7.5 Socio-Economic Impacts

Aside from the benefits discussed earlier, the following effects would be produced from the implementation and completion of the sediment and flood control works:

(1) stimulative effect for the promotion of the development of the socio-economy in the south coastal region by securing the safety of transportation on the main national road of CA-2 and the national railway;

(2) stabilization of the people's livelihood in the Study Area by the reduction of flood menace, improvement of environmental conditions and the effective use of land; and

(3) greater employment opportunities for people in and around the Department of Escuintla through the implementation of the construction works.

CHAPTER VIII. RIVER ADMINISTRATION SYSTEM

8.1 General

Water administration covers rivers, seacoasts, sediments, environments, etc., and its management items are as follows:

(1) Flood control;
(2) Water resources development;
(3) Arrangement of water utilization;
(4) Debris control;
(5) Flood forecasting, warning, and defense activities;
(6) Seacoast preservation;
(7) Environment conservation; and so on.

In Guatemala, there does not seem to exist an integrated government agency performing nationwide water administration. Various agencies are individually in charge of management for river water utilization, as well as restoration works of damages caused by flood and sediment discharge.

This chapter deals with the functions and activities of the agencies in charge of water management and the related laws in Guatemala. The water management system in foreign countries, such as Japan, the United States of America and the United Kingdom, are also briefly discussed for possible reference in the establishment of a new system in the country.

8.2 Water Management in Guatemala

8.2.1 Government Machinery

The Republic of Guatemala and its people are governed by three branches of execution, legislation and judicature. The administrative functions are vested in the Executive Branch which

is headed by the President of the Republic of Guatemala who represents the nation and acts with his Ministers, either separately or jointly.

The Central Government

The Central Government of Guatemala resides in Guatemala City, and its organization includes eleven (11) ministries which are divided into directions having specific functions. Agencies that function as corporations or institutions have also been established as decentralized agencies under the ministries. These agencies are afforded budgetary assistance from their respective ministry, and their programs are implemented with the approval of the ministry to which they belong. (Refer to Fig. 8-1.)

The annual national budgets of Q1,465.7 million, Q1,481.4 million and Q1,314.3 million have been drawn up in 1981, 1982 and 1983, respectively. These national budgets were apportioned to the government agencies as tabulated in Table 8-1, and classified into economic sectors in Table 8-2.

The Local Government

The country is divided into more than twenty (20) departments, the largest administrative division in Guatemala, whose governors are appointed by the President. The departments, however, have no operational organization.

The Governor (Gobernador) of a department acts as the liaison between the Office of President and the municipal governments which are the most-local government units. He also fills the role of Chairman of the Departmental Emergency Committee, which is the execution arm of CONE[1/] in the department level. Serious disasters in the municipalities are

1/ National Emergency Committee

relayed to the Office of the President through the Governor, and restoration works are carried out by the Central Government as the case may be.

The departments are further divided into more than three hundred (300) municipalities. Each municipality has an operational organization which is headed by a Mayor (Alcalde) to provide residents with administrative services. The municipalities, which are under the jurisdiction of the Ministry of the Interior, are afforded budgetary assistance through the National Institute of Municipal Development (INFOM), one of the decentralized agencies.

The operational organization of the Municipality of Escuintla is presented as an example of a local government in Fig. 8-2.

8.2.2 Agencies Concerned in Water Management

Water management in Guatemala is being undertaken by five (5) ministries; (1) Ministry of Communications, Transportation and Public Works, (2) Ministry of Agriculture, Livestock and Nutrition, (3) Ministry of National Defense, (4) Ministry of Public Health and Social Security, and (5) Ministry of the Interior. The departments and the municipal governments take part in management and sometimes, private sectors are involved.

Hereunder summarized are the directions, the corporations under the above ministries, and other agencies that are in charge of water management.

(1) Ministry of Communications, Transportation and Public Works

CAMINOS (General Direction of Roads)
DGOP (General Direction of Public Works)
INSIVUMEH (National Institute of Seismology, Volcanology, Meteorology and Hydrology)

XAYA-PIXCAYA (National Project of XAYA-PIXCAYA)
INDE (National Institute of Electrification)
FEGUA (National Railway of Guatemala)

(2) Ministry of Agriculture, Livestock and Nutrition

DIGESA (General Direction of Agricultural Services)
INAFOR (National Forest Institute)

(3) Ministry of National Defense

IGM (Military Geographic Institute)
CONE (National Emergency Committee)

(4) Ministry of Public Health and Social Security

UNEPAR (Executor Unit of Rural Aqueduct Program)
DGSS (General Direction of Health Service)

(5) Ministry of the Interior

INFOM (National Institute of Municipal Development)

(6) Others

EMPAGUA (Municipal Water Enterprise of the Municipality of Guatemala)

The water management agencies and their organizational interrelation are shown in Fig. 8-3, and the major activities concerning water management of these agencies are summarized in Table 8-3.

The above-mentioned agencies may be broadly classified in three categories according to their water management activities; namely, Flood Prevention, Water Supply, Research and Environmental Conservation, as described hereunder.

Flood Prevention

CAMINOS, FEGUA, DIGESA, INDE and CONE are in charge of prevention, restoration and relief activities concerning damages caused by flood and sediment discharge. Among these five (5) agencies, CAMINOS, FEGUA and DIGESA carry out flood prevention works to protect only their respective facilities. Restoration works are undertaken separately by each agency when its facilities are damaged, except CONE which is responsible for warning and saving lives in case of emergencies such as flooding, volcanic eruption, earthquakes and epidemics.

In case of occurrence of disasters, an inter-institutional committee is organized under the chairmanship of the Vice-Minister of Defense to smoothly carry out rescue and restoration activities by assigning the activities to each agency and preparing their detailed programs.

Water Supply

Service water and sewage facilities are designed, constructed and maintained by so many agencies such as DGOP, INFOM, UNEPAR, DGSS, EMPAGUA, XAYA-PIXCAYA, municipal governments and others, which have a complicated relationship with one another, as tabulated below.

Agency	Services	Objective Area
DGOP	Design	All residential areas
INFOM	Design and construction	Central area of Municipality (Cabecera Municipal)1/
UNEPAR	Design and construction	Community with a population of over 500 approx.

1/ Except for Guatemala and Mixco Municipalities

Agency	Services	Objective Area
DGSS	Design and construction	Community with a population of under 500 approx.
Municipality	Operation and construction	Central area of Municipality
EMPAGUA[1/]	Construction, operation and maintenance	Municipality of Guatemala
XAYA-PIXCAYA	Design and construction	XAYA-PIXCAYA Project Area
Community	Operation and maintenance	Community
Developer	Design and construction	Specific area

DIGESA is in charge of research, planning, construction, operation and maintenance of irrigation and drainage projects in the whole country. In private farms (Finca), however, irrigation and drainage facilities are provided by owners at their own expense, but the area and water consumption volume could not be determined.

INDE is the only agency that is promoting hydropower generation projects, and the scope of its services covers planning, construction, operation and maintenance, and management.

CAMINOS, besides the flood prevention works for roads, carries out dredging works to secure water navigation in the Chiquimulilla Canal.

The Department or the Governor is in charge of coordination among water undertakers. In the departments of Izabal and Solola where water navigation is extensively utilized, the governor also takes charge of the administration of navigation.

1/ Branched out from the government of Guatemala Municipality

Research and Environmental Conservation

Observation on rainfall and river water level is conducted mainly by INSIVUMEH and INDE. INSIVUMEH collects data from 157 rainfall and 38 water level observation stations which were installed all over the country. Besides, INDE has 38 and 42 stations for rainfall and river water level observations, respectively, to collect the data required for the operation of hydropower generation dams.

INAFOR takes charge of the conservation and development of forests and environmental conservation. IGM performs mainly surveying and mapping services.

8.3 Water Management Laws in Guatemala

8.3.1 Existing Laws on Water Management

Water management is currently enforced in relevance to various existing laws concerning service water supply, sewerage, agriculture, hydropower generation, and so on, as presented in Table 8-4. However, no specific law has yet been enacted for the prevention of floods and the management of water utilization on the river basin basis. Flood prevention works are individually provided and maintained by the related agencies themselves, and that the situation of water utilization in a river system cannot be identified.

Although the civil law of Guatemala grants private ownership of water resources in conjunction with development and use of any given land as long as such does not infringe upon public use of the same water, a specific law which states the water use and its allocation needs to be enacted so that public ownership of water can be firmly established. Accordingly, the draft of a new law meant to regulate water management has been under study since 20 years ago.

Though there is no concrete provision of law relating to flood control, the civil law concerning land use provides a landowner with the right to build flood control facilities on his own land.

8.3.2 Draft of "Ley de Aguas"

The Government has been endeavoring, in view of conservation of the natural resources and their proper development as well as of minimizing their loss through a lack of adequate management and control, to establish a law specifying institutions and their activities for such purposes. As to water resources, 20 years have passed since the Government took initiative to establish laws and institutions concerning management of water resources so that water resources would be more rationally used and more smoothly developed. Thus, the Ministry of Communications, Transportation and Public Works organized the "Proyecto de Ley de Aguas" (Water Law Project) which has as its members INFOM, the Municipality of Guatemala, the Ministry of Agriculture, the Ministry of Health and Social Services, the University of San Carlos, and so on. As a result, a Bill concerning water, which was prepared in reference to related laws in other Latin American countries, was submitted to the Congress in 1982, but it failed to be enacted into law due to insufficient time for deliberation.

The Bill has the following aims in order to utilize water sources more rationally and comprehen-sively; namely, the development of water resources, environmental conservation, promotion of drainage and irrigation works, and establishment of legislative system as well as organization for water management.

8.4 Water Management System and Relevant Laws in Foreign Countries

8.4.1 Water Management System in Foreign Countries

In many countries, it has been regarded necessary to establish an administrative organization including an agency authorized

to coordinate water planning and management activities taken by various agencies. Herein introduced are examples of water administration systems of countries such as Japan, the United States of America and the United Kingdom, focusing on the coordination of water management and project execution.

Japan

Japan has a long history of water management. It has been reported that people initiated flood prevention works as early as the 4th century, and that large-scale river improvement works were carried out in the 19th century by the then government. The central government came to assume the responsibility on water management covering the whole country after the centralization of power in 1868.

(1) Administrative Organization

Water management in Japan is carried out on the cabinet level by the Ministry of Construction, which is the lead agency, followed by the Prime Minister's Office, the Ministry of Health and Welfare, the Ministry of Agriculture, Forestry and Fishery, the Ministry of International Trade and Industry, and the Ministry of Transport.

The above-mentioned ministries, except for the Ministry of Construction and the Ministry of Health and Welfare, have some subordinate agencies in charge of water management directly or indirectly according to the regional peculiarities and the contents of management, as shown in Fig. 8-4. The important assignments of these ministries are summarized in Table 8-5.

(2) Coordinating Agency

The Ministry of Construction coordinates inter-ministry activities and approves water utilization programs. In

short, this ministry is fully held responsible in the coordination of water management in Japan. It is composed of the ministry proper, the auxiliary branches which are mainly involved in research and survey works, and the regional offices.

The organization chart of the Ministry of Construction is in Fig. 8-5, showing the River Bureau with its many Divisions and Sections. The divisional function of the River Bureau is explained in Table 8-6.

The regional offices spreading all over the country are held responsible for day-to-day water administration through various work offices dealing with survey, planning, design and project implementation. Local governments also direct water administration for small local rivers under the direction of the Ministry of Construction, while the ministry administers the large rivers which may exert a serious influence over a large area in the multiplex aspect.

(3) Project Execution Agencies

At the ministry level, only the Ministry of Construction and the Ministry of Agriculture, Forestry and Fishery are concerned in project execution. The River Bureau in the Ministry of Construction is responsible for planning, execution, operation and maintenance of comprehensive river basin development projects covering all the large river systems in Japan. Its scope of services includes flood prevention, water resources development, seacoast preservation and environmental conservation. The Sabo Department was established in the River Bureau to carry out the planning and execution of erosion control and landslide prevention works for the large rivers.

The Agriculture Structure Improvement Bureau in the Ministry of Agriculture, Forest and Fishery takes charge

of execution of national reclamation projects for agricultural development, as well as their disaster prevention and restoration works. The Forestry Agency, organized under this ministry, is responsible for the conservation of forests which provide storage of water resources thereby delaying flood runoff. In this connection, this agency is in charge of the execution of landslide prevention works for the purpose of forest conservation.

The United States of America

The Federal Government assumes a leading role in the water management and water resources development. To carry out this task, agencies were created with specific river management responsibilities. The responsibilities grew from single purpose to multiple purpose, as river management projects progressed from responding to one need to fulfilling multiple objectives in each project.

(1) Administrative Organization

A network of agencies at the federal level have been organized for water administration under the jurisdiction of the Office of the President as shown in Fig. 8-6. The major agencies sharing responsibility for water administration are listed in Table 8-7, along with their functional jurisdictions and departmental affiliations. The most important of these agencies from the viewpoint of extent of authority and functional jurisdiction are the Water Resources Council, the U. S. Corps of Engineers, and the Bureau of Reclamation.

(2) Coordinating Agencies

The Water Resources Planning Act of 1965 established the Water Resources Council as an independent executive agency of the U. S. Government to encourage the conservation, development, and utilization of water and related land

resources of the United States on a comprehensive and coordinated basis, and in addition to creating this council, provided for the establishment of river basin commissions.

There are presently seven river basin commissions in the United States. The organization of the New England River Basin Commission is presented as an example in Fig. 8-7.

(3) Project Execution Agencies

In the Federal agencies, the U. S. Army Corps of Engineers and the Bureau of Reclamation serve as project execution agencies on the river basin basis. The Tennessee Valley Authority (TVA) is another agency which has the power necessary to implement projects, but it operates exclusively in the Tennessee River Basin.

The Corps is responsible for portions of long range river basin planning for most large river systems in the United States, as opposed to the limited geographical scope afforded other agencies. Civil works functions include matters relating to the planning, design, construction, operation, and maintenance of river, harbor, and waterway improvements for flood control, navigation, multiple-use purpose, and shore protection projects or programs.

The Bureau of Reclamation is now involved in planning, design, construction, and operation of water resources projects serving irrigation, municipal and industrial water supply, hydroelectric power generation, flood control and navigation, as well as recreation, and fish and wildlife enhancement purposes.

The United Kingdom

The United Kingdom consists of England and Wales, and Scotland and North Ireland, which have their own water administration

systems, though somehow similar to each other. The water administration system in England and Wales is described hereunder as a representative because it covers the largest area in the country and has been recently renewed to perform a proper coordination among the agencies concerned.

In England and Wales, the Department of the Environment, the Ministry of Agriculture, Fisheries and Food, and the Welsh Office have the responsibility of determining through parliament national objectives in the water field and ensuring implementation of legislation.

(1) Administrative Organization

In England and Wales, the major executive responsibilities in the water management field are set forth in the Water Act of 1973, which has reorganized the water administrative organization and defined the roles of the different agencies by establishing rights, duties and powers for both customers of water and water services and the administrative agencies themselves. The reorganized water administrative structure is presented in Fig. 8-8, and the detailed functions of the agencies concerned are summarized in Table 8-8.

(2) Coordinating and Project Execution Agencies

One organization assumes the responsibility of coordination among the agencies concerned in water management and also for execution of projects for river basin development on a comprehensive basis, which may be different from other foreign countries.

The Water Act of 1973 newly established ten water authorities, nine in England and one in Wales, to solve the problems and conflicts involved in water planning and management system. The new authorities were formed from the 29 pre-existing river authorities created by the Water

Resources Act of 1963 and from the 1,393 sewage treatment and sewerage departments of the local authorities in England and Wales, together with the 157 statutory water supply undertakings.

The geographical areas of the water authorities are not based on administrative units, but on groups of river basins; thus, potentially minimizing problems arising from physical interdependencies within hydrological systems. The authorities are multi-functional in that they are responsible for all aspects of water planning and management, in contrast to previous authorities which were responsible for only part of the hydrological cycle. These full responsibilities include the development of water resources (sometimes termed water conservation) and water distribution to domestic, commercial, industrial and agricultural premises. The authorities are also responsible for pollution prevention, and also sewerage and sewage treatment. Duties taken over directly from the river authorities include river management, flood protection, land drainage and sea defenses.

The water authorities are also responsible for promoting fisheries on inland water and estuaries. In addition, every Authority may take steps to secure the use of water and land associated with water for the purpose of recreation and it is their duty to develop water and associated land resources for the best recreational use.

The internal organization of the water authorities involves two tiers. The first tier comprises the regional headquaters' staff organized so that regional water planning problems can be viewed in totality, reflecting the interdependencies inherent in the hydrological cycle. The second tier within the water authorities is at divisional level. The divisions take all responsibilities for water throughout their areas. The committee structure and

operational structure of the Severn Trend Water Authority are presented in Fig. 8-9 as an example.

8.4.2 Laws Related to Water Management in Foreign Countries

In almost every country are currently being enforced many laws and acts in connection with various water management fields, such as flood prevention, sediment flow regulation, water utilization, environmental pollution, and so on. This subsection deals with the legislations for flood prevention in Japan, the United States of America and the United Kingdom, which are closely related to this Project. The legislation for other water management items in these countries is discussed in the Supporting Report.

Japan

The River Law was enacted in 1896 and revised in 1964 for the comprehensive adminstration of all the rivers in Japan, so that occurrence of disasters due to floods and high tides may be prevented and that proper utilization and normal functions of river water may be assured, whereby public safety is conserved and public welfare is promoted through their contribution to conservation and development of the nation. This law classifies the rivers into three classes, together with their specific management systems, so as to facilitate a successful river administration. This law further stipulates the regulation concerning construction of riparian works, countermeasures in case of emergency, usage of rivers, coordination of water use interests, construction of dams, and so on.

The River Law is the basic law for river administration in Japan, and necessary Acts and Regulations have been established thereby according to the administrative nature of the water management from time to time as indicated in Table 8-9. Among the Acts established on the basis of the River Law, the Flood Defense Act and the Sabo Act which are considered important and

especially related to this project are briefly explained as follows.

The Flood Defense Act was enacted in 1948 and stipulates the flood fighting system, the flood forecasting and warning system, the dispatch of flood fighting troops and the financial aspects of such activities. The Sabo Act, enacted in 1897, stipulates erosion and sediment control works in the upstream regions, the method of allocating project cost and restrictions on activities within designated areas.

As for the areas which are not covered by the River Law, there are three acts in force concerning water management. These are the Seacoast Act of 1956, the Landslide Prevention Act of 1958 and the 1969 Act on Disaster Prevention Due to Collapse of Steep Slope Land. The first was prepared to protect the coast and its hinterland from the damage due to tidal waves, high tides, etc. The second stipulates mainly the implementation procedure of counter-landslide works in order to obviate damage caused by landslide and coal-sludge collapse, while the third designates the steep-sloped land areas and stipulates the matters necessary to protect lives from disaster due to the collapse of steep slopes.

The United States of America

The first law enacted by the Federal Government is the River and Harbor Act of 1899 when a low water channel of the Missouri River was constructed by the U. S. Army Corps of Engineers (COE). COE has assumed since then the responsibility of implementing navigation projects for the the whole country; mainly, the district between the Mississippi and the southwest coast.

In 1916, the Mississippi inflicted a great deal of flood damage on the neighboring areas. Considering the big flood as a precept, the Federal Government enacted the Flood Control Act in 1917 which was slightly amended in 1923 and drastically revised in 1928 after the area experienced extensive flood damages by

the Mississippi. This Act was further revised in 1936, 1955, 1960 and 1972, and the Federal Government's functions and responsibilities concerning flood defense activities have been expanded through these revisions. The Watershed Protection and Flood Prevention Act was ratified in 1954 for the effective flood prevention in small-sized river basins.

The Soil Conservation Act was enacted in 1936 for the prevention of soil erosion and river bank scouring which may bring about aggravation or loss of agricultural lands. This Act established the Soil Conservation Service (SCS) under the jurisdiction of the Department of Agriculture.

The National Flood Insurance Act of 1968 set up a program whereby the economic losses attributed to floods could be spread over a larger population base. The Disaster Relief Act of 1972 and the Flood Disaster Protection Act of 1973 extended protection to people suffering from flood disasters.

The important Acts relevant to water management in the United States are listed in Table 8-10.

The United Kingdom

The Land Drainage Act of 1930 established the Catchment Boards, each covering a major river basin or group of smaller rivers, and endowed with general powers for land drainage in the catchment and special powers for flood prevention on certain defined main rivers.

After 1948 when the River Board Act was enacted, the catchment boards gave way to river boards which had additional responsibilities for fisheries, pollution prevention and river gauging and now covered the whole country.

The river authorities replaced the river board after the Water Resources Act of 1963, which expanded the water agencies'

responsibilities to cover flood forecasting, based on the hydrometric networks installed or improved by the river authorities.

The Water Act of 1973 established the water authorities in place of the river authorities to conduct the water management on a comprehensive and coordinated basis.

The other important Acts in force in the United Kingdom are tabulated in Table 8-11, together with the aforementioned Acts.

CHAPTER IX. RECOMMENDATIONS

(1) The long-term sediment and flood control plan has been formulated to meet the social requirements in the Study Area. This plan shows a little bit low economic viability with a relatively big fund requirement.

In consonance with the requirements of the long-term plan, an urgent sediment and flood control plan is proposed on a more practical basis for the target assets to be protected; namely, the CA-2 road bridge and the railway bridge spanning the Achiguate and the Pantaleon rivers that would adversely affect, if damaged, the socio-economic activities in a large area. The urgent proposed plan has been verified to be technically and economically viable with an EIRR of 7.3%. In this respect, it is recommended that the urgent sediment and flood control project be carried forward to the next stage with least lapse of time in due consideration of the enhancement of the national economy through the security of the transportation system.

In the event that financial constraints arise resulting in the difficulty to implement the proposed plan, the urgent alternative plan, which was prepared under the same conditions as those of the urgent proposed plan and whose construction can be stepwisely executed under the limitation of the annual budget for the project, may be implemented.

(2) Only the road bridge and the railway bridge spanning the Achiguate and the Pantaleon rivers will be protected by the urgent plan, while many other assets in the Study Area will remain in a situation vulnerable to flood damage. Therefore, a sediment flow forecasting and warning system that is not too costly but effective for the protection of a large area should be studied. At present, the data required for the establishment of such system are still so insufficient, so

that detailed and accurate observations on the sediment flow should be put into practice without delay.

(3) As to effective sediment control, flood control and river water utilization, an appropriate river management system is indispensable. A systematic organization for river management should be established at the earliest possible opportunity, and maintenance services for the sediment control dams and the river channels should also be continuously performed so that they may efficiently fulfill their functions.

(4) At present, the river basin whose upper reaches is covered mostly by assorted trees, except the area having merely much volcanic debris deposit, has little possibility for afforestation. In the flood control project, the economic viability for afforestation is generally not so high, because its effects for the mitigation of flood damage will yet accrue in the future, though it requires so much initial investment. However, as land use develops in the upper reaches, the necessity of soil conservation may be enhanced. In this respect, it is recommended that further survey and study on afforestation be conducted.

(5) As to future land use and regional development programs, they should be set up taking into account the location of the flood plain which has been clarified through this study.

(6) Since the study was performed on the basis of the existing topographic conditions which are expected to change in the future due to the supply of tremendous amount of sediment, periodical observations on the transitions are recommended by taking aerophotographs, together with the execution of topographic surveys, to have a constant knowledge of such conditions.

(7) Hydrological stations are not sufficient in quantity and no water level gauging station exists in the Study Area. The

provision of an effective and efficient hydrological observation network with some stations in the early stage is recommended, because hydrological observations are essential to precisely estimate hydrological conditions for sediment and flood control works, such as design flood discharge, inundation depth in the flood-prone area, and so on.

TABLES

Table 1-1 (1/6) BASIC DATA UTILIZED IN THE STUDY

Study Item	Data Utilized
A. Surveying/Mapping	1. Tophographic Map of the Study Area (Scale: 1:50,000)
	2. Tophographic Map of the Study Area (Scale: 1:10,000)
	3. Longitudinal Profile of the Achiguate and the Pantaleon Rivers
	4. Cross Section of the Achiguate and the Pantaleon Rivers
	5. Bench Marks in the Study Area
B. Meteorology/ Hydrology	1. Las Crecidas de los Rios Guacalate y Achiguate en Septiembre de 1969, Publicacion No. 59, Naciones Unidas, San Jose, Costa Rica (1970).
	2. Tropical Cyclones of the North Atlantic Ocean, 1971-1980.
	3. Atlantic Hurricane Season of 1976, 1977, 1978, 1979, 1980, 1981, 1982, Monthly Weather Review.
	4. Monthly Rainfall Record of eight (8) stations in the project area (1961-).
	5. Daily Rainfall Record of Main Floods of selected stations in the project area (1961-1982).
	6. Hourly Rainfall Record of Sabana Grande (1972-1979), El Chupadero (1974-1981), and El Recuerdo (1972-1980).
	7. Monthly Temperature Record of five (5) stations in the project area.
	8. Monthly Humidity Record of four (4) stations in the project area.
	9. Monthly Evaporation Record of two (2) stations in the project area.
	10. Monthly Sunshine Record of one (1) station in the project area.

Table 1-1 (2/6) BASIC DATA UTILIZED IN THE STUDY

Study Item	Data Utilized
	11. Annual Maximum Discharge of sixteen (16) stations in the South Region since the beginning of observation.
C. River Improvement Plan	1. Resumen de la Ayuda Proporcionada por el CONE (1975)
	2. Report on New Road Plan between Escuintla and San Jose.
	3. Map of River Basins in Guatemala (Scale: 1:500,000)
	4. Aerophotographs (1947, 1954, 1958, 1967, 1983).
	5. Drawings of Railway Bridge in Achiguate River (1895, 1969).
	6. Drawing of Railway Bridge in Pantaleon River (1895).
	7. Drawing of Road Bridge in Achiguate River (1960).
	8. Drawing of Road Bridge in Pantaleon River.
	9. Sketch Plan of New Road between Escuintla and San Jose.
D. Sediment Control Plan	1. Santiaguito Volcanic Dome, Guatemala (1972).
	2. Nuee Ardente from Santiaguito Volcano, April 1973.
	3. The 1971 and 1973 eruptions of Fuego Volcano, Guatemala, and some socio-economic considerations for the volcanologist (1973).
	4. Studies on volcanic ash from two recent volcanic eruptions in Central America (1973).
	5. The October 1974 basaltic tephra from Fuego Volcano (1978).

Table I-1 (3/6) BASIC DATA UTILIZED IN THE STUDY

Study Item	Data Utilized
	6. Glowing avalanches from the 1974 eruption of Fuego Volcano, Guatemala (1978).
	7. Volcanology, Guatemala/Nicaragua selected materials (1980).
	8. Informe de la Investigacion Realizada el 7 de Julio de 1983 en el Municipio de El Palmar (1983).
	9. Map of River Basins in Guatemala (Scale: 1:50,000, 1:250,000, 1:500,000).
	10. Aerophotographs (1954, 1958, 1964, 1967, 1983).
	11. Geological Map and Report (Scale: 1:1,000,000).
	12. Data on eruption of the Fuego and the Santa Maria volcanoes.
E. Construction Plan and Cost Estimates	1. Encuesta Basica de Manufacturera de Construccion Mano de Obra y Salalios (Directrato General de Estadistica).
	2. Unit costs of labor obtained from CAMINOS.
	3. Unit costs of materials obtained from CAMINOS.
	4. Prices of machines obtained from agents.
	5. Unit costs of machinery obtained from CAMINOS.
	6. Memoria 1982 (CAMINOS).
	7. Unit costs of land acquisition obtained from the Ministry of Public Finance.
F. Socio-Economy	1. Accidentes de Transito (1979-1980).
	2. Anuario Estadistico (1980).
	3. Anuario de Comercio Exterior (1976, 1979, 1980).

Table 1-1 (4/6) BASIC DATA UTILIZED IN THE STUDY

Study Item	Data Utilized
	4. Boletin Estadistico (1975-1980).
	5. II Censo de Agropecuaria (1964).
	6. III Censo de Vivienda (1973).
	7. I Censo Artesanal (1978).
	8. I Censo Artesanal, Tomo V (1978).
	9. III Censo Nacional Agropecuario (1978).
	10. Censos Nacionales (1981).
	11. Breve Monografia de la Republica de Guatemala.
	12. Directorio Nacional de Establecimientos Industriales (1981).
	13. Directorio Nacional de Establecimientos de Atencion Medica.
	14. Estadisticas Agropecuarias Continuas (1975, 1976, 1978-1981).
	15. Excuestas Agricolas de Granos Basicos (1978).
	16. Encuestas Nacionales de Ingresos y Gastos Familiares, Volumen I (1978-1981).
	17. Escuesta Basica de Materiales de Construccion, Mano de Obra y Salarios y Metodogia, para el calculo de los indices respectivos.
	18. Finanzas Municipales (1980-1981).
	19. Interpretacion de las Proyecciones de Poblacion en terminos de demanda de servicios basicos (1950-2000).
	20. Los Indices de Precios al Consumidor para la Republica de Guatemala (1977).
	21. Los Indices de Precios de Materiales de Construccion, Mano de Obra y Salarios, en la Ciudad de Guatemala (1981-1982).

Table 1-1 (5/6) BASIC DATA UTILIZED IN THE STUDY

Study Item	Data Utilized
	22. Metodologia de los Indices de Precios al Consumidor para la Republica de Guatemala durante el ano 1978.
	23. Metodologia Empleada en la Elaboracion de las Proyecciones de Poblacion Urbana-Rural (1978).
	24. Mapa de Capacidad Productiva de la Tierra 1:500,000 Memoria Explicativa (1980).
	25. Mapa con Ruta y Uso Actual de la Tierra 1:500,000 Memoria Explicativa (1981).
	26. Proyeccion de la Poblacion Urbana y Rural por sexo y grupos de edad (1975-2000).
	27. Quinquenio del Comercio de Guatemala-Centroamerica.
	28. Revision del Indice del Costo de la Construccion de Vivienda en la Ciudad de Guatemala (1925-1979).
G. River Administration	1. Report of "Diario de Sesiones"(1979)
	2. Report of Projecto de Ley de Aguas in Guatemala (1981)
	3. Organization Chart of Government of Guatemala
	4. Organization Chart of related agencies
	5. Thesis of "Analisis Critico de la Legislación de Aguas en Guatemala (1978)
	6. Water Law of Mexico, Peru, Domicica, and Argentine
	7. Anuario Estadistico (1979)
	8. Boletin Estadistico (1978-1979, primer)
	9. Boletin Estadistico (1978-1979, segundo)
	10. Boletin Estadistico (1979-1980, lo. y 2o.)

Table 1-1 (6/6) BASIC DATA UTILIZED IN THE STUDY

Study Item	Data Utilized
	11. Boletin Estadistico(1980-1981, 1er)
	12. Finanzas Municipales (1980-1981)
	13. Algunas Cifras Acerca de Guatemala (1982)
	14. Codigo Civil
	15. Codigo Municipal y Sus Reformas (3a edición)
	16. Ley del Organismo Ejectivo
	17. Prontuario de Leyes Tributarias (edición 1984)
	18. Ley de Expropiacion y Sus Reformas
	19. Codigo de Salud
	20. Ley Forestal
	21. Ley Organica del Prespuesto, Contabilidad y Tesoreria de la Nacion y Sus Reglamentos
	22. Ley de Compras y Contrataciones, Su Reglamento, con Sus Reformas y Disposiciones Conexas
	23. Codigo Penal (con sus reformas)
	24. Codigo de Comercio
	25. Ley de Régimen Petralero de la Nación
	26. Legislacion Municipal de la Republica de Guatemala

Table 2-1 MAJOR AGRICULTURAL PRODUCTS OF GUATEMALA, 1974/75-1980/81

Unit; Thousand Tons

Kind	Productions						
	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81
Coffee	157	139	158	168	170	156	----
Cotton	107	98	134	147	159	148	127
Sugar	405	584	501	431	395	432	488
Sugar Cane	4,624	5,763	6,541	5,224	4,622	5,053	5,985
Maize	757	800	777	906	757	1,058	----
Beans	62	73	70	78	---	---	---
Wheat	45	48	56	60	57	50	50
Beef	58	75	70	70	76	79	----

Table 2-2 EXPORT AND IMPORT, 1975-1980

	Amount (Thousand Quetzales)						Average Annual Growth Rate (%)
	1975	1976	1977	1978	1979	1980	1975 - 1980
A. Export	623,621	760,333	1,160,218	1,111,602	1,217,076	1,472,796	18.8
B. Import	732,368	838,430	1,052,508	1,260,661	1,449,395	1,559,085	16.3
C. Total	1,355,989	1,598,763	2,212,726	2,372,263	2,666,471	3,031,881	17.5
D. Diff.	-108,747	-78,097	107,710	-149,059	-232,319	-86,289	
E. Export of Main Goods							
Coffee	164,154	242,952	525,884	477,435	430,301	469,775	23.4
Cotton	74,061	84,970	152,057	139,116	182,763	166,543	17.6
Sugar	116,792	116,724	92,725	45,753	52,390	75,946	-8.2
Beef	16,967	14,447	27,890	30,772	41,192	26,460	9.3
Banana	16,905	21,545	21,039	21,889	17,918	48,214	23.3
Total of E.	388,879	480,639	819,595	714,965	724,564	786,938	15.1
F. E/A(%)	62.4	63.2	70.6	64.3	59.5	53.4	

Table 2-3 GROSS DOMESTIC PRODUCT (GDP) OF GUATEMALA, 1971-1980

	Year										Average Annual Growth Rate (%)
	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1971 - 1978
A. At Current Prices											
Total (Million Quetzales)	1,941	2,054	2,521	3,111	3,577	4,292	5,448	6,044	6,891	7,809	16.9
Annual Growth Rate (%)	-	5.8	22.8	23.4	15.0	20.0	26.9	10.9	14.0	13.3	
Per Capita (Quetzales)	346	355	423	506	564	657	809	871	963	1,060	13.2
Annual Growth Rate (%)	-	2.6	19.2	19.6	11.5	16.5	23.1	7.7	10.6	10.1	
B. At 1958 Constant Prices											
Total (Million Quetzales)	1,774	1,870	2,010	2,111	2,134	2,309	2,610	2,691	2,757	2,811	5.2
Annual Growth Rate (%)	-	5.4	7.5	5.0	1.1	8.2	13.0	3.1	2.5	2.0	
Per Capita (Quetzales)	316	323	337	343	337	353	388	388	385	381	2.1
Annual Growth Rate (%)	-	2.2	4.3	1.8	-1.7	4.7	9.9	0.0	-0.8	-1.0	

Table 2-4 SHARE IN GDP BY INDUSTRIAL SECTOR, 1971-1980

Unit: %

Industrial Origin	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1. Agriculture	27.7	28.3	27.9	27.9	28.0	27.3	26.3	25.9	25.4	24.9
2. Mining	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.5
3. Manufacturing Industries	16.0	15.7	15.9	15.7	15.1	15.6	16.0	16.2	16.3	16.7
4. Construction	1.5	1.7	1.9	1.7	1.9	3.0	3.2	3.1	3.2	3.2
5. Electricity, Gas, Water Supply	1.2	1.3	1.3	1.3	1.4	1.4	1.6	1.7	1.7	1.7
6. Transportation & Communications	5.6	5.8	6.0	6.4	6.4	6.5	6.5	6.6	6.7	6.9
7. Commercial Services	28.6	28.0	28.1	28.4	27.6	27.9	28.2	28.1	27.5	27.0
8. Financial Services	2.3	2.3	2.5	2.5	2.6	2.6	2.9	3.0	3.4	3.4
9. Housing	6.7	6.4	6.1	5.8	5.9	4.4	4.5	4.5	4.5	4.4
10. Public Administration	4.7	4.8	4.6	4.6	5.0	5.2	4.8	4.8	4.9	5.2
11. Other Services	5.6	5.6	5.6	5.6	6.0	6.0	5.9	5.9	6.1	6.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 3-1 POPULATION BY DEPARTMENT IN 1950, 1964, 1973 AND 1981

Region	Area (km^2)	Population Census (persons)				Average Annual Growth Rate of Population (%)			Population Density Per km^2 in 1981
		1950	1964	1973	1981	1950-1964	1964-1973	1973-1981	
Republic of Guatemala	108,889	2,790,868	4,287,997	5,211,929	6,054,227	3.11	2.19	1.89	56
Departments									
Guatemala	2,126	438,913	810,858	1,127,845	1,311,192	4.48	3.73	1.90	617
El Progreso	1,922	47,874	65,582	73,176	81,188	2.27	1.22	1.31	42
Sacatepequez	465	60,124	80,942	99,710	121,127	2.15	2.34	2.46	260
Chimaltenango	1,979	121,480	163,153	193,557	230,059	2.13	1.23	2.18	116
Escuintla	4,384	123,759	270,267	300,140	334,666	5.74	1.17	1.37	76
Santa Rosa	2,955	109,836	157,040	176,198	194,168	2.59	1.29	1.22	66
Solola	1,061	82,921	107,822	126,884	154,249	1.89	1.83	2.47	145
Totonicapan	1,061	99,354	141,772	166,622	204,419	2.57	1.81	2.59	193
Quetzaltenanago	1,951	184,213	270,916	311,613	366,949	2.79	1.57	2.06	188
Suchitepequez	2,510	124,403	186,634	212,017	237,554	2.94	1.43	1.43	95
Retalhuleu	1,856	66,861	117,562	133,993	150,923	4.11	1.46	1.50	81
San Marcos	3,791	232,591	336,959	388,100	472,326	2.68	1.58	2.49	125
Huehuetenango	7,400	200,101	288,088	368,807	431,343	2.64	2.78	1.98	58
Quiche	8,378	174,911	249,939	300,641	328,175	2.58	2.07	1.10	39
Baja Verapaz	3,124	66,313	96,485	106,909	115,602	2.71	1.15	0.98	37
Alta Verapaz	8,686	189,812	260,498	276,370	322,008	2.29	0.66	1.93	37
Peten	35,854	15,880	26,562	64,503	131,927	3.74	10.36	9.36	4
Izabal	9,038	55,032	116,685	170,864	194,618	5.52	4.33	1.64	22
Zacapa	2,690	69,536	96,554	106,726	115,712	2.37	1.12	1.02	43
Chiquimula	2,376	112,841	149,752	158,146	168,863	2.04	0.61	0.82	71
Jalapa	2,063	75,190	99,153	118,103	136,091	2.00	1.96	1.79	66
Jutiapa	3,219	138,925	194,774	231,005	251,068	2.44	1.91	1.05	78

Table 3-2 POPULATION AND NUMBER OF HOUSES AND HOUSEHOLDS IN THE DEPARTMENT OF ESCUINTLA IN 1981

Administration	Population	Number of Houses	Number of Households	Average Size of Family
Republic of Guatemala	6,054,227	1,259,598	1,151,872	5.26
Department of Escuintla	334,666	70,368	65,751	5.09
Municipality				
Escuintla	75,442	15,110	14,893	5.07
Siquinala	8,646	1,621	1,514	5.71
Masagua	20,369	4,416	4,032	5.05
La Democracia	13,059	2,911	2,595	5.03
San José	23,613	5,329	4,668	5.06
Sub-total	141,129	29,450	27,702	5.09
Santa Lucia	44,422	9,513	8,884	5.00
La Gomera	31,227	7,046	6,342	4.92
Sub-total	75,649	16,559	15,226	4.97
Tiquisate	35,719	7,864	7,378	4.84
Guanagazapa	8,137	1,743	1,555	5.23
Iztapa	6,547	1,462	1,221	5.36
Palin	14,140	2,439	2,839	4.98
San Vicente Pacaya	7,076	1,545	1,403	5.04
Nueva Concepcion	46,269	9,306	8,427	5.49
Sub-total	117,888	24,359	22,823	5.17

Table 3-3 POPULATION AND WORKING POPULATION BY AGE AND SEX GROUP IN 1981

	Republic of Guatemala				Department of Escuintla				Study Area			
	Over 10 years		Total		Over 10 years		Total		Over 10 years		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Population												
Male	2,024,311	(67.1)/1	3,015,926		118,514	(68.2)/1	173,895		77,952	(68.9)/1	113,080	
Female	2,070,842	(68.2)	3,038,401		108,277	(67.3)	160,771		70,710	(68.2)	103,696	
Total	4,095,153	(67.6)	6,054,227		226,791	(67.8)	334,666		148,662	(68.6)	216,778	
Working Population												
Male	1,449.058	(71.6)/2	1;449,058	(48.0)/3	88,034	(74.3)/2	88,034	(50.6)/3	58,362	(74.9)/2	58,362	(51.6)/3
Female	247,406	(11.9)	247,406	(8.1)	8,250	(7.6)	8,250	(5.1)	5,887	(8.3)	5,887	(5.7)
Total	1,696,464	(41.4)	1,696,464	(28.0)	96,284	(42.5)	96.284	(28.8)	64,249	(43.2)	64,249	(29.6)

/ 1 and / 3: Percentage to the total population by sex group.
/ 2: Percentage to the total population of the same age by sex group.

Table 3-4 (1/3) FLOOD AND SEDIMENT DAMAGES IN ACHIGUATE AND PANTALEON RIVER BASINS

Date	Cause of Flood	Achiguate River Basin	Pantaleon River Basin
Sep. 5 1969	Hurricane Francelia	Achiguate, Mazate and Gaucalate rivers overflowed. Inundation area: 136.8 km^2, 50 dead and 100 injured in Antigua. Guacalate bridges and railway Achiguate, Aceituno bridges were destroyed. Destruction of rialway at Obispo Bridge.	Flooding along Pantaleon and Taniluya
Sep. 26 1969		Escuintla, 4 dead	
Jul. 27 1970		Ceniza Bridge destroyed.	
Sep. 29-31 1970		Achiguate and Guacalate rivers overflowed. Escuintla, agriculture and cattle damage.	
Sep. 9 1971		Road to San Jose was cut off by water from Achiguate river.	
----- Eruption of Fuego Volcano on Sep. 14, 1971 -----			
Sep. 24 1971	Hurricane Olivia	Inhabitants evacuated, Siquinala	Flood and debris flow along Pantaleon and Taniluya rivers. CA-2 bridge was destroyed .
Oct. 10 1971			Railway bridge was washed out.
Aug. 3 1972		Escuintla, houses were damaged by flood from Mazate river.	

Table 3-4 (2/3) FLOOD AND SEDIMENT DAMAGES IN ACHIGUATE AND PANTALEON RIVER BASINS

Date	Cause of Flood	Achiguate River Basin	Pantaleon River Basin
Oct. 10 1972		Escuintla, Plantation was inundated by flood from Obispo river.	
Jun. 26 1973			Railway bridge was destroyed. Right bank of CA-2 road bridges was scoured.
Aug. 21 1973		Escuintla, Plantation damaged by flod from Obispo river.	
Sep. 21 1974	Hurricane Fifi	Traffic to San Jose, interrupted.	Inundation Area: 13.3 km^2, Blance and Petaya bridges were destroyed.
Jul. 1 1976		Traffic to San Jose interrupted by flood from Achiguate river.	
Sep. 17 1977		-- Ditto -- Cultivated land along Achiguate river was inundated.	
Sep. 6 1978		Sinquinala, big damages caused by flood from Mazate river.	
Sep. 12 1978		-- Ditto --	
Oct. 11 1978		Road to San Jose was cut off by flood from Achiguate river.	
Aug. 31 1979		-- Ditto -- Cultivated land along Achiguate river was inundated.	

Table 3-4 (3/3) FLOOD AND SEDIMENT DAMAGES IN ACHIGUATE AND PANTALEON RIVER BASINS

Date	Cause of Flood	Achiguate River Basin	Pantaleon River Basin
Sep. 3 1979		Road to San Jose was cut off by flood from from Achiguate river.	
Sep.10 1979			Railway bridge was partially destroyed. Some casualities due to flood.
Sep. 21 1979		Mazate bridge was partially destroyed.	
Sep. 12 1982	Hurricane Paul	Inundation area was almost same scale as that in 1969.	

SOURCE : "El Imparcial" and Report of CAMINOS

NOTE : Road bridge and railway bridge have been repeatedly reconstructed after destruction by flood.

Reconstruction data are as follows:

Achiguate River	CA-2 road bridge	: 1964 and 1970
	Railway bridge	: 1970
Pantaleon River	CA-2 road bridge	: 1964 and 1973
	Railway bridge	: 1972 and 1979

Table 3-5 AVERAGE DAILY TRAFFIC VOLUME OF VEHICLES ON MAJOR ROADS IN THE DEPARTMENT OF ESCUINTLA, 1978-1982

Station	Road	Traffic Volume 1978	1979	1980	1981	1982	Average Annual Increase Rate (%) 1978-1982
200/1	CA-2	3,706	4,469	4,548	4,558	4,318	7.09
207	CA-2	5,577	5,141	4,729	5,340	5,187	-1.83
208	CA-2	3,311	4,137	3,641	3,338	3,653	2.49
	Feeder of						
0205	CA-2	1,786	1,934	1,466	1,233	1,146	-11.51
0206	"	1,441	1,403	1,622	1,184	1,155	-5.69
0207	"	1,282	1,920	1,332	1,214	1,261	-0.41
0208	"	1,194	1,115	1,199	1,088	1,311	2.36
0209	"	1,553	1,435	1,187	953	1,068	-9.81
0904	CA-9	3,432	3,449	2,944	3,185	--	-2.46
0905	"	1,689	1,723	1,521	1,398	1,678	-0.16
0906	"	839	1,118	1,296	1,280	1,479	15.23
0907	"	691	1,037	1,031	1,322	1,298	17.07

/1 : Station 200 is situated at 78 km from the Municipality of Guatemala.

Table 3-6 LAND USE IN THE REPUBLIC OF GUATEMALA AND THE DEPARTMENT OF ESCUINTLA

Land Use	Area			
	Republic of Guatemala (km^2)	(%)	Department of Escuintla (km^2)	(%)
1. Cultivated	11,715	10.8	2,307	52.6
2. Cultivated and Pasture	14,951	13.7	163	3.7
3. Pasture	13,338	12.2	1,323	30.2
Sub-total	40,004	36.7	3,793	86.5
4. Forestry	43,226	39.7	63	1.4
5. Waste	24,091	22.1	472	10.8
6. Lake and Swamp	1,274	1.2	---	---
7. Sand and Rock	294	0.3	56	1.3
Sub-total	68,885	63.3	591	13.5
TOTAL	108,889	100	4,384	100

Table 3-7 LAND USE IN THE STUDY AREA

Land Use	Area					
	Total		Achiguate River Basin		Pantaleon River Basin	
	(ha)	(%)	(ha)	(%)	(ha)	(%)
1. Town	1,641	1.3	1,364	1.3	277	1.3
2. Coffee and Cacao	2,262	1.7	2,009	1.8	253	1.2
3. Orchard	1,031	0.8	587	0.5	444	2.1
4. Sugar Cane	16,744	12.9	12,138	11.2	4,606	21.3
5. Palm	31	0.0	31	0.0	40	0.0
6. Banana	1,029	0.8	943	0.9	86	0.4
7. Cotton	3,932	3.0	3,102	2.9	830	3.9
8. Maize	8,571	6.6	6,879	6.3	1,692	7.8
9. Sesame	189	0.1	96	0.1	93	0.4
10. Pasture	53,448	41.1	44,821	41.3	8,627	39.9
Sub-Total (2-10)	88,878	68.3	71,970	66.3	16,908	78.3
11. Road & Railway	3,636	2.8	2,897	2.7	739	3.4
12. Forestry	29,005	22.3	26,236	24.1	2,769	12.8
13. Waste	3,831	2.9	3,474	3.2	357	1.6
14. Lake, Swamp & River	4,142	3.2	3,853	3.3	559	2.6
15. Salina	151	0.1	151	0.1	---	---
16. Sand & Rock	557	0.4	289	0.3	268	1.3
Sub-Total (12-16)	37,686	28.9	33,733	31.0	3,953	18.3
TOTAL	130,200	100	108,600	100.0	21,600	100.0

Table 3-8 ON-GOING PROJECTS IN THE STUDY AREA

Project	Location	Execution Body	Cost (10^3 Quetzales)	Period of Construction (year)
Highway Construction	Escuintla-San Jose	CAMINOS	16,675	1984 and 1985
Railway Rehabilitation	Sta. Maria-San Jose	FEGUA	6,900	1985
New Port Construction	San Jose	UNECPA	296,100	from 1980 to 1986

Table 3-9 MONTHLY MEAN RAINFALL

Code	Name of Station	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	Remarks
5.8.2	San José FEGUA	0 (0)	0 (0)	4.7 (1)	28.1 (2)	79.1 (6)	236.4 (13)	155.3 (10)	156.7 (10)	240.4 (12)	137.8 (8)	57.6 (2)	5.7 (1)	1101.8 (60)	1960-79
5.6.5	Sta. María FEGUA	3.6 (1)	3.9 (1)	18.7 (1)	79.5 (5)	231.1 (12)	386.5 (17)	285.0 (15)	328.6 (17)	444.0 (18)	317.4 (17)	106.6 (6)	19.9 (1)	2224.0 (109)	1960-79
5.10.5	Santa Lucía FEGUA	11.2 (1)	11.5 (1)	34.0 (3)	133.4 (7)	316.7 (14)	484.0 (20)	357.1 (17)	404.3 (18)	567.6 (19)	471.9 (19)	154.1 (7)	23.0 (1)	2968.8 (125)	1960-79
5.1.2	Escuintla FEGUA	3.7 (2)	9.9 (1)	24.4 (2)	100.3 (7)	324.4 (14)	565.9 (19)	284.2 (15)	334.9 (16)	571.3 (21)	340.4 (15)	125.5 (5)	9.6 (1)	2694.5 (111)	1960-79
5.1.4	Ceylan	21.8 (2)	28.4 (3)	76.0 (5)	204.1 (11)	605.8 (21)	767.0 (26)	484.2 (21)	583.4 (23)	797.5 (28)	576.3 (24)	180.2 (8)	41.5 (4)	4366.2 (172)	1960-79
5.10.3	Los Tarros	29.0 (3)	34.2 (3)	80.0 (5)	235.8 (10)	517.1 (17)	736.9 (22)	614.0 (20)	650.5 (21)	865.9 (24)	749.0 (22)	256.5 (10)	55.0 (2)	4824.4 (156)	1960-79
16.1.1	Antigua E.E.	2.4 (1)	0 (1)	6.3 (1)	17.7 (2)	103.1 (6)	225.7 (15)	154.0 (11)	143.2 (13)	202.7 (15)	91.3 (8)	16.0 (2)	1.4 (1)	963.8 (73)	1960-79
3.5.2	El Recuerdo	9.3 (4)	6.6 (2)	11.3 (2)	46.5 (6)	128.9 (14)	275.0 (22)	190.2 (19)	204.6 (18)	329.7 (23)	122.3 (16)	34.9 (9)	9.3 (4)	1368.6 (141)	1968-79

Note: Figures in Parentheses are mean rainfall days in the month.

Table 3-10 MONTHLY MEAN TEMPERATURE

(Unit: °C)

Code	Name of Station	Item	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
5.8.5	Puerto San José P.H.C	Max.	31.5	32.2	32.8	33.4	31.6	30.7	31.8	31.5	30.6	31.3	31.7	31.9	31.6
		Ave.	25.7	26.2	27.5	28.3	28.3	27.3	27.9	27.5	26.4	26.8	27.0	26.4	27.0
		Min.	18.4	18.5	20.6	22.2	23.5	22.5	22.5	22.7	22.8	22.6	21.9	19.5	21.6
5.1.17	El Chupadero P.H.C.	Max.	33.9	34.8	34.7	33.6	33.0	32.1	33.0	32.7	32.0	32.6	33.0	33.5	33.2
		Ave.	25.8	25.6	26.5	26.1	26.3	25.8	25.9	25.9	25.3	25.6	26.0	25.9	25.9
		Min.	20.0	20.2	21.2	21.5	21.4	21.7	21.5	21.2	21.0	21.0	20.8	19.6	20.9
5.10.8	Camantulul	Max.	32.1	33.1	33.7	33.5	32.0	31.0	31.0	31.6	30.8	30.8	31.3	31.7	31.8
		Ave.	24.1	25.5	25.6	26.0	25.7	25.3	25.5	25.0	24.8	24.7	24.8	24.2	28.0
		Min.	16.0	16.1	17.5	18.8	20.2	20.0	19.7	19.2	19.6	18.7	18.2	16.5	18.5
5.1.9	San Andrés /1 Osuna	Max.	27.4	28.3	28.0	28.2	27.4	26.6	26.4	27.7	26.3	26.5	26.9	27.3	27.2
		Ave.	24.3	24.8	24.8	24.8	24.6	24.0	23.9	24.0	23.7	23.8	24.1	24.2	24.2
		Min.	21.3	21.4	21.3	21.5	21.8	21.5	21.4	21.4	21.2	21.2	21.3	21.1	21.4
3.5.2	El Recuerdo	Max.	20.7	21.0	22.0	21.8	22.4	20.5	21.1	20.7	20.3	20.9	21.2	21.8	21.2
		Ave.	13.4	13.6	14.8	15.4	16.5	15.7	15.8	15.6	15.3	15.5	14.8	14.2	15.0
		Min.	6.2	6.2	7.7	9.0	10.7	10.9	10.5	10.6	10.4	10.1	8.4	6.7	8.9

/1 : This station is located at the skirts of Fuego Volcano in Ceniza River Basin (760 m. MSL)

Table 3-11 MONTHLY MEAN HUMIDITY

(Unit: %)

Code	Name of Station	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
5.1.14	Sabana Grande	69.00	67.27	72.55	75.64	85.45	86.91	82.55	82.73	79.64	85.73	76.36	70.91	77.90
5.1.17	El Chupadero	70.44	65.44	66.22	69.44	77.78	81.89	79.33	78.78	80.44	81.33	76.22	67.89	74.60
5.8.5	San Jose Aero-puerto	75.38	71.50	73.88	73.88	80.00	82.38	80.88	82.38	84.88	83.88	79.25	75.00	78.52
5.10.8	Canantulul	76.17	73.50	73.58	75.08	83.42	85.50	84.33	84.67	85.92	86.67	81.67	78.83	80.78

Table 3-12 MONTHLY MEAN EVAPORATION

(Unit: mm/day)

Code	Name of Station	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
5.1.14	Sabana Grande	4.7	4.8	3.9	3.4	2.4	2.7	3.1	2.8	3.1	3.9	4.1	4.2	1244.9 /1
5.10.8	Camantulul	4.7	5.4	5.4	4.9	4.2	3.4	4.0	4.2	3.8	3.5	4.0	4.1	1583.1 /1

/1 : Unit mm/year

Table 3-13 VOLCANIC ACTIVITIES AND INFLUENCES

Year	Period	Intensity	Lava flow *	Explosion of a lava dome or a spine	Lahar or nuee ardentes	Ash (normal Explosion)	Solfatara fields vaporous	Other activities	Remarks	Damages caused by volcanic activities	Year & Period	Precipitation	Sedimentation or flood damage
1821–1927			* Ashflows are easily termed "lava flow" by inhabitants. For this reason, current reports and possibly historical accounts may be misleading				○		· Ashes fell as far as Salvador and Honduras. In Guatemala City, 138 Kg tephra fell on 1m² during one hour. The top (50 ~ 80m ?) of the volcano was destroyed, and a new crater, deeply breached in NE direction, was formed. Hot avalanches came down.				
1932	21-22 Jun	◎			○ (hot avalanches)	○					1827.27 June 1827.29 July 1932.30 Aug 1932.10 Sep 1932.14 Oct 1933.11 July 1933.14 Sep 1933.22 Sep 1933.25 Sep 1933.28 Sep 1934.8 June 1936.13 June 1936.9 Oct		· Damages cause by the storm serious. railway destroyed in San Jose, in flooded. · Numerous damage in La Escuintla, due to a violent cyclon. · damages due to roins in the road to Esquintla · Yepocapa and this sufferes heavy damages. · San Jose is flooded. Guacalate river overflowed. · Strong hurricane raged over the city San Jose · San Jose flooded due to hevy rain. · Guacalate river overflowed. · San Jose abandaned by las inhabitants. · Escuintla were panicked by a very strong cyclon. · San Jose flooded. · San Jose flooded. · San Jose flooded again.
1944	end of the year?								· From 1932 till 1944 observations are failing.				
1947	?												
1949	Nov												
1953	11 Apr	◎	○	○ (Lava dome)		○ (Block scoria)	○		· S & W top slopes are covered with black scoria. Crater, breached in NE direction, was filled with fresh lava up to about 20m. New lava had flown throw the deep noch of 1932 in NE direction reaching downwards halfway the mountain in slope				
1954	9 Sept		○										
1955	July			○ (Spin)									
1957						○							
1962	3.6 Aug	◎			○ (Lahar)	○ (Ash flows)			· Central crater explosive activity and lahar		1968.11 Sep		· San Jose flooded due to the rivermouth closing Water level reached over 1 meter.
-	Oct								· Strong explosive activity, central crater lava. Ash clowd estimated to 12.000 m.		1968.18 Oct		· San Jose port flooded. 5000 inhabitants ev cuated.
-	9 Nov	)											
1963	28.30 Sept	◎	○					○ (Mud flows)	· Explosive activity central crater, mud flows, lava, SE flank.		1968. 19 Oct		· 4000 inhabitants evacuated from San Jose.
1966	7 Feb								· Explosive activity central crater.		1969. 5 Sep		House almost submerged. This flood is due to overflow of Achiguate river.
	20 Apr								· Ash eruption largest since 1932, lava flow				
	1 May	◎							· Ash clowd estimated to 12,000m.				· Harricane most heavily hits Escuintla.
	12.13 Aug										1969.26 Sep		· 4 dead by flood situation was worse in Escuintla San Jose is flooded and has been evacuated.
1967	22.24 Apr								· Ash eruption				
1971	14 Sept	◎			○ (nuees arsentes)	○ (Basaltic ash, scoria ash flows)			· The 1971 event was the largest by far of all the recent Fuego activity. All observers agree that this was the most spectacular eruption of Fuego in memory (at least 70 years) The eruption consisted of large Vulcanian type eruption and of nuees ardentes which flowed down various gulleys on the flanks of the cone. The most notable flows occured in Barrancos Honda, Las Lajas, and Conica. Eruption cloun reached over 10.000 m in height. · Privailing winds deposited a 1 cm layer of ash more them 140 km to the west. Up to 5 cm size scoria was transported 8 km to the west, where the town of Yepocapa was covered with 30cm of ash.	About 20% of the roofs in Yepocapa were collapsed, including many of pubric buildings. Volume of ash produced this 1971 eruptions estimates to about 02 x 10⁹ m³	1970.30 July 31 July 1971. 9 Sep 1971.25 Sep 1971.15 Oct 1971.21 Oct 1972. 3 Aug 1972.10 Oct 1973.21 Aug		· Achiguate and Guacalate rivers over flowed. · Achiguate and Guacalate river damaged and lost the agricultural land. · Achiguate river and affluents overflowed in the road to San Jose in the 96-100Km. · Several river overflowed due to eruption of the Fuego Volcano. The bridge over the Panzaleon river bridge falls interrupting the road. Siquinala is evacuated. · One dead, several wounded and destroyed houses due to overflowing of Guacalate and Achiguase rive in Masagua Escuintla, Siquinala suffered from the overflowing of the Obispo river. · A Bailey bridge and two other were destroyed by the Panzaleon river which overflowed again due to heavy rains. The railway brige over the Panzaleon river was destroyed. · In La Democracia in Escuintla, the Mazate river overflowed flooding houses and lots. Mazate river overflowed flooding La Democracia. · Obispo river in Democracia overflowed due to heavy sedimentation.
1973	22 Feb					○ (steam emission)			· The 1973 eruption was much less than violent and produced only a fraction of the ash volume of the 1971 eruption. · There was continuous steam emission but no explosive activity similar to the 1971 eruption. · Acatenango which is a twin of the Fuego volcano started gentle. Xiny ash eruption on Nov. 12. 1972, the first since 1927. Ash continued to rise in the crater, but never developed into an actual explosive eruption. · On this day, there were strong steam emissions from Fuego, and ligth ash fall and ash flows started the following day. In summerly. Fuego erupted ash from Feb 23 to March 2, and had renewed ash fall on March 22. and 23, for a total of 10 days of ash eruption. · Expect for a brief shower of 1 cm scoria fallen on the SE slope of the cone, most of the materials was fine sand to dust in size. The 1 cm isopach extended to about 10Km southly from the crater.				
	23 Feb 28 March (With a quiet interval from 3 to March)					○ (ash fall ash flows black scoria)							
1974	10 Oct	◎				○ (ash fall ash flows)			· The eruption began at 4 a.m. with small eruption of ash fall and ash flows · A period of intense activity began at 2 a.m. and contined to 7 p.m. A thick ash cloud rose over 7500m above the summit, and numerous hot ash flows cascaded down the slopes of the volcanic cone. · A renewed eruption lasted from 9:45 p.m. 17 Oct. to 12 p.m. 19 Oct. The smallest of the major period of activity occured 19 Oct. and lastud for an undetermined length of time. · In the afternoon and evening, Fuego was once again in violent activity for at lest 4-6 hours. Gas cloud rose 3 or more kilometers above the summit, and this episodes concluded the eruptions period of intensive activity. This activity was characterised by the emission of gas and ash in a cloud reaching to 1000~2,000 m over the summit. · Sine 23 Oct, the gas and ash cloud have not exceeded 1.500m in height, from 4 Dec. through 12 Dec. 12, the plume from the crater rose only a few hundred meter at most and contained almost no ash.	Winds at the time of the eruption carried the ash in a westerly direction. Acording to Dr Samuel Bonis who prepareed the isopach map of the ash thickness, 185 x 10⁶ m³ of ash was produced by the 4 major eruptive episodes, about 3 times the calculated volume of the 1971 eruption.	1974.21 Sep		· The water level in San Jose rose two meters cutting all comunication was with Esquintla.
	14 Oct					○ (ash fall ash flows)							
	17-19 Oct					○ (ash fall and gas)							
	23 Oct – 4 Dec					○ (ash fall) and gas)							
1975	28 May					○ (ash fall ash flow!)			· Small ash eruptions, possible ash flow		1975.29 Sep		· San Jose port flooded due to overflowing of the Achiguate and Guacalate river. The Barrio Cerritos (a neighbourhood) of San Jose is completely flooded.
	22 July – 4 Aug					○ (ash fall ash flow!)			· Sporadic very small ash eruptions, possible ash flows 22 July.		1975.11 Sep		Traffic interrupted in the 78.100 km due to the overflowing of Achiguate river.
	18 Sep and continuing					○ (ash fall)			· Increasing vapur emission followed by small airfall ash eruption				
	11-21 Oct					○ (ash fall)			Larger airfall eruptions ash falling at Antigua		1976 1 July		· Achiguate river overflowed in the 78.79. 93 and 94 km of the road to the San Jose port road.
1977	3 Mar					○ (ash fall ash fall)			· Small ash eruption · Small ash eruption		1977.17 Sep		· Achiguate and Guacalate rivers overflowed
	19 Apr												
	11 Sep and continuing					○ (ash fall)			· Weak airfall eruptions				
1978	Jun					○ (ash fall)			· Light eruption		1978. 6 Sep		· At Siquinala, big damages when the river Mazate overflowed.
1979	23 Jun								· Intense activity		12 Sep		· Mazate river overflowed
	10 Feb								· Intense activity		11 Oct		· Road to San Jose with half way between 20 and 30 km due to the out flood of Achiguate River
											1979. 1 Sep		· Achiguate River flooded and road to San Jose interrupted damaging the agricultural crops.
											3 Sep		· The road to San Jose flooded in several kms by the Achiguate river.
1980	11 Jun								· Weak eruption		1982.20 July		· Strong rains accompanied of hurricanes winds scouring last night at Escuintla getting down trees and leaving 5 houses without ceilling.
	3 Feb								· Weak eruption		1983.10 Sep		· Achiguate river flooded again. Over 5.000 inhabitants evacuated.

Table 4-1 PROBABLE SEDIMENT DISCHARGE

Return Period	Achiguate River				Pantaleon River			
	Probable Discharge	Probable Sediment Discharge	Allowable Sediment Discharge /1	Exceeding Sediment Volume /1	Probable Discharge	Probable Sediment Discharge	Allowable Sediment Discharge /1	Exceeding Sediment Volume /1
	$x10^6 m^3$/flood	$x10^3 m^3$/flood	$x10^3 m^3$/flood	$x10^3 m^3$/flood	$x10^6 m^3$/flood	$x10^3 m^3$/ flood	$x10^3 m^3$/flood	$x10^3 m^3$/flood
50	24.6	2,200	100	2,100	22.9	3,440	410	3,030
			50	2,150			320	3,120
30	22.3	1,940	90	1,850	20.8	3,100	370	2,730
			50	1,890			290	2,810
20	20.5	1,740	80	1,660	19.1	2,790	340	2,450
			40	1,700			270	2,520
10	17.3	1,420	70	1,350	16.3	2,300	290	2,010
			40	1,380			230	2,070
5	14.1	1,110	60	1,050	13.3	1,820	240	1,580
			30	1,080			190	1,630

/ 1 : Upper line: Entire river course improvement
Lower line: Partial improvement

Table 4-2 PROBABLE DISCHARGE

Unit: m^3/s

Return Period	Achiguate		Pantaleon
	Control Point I CA=205.1 km^2	Control Point II CA=956.2 km^2	Control Point CA=150.0 km^2
50	1310 (6.39)	1860 (1.95)	1220 (8.13)
30	1190 (5.80)	1670 (1.75)	1110 (7.40)
20	1090 (5.31)	1520 (1.59)	1020 (6.80)
10	920 (4.49)	1250 (1.31)	870 (5.80)
5	750 (3.66)	970 (1.01)	710 (4.73)
2	480 (2.34)	550 (0.56)	470 (3.13)

NOTE: Figures in Parentheses show the specific discharge;
Unit: $m^3/sec/km^2$

Table 4-3 (1/2) INUNDATION WATER STAGE (ACHIGUATE RIVER BASIN)

(Unit: m)

Section	Extent of Inundation Water	Return Period					
		50 year	30 year	20 year	10 year	5 year	2 year
Road Bridge		Not Washed away /1					
(From 42km) to 34km	400	1.56 (1.48)	1.43 (1.35)	1.36 (1.28)	1.19 (1.14)	1.01 (0.69)	0.66 (0.62)
Railway Bridge		Washed away					
28km left (over flowed)	200	0.8	0.75	0.69	0.60	0.51	0.37
28km	400	1.6	1.5	1.4	1.2	1.0	0.65
(From 26km) to 20km	200	0.6	0.55	0.5	0.4	0.35	0.25
16km	2500	0.5	0.48	0.45	0.4	0.35	0.22
12km	400	0.42	0.40	0.37	0.33	0.29	0.19
8km	5500	0.34	0.32	0.29	0.27	0.23	0.16
4km	7000	0.25	0.23	0.22	0.20	0.18	0.13
0km	7000	0.25	0.23	0.22	0.20	0.18	0.13

/ 1: During the flood, the bridge falls into dangerous condition of collapse by the sediment discharge, so that transportation is interrupted, which considered flood damage.

/ 2: Figures in parentheses show the water stage under the condition of sediment deposition for urgent plan.

Table 4-3 (2/2) INUNDATION WATER STAGE (PANTALEON RIVER BASIN)

(Unit: m)

Section	Extent of Inundation Water	Return Period					
		50 year	30 year	20 year	10 year	5 year	2 year
Road Bridge		Not washed away					
Railway Bridge		Washed away					
(From 20km) to 16 km	200	1.16 (0.58)	0.98 (0.45)	0.88 (0.33)	0.60 (1.16)	0.32 (0.0)	0 (0.0) / 2
16km Right (1)	1000	0.32	0.29	0.27	0.23	0.18	0.07
16km Right (2)	500	0.70	0.65	0.60	0.50	0.40	0.22
Pataya Road Bridge		Washed away			Not washed away		
(From 14km) to 8km		No damage					
6km Left	500	0.51	0.48	0.46	0.42	0.36	0.25
(from 6 km) to 0km	500	0.52	0.52	0.82	0.52	0.52	0.52

/ 1: During flood time, the bridge falls into dangerous condition of collapse due to the sediment discharge so that transportation is interrupted which is considered as flood damage.

/ 2: Figures in parentheses show water stage under the condition of sediment deposition for urgent plan.

Table 4-4 INTEREST RATES OF INTERNATIONAL FINANCING AGENCIES

Agency	Interest Rate
Inter-American Development Bank (BID)	1% - 2%
International Development Agency (AID)	2% - 3%
Central American Economic Integration Bank (BCIE)	6%
International Bank for Reconstruction and Development (IBRD)	9%
Venezuelan Investment Fund (FIV)	8.25%
Central American Economic Investment Bank (BCIE)	8.75%
Average	
(1) Average of International Agencies	5%
(2) Average of Local Financing Agencies	8%
(3) Average of (1) and (2)	6.5%

Table 5-1 COMPARATIVE STUDY FOR PARTIAL RIVER IMPROVEMENT (CASE II)

(1) River	(2) Asset to be Protected	(3) No.	(4) Method	(5) Required work	(6) Total Construction Cost $\times 10^3$ US$	(7) Annual Benefit $\times 10^3$ US$	(7)/(6)
Achiguate River	CA-2 road Bridge & railway bridge	I-1	River channel improvement (I)	River Course (43km - 42.8km) (41.7km - 38km)	6,050	1,280	0.21
		I-2	River channel improvement (II)	River course (43km - 42.8km) (40.4km - 38.0km) Training levee (41.7km - 40.4km)	6,140	1,280	0.21
		I-3	Heightening of railway bridge	River course (43km - 42.8km) Bridge reconstruction, Raising of approach, Railway embankment (4,000m)	11,300	1,160	0.10
	Urban area of Finca La Trinidad	II-1	River channel improvement	River course (31.5km - 25.5km)	8,350	1,030	0.12
		II-2	Raising of CA-9 road	Road raising (H=1.25m, L=2,500)	2,560	880	0.34
		II-3	Ring Levee	Embankment/ revetment (H=1.75, L=4,000m)	2,150	170	0.08
	Urban area of La Barrita	III-1	River channel improvement & training levee	River course (8km - 0km) Training levee (9km - 8km)	22,400	760	0.03
		III-2	Ring levee	Embankment/ revetment (H=1.45m, L=5,000m)	2,220	240	0.11
Pantaleon River	CA-2 road bridge & railway bridge	IV-1	River channel improvement (I)	River course (21.4km - 21.35 km) (20.5km - 18 km)	5,460	670	0.12
		IV-2	River channel improvement (II)	River course (21.4km - 21.35km) (18.3km - 18 km) Training levee (20.5km - 18.3 km)	8,180	670	0.08

Table 5-2 CONSTRUCTION COST

Works Item	Unit	Quantity			Cost ($\times 10^3$)		
		Achiguate River	Pantaleon River	Total	F.C. (US$)	L.C. (Q.)	Total (US$)
1. Sediment Control Dam							
Excavation	m^3	103,000	202,000	305,000	824	519	1,343
Back-filling	m^3	9,400	14,300	23,700	74	89	163
Main Dam	m^3	78,000	126,000	204,000	7,175	6,895	14,070
Sub Dam	m^3	10,000	11,000	21,000	743	878	1,621
Apron and Side Walls	m	69	140	209	651	579	1,230
Saddle Dam	m	170	--------	170	174	107	281
Sub-total of 1.					9,641	9,067	18,708
2. River Improvement							
Excavation	m^3	1,140,000	240,000	1,380,000	3,174	1,932	5,106
Embankment	m^3	160,000	--------	160,000	1,488	944	2,432
Sodding	m^2	79,000	7,000	86,000	-------	147	147
Drainage Ditch	m	12,000	--------	12,000	588	684	1,272
Revetment(1:0.5)	m	4,600	4,600	9,200	947	1,008	1,955
Groundsill	Unit	15	45	60	1,383	1,256	2,639
Check Groundsill	Unit	2	2	4	171	202	373
Ring Levee	m	5,000	--------	5,000	510	424	934
Drainage Facility	L/S	1	--------	1	490	130	620
Sub-total of 2.					8,751	6,737	15,478
Sub-total of 1. and 2.					18,392	15,794	34,186
3. Preparation Cost (10% of total of 1. and 2.)	L/S				1,839	1,579	3,418
4. Land Acquisition Cost							
Dam Construction	ha	4	--------	4	--------	3	3
River Improvement	ha	24	--------	24	--------	17	17
5. Engineering Services	L/S				5,526	1,374	6,900
6. Administration Cost	L/S				216	448	664
Sub-total of 1. to 6.					25,973	19,215	45,188
7. Physical Contingency (10% of total of 1. to 6.)	L/S				2,597	1,922	4,519
Grand Total of 1. to 7.					28,570	21,137	49,707

Table 5-3 ANNUAL DISBURSEMENT SCHEDULE

Unit:
Total : US$ x 10^3
F.C : US$ x 10^3
L.C : Q x 10^3

Item	Total	F.C	L.C	1st.		2nd.		3rd.		4th.		5th.		6th.		7th.	
				F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	F.C	F.C	L.C
1.Sediment Control Dam	18,708	9,641	9,067	-----	-----	-----	-----	1,153	1,042	2,702	2,532	2,639	2,494	1,957	1,847	1,190	1,152
2.River Improvement	15,478	8,751	6,727	-----	-----	-----	-----	-----	-----	1,166	900	2,184	1,827	2,573	1,872	2,828	2,128
Sub total of 1. and 2.	34,186	18,392	15,794	-----	-----	-----	-----	1,153	1,042	3,868	3,432	4,823	4,321	4,530	3,719	4,018	3,280
3.Preparation Cost (10% of total of 1. and 2.)	3,418	1,839	1,579	-----	-----	-----	-----	115	104	387	343	482	432	453	372	402	328
4.Compensation	20	-----	20	-----	-----	-----	20	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Sub total of 1. to 4.	37,624	20,231	17,393	-----	-----	-----	20	1,268	1,146	4,255	3,775	5,305	4,753	4,983	4,091	4,420	3,608
5.Engineering Services	6,900	5,526	1,374	1,111	305	740	204	795	173	720	173	720	173	720	173	720	173
6.Administration Cost	664	216	448	113	53	75	35	28	72	-----	72	-----	72	-----	72	-----	72
Sub total of 1. to 6.	45,188	25,973	19,215	1,224	358	815	259	2,091	1,391	4,975	4,020	6,025	4,998	5,703	4,336	5,140	3,853
7.Physical Contingency (10% of total of 1. to 6.)	4,519	2,597	1,922	122	36	81	26	209	139	498	402	603	500	570	434	514	285
Total of 1. to 7.	49,707	28,570	21,137	1,346	394	896	285	2,300	1,530	5,473	4,422	6,628	5,498	6,273	4,770	5,654	4,238
8.Price Contingency F.C (6 %) L.C (6 %)	13,492	7,611	5,881	-----	-----	54	17	284	189	1,045	845	1,740	1,443	2,122	1,613	2,366	1,774
9.Grand total of 1. to 8.	63,199	36,181	27,018	1,346	394	950	302	2,584	1,719	6,518	5,267	8,368	6,941	8,395	6,383	8,020	6,012

Table 6-1 COST COMPARISON FOR RIVER IMPROVEMENT METHODS

River	Case No.	Principal River Improvement Method	Return Period (year)	Construction Cost (x 10^3 US$)		
				River Improvement	Sediment Control Dam	Total
Achiguate River	A-E-5	Channel excavation	5	4,980	4,880	9,860
	A-E-10	- do. -	10	5,390	5,330	10,720
	A-E-30	- do. -	30	5,810	6,130	11,940
	A-T-5	Channel excavation and construction of training levee	5	3,470	4,880	8,350
	A-T-10	- do. -	10	3,770	5,330	9,100
	A-T-10'	- do. -	10 (30)	4,110	5,330	9,440
	A-T-30	- do. -	30	5,820	6,130	11,950
Pantaleon River	P-E-5	Channel excavation	5	2,360	2,630	4,990
	P-E-10	- do. -	10	2,490	3,000	5,490
	P-E-10'	- do. -	10 (30)	2,700	3,000	5,700
	P-E-30	- do. -	30	4,580	5,590	10,170
	P-T-5	Construction of training levee	5	3,890	2,630	6,520
	P-T-10	- do. -	10	4,310	3,000	7,310
	P-T-30	- do. -	30	7,930	5,590	13,520

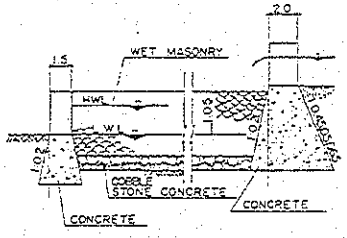
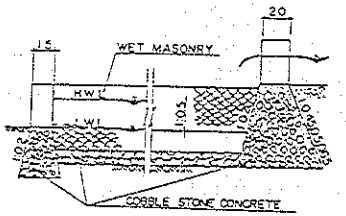
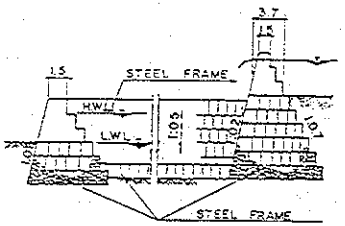
Table 6-2 ECONOMIC COMPARISON FOR PROJECT SCALES

Unit: x 10^3US$

Study Case	Construction Cost		Annual O M R Cost/1	Annual Benefit /1					EIRR
	Base Cost	Economic Cost		Railway Bridge/2	Road Bridge/3	Traffic /4	Houses /5	Total	(%)
A-T-5 & P-E-5	13,340	11,340	260	360	100	680	110	1,250	6.0
A-T-10 & P-E-10	14,590	12,410	260	420	110	800	130	1,460	7.0
A-T-10´& P-E-10´	15,140	12,870	260	420	110	800	130	1,460	7.0
A-T-30 & P-E-30	22,110	18,790	260	470	130	880	150	1,630	5.0

/1 : Economic Cost
/2 : Loss of National railway bridge
/3 : Partial damage to CA-2 road bridge
/4 : Interruption of Traffic
/5 : Damage to houses, house-hold effects and agricultural crops.

Table 6-3 COST COMPARISON FOR SEDIMENT CONTROL DAM TYPES

Item		Dam Type: Concrete	Cobble Stone Concrete	Steel Flame
Section of Dam (Unit ; m)				
Base Construction Cost ($\times 10^3$ US$)	A-1 Dam	2,900	2,500	4,900
	C-1 Dam	2,500	2,200	4,400
	P-2 Dam	3,000	2,600	5,300
	Total	8,400	7,300	14,600

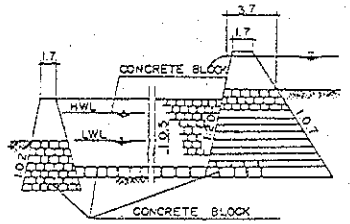
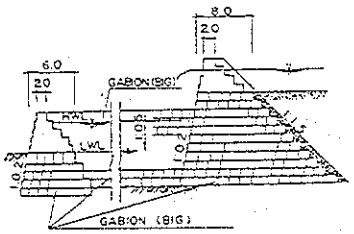
Item		Dam Type: Concrete Block	Gabion Mattress
Section of Dam (Unit; m)			
Base Construction Cost ($\times 10^3$ US$)	A-1 Dam	3,700	3,300
	C-1 Dam	3,100	2,900
	P-2 Dam	3,900	3,700
	Total	10,700	9,900

Table 6-4 DIMENSIONS OF SEDIMENT CONTROL DAMS

Plan	River	Dam Name	Dam Site	Main Dam: Effective Height	Main Dam: Dam Height (m) Overflow Section	Main Dam: Dam Height (m) Non-overflow Section (max.)	Main Dam: Gradient of Upstream Slope	Main Dam: Crest Length (m)	Overflow Section: Design Discharge (m^3/sec)	Overflow Section: Bottom Width (m)	Overflow Section: Water Depth (m)	Sub Dam: Dam height (m) Overflow Section	Sub Dam: Dam height (m) Non-overflow Section	Apron: Length (m)	Apron: Thickness (m)	Side Well: Height (m)
Proposed	Achiguate	A-1	A	6.5	7.0	10.4	1:0.50	409	1,250	180	2.4	4.0	7.4	24	1.0	5.1
		C-1	D	4.5	6.0	9.1	1:0.45	425	1,250	220	2.1	3.5	6.6	21	1.0	4.6
	Pantaleon	P-2	F'	9.0	11.0	14.6	1:0.65	392	1,250	160	2.6	4.5	8.1	29	1.3	5.8
Alternative	Achiguate	A-1	A	5.0	5.0	9.0	1:1.0	404	1,250	180	2.4	---	---	12	2.0	---
		A-1'	B	3.5	4.0	8.0	1:1.0	401	1,200	180	2.3	---	---	12	2.0	---
		A-2	C	5.0	5.0	10.0	1:1.0	101	1,050	70	3.9	---	---	12	2.0	---
		C-1	D	4.5	5.0	8.0	1:1.0	424	1,250	220	2.1	---	---	12	2.0	---
	Pantaleon	P-2	F	5.0	5.0	9.0	1:1.0	276	1,250	160	2.6	---	---	12	2.0	---
		P-2'	G	4.0	4.0	8.0	1:1.0	308	1,100	120	2.8	---	---	12	2.0	---
		P-3	H	5.0	5.0	9.0	1:1.0	167	1,100	120	2.8	---	---	12	2.0	---
		P-4	I	5.0	5.0	9.0	1:1.0	170	1,100	120	2.8	---	---	12	2.0	---
		P-5	J	5.0	5.0	9.0	1:1.0	158	1,100	120	2.8	---	---	12	2.0	---

Table 6-5 COST COMPARISON FOR RIPARIAN STRUCTURE TYPES

Purpose	Structure	Durability	Type	Description	Cost (US$) Construction	Replacement	Total
Bank Protection	Revetment	Permanent	R 1	Concrete retaining wall (n=1: 0.5) with foot protection of gabion mattresses	470 /m	0 /m	470/m
			R 2	Concrete block (n=1:0.5) with foot protection of gabion mattresses	480	0	480
			R 3	Wet masonry (n=1:0.5) with foot-protection of gabion mattresses	290	0	290
		Semi Permanent	R 4	Gabion cylinder (n=1:1.5)	210	420 /1	630
	Groyne	Permanent	G 1	Non-permeable concrete groyne (@ 20m)	410	0	410
			G 2	Non-permeable wet masonry groyne (@ 20m)	530	0	530
		Semi Permanent	G 3	Permeable foot protection groyne of wooden piles (@ 20m)	110	220 /1	330
			G 4	Permeable foot protection groyne of cribs (@ 20m)	67	133 /1	200
Riverbed Stabilization	Groundsill	Permanent	GS 1	Concrete type with concrete sub groundsill and concrete apron	120×10^3/Unit	0×10^3/Unit	120×10^3/Unit
			GS 2	Concrete type with apron of gabion mattresses	74	0	74
		Semi Permanent	GS 3	Concrete block type	46	92 /1	138
			GS 4	Gabion mattress type	29	58 /1	87

/1. Replacement will be carried out twice a project life (30 years), because these structures have a life of 10 years.

Table 6-6 CONSTRUCTION PLAN (PROPOSED PLAN)

Work Item	Unit	Quantity			Cost (x 10^3)		
		Achiguate River	Pantaleon River	Total	F.C (US$)	L.C (Q.)	Total (US$)
1. Sediment Control Dam					(2,500)	(2,538)	(5,038)
Excavation	m^3	56,800	51,200	108,000	292	184	476
Embankment and Back-filling	m^3	28,700	5,400	34,100	106	126	232
Concrete Works	m^3	25,200	16,100	41,300	1,776	1,446	3,222
Boulder Works for Main and Sub Dams	m^3	7,600	4,500	12,100	100	64	164
Boulder Works for Apron	m^3	5,300	3,700	9,000	62	40	102
Form Works	m^2	20,100	9,200	29,300	0	557	557
Wet Masonry Works for Side Walls	m^2	520	390	910	14	29	43
Saddle Dam Works	m	150	0	150	150	92	242
2. River Improvement					(2,893)	(2,344)	(5,237)
Excavation of River Channel	m^3	552,000	163,000	715,000	1,645	1,001	2,646
Excavation and Back-filling of Trench	m^3	21,600	36,100	57,700	138	87	225
Wet Masonry Works (Type A)	m^2	8,020	0	8,020	56	144	200
Wet Masonry Works (Type B)	m^2	0	10,200	10,200	112	255	367
Base Concrete Works for Wet Masonry (Type A)	m	1,630	0	1,630	26	34	60
Base Concrete Works for Wet Masonry (Type B)	m	0	2,280	2,280	55	66	121
Gabion Mattress Works for Wet Masonry	m^3	2,450	3,420	5,870	194	23	217
Foot-protection Groyne works (Crib)	Unit	68	0	68	24	38	62
Concrete and Form Works for Grondsill	m^3	2,760	6,600	9,360	384	665	1,049
Gabion Mattress Works for Groundsill	m^3	2,100	5,760	7,860	259	31	290
Sub-total of 1. and 2.					(5,393)	(4,882)	(10,275)
3. Preparation Works (10% of Total of 1. and 2.)	L/S	------	------	------	539	488	1,027
4. Engineering Services	L/S	------	------	------	2,100	400	2,500
5. Land Acquisition	ha	4	0	4	0	3	3
6. Administration Cost	L/S	------	------	------	0	414	414
7. Physical Contingency (10% of Total of 1. to 6.)	L/S	------	------	------	803	619	1,422
Sub-total of 1. to 7.					(8,835)	(6,806)	(15,641)
8. Price Contingency (6% for F/C and L/C)	L/S	------	------	------	2,677	2,140	4,817
Grand Total					11,512	8,946	20,458

Table 6-7 ANNUAL DISBURSEMENT SCHEDULE (PROPOSED PLAN)

Unit; x 10^3 US$

Item	1986		1987		1988		1989		1990		Total		
	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	Grand
1. Sediment Control Dam	-----	-----	-----	-----	1,250	1,269	1,000	1,015	250	254	2,500	2,538	5,038
2. River Improvement	-----	-----	-----	-----	-----	-----	2,170	1,758	723	586	2,893	2,344	5,237
3. Preparation Works	-----	-----	250	254	289	234	-----	-----	-----	-----	539	488	1,027
4. Engineering Services	740	118	198	19	475	113	502	113	185	37	2,100	400	2,500
5. Land Acquisition	-----	-----	0	3	-----	-----	-----	-----	-----	-----	0	3	3
6. Administration Cost	0	83	0	83	0	83	0	83	0	82	0	414	414
7. Physical Contingency (10% of Total of 1. to 6.)	74	20	45	36	201	170	367	297	116	96	803	619	1,422
Sub-total of 1. to 7.	(814)	(221)	(493)	(395)	(2,215)	(1,869)	(4,039)	(3,266)	(1,274)	(1,055)	(8,835)	(6,806)	(15,641)
8. Price Contingency (6% for F/C and L/C)	101	27	94	75	583	492	1,365	1,104	534	442	2,677	2,140	4,817
Total	915	248	587	470	2,798	2,361	5,404	4,370	1,808	1,497	11,512	8,946	20,458

Table 6-8 CONSTRUCTION COST (ALTERNATIVE PLAN)

Work Item	Unit	Quantity			Cost ($\times 10^3$)		
		Achiguate River	Pantaleon River	Total	F.C (US$)	L.C (Q.)	Total (US$)
1. Sediment Control Dam					(3,137)	(4,760)	(7,897)
Excavation	m^3	29,400	34,200	63,600	172	108	280
Back-filling	m^3	5,600	6,600	12,200	38	45	83
Gabion Mattress Works	m^3	103,000	92,000	195,000	2,730	4,485	7,215
Boulder Works	m^3	2,600	3,100	5,700	47	30	77
Saddle Dam Works	m	150	0	150	150	92	242
2. River Improvement					(1,777)	(1,511)	(3,288)
Excavation of River Channel	m^3	505,000	146,000	651,000	1,497	911	2,408
Gabion Cylinder Works	m^3	4,960	5,980	10,940	98	284	382
Foot-protection Groyne Works (Crib)	Unit	68	0	68	17	45	62
Gabion Mattress Works for Groundsill	m^3	3,150	8,640	11,790	165	271	436
Sub-total of 1. and 2.					(4,914)	(6,271)	(11,185)
3. Preparation Works (10% of Total of 1. and 2.)	L/S	------	------	------	491	627	1,118
4. Engineering Services	L/S	------	------	------	2,100	400	2,500
5. Land Acquisition	ha	4	0	4	0	3	3
6. Administration Cost	L/S	------	------	------	0	444	444
7. Physical Contingency (10% of Total of 1. to 6.)	L/S	------	------	------	751	775	1,526
Sub-total of 1. to 7.					(8,256)	(8,520)	(16,776)
8. Price Contingency (6% for F/C and L/C)	L/S	------	------	------	2,435	2,597	5,032
Grand Total					10,691	11,117	21,808

Table 6-9 ANNUAL DISBURSEMENT SCHEDULE (ALTERNATIVE PALN)

Unit; x 10^3 US$

Item	1986		1987		1988		1989		1990		Total		
	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	Grand
1.Sediment Control Dam	-----	-----	-----	-----	1,568	2,380	1,255	1,904	314	476	3,137	4,760	7,897
2.River Improvement	-----	-----	-----	-----	-----	-----	1,333	1,133	444	378	1,777	1,511	3,288
3.Preparation Works	-----	-----	313	476	178	151	-----	-----	-----	-----	491	627	1,118
4.Engineering Services	740	118	198	19	475	113	502	113	185	37	2,100	400	2,500
5.Land Acquisition	-----	-----	0	3	-----	-----	-----	-----	-----	-----	0	3	3
6.Administration Cost	0	89	0	89	0	89	0	89	0	88	0	444	444
7.Physical Contingency (10% of Total of 1. to 6.)	74	21	51	59	222	273	310	324	94	98	751	775	1,526
Sub-total of 1. to 7.	(814)	(228)	(562)	(646)	(2,443)	(3,006)	(3,400)	(3,563)	(1,037)	(1,077)	(8,256)	(8,520)	(16,776)
8.Price Contingency (6% for F/C and L/C)	101	28	107	123	643	791	1,149	1,204	435	451	2,435	2,597	5,032
Total	915	256	669	769	3,086	3,797	4,549	4,767	1,472	1,528	10,691	11,117	21,808

Table 7-1 SHADOW EXCHANGE RATE (SER) ESTIMATED ON THE BASIS OF AMOUNTS AND DUTIES OF IMPORT AND EXPORT, 1976-1980

Unit: Million Quetzales

Item	Year				
	1976	1977	1978	1979	1980
Import(CIF)					
Amount(I)	838.4	1,052.5	1,260.7	1,449.4	1,559.1
Duty(di)	48.5	77.1	82.5	83.3	81.5
I + di	886.9	1,129.6	1,343.2	1,532.7	1,640.6
Export(FOB)					
Amount(E)	760.3	1,160.2	1,111.6	1,217.1	1,472.8
Duty(de)	49.1	151.6	158.4	129.2	146.9
E - de	711.2	1,008.6	953.2	1,087.9	1,325.9
I + E	1,598.7	2,212.7	2,372.3	2,666.5	3,031.9
I+di+E-de	1,598.1	2,138.2	2,296.4	2,620.6	2,966.5
SER	1.00	0.97	0.97	0.98	0.98

Note: SER = I+E/I+di+E-de

Table 7-2 UNIT YIELD AND UNIT PRICE OF AGRICULTURAL CROPS IN THE DEPARTMENT OF ESCUINTLA IN 1984

Crops	Unit Yield (kg/ha)	Unit Price (Q/kg)
Sugar	8,000	0.350
Pasture (Q/ha) /1	225	
Maize	850	0.240
Cotton	1,700	1.200
Banana	60,000	0.200
Orchard /2	60,000	0.200
Coffee	550	3.200
Upland crops /3	25,000	0.300

/1 : estimated on the basis of the production of beef and milk

/2 : orange and other tree fruits

/3 : vegetables, beans, etc., except sugar cane and maize

Table 7-3 DAMAGE RATE OF ASSETS SUBMERGED

(a) Excluding Sediment Accumulation of Earth and Sand

Assets	Inundation Depth (m)							
	0.01 to 0.25	0.25 to 0.49	0.50 to 0.74	0.75 to 0.99	1.00 to 1.24	1.25 to 1.49	1.50 to 1.99	2.00 to 2.99
1. General Assets								
House	0.078	0.151	0.192	0.26	0.258	0.292	0.341	0.439
Household Effects	0.050	0.115	0.167	0.215	0.262	0.307	0.373	0.499
2. Agricultural Crop								
Sugar Cane	0.05	0.60	0.70	0.75	0.80	0.85	0.90	1.00
Pasture	0.35	0.50	0.60	0.65	0.70	0.75	0.80	0.90
Maize	0.45	0.60	0.70	0.75	0.80	0.85	0.90	1.00
Cotton	0.40	0.60	0.70	0.80	0.90	1.00	1.00	1.00
Banana	0.10	0.25	0.40	0.50	0.60	0.70	0.80	1.00
Orchard /1	0.05	0.10	0.15	0.20	0.25	0.30	0.40	0.50
Coffee	0.20	0.40	0.50	0.60	0.70	0.80	1.00	1.00
Upland Crops /2	0.55	0.70	0.80	0.85	0.90	0.95	1.00	1.00

(b) Including Sediment Accumulation of Earth and Sand

Assets	Inundation Depth (m)							
	0.01 to 0.25	0.25 to 0.49	0.50 to 0.74	0.75 to 0.99	1.00 to 1.24	1.25 to 1.49	1.50 to 1.99	2.00 to 2.99
1. General Assets								
House	0.117	0.227	0.288	0.339	0.387	0.438	0.512	0.659
Household Effects	0.075	0.173	0.250	0.322	0.393	0.460	0.560	0.749
2. Agricultural Crops								
Sugar Cane	0.65	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Pasture	0.50	0.75	0.90	1.00	1.00	1.00	1.00	1.00
Maize	0.65	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Cotton	0.60	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Banana	0.15	0.40	0.60	0.75	0.90	1.00	1.00	1.00
Orchard /1	0.10	0.15	0.25	0.30	0.40	0.45	0.60	0.75
Coffee	0.30	0.60	0.75	0.90	1.00	1.00	1.00	1.00
Upland Crops /2	0.80	1.00	1.00	1.00	1.00	1.00	1.00	1.00

/1 : orange and other tree fruits
/2 : vegetables, beans, etc., except sugar cane and maize

Table 7-4 ANNUAL FLOW OF ECONOMIC COST AND BENEFIT AND ECONOMIC INTERNAL RATE OF RETURN FOR PROPOSED LONG-TERM PLAN

Unit: US$10^3

Year	Economic Cost		Economic Benefit
	Construction Cost	OMR Cost /1	
1	1,683		
2	1,139		
3	3,608		
4	9,252	100	696
5	11,326	200	1,391
6	10,349	300	2,087
7	9,276	400	2,782
8		500	3,478
9		500	3,478
10		500	3,478
'		'	'
'		'	'
'		'	'
'		'	'
'		'	'
'		'	'
37		500	3,478
Total	46,633	16,000	111,296

EIRR = 5.1%

/1 : Operation, maintenance and replacement cost

Table 7-5 ANNUAL FLOW OF ECONOMIC COST AND BENEFIT AND ECONOMIC INTERNAL RATE OF RETURN FOR PROPOSED URGENT PLAN

Unit: US$10^3

Year	Economic Cost		Economic Benefit
	Construction Cost	OMR Cost /1	
1986	1,003		
1987	830		
1988	3,812	52	293
1989	6,830	104	586
1990	2,175	208	1,172
1991		260	1,465
1992		260	1,465
1993		260	1,465
'		'	'
'		'	'
'		'	'
'		'	'
'		'	'
'		'	'
'		'	'
'		'	'
2020		260	1,465
Total	14,650	8,164	46,001

EIRR = 7.3%

/1 : Operation, maintenance and replacement cost

Table 7-6 ANNUAL FLOW OF ECONOMIC COST AND BENEFIT AND ECONOMIC INTERNAL RATE OF RETURN FOR ALTERNATIVE URGENT PLAN

Unit: US$10^3

Year	Economic Cost		Economic Benefit
	Construction Cost	OMR Cost /1	
1986	1,009		
1987	1,114		
1988	5,012	108	293
1989	6,445	216	586
1990	1,957	432	1,172
1991		540	1,465
1992		540	1,465
1993		540	1,465
'		'	'
'		'	'
'		'	'
'		'	'
'		'	'
'		'	'
'		'	'
'		'	'
2020		540	1,465
Total	15,537	16,956	46,001

EIRR = 4.4%

/1 : Operation, maintenance and replacement cost

Table 8-1 BUDGET OF GOVERNMENTAL AGENCIES IN GUATEMALA

Unit: $x10^3$ Quezales

Governmental Agencies	1981 Budget	%	1982 Budget	%	1983 Budget	%
Judicial	8,246	0.6	8,291	0.6	8,291	0.6
Office of the President	155,148	10.6	131,919	8.8	82,789	7.1
Foreign Affairs	9,820	0.7	10,518	0.7	10,312	0.7
Interior	42,998	2.9	47,058	3.2	49,261	3.7
National Defense	78,981	5.4	86,727	5.9	142,524	0.8
Public Finance	393,101	26.7	403,612	27.2	362,411	27.6
Education	156,213	10.7	156,735	10.6	162,884	12.4
Public Health and Social Assistance	120,784	8.2	139,450	9.4	101,037	7.7
Labor and Social Security	4,457	0.3	3,373	0.2	3,301	0.3
Economics	9,301	0.6	11,676	0.8	5,205	0.4
Agriculture	71,896	4.9	72,031	4.9	77,305	5.9
Communication and Public Works	409,853	28.0	405,026	27.3	294,334	22.4
Public	1,136	0.1	1,303	0.1	944	0.1
Accounting Office	3,765	0.3	3,712	0.3	3,655	0.3
T o t a l	1,465,699	100	1,481,431	100	1,304,253	100

Note: The Ministry of Energy and Mines was established in 1983, and its budget was included in that for the Office of the President.

Source: Presupuesto de Ingresos y Egresos del Estado. Dec. 1982, Fiscal 1983, Ministerio de Finanzas Publicas

Table 8-2 DISTRIBUTION OF BUDGET BY SECTOR IN GUATEMALA

Fiscal Year: 1983
Unit: $x10^3$ Quetzals

Sector	Budget	%
General Administration and Services	57,452	4.4
Defense and Internal Security	128,590	9.8
Finance	259,216	19.7
Urban Housing Development	14,493	1.1
Mineral and Hydrocarbon	5,010	0.4
Agriculture	68,138	5.2
Industry and Commercial	11,083	0.8
Tourism	2,651	0.2
Transportation	141,468	10.8
Communication	8,623	0.7
Energy	132,042	10.0
Health and Social Assistance	105,084	8.0
Labor and Social Security	220,893	16.8
Science and Cultural Education	159,510	12.1
T o t a l	1,314,253	100.0

Source : Presupuesto de Ingresos y Egresos del Estado. Dec. 1982
Fiscal 1983, Ministerio de Finanzas Publicas

Table 8-3 (1/3) ACTIVITIES OF WATER MANAGEMENT AGENCIES IN GUATEMALA

Ministry	Agency	Activities for Water Management
Communication, Transportation and Public Works	General Direction of Roads (CAMINOS)	- Flood prevention and restoration works of roads and road bridges - Dredging of Chiquimulilla Canal maintain normal navigation - Surveying works of the river channel in the vicinity of road bridges
	General Direction of Public Works (DGOP)	- Planning and design of water supply system for urban areas - Planning and design of sewege system for urban areas
	National Institute of Seismology, Volcanology, Meteorology and Hydrology (INSIVUMEH)	- Hydrological study - Observation of rainfall and water stage - Operation and maintenance of its facilities
	National Project of XAYA-PIXCAYA (XAYA-PIXCAYA)	- Design and construction of service water supply system for the Municipality of Guatemala which takes in water from Xaya and Pixcaya rivers
	National Institute of Electricity (INDE)	- Design, construction, operation maintenance and management of hydro-power generation facilities - Observation of rainfall and water stage related to hydro-power generation

Table 8-3 (2/3) ACTIVITIES OF WATER MANAGEMENT AGENCIES IN GUATEMALA

Ministry	Agency	Activities for Water Management
Communication, Transportation and Public Works	National Railway of Guatemala (FEGUA)	- Flood prevention and restoration works for railway and its bridges - Surveying works of the river channel in the vicinity of railway bridges - Observation of rainfall related to railway operation
Agriculture, Livestock and Nutrition	General Direction of Agricultural Services (DIGESA)	- Design, construction, operation and maintenance of irrigation and drainage facilities - Flood prevention and restoration works of these facilities
	National Institute of Forest (INAFOR)	- Conservation and fostering of national forest in the river basin - Environmental conservation and maintenance of ecological balance in the river basin
National Defense	Military Geographic Institute (IGM)	- Topographical survey and mapping - Geological survey - Lnad use survey
	National Emergency Committee (CONE)	- Research on areas vulnerable to disasters - Warning against disaters and direction of evacuation - Rescue activities for victims

Table 8-3 (3/3) ACTIVITIES OF WATER MANAGEMENT AGEMCOES IN GUATEMALA

Ministry	Agency	Activities for Water Management
Public Health and Social Assistance	Executor Unit of Rural Aqueduct Program (UNEPAR)	- Design and construction of the supply facilities for villages with a population of about 500 or more
	General Direction of Health Services (DGSS)	- Design and construction of water supply facilities for communities with a population of about 500 or less - Analysis and conservation of quality of service water, river and lake water
Interior	National Institute of Municipal Development (INFOM)	- Design and construction of water supply facilities and sewege facilities in the central areas of Municipalities (except Guatemala and Mixco)
(Guatemala Municipality)	Municipal Water Enterprise (EMPAGUA)	- Construction of water supply and sewage facilities designated by DGOP in Guatemala Municipality (except the XAYA-PIXCAYA project area) - Operation and maintenance for all the water supply and sewage facilities constructed in Guatemala Municipality - Observation of water levels

Table 8-4 PRINCIPAL LAWS CONCERNING WATER MANAGEMENT IN GUATEMALA

Name of the Law	Year of Enactment
Regulation for Registry, Matriculation and Inscription of Vessels, Ships and Craft	1932
Organic Law of INFOM	1957
Municipal Code	1957
Law on Foundation of INDE	1959
Law of Agrarian Transformation	1962
Civil Code	1963
Regulation for the Rural Operation System of Domestic Water	1967
General Regulations of CONE	1969
Water Conduction Act	1972
Regulation of Irrigation	1972
National Harbor Commission	1972
Organic Law of INAFOR	1974
Forestry Law	1974
Regulation of INSIVUMEH	1974
Code of Health	1979
Regulation of the Ministry of Agriculture Livestock and Nutrition	1982

Table 8-5 (1/2) CONTENTS OF WATER MANAGEMENT BY MINISTRIES IN JAPAN

Ministry	Functions and Responsibilities
MINISTRY OF CONSTRUCTION	- Formulation of Riparian Projects - Water control activities including flood control, riparian restoration works, etc. - Adjustment and approval of water utilization programs - Formulation and implementation of water resources development - Observation of water-level, discharge and precipitation - Conservation of water quality - Prevention of damages due to debris and sharply sloped terrain
PRIME MINISTER'S OFFICE Subordinate Agencies: - Hokkaido Development Agency - Environmental Agency - Okinawa Development Agency - National Land Agency	- Investigation and formulation of development plans palns in Hokkaido and Okinawa - Formulation of policies and long-term plans for water resources development as well as disaster prevention - Conservation of water quality and wild life - Ecological preservation
MINISTRY OF HEALTH AND WELFARE	- Assurance of purity of water supplied through water works - Conservation of water quality

Table 8-5 (2/2) CONTENTS OF WATER MANAGEMENT BY MINISTRIES IN JAPAN

Ministry	Functions and Responsibilities
MINISTRY OF AGRICULTURE, FORESTRY AND FISHERY	- Development and use of irrigation water
Subordinate Agencies: - Food Agency - Forestry Agency - Fishery Agency	- Flood control in minor river basins - Development of fisheries
MINISTRY OF INTERNATIONAL TRADE AND INDUSTRY	- Hydro-electric power - Assurance of industrial water
Subordinate Agency: - Agency of Natural Reserches and Energy	- Regulation of drainage water (water quality conservation)
MINISTRY OF TRANSPORT	- Observation of rainfall and weather forecasting
Subordinate Agency: - Meterological Agency	- Announcement of flood warnings

Table 8-6 (1/2) CONTENTS OF RIVER ADMINISTRATION BY DIFFERENT DIVISIONS OF THE RIVER BUREAU OF THE MINISTRY OF CONSTRUCTION

Division	Functions and Responsibilities
General Affairs	- Coordination within the River Bureau
Water Administration	- Drafting of laws and ordinances in connection with river administration - Issurance of water use permits - Administrative supervision of river and seacoasts
Planning	- Comprehensive planning for river and seacoast projects - Coordination of water resources development projects - Water quality and environmental problems - International affairs
River Improvement	- Investigation into planning, implementation of construction and maintenance as well as management of river channels
Urban Rivers	- Investigation into planning and implementation of construction as well as management of urban rivers
Development	- Investigation into planning, construction and management of multipurpose dams - Enforcement of the Water Resources Development Public Corporation Act - Technical judgements regarding permission of water usage - Structural regulations for dams - Water resources development and natural environmental conservation

Table 8-6 (2/2) CONTENTS OF RIVER ADMINISTRATION BY DIFFERENT DIVISIONS OF THE RIVER BUREAU OF THE MINISTRY OF CONSTRUCTION

Division	Functions and Responsibilities
Seacoast	- Investigation into planning and execution of coastal conservation projects - Improrvement and maintenance of seacoast
Disaster Prevension	- Estimation of expenditure on natural disaster rehabilitation projects for public utility facilities - Natural disaster prevention planning, natural disaster precautions, natural disaster emergency countermeasures and natural disaster rehabilitation
Sabo	- Coordination in the Sabo Department - Investigation into planning and implementation as well as direction and supervesion of the Sabo works - Maintenance and management of Sabo facilities
Slope Conservation	- Investigation into planning and implementation for landslide prevention works, coal slagheap collapse prevention works - Maintenance of facilities mentioned above

Table 8-7 (1/2) MAJOR FEDERAL AGENCIES AND THEIR RESPONSIBILITIES FOR WATER MANAGEMENT IN THE UNITED STATES OF AMERICA

Agency	Major Responsibilities
U.S. Water Resources Council	- Coordination/administration river planning
	- Grants to states for planning
	- Coordination river basin commissions
U.S. Department of Defense	
Corps of Engineers	- Navigation
	- Hydroelectric power generation
	- Municipal/industrial water supply
	- Water quality
	- Recreation
U.S. Department of the Interior	
Bureau of Reclamation	- Hydroelectric power generation
	- Municipal and industrial water supply
	- Irrigation
	- Floodplain management/navigation
	- Water quality
	- Recreation
Geological Survey	- Floodplain management
	- Water quality and quantity records
Heritage, Conservation and Recreation Service	- Preservation of cultural and historical values
Fish and Wildlife Service	- Fish and wildlife habitant values

Table 8-7 (2/2) MAJOR FEDERAL AGENCIES AND THEIR RESPONSIBILITIES FOR WATER MANAGEMENT IN THE UNITED STATES OF AMERICA

Agency	Major Responsibilities
U.S. Water Resources Council	- Coordination/administration river
U.S. Department of Agriculture	
Soil Conservation Service	- Floodplain management
	- Irrigation
	- Water quality
	- Recreation
U.S. Department of Energy	- Hydroelectric power generation
U.S. Depatment Protection Agency	- Water quality
	- Foodplain management
	- Financing/budgeting (grants)
Tennessee Valley Authority	- Navigation
	- Hydroelectric power generation
	- Municipal and industrial water supply
	- Floodplain management
	- Water quality
	- Recreation

Table 8-8 (1/2) CONTENTS OF WATER MANAGEMENT BY AGENCIES IN THE UNITED KINGDOM

Agency	Functions and Responsibilities
Department of the Environment Water Authority	- Overall responsibility of water administration in England and Wales - Water administration in connection with land use plan; improvement of urban environments; conservation of non-urban areas; recreational use of waters; water pollution control; urban housing plan; construction of new towns - City water-works - Conservation of water sources - River-water pollution control - Recreational use of waters
Ministry of Agriculture, Fisheries and Food Water Authority	- Fisheries promotion and control - Inland water elimination - Drainage works from inland and coastal areas and responsibility on water related to fisheries in England and Wales
National Water Counsil	- Negotiation on working conditions of fishery workers - Labor information services on behalf of water agencies and waterworks companies - Education and training of the fishery workers - Technical assistance to water agencies - Inspection and test of waterworks fittings

Table 8-8 (2/2) CONTENTS OF WATER MANAGEMENT BY AGENCIES IN THE UNITED KINGDOM

Agency	Functions and Responsibilities
Water Space Amenity Commission	- Maintenance of water space amenities and agreeable environments in England - Combination of national water space and recreational activities
Water Data Unit	- Information-exchange among various water agencies and the Central Government
Water Research Center	- Research on water pollution along rivers, on the seacoast and estuaries - Research on sewarage water disposal and waste disposal - Studies on water resources, city water treatment, city water and sewarage conveyance, and health-related water quality problems - Technical assistance on the field

Table 8-9 MAJOR ACTS RELATED TO WATER MANAGEMENT IN JAPAN

Name of the Law	Year of Enactment/Revision
River Law	1894, 1964
Sabo Act	1897
Flood Fighting Association Act	1908
Act on Reclamation of Public Water Surface Area	1921
Flood Fighting Act	1948
Act on Financial Aid for Relief Projects of Public Utilities	1951
Seacoast Act	1956
Specified Multipurpose Dam Act	1957
Sewerage Act	1958
Landslide Prevention Act	1958
Basic Act on Counter Measures Against Natural Disasters	1961
Act on Anti-erosion and Anti-flood Special Measures	1960
Flood Control Special Accounting Act	1960
Water Resources Development Promotion Act	1961
Water Resources Development Public Corporation Act	1961
Act on Financial Aid for Relief from Severe Natural Disasters	1961
Act on Disasters Prevention due to Collapse of Steep Slope Land	1969
Basic Act for Environment Pollution Control	1970
Water Pollution Control Act	1970
Act on Special Measures for the Reservoir Area Development	1973

Table 8-10 MAJOR ACTS RELATED TO WATER MANAGEMENT IN THE UNITED STATES OF AMERICA

Name of the Law	Year of Enactment/Revision
River and Harbor Act	1899
Reclamation Act	1902
Flood Control At	1917, 1928, 1936, 1955, 1960
Tennessee Valley Authority Act	1933
Soil Conservation Act	1936
Reclamation Project Act	1939
Watershed Protection and Flood Prevention Act	1954
Water Resources Planning Act	1965
National Flood Insurance Act	1968
National Environmental Policy Act	1970
Federal Water Pollution Control Act	1972
Disaster Relief Act	1972
Flood Disaster Prevention Act	1973
Water Resources Development Act	1974
Clean Water Act	1977

Table 8-11 MAJOR ACTS RELATED TO WATER MANAGEMENT IN THE UNITED KINGDOM

Name of the Law	Year of Enactment/Revision
Water Works Clauses Act	1847, 1863
Public Health Act	1875, 1936
Water Act	1945, 1973
River Pollution Prevention Act	1876, 1951
Land Drainage Act	1930, 1961
River Board Act	1963
Control of Pollution Act	1974