - (a) Describe how authorizing and appropriations committees of Senate and House have been or will be notified concerning the project; (a) A Congressional Notification has been forwarded to Congress.
 - (b) is assistance within (Operational Year Budget) country or international organization allocation reported to Congress (or not more than \$1 million over that amount)? (b) Yes.

2. FAA Sec. 611(a)(1). Prior to obligation in excess of \$100,000, will there be
 - (a) engineering, financial or other plans necessary to carry out the assistance and (b) a reasonably firm estimate of the cost to the U.S. of the assistance? (a) Yes.
 - (b) Yes.

3. FAA Sec. 611(a)(2). If further legislative action is required within recipient country, what is basis for reasonable expectation that such action will be completed in time to permit orderly accomplishment of purpose of the assistance? No further legislative action is required.

4. FAA Sec. 611(b); FY 1982 Appropriation Act Sec. 501. If for water or water-related land resource construction, has project met the standards and criteria as set forth in the Principals Yes.

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and Standards
for Planning Water and
Related Land Resources,
dated October 25, 1973?

5. FAA Sec. 611(e). If project is capital assistance (e.g., construction), and all U.S. assistance for it will exceed \$1 million, has Mission Director certified and Regional Assistant Administrator taken into consideration the country's capability effectively to maintain and utilize the project? Yes.
6. FAA Sec. 209. Is project susceptible to execution as part of regional or multilateral project? If so, why is project not so executed? Information and conclusion whether assistance will encourage regional development programs. The project is not appropriate for regional execution.
7. FAA Sec. 601(a). Information and conclusions whether project will encourage efforts of the country to: (a) increase the flow of international trade; (b) foster private initiative and competition; and (c) encourage development and use of cooperatives, and credit unions, and savings and loan associations; (d) discourage monopolistic practices; (e) improve technical efficiency of industry, agriculture and commerce; and (f) strengthen free labor unions. The rehabilitation and expansion of Antigua's presently inadequate potable water supply system is a necessary adjunct to growth in the island's tourism and industrial sectors and as such will directly support an increased flow in international trade.

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8. FAA Sec. 601(b).
Information and conclusions on how project will encourage U.S. private trade and investment abroad and encourage private U.S. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise). U.S. goods and services will be used in the project as appropriate.
9. FAA Sec. 612(b), 636(h); FY 1982 Appropriation Act Sec. 507. Describe steps taken to assure that, to the maximum extent possible, the country is contributing local currencies to meet the cost of contractual and other services, and foreign currencies owned by the U.S. are utilized in lieu of dollars. The host country is contributing staff, facilities and related support for the project.
10. FAA Sec. 612(d). Does the U.S. own excess foreign currency of the country and, if so, what arrangements have been made for its release? No.
11. FAA Sec. 601(e). Will the project utilize competitive selection procedures for the awarding of contracts, except where applicable procurement rules allow otherwise? Yes.
12. FY 1982 Appropriation Act Sec. 521. If assistance is for the production of any commodity for export, is the commodity likely to be in surplus on world markets at the time the resulting productive capacity becomes operative, and is such N/A.

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assistance likely to cause substantial injury to U.S. producers of the same, similar or competing commodity?

13. FAA 118(c) and (d).
Does the project take into account the impact on the environment and natural resources? If the project or program will significantly affect the global commons or the U.S. environment, has an environmental impact statement been prepared? If the project or program will significantly affect the environment of a foreign country, has an environmental assessment been prepared? Does the project or program take into consideration the problem of the destruction of tropical forests?

An environmental assessment has been prepared.

14. FAA 121(d). If a Sahel project, has a determination been made that the host government has an adequate system for accounting for and controlling receipt and expenditure of project funds (dollars or local currency generated therefrom)?

N/A.

B. FUNDING CRITERIA FOR PROJECT

1. Development Assistance Project Criteria
- a. FAA Sec. 102(b), 111, 113, 281(a). Extent to which activity will (a) effectively involve the poor in development, by extending access to economy at local level, increasing labor-

N/A.

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intensive production and the use of appropriate technology, spreading investment out from cities to small towns and rural areas, and insuring wide participation of the poor in the benefits of development on a sustained basis, using the appropriate U.S. institutions; (b) help develop cooperatives, especially by technical assistance, to assist rural and urban poor to help themselves toward better life, and otherwise encourage democratic private and local governmental institutions; (c) support the self-help efforts of developing countries; (d) promote the participation of women in the national economies of developing countries and the improvement of women's status; and (e) utilize and encourage regional cooperation by developing countries?

- b. FAA Sec. 103, 103A
104, 105, 106. Does the project fit the criteria for the type of funds (functional account) being used? N/A.
- c. FAA Sec. 107. Is emphasis on use of appropriate technology (relatively smaller, cost-saving, labor-using technologies that are generally most appropriate for the small farms, small businesses, and small incomes of the poor)? N/A.

- d. FAA Sec. 110(a). Will the recipient country provide at least 25% of the costs of the program, project, or activity with respect to which the assistance is to be furnished (or is the latter cost-sharing requirement being waived for a "relatively least developed" country)? N/A.
- e. FAA Sec. 110(b). Will grant capital assistance be disbursed for project over more than 3 years? If so, has justification satisfactory to Congress been made, and efforts for other financing, or is the recipient country "relatively least developed"? N/A.
- f. FAA Sec. 122(b). Does the activity give reasonable promise of contributing to the development of economic resources, or to the increase of productive capacities and self-sustaining economic growth? N/A.
- g. FAA Sec. 281 (b). Describe extent to which program recognizes the particular needs, desires, and capacities of the people of the country; utilizes the country's intellectual resources to encourage institutional development; and supports civil education and training in skills required for effective participation in governmental processes essential to self-government. N/A.

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2. Development Assistance Project Criteria (loans Only) N/A.
- a. FAA Sec. 122(b). Information and conclusion on capacity of the country to repay the loan, at a reasonable rate of interest. N/A.
- b. FAA Sec. 620(d). If assistance is for any productive enterprise which will compete with U.S. enterprises, is there an agreement by the recipient country to prevent export to the U.S. of more than 20% of the enterprise's annual production during the life of the loan? N/A.
- c. ISDCA of 1981, Sec. 724 (c) and (d). If for Nicaragua, does the loan agreement require that the funds be used to the maximum extent possible for the private sector? Does the project provide for monitoring under FAA Sec. 624(g)? N/A.
3. Project Criteria Solely for Economic Support Fund
- a. FAA Sec. 531(a). Will this assistance promote economic or political stability? To the extent possible, does it reflect the policy directions of FAA Section 102? Yes.
- b. FAA Sec. 531(c). Will assistance under this chapter be used for military, or paramilitary activities? No.
- c. FAA Sec. 534. Will ESF funds be used to finance the construction of the No.

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operation or maintenance of, or the supplying of fuel for, a nuclear facility? If so, has the President certified that such use of funds is indispensable to non-proliferation objectives?

- d. FAA Sec. 609. If commodities are to be granted so that sale proceeds will accrue to the recipient country, have Special Account (counterpart) arrangements been made? No.

5C(3) - STANDARD ITEM CHECKLIST

Listed below are statutory items which normally will be covered routinely in those provisions of an assistance agreement dealing with its implementation, or covered in the Agreement by imposing limits on certain uses of funds.

These items are arranged under the general headings of (A) Procurement, (B) Construction, and (C) Other Restrictions.

A. Procurement

- | | | |
|----|--|-----|
| 1. | <u>FAA Sec. 602.</u> Are there arrangements to permit U.S. small business to participate equitably in the furnishing of goods and services financed. | Yes |
| 2. | <u>FAA Sec. 604(a).</u> Will all commodity procurement financed be from the U.S except as otherwise determined by the President or under delegation from him? | Yes |
| 3. | <u>FAA Sec. 604(d).</u> If the cooperating country discriminates against U.S. marine insurance companies, will agreement require that marine insurance be placed in the U.S. on commodities financed? | N/A |
| 4. | <u>FAA Sec. 604(e).</u> If offshore procurement of agricultural commodity or product is to be financed, is there provision against such procurement when the domestic price of such commodity is less than parity? | N/A |
| 5. | <u>FAA Sec. 608(a).</u> Will U.S. Government excess personal property be utilized wherever practicable in lieu of the procurement of new items? | Yes |
| 6. | <u>FAA Sec. 603.</u> (a) Compliance with requirement in section 901(b) of the Merchant Marine Act of 1936, as amended, that at least 50 percentum of the gross tonnage of commodities (computed separately for dry bulk carriers, dry cargo liners, and tankers) financed shall be transported on privately owned U.S.-flag commercial vessels to the extent that such vessels are available at fair and reasonable rates. | Yes |
| 7. | <u>FAA Sec 621.</u> If technical assistance is financed, will such assistance be furnished to the fullest extent practicable as goods and professional and other services from private enterprise on a contract basis? If the facilities of other Federal agencies will be utilized, are they particularly suitable, | Yes |

not competitive with private enterprise, and made available without undue interference with domestic programs?

8. International Air Transport Fair Competitive Practices Act, 1974. If air transportation of persons or property is financed on grant basis, will provision be made that U.S.-flag carriers will be utilized to the extent such service is available? Yes

9. FY 79 App. Act. Sec. 105. Does the contract for procurement contain a provision authorizing the termination of such contract for the convenience of the United States? Yes

- B. Construction
 1. FAA Sec. 601(d). If a capital (e.g., construction) project, are engineering and professional services of U.S. firms and their affiliates to be used to the maximum extent consistent with the national interest? Yes

 2. FAA Sec. 611(c). If contracts for construction are to be financed, will they be let on a competitive basis to maximum extent practicable? Yes

 3. FAA Sec. 620(k). If for construction of productive enterprise, will aggregate value of assistance to be furnished by the U.S. not exceed \$100 million? N/A

- C. Other Restrictions
 1. FAA Sec. 122(e). If development loan, is interest rate at least 2% per annum during grace period and at least 3% per annum thereafter? N/A

 2. FAA Sec. 301(d). If fund is established solely by U.S. contributions and administered by an international organization, does Comptroller General have audit rights? N/A

 3. FAA Sec. 620(h). Do arrangements preclude promoting or assisting the foreign aid projects or activities of Communist-bloc countries, contrary to the best interests of the U.S.? Yes

 4. FAA-Sec. 636(i). Is financing not permitted to be used, without waiver, for purchase, long-term lease, or exchange of motor vehicle manufactured outside the U.S., or guaranty of such transaction? Yes

5. Will arrangements preclude use of financing:
- a. FAA Sec. 104(f). To pay for performance of abortions or to motivate or coerce persons to practice abortions, to pay for performance of involuntary sterilization, or to coerce or provide financial incentive to any person to undergo sterilization? Yes
 - b. FAA Sec. 620(g). To compensate owners for expropriated nationalized property? Yes
 - c. FAA Sec. 660. To finance police training or other law enforcement assistance, except for narcotics programs? Yes
 - d. FAA Sec. 662. For CIA activities? Yes
 - e. FAA Sec. 636(i). For purchase, sale, long-term lease, exchange or guaranty of the sale of motor vehicles manufactured outside U.S., unless a waiver is obtained? Yes
 - f. FY 1982 Appropriation Act, Sec. 503. To pay pensions, annuities, retirement pay, or adjust service compensation for military personnel? Yes
 - g. FY 1982 Appropriation Act, Sec. 505. To pay U.N. assessments, arrearages or dues? Yes
 - h. FY 1982 Appropriation Act, Sec. 506. To carry out provisions of FAA section 209(d) (Transfer of FAA funds to multilateral organizations for lending? Yes
 - i. FY 1982 Appropriation Act, Sec. 510. To finance the export of nuclear equipment, fuel, or technology or to train foreign nationals in nuclear fields? Yes
 - j. FY 1982 Appropriation Act, Sec. 511. Will assistance be provided for the purpose of aiding the efforts of the Government of such country to repress the legitimate rights of the population of such country contrary to the Universal Declaration of Human Rights? No
 - k. FY 1982 Appropriation Act, Sec. 515. To be used for publicity or propaganda purposes within U.S. not authorized by Congress? No



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ANNEX D

GOVERNMENT OF ANTIGUA AND BARBUDA
OFFICE OF THE PRIME MINISTER

St. John's, Antigua, West Indies
Telephones: 20773, 79
21240

Cable Address: OFPREM ANU
Telex: 2127 OFPREM AK

Ref. No. O.P.M 31/64

11th March, 1983

His Excellency,
Ambassador Milan Bish,
U.S. Embassy,
P.O. Box 302
Bridgetown
Barbados.

Your Excellency,

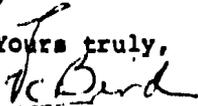
During the past few months members of the USAID staff together with the J.M. Montgomery engineering consultants have met with officials of the Government of Antigua and Barbuda to discuss possible assistance that AID might provide in the development of our water supply system.

As you know, the unconstrained demand for water in Antigua already exceeds current production, and without some kind of intervention, the gap will only widen. In addition, my Government is committed to establishing the Antigua Public Utilities Authority as a financially and technically viable institution. To that end, I will endorse all measures, including establishment of a governing board of APUA, required staffing, enforcement of the collection of past due billings, and prompt payment by Government of its accounts outstanding, necessary to reach this objective. In terms of addressing the most pressing needs at hand, we hope that you will consider financial assistance for a program of activities as recommended in the J.M. Montgomery report, as follows:

- Ground water development through a well rehabilitation program
- Expansion of transmission, storage and distribution capacity
- Restoration of the Potworks intake facility and Delaps Treatment Plant
- Placement of the water treatment plants at Collins, Gray's Hill and Wallings
- Assistance to the water division of the Antigua Public Utilities Authority.

The total of all activities above for which your assistance is requested is U.S.\$9.7 million. Of this, we request that a minimum of \$3.0 million, corresponding to technical assistance, training and engineering costs be grant-funded with the balance provided on a concessional loan basis.

I know that you will give careful consideration to financing a water supply project for Antigua, and I look forward to holding further discussion with you regarding this proposal,

Yours truly,

V.C. Bird,
Prime Minister.

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ANNEX E

CERTIFICATION PURSUANT TO SECTION 611(e) OF THE
FOREIGN ASSISTANCE ACT OF 1961, AS AMENDED

I, William B. Wheeler, as Director of the Agency for International Development, Regional Development Office/Caribbean having taken into account, among other things, the maintenance and utilization of projects in the Caribbean region previously financed or assisted by the United States, do hereby certify that in my judgement the Government of Antigua has both the financial capacity and the human resources capability to effectively utilize and maintain goods and services procured under the proposed capital assistance loan and grant project entitled Antigua Water Supply.

This judgement is based upon the implementation record of externally financed projects, including AID-financed projects, in Antigua, the commitments from the Government of Antigua and the quality of the planning which has gone into this new project.

(Signed) William B. Wheeler
William B. Wheeler
Director

(Date) 3/24/83

ANNEX IX.F

PROJECT ANALYSES

1. Technical

a. General Considerations

The Project design is based on a recent study of the domestic water supply problem in Antigua by the Consultant Engineering firm of James E. Montgomery (J.M.M.). The study determined that Antigua has a current water deficit of at least one million imperial gallons per day which will grow to a deficit of 3.6 imgd by the year 2000. The Project has been designed to address this problem in the most suitable and cost-effective manner, and will finance the following activities:

- (1) Ground water development;
- (2) Improved water storage and transmission/distribution systems;
- (3) Water facilities treatment improvement; and
- (4) Institutional development.

The project activities have been developed in conjunction with the Antigua Public Utilities Authority in a manner consistent with the GOA resources and the best application of present day technology.

b. Selection of Alternatives and Methodology

(1) Ground Water Development

The selection of alternatives included the following:

- (i) Rehabilitation of existing wells; and
- (ii) New well development.

The final selection was based on the least cost alternatives yielding the highest availability of water production. Accordingly the planned ground water development element of the Project will involve rehabilitation of 32 existing wells in the Southern volcanic region to provide an increased yield of approximately 1,220,000 imperial gallons per day.

c. Improved Water Storage and Transmission/Distribution Systems

Given an increase in available water it becomes necessary to provide for storage, transmission and distribution of the increased amount. The existing water supply system of storage facilities, transmission lines and distribution networks was analyzed in the light of the development of increased water supply into the system. In arriving at a

decision to resolve the problem of handling the increase water into the system, alternatives were compared considering both initial and ongoing costs.

- (1) Transmission - In the case of the need for increased transmission between All Saints and Scotts Hill reservoirs, it was determined most economical to install the 18 inch diameter pipe between the two reservoirs. Alternatives including parallel pipe installation, restoration of existing pipe lines and modifications to an existing pumping station were found to be more costly than the above-mentioned 18 inch gravity line.

A 2000 ft 6 inch line will be installed to connect the 18 inch Saints/Scotts Hill line with the 4 inch distribution line serving the village of Sea View Farm.

- (2) Storage - Alternate plans for increasing water storage include construction of a new 1.6 million imperial gallon reservoir to augment the 400,000 imperial gallon reservoir at All Saints as compared with relocating the welded steel storage tank at the now abandoned Crabbs Peninsula Desalting plant. Recently acquired data indicate that relocating the Crabbs Peninsula tank will be as costly as the purchase of a new one. As the Crabbs Peninsula tank has never been inspected internally and its condition is not accurately known, it was decided to purchase a new reservoir. Additionally, to improve storage through impounding, a new Body Pond Pump Station will be constructed including 700 ft of 6 inch pipe to connect the pump station with Fishers Dam.

- (3) Improvements to Existing Water Supply Facilities

Potworks/Delaps restoration includes work on the Potworks Reservoir System; the Potworks Pumping Station; and the Delaps Water Treatment Works.

Minor improvements to the Potworks Dam facilities are required so the system functions at full capacity. They include pipe screens and a walkway from the dam to the draw-off structure.

The Delaps Water Treatment Works is an important part of the Antigua Water Supply System. In order for the plant to function properly improvements are required including the installation of a flash mixer, additions to the chlorination system and laboratory equipment replacement.

- (4) Water Treatment Improvements - as noted above, the project has been designed to meet a basic problem which is a shortage of potable water in Antigua. However, a secondary problem with domestic water in Antigua is a growing concern with respect to water quality. Existing water treatment facilities in Antigua were carefully inspected to determine what improvements were required to provide the desired quality as well as quantity of water. The problem in this case is not a question of methodology, but a question of which alternative provides the least solution at the least cost. The solution in this case will involve replacement of the Grays Hill and Collins Water Treatment Works and restoration of the Wallings Works, as indicated in the project description.
- (5) Institutional Development - Finally, in order to complete a well-balanced project design, the institutional development addresses the operational and administrative side of the project.

2. Financial

a. Historical Results

On an accrual basis, the Water Division showed a loss of approximately EC\$68,000 in 1980, and profit of EC\$175,000 in 1981, and an unofficial loss of approximately EC\$1,525,000 in 1982 (all fiscal years ending June 30). Extrapolating the first quarter current year results, the unofficial estimate for the year ending June 30, 1983 would be approximately EC\$1,600,000.

The JMM consultant estimate for the current year is a net profit of approximately EC\$33,000 (See Table 5). It is based on an estimate of income higher than that of APUA, and a revised allocation of debt burden between the Water and Electricity Divisions which ties loans directly to the Department which benefits from the loan.

No matter which estimate is used, the Water Division has historically had a negative cash flow, and will continue to experience a slight negative cash flow during the current year. Operations have been financed by increasing short term debt, and by failure to pay interest and principal when due.

The single greatest financial and cash increase between 1981 and 1982 was in wages and salaries, which increased almost 25 percent. APUA estimates that wages and salaries will grow approximately 8% in the current fiscal year, if first quarter trends are projected through the year.

Historical trends are of little use in estimating future financial and cash flow results in the Water Division of APUA when related to the Project. Insufficient information exists to establish a meaningful historical time series, and changes in operations and policy have been major contributors to changing results over time. However, since a major change in practice and procedure is required for the financial success of the Project, several assumptions were made regarding increased financial activity. Operational costs increasing throughout the Project have averaged about 5-8%. The estimates of future income, expense, and cash flow are based on a series of assumptions which are felt to be reasonable, but which make only very limited use of historical data.

b. Estimated Revenues

Revenues for the period July 1, 1983 through June 30, 1993 were estimated on the following basis. Additional water to be produced as a result of Project implementation was added to total current production in the year it should come available, and was compared to the estimates of the unconstrained demand upon the system for those years. Unconstrained demand is the quantity of water that would be demanded by the service population at current prices if the supply available was unlimited. In every year actual projected production falls short of the unconstrained demand.

Estimated production was reduced by a factor to include unaccounted-for water (water lost to leaks, unbilled/wastage, etc.). Over the Project period unaccounted-for water was reduced from a beginning 30% of total estimated production to 20%, to reflect increased system operations efficiency. The original 30% is a JMM estimate which is felt to better represent actual losses than the 18.9% cited in Table 2 of the text which was derived from the Pre-Feasibility Study.

Actual consumption includes a net reduction in standpipe demand over the Project period due to an assumed increase of domestic service connections over time.

The total revenue to be billed each class of user was calculated using current rates, which in real terms are assumed to remain unchanged throughout the Project period. Total revenues accrued were obtained by summing the revenues from each class"

While the current APUA water rate schedule includes higher rates for domestic metered consumption in excess of 4,000 igal/mo, and 10,000 igal/mo, the revenue assumptions were based on all domestic metered connections consuming less than 4,000 igal/mo. Estimates of individual consumption and the number of individuals served by each domestic connection led to this assumption. To the extent that individual domestic connections will consume more than 4,000 igal/mo, total revenues have been understated.

Table 5 sets forth total estimated revenues for the Project period by user class. It should be noted that the estimates for standpipe and Governmental use are based on a prior set of estimates, since most of the water consumed by those two classes of users is unmetered. In addition, Government disputes the billings rendered by APUA, contending they are too high. However, these two classes of users are billed at the lowest rate. It is felt that if it turns out revenues from these users have been overestimated, the shortfall will most likely be met by additional revenues from industrial, commercial, and hotel users. Each of those categories is felt to have been estimated in a conservative manner.

Over the Project period revenues are estimated to increase approximately 60% in constant EC dollar terms.

c. Estimated Costs

Operating costs were estimated for the Water Department over the Project period in two groups. The first are the costs which would be incurred at the current level of water production, without Project created additions. These costs were taken from the operating experience of APUA for the first quarter of the fiscal year beginning July 1, 1982 (the most recent data available). The first quarter results were annualised, and projected into the future.

The second group of costs are those which result from the additions to production capacity, treatment, and potential groundwater development. They do not include costs incurred during construction, but are phased into the operating cost total as the new facilities come on line during the Project period. The vast majority of new operating costs is represented by electrical consumption. The Water Division is assumed to actually pay the Electrical Division for power consumed, as is the case with power costs currently incurred.

Operating costs are assumed to remain constant in real terms during the Project period. This is felt reasonable in light of the institutional development within APUA which is projected for the period. It is probable that some operating cost elements will increase in real terms during the period. But it is felt that they will be offset by reductions in other elements due to increased efficiency of operations.

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Total operating costs are forecast to increase approximately 19% during the Project period in real terms. This may appear optimistic, but examination of the forecasts will show that aside from power consumption, the improvements to the system created by the Project involve very small additional costs. The Project has very great leverage in this respect.

In consultation with APUA financial managers, the debt of the Water and Electrical Divisions was allocated between the two according to the direct benefits created by the loan funds involved. Interest owed by the Water Division over the Project period was estimated in the same manner as operating costs. First, interest was computed on current debt as allocated. Then, new interest due as a result of the Project loan funding was added to arrive at a total for each year of the Project period. The loan was assumed to be at 5%, with a 5 year principal grace period, and a 20 year level term payment thereafter.

Depreciation was estimated in the same manner as interest. Using the depreciation schedule established by the APUA auditors, current assets were depreciated over the Project period. New assets created by project construction were given useful lives and were depreciated over the period, beginning at the end of the first fiscal year in service. The two sets of depreciation were summed to arrive at total depreciation for each fiscal year of the period.

The resulting profit (or loss) for each fiscal year as estimated can be seen at the bottom of Table 5. The APUA Water Division is forecast to go from a small net profit in the year ending June 30, 1983, to a loss of over EC\$180,000 in the next year, turning profitable again in 1984-85 and in each succeeding year of the Project period.

d. Cash Flow

Table 6 presents estimates of cash flow for the Water Division. This analysis is not a conventional Sources and Applications of Funds Statement as often found in financial statements. Instead, the cash flow presented here is an actual estimate of actual cash in versus actual cash out, analogous to the changes which take place within a cash register during the course of a day.

Table 6 presents both a Yearly Balance and an Ending Balance for cash flow. The Yearly Balance represents the outcome of the cash flows in and out during the single fiscal year under consideration. The Ending Balance includes the net surplus (or deficit) position of the Water Division in terms of cash at the beginning of the fiscal year. It represents a running balance, as the outcomes of previous years affect the ending position of the current year.

It is important to note that the Ending Cash Balance of the Water Division is not estimated to become positive until some time in the fiscal year 1984-85. On June 30, 1984 the Balance is estimated to reach a total net deficit of over EC\$836,000. APUA and the Water Department will be required to find short-term bridge financing to cover this deficit. Good business practice strongly recommends that the bridge not consist of deferral of interest and principal payments due creditors. If the Water Division is

TABLE 6

APUA PRO FORMA CASH FLOW

(EC\$000's 1983)

Year Ending June 30

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Beginning Balance	45	(1059)	(836)	809	2895	4942	6649	6908	7155	7391	7625
Receipts											
Operating Revenue	3284	4845	6706	7627	7724	7434	7537	7628	7722	7824	7927
Loan & Grant Funds	-	12660	10057	3472	-	-	-	-	-	-	-
(A) Total Receipts	3284	17505	16763	11099	7724	7434	7537	7628	7722	7824	7927
Funds Available	3329	13114	14946	15012	8492	8852	10116	11750	13488	15337	17298
Expenditures:											
Operating Expenses	4002	4240	4537	4994	5130	5328	5434	5540	5646	5752	5858
Capital Expenditures	-	7741	7155	2552	-	-	-	-	-	-	-
Technical Assistance	-	4919	2902	920	-	-	-	-	-	-	-
Interest (Old Loans)	-	115	89	67	60	29	9	6	5	3	-
Principal Repayment (Old)	386	212	137	135	142	25	25	25	25	25	-
T&T Repayment (PI)	-	-	-	-	-	-	1465	1465	1465	1465	1465
AID Repayment	-	55	298	345	345	345	345	345	345	345	345
(B) Total Expenditures	4388	17282	15118	9013	5677	5727	7278	7381	7486	7590	7668
(A-B) Yearly Balances	(1104)	223	1645	2086	2047	1707	259	247	236	234	259
Ending Balances	(1059)	(836)	809	2895	4942	6649	6908	7155	7391	7625	7884

(one U.S. Dollar = 2.7 EC\$)

AID Loan Amount = US\$6.625 million = EC\$17,230,000 - 2% During Grace (10) = \$345,00

Trinidad & Tobago Loan = TT\$12,000,000 = EC\$13,577,000 i = 4%, Grace = 5 yrs. n = 15 = PMT = 1465

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TABLE 7

APUA PRO FORMA CASH FLOW
(EC\$000's)

Bridge Loan

Year Ending June 30

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>
Beginning Balance	45	-0-	91	1604	3385	5127	6529	6483	6425	6661	6895
Receipts:											
Operating Revenue	3284	4845	6706	7627	7724	7434	7537	7628	7722	7824	7927
Loan & Grant Funds	-	12660	10057	3472	-	-	-	-	-	-	-
(A) Total Receipts	3284	17505	16763	11099	7724	7434	7537	7628	7722	7824	7927
Funds Available	3329	17505	16846	15012	8492	8852	10115	11750	13488	15337	17298
Expenditures:											
Operating Expenses	4002	4240	4537	4994	5130	5328	5434	5540	5646	5752	5858
Capital Expenditures	-	7741	7155	2552	-	-	-	-	-	-	-
Technical Assistance	-	4919	2902	920	-	-	-	-	-	-	-
Interest (Old Loans)	-	115	89	67	60	29	9	6	5	3	-
Principal Repayment (old)	386	212	137	135	142	25	25	25	25	-25	-
T&T Repayment (PI)	-	-	-	-	-	-	1465	1465	1465	1465	1465
AID Repayment	-	55	298	345	345	345	345	345	345	345	345
Bridge Loan (PI)	-	132	132	305	305	305	305	305	-	-	-
(B) Total Expenditures	4388	17414	15250	9318	5982	6032	7583	7686	7486	7590	7668
(A-B) Yearly Balances	(1104)	91	1513	1781	1742	1402	(46)	(58)	236	234	259
Ending Balances	-0-	91	1604	3385	5127	6529	6483	6425	6661	6895	7154

(One U.S. Dollar = 2.7 EC\$)

AID Loan Amount = US\$6.625 million = EC\$17,230,000 - 2% During Grace (10) = \$345,000
 Trinidad & Tobago Loan = TT\$12,000,000 = EC\$13,577,000 i = 4%, Grace = 5 yrs, n = 15 = PMT = 1465

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performing according to estimate, it should be able to arrange short-term financing for the bridge, and easily handle the additional interest and principal payments required, as long as the loan is structured along reasonable lines. Table 7 shows cash flow projections with bridge financing of EC\$1,100,000 in FY 83. Assuming a loan at commercial rates (12%) with amortization over a seven year period, the cash flow of the Water Division would remain positive from FY 84 throughout the period projected (1993). At the end of this time, it is estimated that the Water Division will have a cash surplus in excess of EC\$7,100,000.

3. Economic

a. Key Assumptions

Benefits as measured by incremental revenues from Project improvements were assumed to accrue as the improvements come on stream and actually provide more consumable water.

Incremental revenues were measured on a cash-in basis to APUA, not on an accrual basis. Therefore, they more closely track the Cash Flow estimates rather than the Income Statement estimates.

The salvage value of the improvements at the end of the analysis period is taken as their depreciated asset value.

All benefits and costs are in constant 1983 EC\$.

b. Consumer Surplus

The incremental revenue used as the benefit measurement does not measure what consumers would actually be willing to pay for the incremental water produced by the Project and sold to them. It only measures what they are estimated to actually pay at the current rates in effect. There is no present empirical way to estimate what they would actually pay, but there is evidence that they value the benefits received at a much higher level than the incremental revenue indicates.

The most striking evidence of this is the fact that during periods of water shortage consumers (especially tourist hotels) will pay EC\$75 per 1,000 iganal to water vendors who deliver by truck to their cisterns, when the meter rate to the hotels is only EC\$15 per 1,000 iganal through the APUA distribution system, or five times less. Domestic metered water costs EC\$7 per 1,000 iganal for the first 4,000 iganal per month.

c. Public Health

It is traditional to ascribe a certain degree of benefit to improved public health through water supply improvement, but this is a benefit which is extremely difficult to quantify. However, in the case of Antigua, the disbenefit of not providing an adequate supply of safe potable water would have a particularly adverse impact on the nation's economy, which is highly dependent upon the tourist industry. It is known that outbreaks of water borne disease, especially typhoid, have a high negative impact upon tourist trade. The quality of water delivered by APUA to the final consumer is considered marginal at best, and though there has been no recent significant incidence of disease, an outbreak must be considered possible. The proposed improvement in treatment facilities included in the Project is considered to reduce the possibility by a fairly large factor. Without attempting to estimate the factor, or what the impact of an outbreak would be, it should be noted that a 10% reduction in tourist expenditures from estimated 1981 levels would result in a reduction of income from tourism of approximately US\$4,250,000 or EC\$11,475,000 in one year alone.

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No attempt has been made to quantify benefits in this analysis. First, traditional methods attempt to estimate the reduction in water borne diseases by improved water supply, and relate that to some measure of increased productivity in the work force such as a reduction in work days lost times a lost times a daily wage rate. Quantifying such benefits, however, is a difficult task. Second, Antigua does not have a significant incidence of reported water borne diseases such as typhoid. Therefore, there is no basis for stating that a significant reduction in water borne disease will take place with water supply and treatment improvement.

d. Economic Impact

An increased supply of water and increased dependability of service will have a positive benefit for the tourist industry on Antigua. Again, this benefit cannot be quantified, but it is reasonable to assume that tourists who go without shower or toilet water for hours or days at a time are less likely to return to the island. They are also likely to make their unhappiness known to travel agents and fellow potential tourists, thus reducing the number of tourists who visit the island for the first time. The increase in waste water and pollution is not likely to have a strong effect upon the tourist trade, since most tourists spend the majority of their time in the resort environment where sanitary facilities are adequate. However, pollution of bathing beaches can have a negative impact should it occur, and the presence of waste water in open gutters, as in St. John's, is likely to have some negative impact on the tourist's overall enjoyment, and thus willingness to return.

An increased supply of water will create other non-quantifiable benefits within the economy of Antigua, such as an increase in property values occasioned by the extension of water service to the property line, or by increased dependability of supply. In addition, the climate for industrial expansion and investment is bound to be enhanced by an increased probability that water will be available for process use, or simply for essential (but incidental) services to industry.

APUA BENEFIT/COST CALCULATIONS
FIFTEEN YEAR PROJECT ANALYSIS
 (EC\$000)

YEAR	ACTUAL BENEFITS	ACTUAL COSTS	NET BENEFITS	P V 8% BENEFITS	P V 8% COSTS	P.V.11% BENEFITS	P.V.11% COSTS	P.V.15% BENEFITS	P.V. 15% COSTS
1984	227	7,233	(7,006)	210.2	6697.2	204.5	6516.2	197.4	6289.6
1985	1,978	8,415	(6,437)	1695.8	7214.5	1605.4	6129.8	1495.7	6362.9
1986	2,555	3,147	(592)	2028.2	2498.2	1868.2	2301.1	1680.0	2069.2
1987	2,658	588	2,070	1953.7	432.2	1750.9	307.3	1519.7	336.2
1988	2,765	588	2,177	1881.8	400.2	1640.9	348.9	1374.7	292.3
1989	2,879	588	2,291	1814.3	370.5	1539.2	314.4	1244.7	254.2
1990	2,980	588	2,392	1738.8	343.1	1435.3	283.2	1120.3	221.1
1991	3,084	588	2,496	1666.2	317.7	1338.2	255.1	1008.2	192.2
1992	3,197	588	2,609	1599.3	294.1	1249.8	229.9	908.8	167.1
1993	3,310	588	2,722	1533.2	272.4	1165.7	207.1	818.2	145.3
1994	3,310	588	2,722	1419.6	252.2	1050.2	186.6	711.5	126.4
1995	3,310	588	2,722	1314.4	232.5	946.1	168.1	618.7	109.9
1996	3,310	588	2,722	1217.1	216.2	852.4	151.4	538.0	95.6
1997	3,310	588	2,722	1126.9	200.2	767.9	136.4	467.8	83.1
1998	3,310	588	2,722	1043.5	188.4	691.8	122.9	406.8	72.3
Salvage	3,310	-	-	1047.2	-	694.3	-	408.3	-
TOTAL				23290.2	19927.6	18800.8	18438.4	18518.8	16817.4
Benefit/Cost	<u>At 8% Discount</u>			<u>At 11% Discount</u>			<u>At 15% Discount</u>		
Ratio	1.1687			1.0197			0.8633		

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4. Social Soundness

The existing population of Antigua is 77,000 and is projected to increase to the year 2000 at the percent growth rate of 1.3 percent annually. Projected growth is shown in the table below.

Projected Population - Antigua

<u>Year</u>	<u>Population</u>
1983	77,040
1985	78,975
1990	84,240
1995	89,860
2000	95,850

Although it is a relatively small island of 180 square miles, it is one of the most developed in terms of urbanization. Economic and social variables have contributed to this phenomena due to the movement from a predominantly rural-agricultural society to a much more commercially-oriented focus. Approximately 43,000 of the urban and rural population reside in the area of St. John's, the island's capital.

For 300 years the economy of Antigua was based almost entirely on sugar and cotton. Until the early 1960's sugar and sea island cotton maintained a position of prominence; however the mid-1960's witnessed a major development of tourism and related construction activities, together with a decline of the old, colonial industries. In the 1970's the economy was badly damaged by the closure of the sugar industry in 1973, the oil escalations of 1973 and the closure of the oil refinery in 1975. In addition, economic recessions in the U.S., Canada and the U.K. in the mid-1970's hurt tourism. The economy recovered somewhat in the last six years however, as tourism and manufacturing output doubled between 1977-1981.

Hotels and restaurants contributed 12 percent of the 1981 GDP. There are 34 hotel establishments (with a capacity of 3,642 beds), 32 cottages and apartments and 20 guest houses. The Ministry of Economic Development has estimated that tourism accounts for 60 percent of the GDP when associated services and indirect effects of money circulating through the economy are also included. The tourism growth rate, however, is difficult to predict, as the market is influenced by many outside factors, chiefly the economies of European and North American countries. Past studies have indicated that the number of tourist bed nights is projected to increase from 590,000 in 1980 to 950,000 by the year 2000; thereby increasing employment opportunities in the industry.

In 1981, the employed labor force of 29,211 was distributed as follows:

- Distributive trade, including hotel and restaurants	22.4%
- Other Services	37.2%
- Construction	11.1%
- Transport, storage, and communications	11.1%
- Agriculture	9.0%
- Manufacturing	7.4%
- Other	1.8%

Antigua has a number of favourable developmental conditions: a relatively high overall educational level, easy internal access; favourable national economic conditions, and a progressive five-year development policy which recognizes the need to expand and renovate its public utility system of which water supply has been given priority consideration.

The project will directly benefit the entire population of Antigua and serve to enhance its productive capabilities by providing adequate water supplies for domestic, as well as commercial purposes. In addition, the project will benefit the overall population in the health sector. At present, portions of the existing transmission and distribution systems are poor and open drainage pits and canals constitute a health hazard. There is also some evidence of contamination of the water supply system, although the bacteriological examination carried out so far have been very limited. Even with incomplete reporting, however, there is data to show that gastroenteritis is a major health problem and the leading cause of death in the under five year age group. There is also an adverse health impact resulting from an insufficient quantity of water being supplied, reflected in the high incidence of water-washed diseases (e.g. conjunctivitis) in Antigua.

Improving the water quality, and increasing the supply of potable water then, will have a significant beneficial impact on the health of Antiguan (and presumably for visiting tourists). An increased supply of water will also permit more people to convert from standpipe usage to residential connections, which will promote better hygiene through more convenient access to water. This situation will primarily benefit the lower income groups who are the primary users of standpipe water.

The Antigua Public Utilities Authority is responsible for the provision of water, water supply and sewage disposal services, as well as controlling the country's fresh water resources. This project will serve to enhance the capability of the authority to carry out these responsibilities, thus benefiting the population of Antigua by increasing the water supplies for industry, commerce, tourism, and domestic purposes, in addition to improving the overall standard of living conditions.

Women in Development

Of the total population of approximately 77,000 in Antigua, forty-seven percent are women. Female heads of households are a prevalent feature in the Caribbean with approximately 35% falling into this category in Antigua. As the headship, the female is largely responsible for the management and economic well-being of the family. Women in the Caribbean by the nature of their position in society and multi-dimensional social role, hold positions and are actively involved in all sectors. They play a major role in agriculture, rural, community and social development. The women participate in all aspects of agriculture, raise animals, produce goods and services, as well as collect and carry firewood and water.

Increasing the availability and accessibility to quality water, therefore, would directly benefit the women in Antigua. It will provide a scarce, yet needed commodity, in expanding trade, industry and commerce; thereby expanding opportunities for the highest unemployed group: Women. It will also expand the arable agricultural land and afford opportunities to increase production for home and local consumption. Overall

health of the families should improve with adequate, properly-treated water supplies and time-savings will be realized as water will be more accessible.

The provision of this resource will allow women to participate more fully in national development by enabling them to more easily be involved in the production of goods and services which will meet basic needs, pursue income-generating opportunities resulting from the increased

5. Administrative Analysis

The institutional development of the APUA has fluctuated noticeably during the ten years of its existence. Outside management advisory assistance has been provided to APUA with varying degrees of success and failure. The authority's present capabilities to adequately operate and maintain the water supply systems are marginal and suffer from the lack of funds, insufficient management, untrained personnel and inadequate support equipment and materials. The present water supply system is complex in that it contains numerous treatment facilities and well stations, booster stations and several service elevation zones.

The proposed improvement program will increase service responsibilities and expand an already complex water system. Without further development of institutional capabilities, the water utility could not meet the increased demand for water service over the normal life expectancy of the proposed capital investments. Also, the water utility would be unable to generate sufficient revenues to service improvement loans and maintain the system in an effective and long-lasting manner.

a. Powers, Laws and Regulations of the APUA

The APUA was created by Act No. 10 of 1973 approved on June 28, 1973 and subsequently amended by Acts Nos. 12 of 1973, 16 of 1976, 7 of 1979 and 25 of 1980. The important changes in these amendments were: 1) increasing the Government Board of Commissioners from five to nine members; 2) giving Cabinet the power to dissolve the Board; and 3) officially changing the water rate schedules. The Act is sufficiently broad and complete but is complicated by the inclusion of telephone, electric and water supply services into one enabling legal document. The Act plus amendments consist of 42 pages of conditions, wherein lie several potential problem areas.

The Act provides for the appointment of a 9-man Board of Commissioners including an appointed chairman. The Board has specific, defined rights and responsibilities and is established to provide semi-autonomy in managing the authority's affairs. Policy matters are generally delegated to the Minister of Public Utilities, Aviation and Public Information. Some policy matters are assigned directly to the Cabinet for consideration and approval. The APUA Board was dissolved in 1979 and was only recently reinstated by Cabinet on February 9, 1983. New Board members have not yet been appointed. The Act also provides that five Board members constitute a quorum and that decisions can be made by a "majority vote". This would in effect empower three Board members to make decisions for the 9-man Board, and poses the possibility of a minority making major changes in APUA policy or operations.

The Act provides discretionary powers to establish operating regulations, a normal procedure for water utilities to follow in dealing with water supply conditions and standards, extension of water systems and administration of personnel. The Water Division of APUA, however, has not adopted these essential operating regulations.

The Act empowers the authority to control all or any of the island's water resources, which includes control of exploitation as well as the responsibility for protecting the quality of water resources.

Section 8.2 of the Act authorizes the authority to "establish, operate and maintain a sewerage system in the State". APUA is providing two employees to assist the small, ineffective sewerage plant servicing the hospital, but the organization and staffing at APUA is not equipped to handle sewerage responsibilities. Control of waste water discharges is carried out by the Ministry of Health on an informal and ineffective basis.

b. Organization and Management

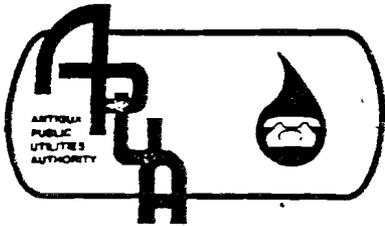
The most important constraint to effective water system management is located here. Since the APUA Board of Commissioners was dissolved in 1979, direction at the top management level has been confused and unclear. The roles of the Minister of Public Utilities, Aviation and Public Information together with his Permanent Secretary have not been clearly defined, causing some conflict in overall APUA management. The management works without essential operating regulations or a clear understanding of its authority and limitation. The combination of nationals and expatriates adds to the confusion with regard to the exact scope of responsibility. The enabling law appears to be largely ignored and is not used as a legal reference by APUA in its day-to-day activities.

Figure sets forth the existing organization plan of APUA. Meter reading is combined with the Electricity Division and the separate water billing and collecting unit is under the APUA Chief Accountant. The Well Drilling and Dratting Sections contain only eight employees whereas the Operation, Maintenance and Construction section contains the bulk of the employees and has the entire responsibility of producing and delivering water to the user. Consequently, the Acting Superintendent in charge of this section has an unusually heavy load of responsibility.

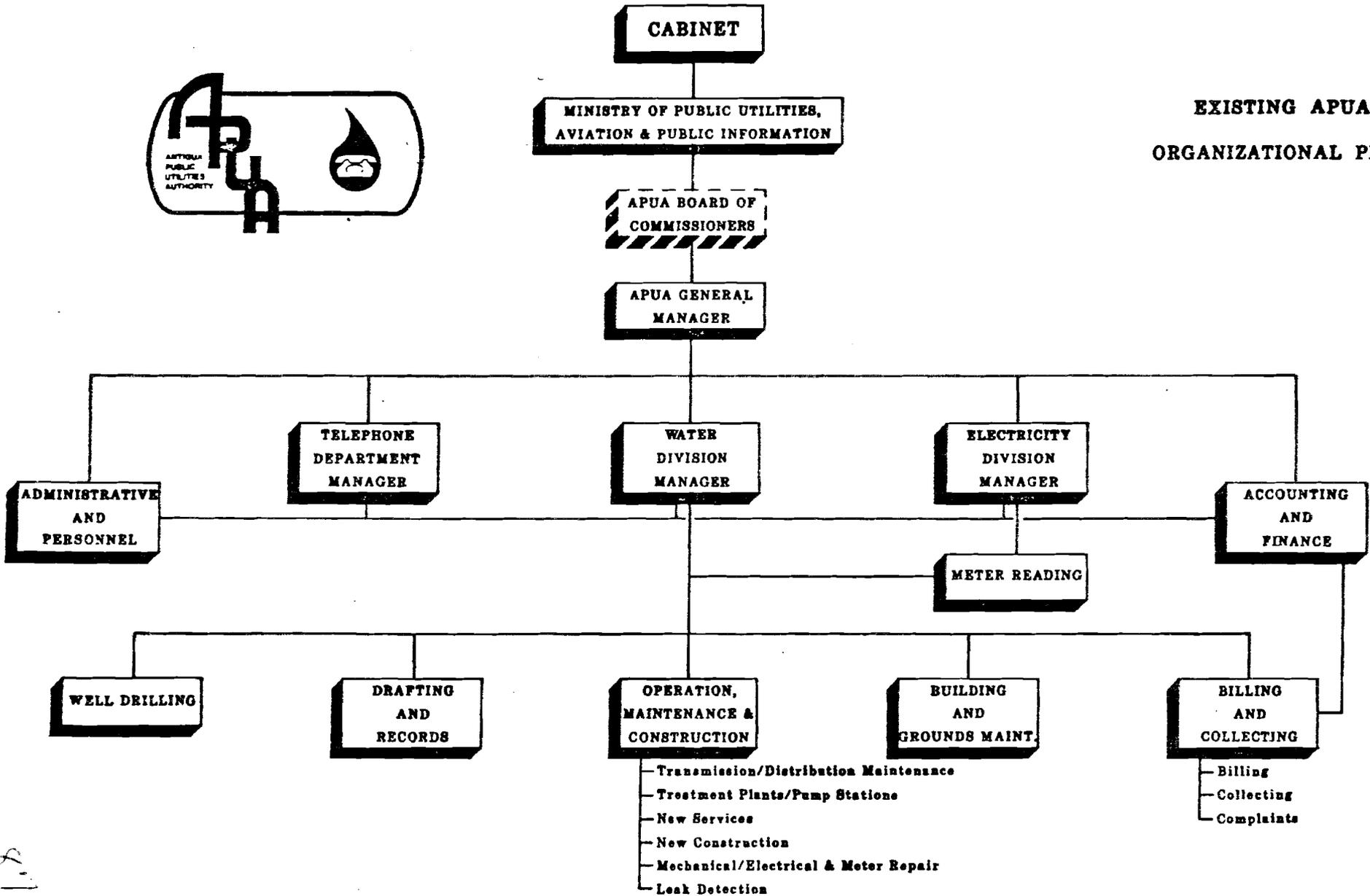
The APUA General Manager and the Water Division Manager are expatriates under temporary assignment from CFTC. Both assignments may terminate around the end of 1983. The APUA Chief Accountant is on similar status. Local counterparts have not been provided for the top two positions and the expatriates are providing direct management services. Middle management is weak because of vacancies and positions filled with undertrained staff. The APUA also suffers from a lack of written programs and procedures and clear delineation of functions and responsibilities.

c. Revenue Collection

Proper revenue collection is needed to exercise fairness to all water customers, to cover payrolls, to purchase essential operating equipment and supplies, and to demonstrate the ability to finance capital improvement programs. Present water revenue collection programs at the APUA are generating revenue amounting to about 39 percent of that due for water supply. This has a markedly adverse effect on the ability to carry out day-to-day operations as well as the ability to finance water system improvements. It is estimated that 50 percent of current billings is lost by not enforcing water bill collections and an additional 28 percent of revenue is lost due to inoperative and unread water meters. The current financial condition of the water division should experience a dramatic improvement once these conditions are corrected.



**EXISTING APUA
ORGANIZATIONAL PLAN**



8.1.8
A

A simple calculation of water bills prepared versus water bills paid shows a payment ratio of about 50 percent over the past several years. (Payment ratios for water utilities in developed countries typically exceed 99 percent billings.) Several conditions have contributed to the low collection ratio in Antigua including a lack of an official collection enforcement policy and procedures; unresolved, disputed water charges going back over many years; the ability of various officials to stop enforcement procedures; and dispute by the Government on the calculation of public standpipe consumption and billings.

Recent efforts have been made to enforce payment of arrears and the payment ratio is beginning to improve. However, a marked increase in the collection of billings will have to be made before the APUA can begin to operate on a self-sustaining basis.

The authority's staff have estimated that about 18 percent of the active, installed water meters cannot be read. Unmetered customers are usually given a very low, or minimum, water consumption billing. A random selection of almost 5 percent of the water meter accounts revealed that 31 percent of the meters were evidently inoperative, 21 percent were estimated charges due to various meter reading problems, and 48 percent were billed on an actual metered consumption calculation. If this is a representative sampling, one-half of the customers are receiving low consumption estimates or minimum charges (i.e. US\$2.70 per month). The estimate of lost revenues based upon the sampling results indicates that at least 28 percent of billable charges are not realized due to faulty meters, unread meters and estimated billings. Added to this is the excessive volume of water used by estimated accounts that deprives other customers of adequate supplies and inflates operating costs through higher pumping and treatment expenses.

A program of corrective action of unreadable or stuck meters was started on January 17, 1983 using the BDD-financed Kent water meters and fittings, but at the present rate of progress it would require over four years to correct the estimated number of meter reading problems.

Water meters are often located close to the customer's residence some distance from the street. Meters are installed exposed at ground level. Access to water meters is often hampered by fences and walls, the owner's dogs, the deposit of earth and trash over the meter, plant growth near the meter, and even by extending the buildings over the meters. Access to the property is sometimes impossible due to the absence of the owners or occupants. Thus, even though the water meter is operational, consumption must sometimes be estimated with the subsequent under-realization of revenues.

d. Operation and Maintenance

Proper system operation and maintenance is the heart of water utility services and determines revenues, customer satisfaction and the ability to benefit from costly water system investments. The APUA has been able to provide a minimum acceptable level of service even when confronted with many constraints and problems. Major constraints include:

- . Shortage of working capital to purchase essential parts, replacement units and support equipment;

- . Difficulty in procuring overseas parts, equipment and supplies in a timely manner;
- . Lack of fully trained personnel in specialty areas;
- . Overburdening of the Acting Superintendent;
- . Shortage of support services such as communication, transportation and parts inventories;
- . Absence of routine operating procedures and preventive maintenance program;
- . Lack of analytical capability in evaluating water production and transmission effectiveness;
- . Need for accurate system maps showing details of the underground facilities.

The latest master plan for the distribution system was completed in 1970 by Halcrow. Various studies have been performed since that time which included population and water demand projections, but a distribution system analysis has not been included. A complete master plan update before any major improvements are made to the transmission and distribution system.

e. Accounting and Commercial Activity

The accounting system is based on a formal chart of accounts encompassing all three utility services. Subsidiary cost centers are used to collect and record costs of operating treatment plants and other major facilities. Financial reports are prepared long after the end of the reporting period and have not been used as management tool in operating the utility. The account classification system does not conform with the "unified system of accounts for water utilities".

The stores inventories are presently being revised to provide better accounting and reconciliation of inventory values. New forms and procedures have been developed but are not yet implemented.

Water billing is handled by eight people completely separated from the telephone and electricity billers. They utilize a multicopy or pegboard system in their billing activities. Bill preparation is complicated because bills are calculated on actual gallonage used instead of by 1,000 gallon units. Accounts are kept on individual customer ledger cards in large wooden bins and are not reconciled to the general ledger controlling accounts receivable.

The billing section is located next to the cashier taking water bill payments, which is the only paying station for water bills. The water bill cashier sits next to two other cashiers who receive electric bill payments. In order for a customer to pay his APUA monthly bills, he must go to the telephone office about five blocks away and then to the head office, waiting first in the electric bill payment line and then in the water bill payment line.

6. Energy Consumption and Production

The Project will finance an alternative energy demonstration program including the hybrid systems described below.

a. Photovoltaic Pumping System

The net change in energy consumption for the project as a whole is basically increased through the addition of new pumping requirements of the rehabilitated water wells. It has been estimated that increased electrical energy requirements to pump 85 igpm @ 300' of head would increase the well field electrical energy demand to \$125,522/year. Given a 70% efficiency factor and the government energy rate of 0.174/kwh, it was considered advantageous to demonstrate the compatibility of providing an alternative energy source to the pumping system at a pre-selected well site. The selected site is in Orange Valley which has a potential water yield of 0.15 mgd.

The demo system will provide one photovoltaic array utilizing storage batteries for inverted DC to AC power on a peak demand basis.

The amount of solar radiation received per unit area in a given time (at a given site) is called insolation solar radiation. Data for several sites in Antigua (expressed in kilowatt hours/meter²) was available from the meteorological station in Barbados, and was recorded as sample data provided under the national energy assessment recently drafted by CARICOM. The insolation rate in Antigua approaches 5.3 kwh/m² which encourages the use of photovoltaic arrays providing inverted electrical power to the 6" submersible pump to be placed at the Orange Valley restored well. Although annual year-to-year variations in weather will cause variances of a few percent from average values the insolation rate for this rather dry island regime provides ample radiation at a rather flat degree of latitude angle.

1) Energy Storage

The amount of energy storage required depends on the application. In some cases it is not necessary (in direct water pumping for example, where the product is stored, or in a grid-connected system where a solar photovoltaic array feeds excess power into a utility grid via synchronous inverted) However, in this program storage is required to act as an energy buffer between the time-varying output of the solar array and the constant power demand of the load, since pumping will be continuous throughout an 18-hour period.

To date, the most economical form of energy storage for photovoltaic applications is the lead acid battery. During the final design stage, consideration by the Engineering Consultant will be given to maximizing the expected depth of discharge of the battery, for deep-discharge applications.

2) Photovoltaic Array Sizing

The load energy requirements are reduced to an average daily demand expressed in kwh. From this, the photovoltaic array size, expressed in rated kw was determined as follows:

	Average Daily Demand (kwh/day)	X	Rating Intensity (kw/m ²)
Array=			
Power (kW)	TT Insolation (kwh/m ² /day)	X	Efficiency Factor F

The Efficiency Factor, F, takes into account losses in the battery, charging circuitry, and low-demand levels. Typical F values for Antigua are between 0.80 and 0.95.

The panels will be mounted on a support structure sturdy enough to withstand the winds expected within Antigua. This was determined to be designed to a maximum wind speed of 36 m/s (=80 mph.) The array will be tilted at an angle to the horizontal close to the latitude angle for the site. The tilt angle can be within $\pm 15^{\circ}$ of the latitude angle without affecting the annual energy output of the array by more than a few percent. Often it is set at an angle greater than the latitude so that output is uniform from season to season. The closer location to the equator reduces the variance of seasonal declination.

3) Wiring and Switchgear

Photovoltaic circuitry will include a series blocking diodes to prevent the battery from discharging through the panels at night. At this juncture it was not felt that it would be necessary to provide fuses for the array, since photovoltaic panels are inherently current limited. However, fuses will be provided between the battery and the load circuit. Lightning protection techniques will also be employed.

Most photovoltaic systems require some form of electronic control unit. In a system with battery storage its purpose will be to regulate, control, or maintain the battery state of charge. Therefore, the sizing of battery storage and photovoltaic array can be determined in the following fashion. The assumption is that the load demand for average energy use of 18 hours/day @ 350w will be maintained. This amounts to 6.3 kwh/day.

Given a TT insolation of 5.3 kwh/m²/day, and taking the Efficiency Factor F as 0.80, the required array size in rated kw is:

$$\frac{6.3}{5.3} \times 1.0 = 1.19 \text{ kw}$$

$$5.3 \times 0.80$$

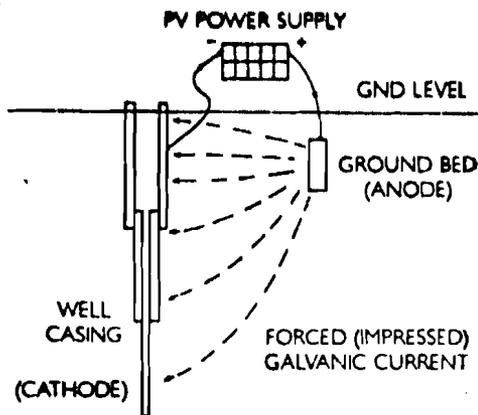
This would require a rated output power of 30 W. which would require a total array area of approximately 200ft². A battery bank having an energy storage capacity of 35kwh would suffice to cover a 5-day sunless period. The water pump and the electronic control unit for this system will incorporate a state of charge indicator, a low-voltage load cutout, and a high-voltage charging current limiter. Maintenance required for this system would be limited to checking the battery electrolyte level every few months. The batteries require replacement after 5-6 years, and all other system components will last in excess of twenty years.

b. Photovoltaic Cathodic Protection System

One of the major causes of early reduced life in steel pipes around Antigua is the high salinity and acidity value of the soils which corrodes metal pipe at an accelerated rate.

Many of the present wells were found to be heavily corroded by the galvanic action on the pipes and subsequently were abandoned far before their useful life was realized.

In order to counteract this corrosive action, most of the new pipes will be non corrosive PVC or asbestos cement (Transite). However, there remain numerous steel well casings which are still servicable and could be protected. Cathodic Protection will be demonstrated on 5-well heads with metallic casings. This requires a cathodic protection device suitable in remote locations without available grid power. There are several solar photovoltaic systems which protect metallic devices. One device, is the impressed current protection system incorporating several small photovoltaic modules as a stand alone power source. (See figure 1).



Solar Powered Impressed Cathodic Protection System.

Photovoltaic energy is used to prevent galvanic action by applying a direct current to a well casing. The steel casing then acts as a cathode and becomes the recipient of metallic ions rather than the donor. In effect, the corrosion mechanism is put into reverse.

Because they are a direct current power source, PV power supplies eliminate the need to invert electrical energy or install power lines or to finance the high costs of operating diesel and thermo-electric generators, PV's are relatively maintenance-free, are reliable, and are cost effective for providing the necessary power in remote environments.

Incorporating a PV power supply into a cathodic protection system is easy and will require very little design time. Because the ac line is not required, the ac rectifier is unnecessary. Figure 1 shows the PV power supply connected to a cathodic protection system and displays the feature of being a totally self-contained power station.

The total cost of the photovoltaic pumping and cathodic protection systems amounts to \$65,000. This includes the design, site selection, and installation of major facilities and measurement/recording test equipment.

ANNEX IX.C

DETAILED COST ESTIMATES

1. Well Rehabilitation Program

(26 Month Project)

No.	Quantity	Item/Description	Unit Cost	Total Cost
<u>Equipment</u>				
1	1	Cable Tool Drilling Machine, Trailer Mounted with all Ancillary Equipment	160,000	160,000
2	1	5-Ton Diesel (Min) Flat Bed 4-Wheel Drive Truck with Winch and Water Tanks	50,000	50,000
3	2	"Crew-Cab" Type, 4-Wheel Drive Vehicles with 6-foot Bed	20,000	40,000
4	1	300-AMP. Heavy Duty Welder with Engine	4,500	4,500
5.	2	120 volt, 50 cycle Diesel Powered Light Plant	3,500	7,000
6	1	Verticle Turbine Pump 6-inch with Right Angle Drive and Diesel Drive Engine	20,000	20,000
7	1	Air Compressor, Diesel, 250 CFM at 150 PSI, Trailer Mounted	35,000	35,000
<u>Supplies</u>				
1.	500ft	Drive or Conductor Casing, Heavy Duty with Starter	36" ft	18,000
2.	1,600ft	8-inch DIA PVC Blank Well Casing	11" ft	17,600
3	1,400ft	8-inch DIA PVC Well Screen with 100 - SLOT	25" ft	35,400
4	800ft	4-inch DIA PVC Piezometer Casing Blank	5" ft	4,000
5.	700ft	4-inch DIA PVC Well Screen with 100 - SLOT	13" ft	9,100
6	30ft	6-inch DIA Submersible Pump with Ancillary Equipment	3,800	114,000

No.	Quantity	Item/Description	Unit Cost	Total Total
7	-	Cement and Filter Pack or Stabilizer Gravel	3,000	3,000
8	-	Repair Existing APUA Reston Bulyrus 22 RW Cable Tool Machine	15,000	15,000
9	18 MO	Rental-APUA Cable Tool Machine	700/MO	12,600
		<u>Manpower</u>		
1	2 (32 MO)	Senior Well Driller with Allowances and Differential	5,600/MO	168,000
2	2 (30 MO)	Mechanic/Welder with Allowances and Differential	4,500/MO	270,000
3	2	Local Helper	850 MO	51,000
TOTAL CONSTRUCTION COST				1,034,400
<u>Shipping and Insurance</u>				
1	-	\$430,600 x 15 percent		64,600
<u>Power</u>				
1	-	850 igpm @ 33' Head 70% EFF. @ \$0.174 KWH		125,522
		Contractors Overhead and Profit (20%)		244,000
		Contingency (10%)		183,000
GRAND TOTAL				1,651,000

Note: Costs are in \$US and include contingency and contractor's overhead and profit. Construction costs are representative of U.S. contractors working in Antigua using local materials and labor, as available. Equipment is based on importation from the U.S. and includes freight, insurance, duties, etc. Costs are indexed to March 1983.

2. All Saints-Scotts Hill Pipeline

No.	Item/Description	Cost(\$)
1	18-inch Pipe (28, 500ft @ \$18.50/ ft)	513,000
2	18-inch Flow Control Valve	5,000
3	Valves, Fittings, Appurtenances (10% Item 1)	51,000
4	Freight, Insurance Duties (Item 1.3) (\$10/1ft)	285,000
5	Excavation	300,000
6	Install Pipe and Backfill	95,000
7	Contractors Overhead and Profit (20%) Plus Contingency (10%)	341,000
TOTAL		1,600,000

Note: Costs are in \$US and include contingency and contractor's overhead and profit. Construction costs are representative of U.S. contractors working in Antigua using local materials and labor, as available. Equipment is based on importation from the U.S. and includes freight, insurance, duties, etc. Costs are indexed to March 1983.

3. Sea View Farms Pipeline

No.	Item/Description	Cost (\$)
1	6"inch PVC Pipe; 2,000 Lf @ \$8/lf	22,000
2	Valves, Fittings, Appurtenances (10% Item 2)	2,200
3	Freight, Insurances Duties (50% Item 1 & 2)	9,000
4	Transport, Excavate. Backfill & Install @ \$6/lf	13,000
5	Contractors Overhead and Profit (15%) plus Contingency (15%)	14,000
	TOTAL	60,200

Note: Costs are in \$US and include contingency and contractor's overhead and profit. Construction costs are representative of U.S. contractors working in Antigua using local materials and labor, as available. Equipment is based on importation from the U.S. and includes freight, insurance, duties, etc. Costs are indexed to March 1983.

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4. body Ponus Pump Station

No.	Item/Description	Cost (\$)
1	Four Pump Units @ 100 ypm, 200' TDH, hp @ \$10,000	56,000
2	Piping, Valves, Misc. Appurtences	25,000
3	Freight, Insurance Duties (15% Item 1-2)	12,000
4	Pipeline From Fishers Dam (700'-6''' @ \$20/1ft)	14,000
5	Building (400 ft. 2 @ \$30/ft 2)	12,000
6	Diesel Engine (CIF)	35,000
7	Electrical and Transiormer	15,000
8	Intake Structure	15,000
9	Contractors Overhead and Profit (20%) Plus Contingency (15%)	66,000
	TOTAL	\$250,000

Note: Costs are in \$US and include contingency and contractor's overhead and profit. Construction costs are representative of U.S. contractors working in Antigua using local materials and labor, as available. Equipment is based on importation from the U.S. and includes freight, insurance, duties, etc. Costs are indexed to March 1983.

5. Potworks Reservoir Draw-off Structure Improvements

No.	Item/Description	Cost (\$)
1	3 Stainless Steel Screens for Pipes at draw-off Structure	15,000
2	Walkway from Draw-off Structure to Dam	32,000
3	Structural Improvements to Draw-off Structure Top	5,000
4	Improvements, as necessary, to air Diffusion System	2,000
5	Insurance and Freight for Imported Equipment	4,000
	Contractor's Overhead and Profit (20%) Plus Contingency (10%)	17,000
	TOTAL	75,000

Note: Costs are in \$US and include contingency and contractor's overhead and profit. Construction costs are representative of U.S. contractors working in Antigua using local materials and labor, as available. Equipment is based on importation from the U.S. and includes freight, insurance, duties, etc. Costs are indexed to March 1983.

6. Delaps Water Treatment Plant Improvements

No.	Item/Description	Cost (\$)
1	Flash Mixer with Ancillary Electrical Work	10,000
2	Replace Sand Filter Media	20,000
3	Two Chlorinators, One Sulfonator	20,000
4	Chlorine Manifold Piping and Switchover Unit	5,000
5	Install APUA-furnished Chemical Feeders with Piping, Valves, etc.	5,000
6	Two Chlorine Gas Leak Dectectors	5,000
7	Laboratory Supplies and Equipment	10,000
8	Two Continuously Analyzing Turbinimeters (plant influent/effluent)	15,000
9	Rehabilitate Plant Sample System	15,000
10	Miscellaneous Electrical/Instrumentation work	10,000
11	Miscellaneous Other Work	20,000
12	Insurance and Freight for Imported Equipment	15,000
	Contractor's Overhead and Profit (20%) plus Contingency (10%)	45,000
	TOTAL	195,000

Note: Costs are in \$US and include contingency and contractor's overhead and profit. Construction costs are representative of U.S. contractors working in Antigua using local materials and labor, as available. Equipment is based on importation from the U.S. and includes freight, insurance, duties, etc. costs are indexed to March 1983.

7. Collins Water Treatment Works (New Plant

No.	Item/Description	Cost (\$)
1	New Package Treatment Plant (0.15 mgd avg.)	135,000
2	Building (2000 sq. ft @ \$30/sq.ft)	60,000
3	Clearwell (15,000 gal)	20,000
4	Waste Backwash and Sludge Sump (15,000 gal)	20,000
5	Pump and Return Line to Collins Reservoir (Sludge and Backwash)	20,000
6	Effluent Pumps to System	30,000
7	Chlorination System (2 lb/hr)	10,000
8	Repairs to Draw-off Line from reservoir to new treatment plant	10,000
9	Repairs to Reservoir Intake Structure Sluice Gate	10,000
10	Insurance and Freight for Imported Equipment	31,000
	Contractor's Overhead and Profit (20%) Plus Contingency (10%)	104,000
		450,000

Note: Costs are in \$US and include contingency and contractor's overhead and profit. Construction costs are representative of U.S. contractors working in Antigua using local materials and labor, as available. Equipment is based on importation from the U.S. and includes freight, insurance, duties, etc. Costs are indexed to March 1983.

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8. Grays Hill Water Treatment Works (New Plant)

No.	Item/Description	Cost (\$)
1	New Package Treatment Plant (0.50 mgd. avg. rate/1.00 mgd peak)	225,000
2	Building (2,200 sq. ft @ \$30/sq. ft)	66,000
3	Clearwell (40,000 gal)	45,000
4	Chlorination System (3 lb/hr Capacity)	27,000
5	Piping Modifications	18,000
6	Raw Surface Water and Well Water Flow Metering	18,000
7	Insurance and Freight for Imported Equipment	32,000
	Contractor's Overhead and profit (20%) Plus Contingency (10%)	119,000
		<hr/> 550,000

Note: Costs are in \$US and include contingency and contractor's overhead and profit. Construction costs are representative of U.S. contractors working in Antigua using local materials and labor, as available. Equipment is based on importation from the U.S. and includes freight, insurance, duties, etc. Costs are indexed to March 1983.

9. Wallings Water Treatment Works (Restoration of Existing Plant)

No.	Item/Description	Costs (\$)
1	New Alum Chemical Storage, Mix and Feed System	5,000
2	Flash Mixer at Plant Influent	5,000
3	Complete Sedimentation Basin Rehab. (pipes, valves, etc.)	8,000
4	Building Expansion (700 sq. ft @ \$30/sq. ft)	21,000
5	Misc. Electrical and Lighting Improvements	15,000
6	Raw Surface Water and Well Water Metering, Valves, etc.	15,000
7	Install Influent and Effluent Turbidimeters	10,000
8	Replace Backwash Pump and Air Scour Compressor, Valves, Piping.	15,000
9	Complete Filter Rehab. (Media, Underdrains, Gravel Support)	10,000
10	Misc. Architectural and Safety Improvements (Handrails, steps, etc).	4,000
11	Cover Clearwell with Hatch and Provide Ladder into Clearwell	1,000
12	New Chlorination System (2 lb/hr capacity)	5,000
13	Lime Feed System, including Storage, Mix Tank and Feeder	40,000
14	Insurance and Freight for Imported Equipment	7,000
	Contractor's Overhead and Profit (20%) Plus Contingency (10%)	30,000
	Total	191,000

Note: Costs are in \$US and include contingency and contractor's overhead and profit. Construction costs are representative of U.S. contractors working in Antigua using local materials and labor, as available. Equipment is based on importation from the U.S. and includes freight, insurance, duties, etc. Costs are indexed to March 1983.

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10. Institutional Development

A.	<u>Technical Assistance & Direct Costs</u>	<u>US\$</u>
	Organization & Management Advisor (24 mos @ \$12,000/mo)	288,000
	Operation & Maintenance Advisor (24 mos @ \$10,725/mo)	257,000
	Accounting, Finance & Systems Advisor (12 mos @ \$11,000/mo)	132,000
	Engineering Planning & Records Advisor (3 mos @ \$11,500/mo)	35,000
	Engineering Master Planner 9 mos @ \$11,500/mo)	104,000
	Water Quality Control Advisor (3 mos @ \$12,000/mo)	36,000
	Public Relations Advisor (3 mos @ \$12,400/mo)	37,000
	Home Office Support (4 mos)	44,000
	Travel & Transportation	43,000
	Housing & Per Diem	85,000
	Shipping Costs	30,000
	Education Allowance & Fringe Benefits	42,000
	Miscellaneous & Contingency (20%)	40,000
		<hr/>
	Sub-Total	1,173,000
B.	<u>Training</u>	
	Observation & On-the-job Training in U.S.A. (7 participants at 35 days each)	31,000
	Special Training Seminars USA (5 participants at 28 days each)	32,000
	International Water Conferences (4 participants at 7 days each)	11,000

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Audio-visual Training Packages, Materials and other 8,000

Reference Materials

Sub-Total 82,000

C.	<u>Equipment & Supplies</u>	<u>Units</u>	<u>US\$</u>
	Backhoe/Loader, 24" Bucket	(2)	76,000
	Truck - 5 Ton Flat Bed	(2)	46,000
	Truck - 3/4 Ton Pickup	(2)	24,000
	Air Compressor with Hand Tools	(2)	8,000
	Portable Generators	(2)	6,000
	Water Meters, Multi-Jet Magnetic Drive with Tail Pieces, Freight and Supplies	(4000)	160,000
	Water Laboratory Equipment & Supplies		60,000
	Sub-Total		380,000
	Inflation (4%)		65,000
	TOTAL		1,700,000

Note: Costs are in \$US and include contingency and contractor's overhead and profit. Construction costs are representative of U.S. contractors working in Antigua using local materials and labor, as available. Equipment is based on importation from the U.S. and includes freight, insurance, duties, etc. Costs are indexed to March 1983.

11. All Saints Reservoir

Item	Cost (\$)
1. Installation of 1.6 mg steel tank, including ring wall, tank preparation, contractor's overhead and profit @ .26¢/U.S. gal.	500,000
2. Freight and Insurance, 50% of \$225,000 (cost of imported steel plates)	113,000
3. Site work	10,000
4. Piping and valving	5,000
5. Contingency (10%)	63,000
Total	691,000

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12. Other Professional Services

Description	Cost (\$)
A. Engineering Design (7% of total estimated construction cost of \$5,700,000)	<u>420,000</u>
Sub-Total	420,000
B. Construction Management	
- Construction Manager (24 months @ \$12,000/month)	28,000
- Hydrogeologist (3 months @ \$12,000/month)	36,000
- Short-term Experts plus direct home office support (6 months @ \$12,000/month)	72,000
Other direct costs during construction (travel, per diem for short-term assistance, freight)	34,000
Secretarial support (3 secretaries @ \$7,000/yr.; 28 months each)	<u>59,000</u>
Sub-Total	489,000
C. Project Coordinator (27 months x \$5,000)	<u>136,000</u>
TOTAL	625,000

Economic Assessment

Antigua and Barbuda's growth performance in 1982 was surprisingly good, although the state, an independent country since 1981, is encountering severe payments difficulties. In the face of the severe global recession, the country grew 2.7 percent; this compares to a 4 percent in 1981 and 7 percent annually in 1977-80. The country's estimated per capita GDP of more than 1,600 at year end 1982 placed it third in English-speaking Eastern Caribbean, behind only Barbados and Montserrat. Opportunities to assist the country exists in agriculture, energy, fiscal management and water.

A. Output

Antigua recorded an increase in real output of 2.7 percent last year compared to 4 percent the year before; while tourism increased, construction activity and the rate of increase in manufacturing output declined.

1. Tourism

Tourism--the island's most important sector--fared remarkably well; arrivals increased between 5-6 percent compared to 1.5 percent a year earlier. Moreover, preliminary winter bookings suggest an 8-10 percent increase in arrivals for 1983. The sector, favored by some of the finest beaches anywhere, was not hard hit by the strengthening of the U.S. dollar, to whom the country's currency is tied, since a good portion of Antigua's visitors come from the United States. Tourism also may have benefitted from the country's new airport terminal. According to estimates, one quarter of the country's labor force was employed directly or indirectly by the tourist industry. Tourism infrastructure is well developed, including recreational spots, historical sites and casinos. The sector does suffer from periodic water shortages--a situation that would be addressed by the water program to be developed under this project. Approximately 90 percent of the tourist sector is under private sector control. However, the Government owns two hotels and is considering building a third.

2. Manufacturing

Manufacturing output was up 6.5 percent in 1982; in 1981 output had increased by 8.2 percent. The sector experienced some difficulties last year; two garment plants employing together at least 300 people closed down. Nonetheless, manufacturing has become increasingly important; the sector's contribution to GDP has doubled over the past 5 years. The Government has encouraged private investment, both domestic and foreign, in manufacturing rather than public involvement. Manufacturing has benefitted from relatively cheap labor, extensive tax holidays, duty-free importation of inputs and equipment, subsidized rent of factory shells and subsidies for the training of local personnel. The sector also has been buoyed by the country's relatively sound economic infrastructure including an airport capable of handling wide-bodied aircraft, although some difficulties exist with respect to port facilities, electricity, and telephones. Moreover, future expansion of the sector will hinge on assurances that ample supplies of water will be available. The manufacturing sector includes import substitution industries--

consumer goods, building materials, motor vehicle assembly, and tire retreading as well as export oriented industries such as textiles and garments, rum and mattresses.

3. Agriculture

The Antiguan Government has made the revitalization of the agricultural sector a development priority. once the mainstay of the economy, agriculture--primarily sugar and cotton--has been declining in importance since the 1960s. Any development thrust in the sector will have to take into consideration manpower problems; in addition to the traditional aversion to work in agriculture, the populace sees better opportunities in work in the tourist and manufacturing sectors. A significant problem in increasing agricultural production is present land tenure and land use practices. Of total agricultural lands, 60 percent are owned by the Government and 50 percent are either abandoned or undercultivated. Agriculture also has been constrained by a lack of requisite inputs, especially machinery. Contributing to the lack of inputs is administered pricing. The Government also needs to pay more attention to promoting marketing and to strengthening the Antigua Development Corporation.

In the first step in revitalizing agriculture, the GOAB has sought to reintroduce sugar. Under a CDB project, a sugar factory was constructed and acreage planted, but the program has run into a number of problems. In 1981, cane was left unharvested in the fields because of the inability to secure workers and last year, when workers were brought in from St. Lucia, mechanical difficulties prevented the factory from operating.

4. Construction

Last year, construction activity faltered, declining an estimated 8 percent after having risen 10 percent in 1981. Work on two major facilities--the Halcyon Cove Hotel and reconstruction of the West Indies Oil Company refinery--had been largely completed in 1981.

B. Balance of Payments

While declining imports associated with the fall off in construction activity produced a slight improvement last year, the country still continues to encounter acute balance of payments difficulties. Antigua's current account deficit, which stood at but 3 percent of GDP in 1977, reached 45 percent in 1981 up from 37 percent in 1980. Responsible for the 1981 increase was (a) a substantial hike in the food import bill, (b) the large increase in imports of capital goods--particularly for the rehabilitation and expansion of the oil refinery, and (c) the slow-down in tourist earnings. A substantial portion of deficits continues to be financed by borrowing from the East Caribbean Currency Authority (ECCA).

At year end 1981, the external public and publicly guaranteed debt of Antigua amounted to \$58 million or 46 percent of GDP, having increased at an annual rate of almost 30 percent over 1977-81. Nearly 70 percent of the foreign borrowing in the five year period was at commercial terms, principally for the purchase of generators for the Antigua Public Utilities Authority and for the construction of hotel facilities. Consequently, Antigua's debt service has risen from 2.3 percent of export earnings in 1977 to an estimated 7.9 percent in 1981.

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Antigua is now in arrears on loans from the Caribbean Development Bank (CDB), the U.K., and the United States. Its arrearages to the CDB total \$430,00, of which \$200,000 has been in arrears for 2-6 months and the remainder over six months. These arrears represent 4.7 percent of the country's total loans outstanding with the CDB, or more than 10 percent of total CDB arrears, (the average arrearage for a CDB client is 1.3 percent). The U.K. has ceased providing export credit insurance to Antigua. Over the past year, the Government of Antigua failed to repay (a) a \$7.7 million loan to a British firm for the purchase of generators for APUA, and (b) a \$1.3 million loan also to a British firm for fire engines. Both loan had been guaranteed by the U.K. counterpart to the U.S.'s Export-Import Bank. As a pre-condition to receiving assistance under this project, Antigua was to commence making payments to the U.S. Export-Import Bank; the country had been in arrears on a \$7.5 million loan secured from the Bank. As an outgrowth of discussions held recently, the Government has decided to commence making the payments. This decision augurs well, suggesting that the country may be willing to make the hard choices that will be required if it is to regain financial solvency.

C. Public Finances

The performance of the public finances is extremely disappointing, especially in light of past GOAB promises to make improvements. The public finances worsened in 1981, a trend that continued last year. Given the amount of tax revenues that are generated, the Government simply spent too much. For instance, in 1981 central government expenditures increased by more than 33 percent, including a 30 percent hike in civil servants' pay late in the year and significant independence celebration-related expenses. The Government also continues to play the role of employer of last resort and consequently the civil servant wage bill remains too large. In addition, there is concern over the large proportion of the total government capital spending that has gone into hotel construction especially given that the construction has been financed by lending from abroad at hard terms. Moreover, the Government is now considering financing new hotel construction of as much as \$200 million; while some of the financing would be at concessional terms, a portion would be at "hard" terms.

D. Energy

Antigua has the highest per capita energy consumption in the Eastern Caribbean, utilizing about 1,000 barrels of petroleum products per day and does not have any oil or hydro resources. Hence, the Government is implementing energy conservation measures (although retail prices of petroleum remain among the lowest in the region), and is keenly interested in developing alternative energy sources. Conversion of oil-fired boilers to coal/water as well as wind and photovoltaic power applications will be explored. A recently completed energy assessment, conducted with CARICOM assistance under the USAID-financed regional energy project, provides a sound basis for long-term energy development and plans.