

MEDELLIN RIVER SANITATION PROJECT - FIRST PHASE

(CO-0082)

EXECUTIVE SUMMARY

BORROWER: Empresas Públicas de Medellín (EPM)

GUARANTOR: Republic of Colombia

EXECUTING AGENCY: Empresas Públicas de Medellín

AMOUNT AND SOURCE:	IDB:	US\$130,000,000 (OC)
	Local counterpart funding:	<u>US\$102,000,000</u>
	Total:	US\$232,000,000

TERMS AND	Amortization period:	25 years
CONDITIONS:	Disbursement period:	5 years
	Interest rate:	variable
	Inspection and supervision:	1%
	Credit fee:	0.75%

OBJECTIVES: The overall objective of the project is to improve the quality of life, health and environmental conditions for the population of 2.5 million in the Aburrá valley. The specific objectives include: (a) the partial decontamination of the Medellín River and the mountain streams that feed into it; (b) the treatment of a portion of the wastewater generated in the valley through the construction of the San Fernando wastewater treatment plant, the first of four plants contemplated in the region's master plan for sewage treatment; (c) the extension and improvement of potable water and sewage services; (d) the optimization of potable water distribution, bringing the unaccounted-for water level down from 38% current to 30% by 1999; (e) the preparation of the designs for the second stage of the master plan to improve sanitary conditions in the region; as well as (f) institutional strengthening of the water supply and sewerage enterprise of EPM.

DESCRIPTION: To accomplish these objectives a set of integrated activities has been designed. The investments are divided into two categories: (a) specific projects (wastewater treatment plant and intercepting sewer mains); and (b) multiple works (all the other works contemplated). To accomplish the objectives described in the above paragraph, the following activities will be executed: (a) construction of a

secondary wastewater treatment plant, with an initial capacity of 2 m³/second; (b) construction of 102 km of collectors parallel to the ravines whose streams empty into the Medellín River and 29 km of intercepting sewer mains along the Medellín River; (c) construction of 71 km of sewers for effluent control; (d) construction of 2,500 storm drains and 250 overflow channels; (e) 11,250 residential potable water and sewer connections, 14,750 residential or service connections, and construction of 66 km of sewers and 82 km of potable water systems; (f) acquisition and installation of 156,000 potable water meters, spare parts for 150,000 water meters, and equipment to control water pressure; (g) construction of four storage tanks; (h) acquisition of 69,000 covers for potable water meter boxes and 400 km of copper tubing; (i) realignment of nine water supply system service areas; (j) maintenance works at the Piedras Blancas dam; (k) construction of potable water distribution systems; (l) acquisition of operating and maintenance equipment; (m) replacement of 103 km of potable water distribution lines; (n) construction of three operations and maintenance centers; (o) institution-strengthening program; and (p) additional activities related to the preparation of designs for the second phase of the wastewater treatment master plan (1999-2004). The above figures are understood to be approximate within the requirements of the system's overall operations.

**ENVIRONMENTAL
CLASSIFICATION:**

The Environmental Management Committee, at its meeting of April 20, 1993, classified this as a Category III operation. The Environmental Summary was approved on August 10, 1993.

BENEFITS:

The benefits of the project consist of improvement in the environmental conditions and quality of life for a large proportion of the population of the Aburrá valley, particularly low-income residents who live along the sides of ravines which serve as dumps for untreated sewage, on the banks of the highly polluted Medellín River, and in the upper extremes of the valley where water and sewerage services are currently unavailable. Based on the proximity of their residences to works contemplated, it is estimated that the project will have approximately one million direct beneficiaries. The extension of the system of collectors and intercepting sewer mains will decrease exposure of the population to wastewater and its related diseases. The wastewater treatment plant will treat approximately 23% of the total discharges in the region. The program to diminish the level of unaccounted-for water should

result in a reduction in the use of potable water and conserve a scarce resource.

RISKS:

This project is only the first phase of a medium-term effort whose goal is to eventually treat approximately 90% of the wastewater discharged into the bodies of water of the valley. Though the project will result in an improvement in the Medellín River's water quality, the river's uses will continue to be extremely limited until at least the execution of the second phase of the master plan for sewage which involves the construction of a 8 m³/s treatment plant in the municipality of Bello. Based on the firm commitment to the project of EPM and the municipal governments as well as the national government, the likelihood is limited that the decontamination of the region will become a lesser priority in the coming years. The financial projections for EPM indicate that it will generate adequate resources for the local counterpart related to this operation as well as to finance a significant portion of the future investments related to the construction of the second wastewater treatment plant foreseen in the period 1999 to 2004. EPM's experience in the operation of wastewater plants is limited to the model El Retiro plant. In order to compensate, EPM will secure training for employees as well as the technical assistance of consultants and vendors. The completion of the final designs of the specific projects component requires additional work, but it is not expected that this will cause project execution delays. The preliminary budgets for these items were closely reviewed during the analysis mission, and the project team is comfortable with the figures presented. Should the costs rise, there exist contingencies in the budget as well as a strong cash generation capacity on the part of EPM.

**EXCEPTIONS TO
BANK POLICY:**

Exceptions to Bank policy that are recommended by the project team include: (a) initiation of works related to four bids as late as the second semester of the fourth year of execution; and (b) assembly of certain equipment by specialized EPM personnel (force account) for a cost of up to US\$2.6 million.

**THE BANK'S
COUNTRY AND
SECTOR STRATEGY:**

The project is consistent with the objectives of the Seventh Replenishment of the Bank's resources, wherein priority is given to projects which preserve and improve the environment by means of basic sanitation measures. The project is also consistent with the overall strategy agreed upon by the Bank and Colombia, which specifies among the priorities for 1993 to 1995, protection of the environment and

management of natural resources and increased support for social sector programs.

The Bank has financed six successive phases of programs to improve and expand the potable water and sewerage services of EPM, with loans totaling US\$282.3 million. The first credit was authorized in 1961, and the most recent was approved in 1984, completing execution in mid 1993. The operations financed have been executed in a satisfactory manner, meeting stated objectives in all cases, though usually completing execution beyond the estimated period.

I. FRAME OF REFERENCE

A. Sectoral strategy of the Government of Colombia

- 1.1 Despite heavy government investment over the past several years, water and sewerage service coverage in Colombia does not meet international standards for its per capita income level. Estimates for 1991 showed nearly 11 million people in Colombia without home water service and 16 million without sewerage hookups. Only 52% of the country's operational potable water supply systems included some type of treatment facility.
- 1.2 As a rule, institutional management and pricing policy within this sector are somewhat disorganized, and Empresas Públicas de Medellín [Medellín Public Utilities] (EPM) is no exception in this regard. Moreover, the nationwide loss factor is nearly 50% as a result of poor maintenance and inadequate resource management.
- 1.3 Service levels and quality vary from one municipality to another. Water service coverage in the country's three largest cities (Bogota, Medellín and Cali) is about 94%, with adequate water quality and with 87% of the population connected to a sewerage system. Conditions in rural areas are not nearly so good, with only 24% of the population having access to potable water and only 8% to a sewerage system.
- 1.4 In 1991 the government approved a sector adjustment plan for 1991-1994 in response to these problems and to the difficulties faced by many municipalities in attempting to expand their water supply and sewerage systems in search of acceptable sanitation conditions. The plan included the following objectives: 1/
 - a. restructure institutions sector-wide, decentralizing their management at the municipal level;
 - b. improve nationwide potable water and sewerage service coverage from 66% to 76% and from 51% to 57% respectively to make new potable water services available to roughly six million inhabitants and provide sewerage service to four million inhabitants;
 - c. improve water quality to ensure that all water supplied to the public by water supply systems is safe; and
 - d. design and implement projects as part of a strategic sewage treatment plan for large cities.

1/ CONPES, DNP-2532-UDU, Potable water and basic sanitation, Sector adjustment plan (SAP), Phase II, 1991-1994.

- 1.5 The government estimated that execution of this plan would require approximately US\$976 million, including US\$854 million in investments in potable water and environmental sanitation projects for large cities and seats of municipal government to expand water and sewerage service coverage from 87% to 92% and from 72% to 76% respectively, and US\$122 million earmarked for rural areas to improve water and sewerage service coverage from 24% to 40% and from 8% to 16% respectively.
- 1.6 A number of adjustment, restructuring, institution-building and institution-strengthening efforts for municipal utilities have been successfully launched with the support of the sector adjustment plan. Most program initiatives proposed are expected to be financed by late 1994 with national and municipal government funds and foreign borrowing.
- 1.7 The Bank is using integrated rural development (loan 608/OC-CO) and land development (loan 715/OC-CO) program resources to bolster government efforts in pursuit of the aforesaid three first objectives. The Pacific coast sustainable development program (CO-0059) currently in the preparation phase will finance projects in various social sectors, including sanitation works in one of the regions of the country where potable water and sewerage service coverage is poorest.
- 1.8 Having attained the three first objectives in the Aburrá valley, the project proposed in this document focuses on the plan's fourth objective and, as such, would represent one of the country's first large-scale efforts to clean up a river cutting through one of its major cities.

B. Description of the project area

- 1.9 The Aburrá valley, with a population of 2.5 million, is formed by 10 municipalities, the most prominent being the city of Medellín, Colombia's second largest. The other municipalities that make up the area include: Girardota, Copacabana, La Estrella, Bello, Envigado, and Itagüí, all of which are served by the Empresas Públicas de Medellín (EPM), and Barbosa and Caldas, which are located at the northern and southernmost points of the valley and remain outside of the service area. The valley is situated within the country's central mountain range (the "cordillera central") and has a land area of 1,165 km². Level area within the valley is extremely limited and costly, which has resulted in a large proportion of the population residing along the sides of the ravines and the banks of the Medellín River.
- 1.10 The Medellín River cuts through the center of the Aburrá valley and is traversed twice daily by a large proportion of the population. Efforts undertaken to decontaminate the river have received support among the residents who recognize that contamination of the

Medellín River is one of the most serious environmental problems facing the region.

- 1.11 The 200 ravines in the valley collect all of the rain water and much of the residential and industrial wastewater. As EPM has constructed water and sewer services, the highest quality of any city in Colombia, the company has depended upon the ravines to collect the wastewater and to transport it to the river; this has resulted in the ravines and river functioning in part as open sewers. Over the years, investments have been made to construct collection systems parallel to the ravines and river which have improved the sanitary conditions, but little or no treatment is performed on the wastewater prior to its discharge into the Medellín River.

C. Contamination problem

- 1.12 The rapid increase in the population and the level of industrialization of the Aburrá valley, which contains Colombia's second largest industrial park, and the lack of infrastructure to treat the volume of wastes transported through the sewer system have resulted in serious contamination problems creating health and environmental hazards for the local population. The deteriorated condition of the ravines and river directly affects those who live nearby, predominantly the poorest segments of the population, and indirectly affects practically all residents of the region, particularly during the summer months when wastewater makes up a large portion of the total water in the river. The high degree of contamination creates an environment which promotes proliferation of mosquitos and rodents, as well as unpleasant odors. Health risks are exacerbated when the ravines and river are utilized as recreation areas and there is contact with coliforms and chemicals in the highly polluted waters (see photos in Annex I-1).
- 1.13 Additional effects of the contamination in the valley are felt further downstream where the severely polluted waters cannot be used for irrigation. The high levels of contamination also complicate the generation of hydroelectric energy, due to eutrophication of the reservoir waters.
- 1.14 Detailed information on the level of contamination of the Medellín River has been compiled since the early seventies, and includes quantification of such indicators as biochemical demand for oxygen (BDO), suspended solids (SS), nitrogen (N), and phosphorus (P). These indicators demonstrate the extremely high level of contamination and a notable deterioration of the river during the past 20 years. Measurements of BDO have doubled in certain segments of the river, reaching levels ranging from 60 mg/l to over 100 mg/l; a healthy level of BDO to sustain marine life would be 5 mg/l. Dissolved oxygen has also deteriorated over the past two decades dropping to levels as low as 0.5 mg/l. The acceptable level to sustain marine life would be 6 mg/l, while 4 mg/l would be considered

reasonable for industrial processes, recreation, and non-potable purposes (see graphs in Annexes I-2 and I-3).

- 1.15 Efforts to control contamination have focused primarily on elimination of direct dumping of garbage and wastewater into the ravines through the construction of collectors and working with industries to assure that their discharges meet standards in order not to damage the sewer system.
- 1.16 In 1990, the average discharge of sewage into the Medellín River was 8.77 m³/second. This included 228,000 kg/day of suspended solids and 224,000 kg/day of BDO. The 4,300 industries of the Aburrá valley are responsible for approximately 25% of sewage generation.

D. Problem of unaccounted-for water

- 1.17 EPM has historically suffered a high rate of unaccounted-for water. A part of the explanation for this is related to the topography of the Aburrá valley in which water is transported both by gravity as well as by pumps up one side of the mountain, down into the valley, and up the other mountain. In 1979, with unaccounted-for water at 42% of total production, EPM initiated a program which included: replacement of 308 km of asbestos/cement pipes with ductile iron pipes, reordering of regulatory valves to better control water pressure, replacement of water meters, use of domestic connections made of copper, installation of more accurate meters at the production stage, and computerization of the overall monitoring system permitting a constant two-way flow of information between the control and distribution centers.
- 1.18 The effort to reduce water losses is complicated by the demand to expand services to residences located higher up the mountains. The extension of services to these new users frequently requires pumps and the installation of additional distribution systems which may expand the possibility of losses. Presently there are 70 distribution tanks in use and 11 new ones are scheduled for construction prior to the end of the decade. These tanks are strategically placed throughout the valley at an altitude variance of 551 m.
- 1.19 As a result of measures taken since 1979, unaccounted-for water has declined from 42% of production in 1979 to 38% in 1992. During the same period production increased by 42% to 281 million m³/p.a. EPM relates unaccounted-for water to the following: errors in water meters of users (13.6%), errors in production meters (2%), fraudulent connections (5.5%), leaks (15.3%), and various others (1.6%).

E. Sanitary infrastructure in the Aburrá valley

1. Water supply

- 1.20 EPM is presently responsible for all aspects of water supply for seven of the ten municipalities of the Aburrá valley. Services will be extended to Girardota during the coming years, leaving only Barbosa and Caldas, with services provided by the Asociación Antioqueña de Acueducto y Alcantarillado [Antioquia Water and Sewerage Service] (ACUAANTIOQUIA). Potable water is provided through a sophisticated, integrated system. The newest treatment plant, Manantiales, financed as a component of the Bank's loan 499/OC-CO, is a state-of-the-art, fully computerized plant, treating water from the Rio Grande II reservoir.
- 1.21 EPM has 442,000 potable water connections, representing 98% of the potential users in its service area, of which 98.3% have water meters. The population that benefits from EPM's water services totals 2.2 million. Annual increases in connections have ranged from 3.5 to 11% per annum since 1979, resulting in a total increase in users of 127%.
- 1.22 In 1979, EPM initiated a program to legalize provisional or fraudulent water connections generally found in low-income sectors of the valley. The program allows beneficiaries a reasonable period in which to pay for the hook-up and has resulted in 94,000 new connections since its inception.

2. Sewerage connections and treatment

- 1.23 EPM total sewerage connections at the end of 1992 were 426,000, covering a population of approximately 2.1 million, or 94% of the potential users in the service area.
- 1.24 The investments necessary for a comprehensive sewage treatment system have been undertaken gradually during the past 30 years, and the region and EPM are entering the final phase which involves the construction of large capacity wastewater treatment plants. EPM's focus to date has been to provide for efficient collection of wastewater through the construction of a sewer system network, which includes collectors parallel to the ravines and intercepting sewer mains along the banks of the river. Until all of the proposed wastewater treatment plants become operational, which is projected to occur in the period 1999-2020, untreated sewage will continue to enter the Medellín River from the ravines, collectors, intercepting sewer mains, as well as from direct connections established by users.

F. Control of industrial wastewater discharges

- 1.25 Regulations establishing the minimum national standards for industrial and residential discharges are based on Decree 1,594 of

1984 of the Health Ministry and Resolution 951 of 1989 of the National Planning Department. If an industry does not meet the norms, it can be required to perform pre-treatment of its discharges by the Instituto Nacional de los Recursos Naturales [National Natural Resources Administration] (INDERENA). In areas where autonomous regional corporations, responsible for management of renewable natural resources, have been established by the national government, control of natural resources, including wastewater discharges, has been delegated by INDERENA. In the case of the Aburrá valley, no regional corporation exists and INDERENA has responsibility to monitor industrial discharges. Due to chronic funding problems and an overworked, undermotivated staff, INDERENA does not adequately perform its function. Many companies do not comply with commitments reached with INDERENA to lower contamination (BDO, SS) and enforcement is weak.

- 1.26 The executive has proposed the liquidation of INDERENA and its replacement with a Ministry of the Environment, and in those areas where regional corporations currently do not exist, they would be created. The proposal has been actively debated and in August 1993, the Senate authorized the initiative. It is now before the lower house of the Congress, and action is expected by year-end. In the environmental program (loans 910/SF-CO and 774/OC-CO) approved in September 1993, significant resources are allocated for institutional strengthening of the new ministry as well as the regional corporations which will take the place of INDERENA.
- 1.27 Approximately 4,300 industries are connected to the sewer system, of which EPM has classified 239 as major users due to their level of usage and the degree of contamination of their discharges. To protect the sewer system, EPM requires 102 companies to perform pre-treatment to control pH, temperature, solid wastes, or toxic chemicals or substances. EPM estimates that 46 industrial users will be subject to a special tariff if they do not reduce the level of BDO and SS in their discharges by the time EPM's first major wastewater treatment plant comes on stream. Currently five companies connected to the EPM system do not meet sewer system standards; these companies are adapting their production processes and all are expected to be in compliance by mid-1995.
- 1.28 There are 30 industries in the EPM service area which are not connected to the sewer system and all are taking the necessary actions to become connected. EPM has the authority to require those companies in its service area to connect with its system. The discharges of industrial users not connected to the EPM system as well as the wastewater treatment plant under consideration in this operation are required to meet the national standards mentioned earlier.
- 1.29 A public/private initiative to reduce levels of industrial contamination in the Aburrá valley has been undertaken through the efforts of the Asociación Nacional de Industrias [National Association of

Industrialists] (ANDI), EPM, and various universities. The initial phase involves: (a) improvements in the accuracy of measurements of levels of contamination from industrial effluents; and (b) pilot efforts to bring international experts to Medellín to work with key sectors of the regional economy to improve production processes and reduce levels of contamination. The Bank has offered to support this through technical cooperation resources.

G. Country strategy and experience of the Bank

- 1.30 The proposed project is consistent with the overall strategy of the Bank, which specifies as priorities for 1993 to 1995: (a) the protection of the environment and management of natural resources; (b) support for modernization of the economy; and (c) expanded access to the fruits of economic progress for low-income groups.
- 1.31 At the sector level, the Bank has helped finance numerous potable water and sewerage projects in Colombia, in the form of specific multiple-works projects or as part of integrated urban or rural development programs. The Bank has granted a total of US\$627.2 million in loans to finance projects in this sector.
- 1.32 The Bank has financed six consecutive phases of programs executed by EPM to upgrade and expand potable water and sewerage services, with loans totaling US\$282.3 million. The earliest such loan was granted back in 1961, and execution of its most recent loan, approved in December of 1984, was completed in 1993. All programs conducted to date have been successfully executed.
- 1.33 Río Grande II (499/OC-CO), the last Bank-financed EPM project, had an original budget of US\$611 million, with the following objectives: (a) generation of 322.5 MW at two power plants; (b) potable water production, treatment and distribution; and (c) expansion of sewerage service coverage. The original project budget was increased to US\$670 million and its implementation period was expanded from five to eight and a half years for full achievement of all project goals and objectives. The major causes of the lag in project implementation were: (a) delays in the preparation of bidding conditions and in their approval by the Bank; (b) cancellation of a large pipe contract requiring over two years to complete; (c) processing of 60 calls for bids instead of the 25 originally envisaged; and (d) delays in obtaining the import permit for goods from the Instituto de Comercio Exterior [Foreign Trade Commission] (INCOMEX). Preparations for the present project included agreements on measures to avoid a repetition of the aforementioned problems.

H. Experience of other international institutions

- 1.34 The World Bank (IBRD) is actively involved in the sanitation sector in Colombia. The IBRD has a long history with EPM, with a total of US\$474 million in approved loans, primarily in the power and

telephone communication areas. Its most recent loan was part of a cofinancing arrangement with the IDB for the Río Grande II project (US\$164.5 million) which included a US\$41.4 million water works component. The last disbursement on this loan is scheduled for December 1993.

- 1.35 Other sources of financing for Colombia's sanitation sector include bilateral loan and grant funds furnished by the governments of several countries, including Japan, the United States of America, the Netherlands and Germany, and by the United Nations Development Programme (UNDP).

I. Design of the project

- 1.36 The unfinished state of the sewer system in the Aburrá valley creates environmental and health problems. The project will launch the region on the final phase of a complete sanitation system in which sewage is not only effectively collected but also properly treated before discharge into the river. This phase will be initiated with this project, as the wastewater treatment plant projected herein is only the first of four that EPM estimates will be constructed during the next fifteen to twenty years. The project will also deal with weaknesses in distribution of potable water, which currently result in a level of unaccounted-for water above what would be considered reasonable. The proposed loan also includes resources for the designs and studies related to the second wastewater treatment plant that is projected to be constructed during the period 1999-2004.
- 1.37 The project has been formulated in accordance with the Bank's guidelines and is consistent with its policies and priorities; it will contribute to improvement in the environment and quality of life of the 2.5 million inhabitants of the Aburrá valley, particularly members of low-income groups. The project will serve as a model for other urban centers of Colombia and the region which have equally severe wastewater disposal problems that must be treated in the coming years.

II. THE PROJECT

A. Objectives

- 2.1 The overall project objective is to improve the quality of life and health and environmental conditions for Aburrá valley residents. The project will benefit virtually the entire population of this region and particularly persons: (a) living in proximity to ravines collecting used water and having no covered systems; (b) living along the banks of the Medellín River; and (c) living in the upper reaches of the valley lacking adequate water and sewerage connections. The project will improve the efficiency of EPM operations by significantly reducing the high level of losses in potable water distribution.
- 2.2 The specific project objectives will focus on:
- a. cleaning up parts of the Medellín River and its tributaries;
 - b. treating a portion of the area's wastewater through construction of the San Fernando wastewater treatment plant (WTP), the first of four such plants contemplated by the master sewage treatment plan;
 - c. upgrading and expanding potable water and sanitary sewerage services to urban areas still lacking such services;
 - d. optimizing potable water distribution system operations by using water more efficiently and reducing losses;
 - e. preparing for the next phase of the comprehensive sanitation plan for the Aburrá valley; and
 - f. strengthening the institutional capacity of the EPM's water and sewerage enterprise (AyA).

B. Goals

- 2.3 The goals of project execution are to: (a) intercept and treat approximately 23% of the wastewater generated in the Medellín metropolitan area (MMA) at the San Fernando WTP; (b) collect wastewater currently discharged into various ravines for the cleanup of 67 km of streams running through those ravines; (c) improve water service quality in nine potable water system service areas; and (d) reduce unaccounted-for water from its present level of 38% down to 30% by the end of 1999.

C. Description

- 2.4 A package of actions comprising the first phase of the Medellín River sanitation project has been designed and developed in furtherance of the aforesaid goals and objectives, with two categories of investments: (a) specific works (San Fernando WTP and intercepting sewer mains); and (b) multiple works (all other works).

1. Sanitation (US\$106,370,000)

a. Treatment and interception

- 2.5 This component involves construction of the following facilities:

- a. Treatment plant: construction of a secondary 2 m³/s WTP in the municipality of Itagüí in the upper Medellín River valley (see Annexes II-1 and II-2); and
- b. Intercepting sewer mains: 29 km of intercepting sewer mains consisting of plain and reinforced concrete pipes with diameters ranging from 0.75 to 2.25 m.

b. Sewer system

- 2.6 This component involves construction of the following works (see Annex II-3):

- a. Sewer systems: 71 km of collection systems for effluent control; 66 km of Home Improvement Program (HIP) sewer systems for 11,250 low-income housing units; and 14,750 house connections or service hookups.
- b. Collectors: 102 km of collectors consisting of plain or reinforced concrete pipes with diameters ranging from 0.20 to 1.30 m.
- c. Storm drains and overflow channels: construction of approximately 2,500 storm drains and 250 overflow channels.

2. Water supply (US\$53,040,000)

- 2.7 This component involves procurement of the following equipment and construction of the following works (see Annex II-4):

- a. 156,000 water meters and spare parts for 150,000 meters;
- b. 69,000 cast iron meter covers;
- c. 400 km of copper pipes;

- d. electric equipment and fittings for pumping stations and potable water treatment plants;
- e. four tanks with an aggregate 11,000 m³ capacity;
- f. upgrading of the Piedras Blancas dam to ensure a regular water supply to the Villa Hermosa plant;
- g. upgrading of the 1,700-meter-long concrete channel connecting the Tablaza tank to the Villa Hermosa water treatment plant;
- h. potable water distribution systems for five districts in the municipality of Itagüí;
- i. operating and maintenance equipment;
- j. three operations and maintenance centers in the north, south and Belén districts;
- k. replacement of approximately 103 km of pipes in eight districts of the MMA, including six districts on the west bank and two on the east bank of the Medellín River, and installation of 43 pressure regulating valves;
- l. installation of 82 km of potable water distribution systems and 11,250 house connections under the HIP; and
- m. realignment of nine water supply service areas.

3. Future plan and institutional strengthening (US\$7,410,000)

- 2.8 This component includes the following complementary activities: (a) designs for the next phase of the Medellín River sanitation plan; (b) training; (c) procurement of computer hardware and development of software; and (d) resettlement of displaced families.

a. Future plan

- 2.9 EPM is planning to clean up the Medellín River in three phases, with the present project representing phase one of its sanitation plan. EPM's financial projections for the upcoming five-year period provide for the equivalent of US\$3.1 million to purchase some 50 hectares of land in the municipality of Bello along the banks of the Medellín River between 1995 and 1997 as the site of a second secondary WTP with an aggregate 8 m³/s capacity. An estimated US\$4 million in funding is included for the preparation of studies and designs for this plant to pursue the second phase of the plan.

b. Training

- 2.10 The project includes a training component for mid-level AyA professional and technical staff members with the following elements: (a) advanced courses abroad leading to a master's degree for six professional staff members; (b) courses leading to a master's degree from a Colombian university for 10 professional staff members; (c) medium-term training courses abroad for 21 technical staff members, particularly in the area of WTP operation and maintenance; (d) attendance of seminars and conferences by 35 staff members; and (e) technical training in other IDB member countries for 28 staff members. The estimated cost of the staff training program is US\$495,000.

c. Procurement of computer equipment

- 2.11 AyA is planning to purchase US\$915,000 worth of computer equipment to provide increasingly efficient and higher-quality service, with US\$827,000 earmarked for the procurement of computer hardware and the remainder for software.

d. Resettlement of displaced families

- 2.12 Construction work on the northern intercepting sewer main to conduct wastewater to the site of the future WTP in Bello would require the resettlement of approximately 140 families identified based on a preliminary survey to gather data on the characteristics of target individuals and households and basic information for resettlement purposes. The anticipated cost of this component is US\$2 million, without providing for contingencies and price escalation.

D. Total project cost

- 2.13 The total project cost, in line with the foregoing description, is estimated at the equivalent of US\$232 million, broken down by sources of financing and investment categories in the table presented below, followed by a description of each cost item. The methods and criteria used in developing the budget presented below are considered sound.

Cost and financing of the project by category (In US\$ thousands - constant prices)				
Category	IDB	EPH	Total	%
1. Administration	-	8,665	8,665	2.7
1.1 Engineering and administration 1/	-	6,000	6,000	2.6
1.2 Works supervision	-	2,665	2,665	1.1
2. Direct costs	85,280	74,150	159,430	88.7
A. Specific works component	42,710	20,000	62,710	27.0
2.1 Treatment	35,150	12,110	47,260	20.4
2.1.1 Civil works	13,150	8,960	22,110	9.5
2.1.2 Equipment and assembly	22,000	3,150	25,150	10.9
2.2 Wastewater intercepting sewer mains	7,560	7,890	15,450	6.6
B. Multiple water works	42,550	54,150	96,700	41.7
2.3 Sanitation	16,600	27,060	43,660	18.8
2.3.1 Collection	8,150	17,880	26,030	11.2
2.3.2 Transmission	8,450	9,180	17,630	7.6
2.4 Water supply system	25,950	27,090	53,040	22.9
2.4.1 Collection and treatment	5,630	1,230	6,860	3.0
2.4.2 Distribution	20,320	25,860	46,180	19.9
3. Associated costs	3,910	3,500	7,410	3.2
3.1 Future plan and institutional strengthening	2,500	1,500	4,000	1.7
3.2 Computer systems	915	-	915	0.4
3.3 Training program	495	-	495	0.2
3.4 Family resettlement/northeastern district	-	2,000	2,000	0.9
4. Unallocated 2/	14,615	13,325	27,940	12.0
4.1 Contingencies	5,600	3,860	9,460	4.0
4.2 Escalation	9,015	9,465	18,480	8.0
5. Finance charges	28,215	2,360	30,575	12.4
5.1 Interest	24,915	-	24,915	10.8
5.2 Credit fee	-	2,360	2,360	1.0
5.3 Inspection and supervision	1,300	-	1,300	0.6
Total	130,000	102,000	232,000	100.0
Percentage	58%	44%	100%	
1/ Includes financing from FONADE in the amount of US\$3,196,000 equivalent.				
2/ Excludes multiple-works component B.				

1. Administration (US\$8,665,000)

- 2.14 This cost category, representing 3.74% of the total project cost, is divided into the following subcategories:

a. Project studies, designs and administration (US\$6,000,000)

- 2.15 This subcategory covers the cost of services to be furnished by individual consultants and consulting firms engaged to prepare part of the project studies, engineering designs and technical specifications. AyA will execute part of these studies and engineering designs and will provide project administration services, at an estimated cost of US\$5.75 million, which is not included in the cost breakdown since it will be using in-house staff members.

b. Supervision (US\$2,665,000)

- 2.16 This subcategory covers costs associated with the supervision of certain potable water supply and sewerage works by consulting firms. All other project works will be supervised by AyA personnel, with the value of these services estimated at US\$5.5 million.

2. Direct costs (US\$159,410,000)

- 2.17 This cost category, representing 68.7% of the total project cost, is divided into the following subcategories:

a. Sanitation

(i) San Fernando WTP (US\$47,260,000)

- 2.18 This subcategory covers construction costs for civil works valued at US\$22.1 million and equipment procurement and installation costs estimated at US\$25.15 million.

(ii) Intercepting sewer mains (US\$15,450,000)

- 2.19 This subcategory covers construction costs for 29 km of intercepting sewer mains.

(iii) Sanitation component - collection works (US\$26,030,000)

- 2.20 This subcategory covers construction costs for the following works: (a) 66 km of HIP systems and 11,250 house connections and 3,500 non-HIP house connections; (b) 2,500 storm drains; (c) 250 works for wastewater discharge collection; and (d) installation of 71 km of effluent control systems.

(iv) Transmission works (US\$17,630,000)

- 2.21 This subcategory refers to the construction of 102 km of collectors.

b. Water supply

(i) Collection and treatment (US\$6,860,000)

- 2.22 This category refers to the cost of electric equipment and fittings for pumping stations and the potable water treatment plant, valued at US\$1.67 million, and the cost of civil works to upgrade the Piedras Blancas dam and the channel between Tablaza and the Villa Hermosa plant, in the amount of US\$5.19 million.

(ii) Distribution (US\$46,180,000)

- 2.23 This category covers procurement of the following goods and construction of the following civil works: (a) 156,000 water meters and spare parts for 150,000 meters; (b) 69,000 cast iron meter covers; (c) 400 km of half-inch copper pipes; (d) four tanks with an 11,000 m³ aggregate capacity; (e) installation of potable water distribution systems in five districts in the municipality of Itagüí; (f) replacement of approximately 103 km of pipes; (g) procurement and installation of 46 km of pipes and 43 pressure regulating valves for the realignment of nine potable water system service areas; (h) construction of three operations and maintenance centers; and (i) procurement of tools and equipment for service operation and maintenance.

3. Associated costs (US\$7,410,000)

- 2.24 This category, representing 3.2% of the total project cost, covers expenses to execute the following activities:

a. Future plan: 1999-2004 (US\$4,000,000)

- 2.25 These funds will be used to prepare studies and designs for the Bello WTP.

b. Training (US\$495,000)

- 2.26 This item covers tuition, housing, food, books, transportation, insurance and other costs associated with master's programs, intermediate-level courses, technical training and attendance at seminars and congresses abroad.

c. Procurement of computer equipment (US\$915,000)

- 2.27 These funds will be used for the purchase of computer hardware and the development of software.

d. Resettlement of families (US\$2,000,000)

- 2.28 These funds will be used to resettle and/or compensate 140 families.

4. Unallocated costs (US\$27,940,000)

- 2.29 This category, representing 12% of the total project cost, covers potential cost overruns for the specific works component from: (a) additional costs incurred as a result of unforeseen circumstances impossible to anticipate in designs and specifications for project works; and (b) price escalation that might occur during the course of the project execution period.
- 2.30 The provision for contingencies (US\$9,460,000) was figured at 12% of estimated baseline costs. This percentage is considered reasonable and is consistent with the features of this project component and with Bank policy. The provision for price escalation (US\$18,480,000) is based on inflation factors and indexes used by the Bank in Colombia.
- 2.31 Provisions for contingencies and escalation for the global multiple-works component are included in the direct cost figures for this component and are figured at more or less the same rates as for the specific works component.

5. Finance charges (US\$28,575,000)

- 2.32 This category, accounting for 12.4% of the total cost, covers: (a) interest accruing during the project execution period (US\$24,915,000); (b) the applicable credit fee (US\$2,360,000); and (c) the cost of the Bank's inspection and supervision of the project (US\$1,300,000).

E. Criteria for estimating costs

1. Specific works component

- 2.33 The basic design for the San Fernando WTP was prepared back in 1983. In August 1993, EPM had the cost of the plant reviewed and updated based on the characteristics of wastewater to be treated therein and the requirements for effluents prior to their discharge into the Medellín River. This update placed the estimated plant cost at the equivalent of US\$47.25 million, which the Bank considers reasonable. EPM based its cost figure for the 29 km of intercepting sewer mains on unit costs under recent contracts for similar works.

2. Global multiple-works component

a. Water works

- 2.34 Most of the goods to be procured for this component involve equipment, meters, pipes, electric equipment and operating and maintenance equipment. EPM has recently purchased similar items, whose unit costs are regularly updated and considered reasonable. Many of these items are subject to a 14% value added tax (VAT). The cost of imported items will need to be adjusted for import duties over and above the VAT.
- 2.35 Moreover, EPM has updated unit cost figures for most civil works, such as tank construction and the installation of meters and pipes, from recent contracts for similar works, making these estimates reliable. Civil works are not subject to value added taxes.

b. Sanitation works

- 2.36 These works are similar to other recent or ongoing works for which EPM maintains regularly updated cost figures which the Bank has judged to be reasonable.

3. Financing

a. Bank resources

- 2.37 The Bank will finance 56% of the cost of the proposed project, i.e. US\$130 million, to be drawn from the ordinary capital and disbursed in foreign exchange in accordance with Bank policy.
- 2.38 The resources of the Bank's loan proceeds will be used to defray:
(a) 53.5% of the cost of materials and direct construction costs;
(b) 52.8% of associated costs; (c) 52.3% of unallocated costs; and
(d) 91.7% of finance charges, namely interest payments during the five-year project execution period and inspection and supervision fees.
- 2.39 The proposed Bank loan would be subject to the following terms and conditions:

Terms and conditions	Foreign exchange (OC)
Interest rate	Variable
Credit fee	0.75%
Inspection and supervision	1%
Disbursement	5 years
Grace period	5 years
Amortization period (including the grace period)	25 years

b. Local contribution

- 2.40 EPM will furnish the equivalent of US\$102 million (44% of the total) in local counterpart funding. The feasibility and timely availability of this local contribution are discussed in chapter V.
- 2.41 These counterpart funds will be used to defray: (a) 100% of engineering and administration costs; (b) 46.5% of direct costs; (c) 47.2% of associated costs; (d) 47.7% of unallocated costs; and (e) 8.3% of finance charges, namely the credit fee.

c. Criteria for allocation of the Bank and counterpart resources

- 2.42 The allocation of the Bank and local counterpart funding is based on the following criteria:

(i) Engineering and administration

- 2.43 This category will be financed in full with the local contribution in consideration of the following factors:
- a. Consulting firms have already been engaged to prepare studies and preliminary engineering designs in accordance with contracting procedures acceptable to the Bank, established under domestic legislation.
 - b. The Bank has verified that selected firms have the necessary qualifications and experience to furnish these services.
 - c. There is a wide range of local consulting firms available within the country. EPM resorted to international competitive bidding for the most complex facility, namely the San Fernando WTP, selecting a consortium of domestic and international firms to prepare the final designs and furnish advisory services during construction work on this plant.

(ii) Direct costs

- 2.44 Direct costs were allocated based on the technical characteristics and imported components of both services and equipment.

(iii) Associated costs

- 2.45 Studies and designs for the next phase of works would be financed in part with resources from the IDB loan. The manpower training and computer hardware and software subcomponents would be fully financed with proceeds from the Bank loan, while resettlement costs will be financed with local counterpart funds.

III. EXECUTION

A. The executing agency and coordination unit

- 3.1 EPM would serve as the project's executing agency, with AyA's Engineering Division serving as the coordination unit (CU). The AyA Engineering Division has a staff of 217 employees, including 1 division chief, 5 department heads, 2 group coordinators, 60 engineers, 75 engineering aids, 8 draftsmen, 27 topographers and assistants, 1 programming and statistics assistant, 6 reference assistants, 6 secretaries, 5 typists and 21 drivers (see Annex III-1).
- 3.2 The coordination unit staff will be directly responsible for design work, contracting operations and the supervision of construction work. All other aspects of project execution will be handled by specialized EPM divisions such as its Finance Office, in charge of planning for financial needs, its Administration Office, in charge of administering supply contracts for construction work and purchasing land and easements, and its General Secretariat, responsible for furnishing necessary legal advice.

B. Execution procedures

- 3.3 All works would be executed by specialized construction firms selected through international or local public competitive bidding in accordance with Bank policy. EPM will issue calls for bids for procurement of needed goods and will furnish these goods and/or equipment to firms awarded civil works contracts in due time.
- 3.4 EPM has requested that the installation of equipment in the WTP and the El Tesoro-Las Brisas pumping station and other operating and maintenance equipment, for up to the equivalent of US\$2.6 million, be performed on force account by specialized AyA personnel, which is the way it was done at the Manantiales water treatment plant and at ten other potable water pumping stations. In these cases the system of force account is justified in view of the training of technical and professional staff in the setup and use of the equipment, the contractor's reduced overhead, the shortened time-frame with the elimination of the need to conduct a competitive bidding process, and the improved coordination of the civil works with the contractor. Since EPM has technical personnel with ample experience in furnishing these services, as demonstrated in previous phases of work, it is recommended that these services be performed on force account. 2/

2/ See Resolution.

C. Status of project preparation

1. Specific works component

- 3.5 EPM has feasibility studies and preliminary designs for the San Fernando WTP and recently selected a contractor, through a direct call for bids, to prepare the final designs. These designs are scheduled to be completed within 18 months from January of 1994 at a cost of US\$3.7 million.
- 3.6 EPM proposes that the dried sludge produced by the WTP be disposed of in the Curva de Rodas sanitary landfill, whose service life runs through the year 2007, or in another sanitary landfill to be placed in service and operated in tandem with the existing facility on a site closer to the San Fernando WTP. The volume of sludge generated by the plant would represent a mere 4% of the tonnage of solid wastes disposed of at the Curva de Rodas sanitary landfill. The consortium engaged by EPM to prepare the final designs for the WTP will issue a recommendation for the handling of sludge disposal.
- 3.7 EPM has designs for the 1.7 km-long La Estrella intercepting sewer main at the bid stage. It has preliminary designs from the feasibility study for the other intercepting sewer mains, which were included in the project at the Bank's recommendation to intensify its environmental impact, ^{3/} and is currently soliciting bids for the preparation of final designs.

2. Global water and sewerage multiple-works program

a. Potable water

- 3.8 EPM has specifications for goods to be procured and designs for the realignment of nine potable water system service areas, the installation of 46 km of pipes, the pumping station and three of the four tanks and has recently engaged a contractor to upgrade the Piedras Blancas dam. It is about to issue a call for bids for construction of the channel between Tablaza and Villa Hermosa and for extending water service to five districts of the municipality of Itaguí. In short, progress on designs for the potable water supply component stood at 65% as of September 15, 1993.

^{3/} Extension of the intercepting sewer mains to the site of the future Bello WTP would improve water quality along a stretch of the river cutting through a densely populated area of downtown Medellín and would represent an important step towards construction of the Bello plant, which is slated to treat roughly 70% of the wastewater generated by the Medellín metropolitan area.

b. Sanitation

- 3.9 As far as the global multiple sewerage works component is concerned, EPM has designs for systems and HIP works for the first year of execution and for all storm drains and house connections, 40 overflow channels, 15 km of effluent control systems and 23 km of collectors. As of September 15, 1993, progress on designs for this component stood at 26%. EPM is arranging to process bids for the preparation of additional designs for this component so that construction contracts may be awarded in accordance with the bidding schedule.
- 3.10 In short, weighted progress on designs for the global multiple-works component stood at 45% as of September 15, 1993.

D. EPM's employee training policy

- 3.11 EPM has a well-defined policy to assure that employees who participate in education programs either continue with the company for a period of time to justify the investment or repay the cost of the studies. The general requirement is that staff remain for double the period of the studies. Beneficiaries are expected to choose a thesis topic relevant to EPM's activities and to give seminars, upon their return, on their field of study. Should a staff member terminate employment prior to satisfying his commitment, he will be required to repay EPM his future salary remaining under the commitment period. The financial obligation is backed by a bank guarantee.

E. Land rights and easements

- 3.12 EPM has acquired 84% of the total land required of 160,718 m² (16,1 ha) for the San Fernando WTP. Of the remaining area, 40% of which is owned by the municipality of Itagüí, negotiations are at an advanced stage with three of the owners and the fourth parcel will likely be obtained through expropriation ^{4/}; the land is expected to be completely acquired by December 1994. The municipality of Itagüí, through resolution 0417 in June 1988, declared the entire plant site an area of public benefit and assigned the use of the land to EPM. Most of the other land where projects will be executed is owned by municipal governments, including the area required for the extension of the intercepting sewer main in the northeast section of Medellín where approximately 140 families will need to be resettled to permit construction.

F. Timetable for project execution and investment schedule

- 3.13 The period for project execution is five years from the effective date of the loan contract. This time frame is consistent with the

^{4/} Law 9A of 1989.

project scale, with the type of activities envisaged thereunder, with the institutional capabilities of EPM, with its possibilities for furnishing required counterpart funding and with the capacity of prospective contractors to perform construction services and furnish goods on schedule.

- 3.14 A corresponding investment schedule was developed based on the project execution period and EPM planning, as summarized in the following table:

In thousands of U.S. dollars or their equivalent							
	Year 1	Year 2	Year 3	Year 4	Year 5	Total	%
IDB loan (OC)	15,477	29,377	46,746	28,870	9,530	130,000	56.0
Local contribution (EPM)	24,527	21,623	27,054	18,630	6,970	98,804	42.6
FONADE	3,196	-	-	-	-	3,196	1.4
TOTAL	43,200	51,000	73,800	47,500	16,500	232,000	100.0
Percentage	18.6	22.0	31.8	20.5	7.1	100.0	

G. Bidding schedule

- 3.15 During the course of the analysis mission, it was agreed that the total number of calls for bids should be cut back from 101 to 29, including seven international calls for bids for the procurement of goods and 22 calls for bids for construction of civil works (13 local and 9 international). Works have been assembled into bid packages attractive to both domestic and foreign contractors.
- 3.16 Given the timetable for the preparation of certain final designs for the multiple-works component, the capacity of EPM to furnish counterpart funding for this component and the fact that certain work packages would require no more than twelve months to complete, EPM has requested authorization from the Bank to commence works involving four bid packages during the fourth year of project execution. 5/
- 3.17 It is recommended that the system of prequalification or registry of bidders be used for the three most complex works, namely the WTP, the intercepting sewer mains and the upgrading of the Piedras Blancas dam. 6/

5/ See Recommendations.

6/ See Recommendations.

H. Capacity of contractors and suppliers

- 3.18 There is a sufficient number of local and international contractors with capacity to execute the project works, and it is expected that an adequate number of firms will participate in the competitive bidding. The materials and equipment to be used for the project are standard for such works, with the exception being the equipment for the WTP; nevertheless, no problems are foreseen in procurement. Since the equipment and materials required are normally manufactured in most of the Bank's industrialized member countries, no difficulties are anticipated in obtaining them.

I. Studies on subsequent stages

- 3.19 The studies to be conducted starting in the second year of project execution relate to the subsequent stage of the master plan for sanitation of the Medellín River. It is recommended that the borrower submit to the Bank, within 42 months after the effective date of the loan contract, the findings of these studies, which will include the determination of the components that would make up the next stage, the pertinent environmental impact studies financing alternatives and the execution schedule. 7/

J. Operation and maintenance

- 3.20 The project works, once built, will be operated and maintained by AyA. EPM has significant experience in the multiple works programmed, but its experience is limited operating a WTP of the capacity contemplated. The El Retiro plant, constructed with Bank financing in 1985, provided some training and the staff involved will have an important role in the operation of the San Fernando facility. Technical support will be provided by the equipment suppliers and consultants. In addition, EPM's training program, which includes intensive courses, studies at the master's level and short-term visits abroad, will prepare a significant number of employees to operate and maintain the plant.
- 3.21 It is recommended that the loan contract include a commitment by EPM to operate the works executed under the project and maintain them in accordance with generally utilized techniques and practices. 8/

K. Unaccounted-for water

- 3.22 EPM will pursue its efforts to reduce the level of unaccounted-for water and promote efficient water usage by taking steps to help lower the percentage of unaccounted-for water from 38% to 30% by December of 1999. This is considered an acceptable percentage for

7/ See Recommendations.

8/ See Recommendations.

a Latin American water supply system with the number of customers serviced by EPM, considering the area's rugged terrain, with 550-m differences in elevation between service areas. The government loan guarantee document imposes a ceiling on losses, which are to be reduced to 25% of water production by the year 2005. The loan contract will establish a contractual obligation on the part of EPM to reduce the level of unaccounted-for water to no more than 30% within five years. 9/

L. Supervision, monitoring and evaluation

3.23 EPM will submit the following reports to the Bank: 10/

- a. a semi-annual progress report, at the end of each semester during the project's execution, that will cover the accomplishment of physical, financial and technical targets related to the different activities contemplated, including training, reductions in unaccounted-for water, environmental monitoring, and measures taken to reduce levels of contamination of industrial wastewater discharges and a plan of execution for the next year; and
- b. a final report, upon completion of the project, that compares the objectives, proposed schedule and the actual project execution.

3.24 The Bank will monitor the project as follows:

- a. the Country Office in Colombia will assign the necessary technical personnel to closely accompany project execution; and
- b. at the end of the second year of execution, an administration and monitoring mission will be sent from the Country Office to review the state of project execution focusing on the final designs of the WTP and the intercepting sewer mains.

M. Environmental considerations

3.25 The Bank's Environmental Management Committee (CMA), at its meeting of April 20, 1993, classified the project in Category III, based on the project's effects on the environment. The recommendations of the CMA to mitigate negative environmental impacts that may result from the project have been incorporated in the project's design and plan of execution. The environmental legislation in Colombia is considered adequate; enforcement should be improved through the proposal to establish a Ministry of the Environment and to liquidateINDERENA.

9/ See Recommendations.

10/ See Recommendations.

- 3.26 EPM monitors industrial discharges of those industries in its service area to assure that they are within standards that will not cause any damage to the sewer system. EPM has developed a satisfactory database which closely follows the industries that most contribute to the contamination problem. EPM will present to the Bank the results of a study to improve measurement of industrial discharges into the sewer system and a plan to reduce the level of contamination of those same discharges. 11/ During the execution of the project and once the works are put into operation, EPM will be required to meet all environmental regulations and secure all licenses mandated under relevant legislation. 12/

11/ See Recommendations.

12/ See Recommendations.

IV. THE BORROWER AND THE EXECUTING AGENCY

A. The borrower and guarantor

- 4.1 The borrower, executing agency and source of local counterpart funding would be EPM, which would also operate the works resulting from the project through AyA. The guarantor would be the Republic of Colombia.

1. EPM

- 4.2 EPM is an independent public entity created under Decree 58 of August 6, 1955, by the Medellín Municipal Council (MMC). It is an independent public legal entity organized to operate public power, telecommunications, water supply and sewerage utilities and to ensure environmental management as it relates to the operation of these utilities in the municipality of Medellín and the Aburrá valley. EPM may enter into any type of contract with any public or private person for service delivery, exchange or interconnection.
- 4.3 Article 28 of the decree referred to in the preceding paragraph provides for a separation of the assets and income of each of the utilities operated by EPM (power, telecommunications and water and sewerage), which do not as yet have separate legal status. EPM's future plans include establishing a new utility for the distribution of natural gas. Furthermore, its charter indicates that the aforesaid separation of assets and income is applicable to loan proceeds.
- 4.4 EPM is headed by a board of directors which, under the provisions of Municipal Decree 66 of December 1987, is composed of: (a) the Mayor of Medellín or a duly designated member of his cabinet, acting as its chairman; (b) two municipal government officials appointed by the Mayor of Medellín; (c) three Medellín Municipal Council members; and (d) three delegates from civic groups or leagues of consumers serviced by EPM. The Governor of the Department of Antioquia also has a representative on the EPM Board of Directors with voting rights. This board elects EPM's General Manager for one-year terms, who serves as the legal representative, with full responsibility for all administrative, financial, technical, operational and public relations matters and for implementing or ensuring the implementation of all decisions adopted by its Board of Directors.
- 4.5 As of June of 1993, EPM had a roster of 6,427 employees, with 4,279 assigned directly to its utilities (power: 1,810; telecommunications: 1,181; and water and sewerage: 1,288) and 2,148 comprising its administrative and support staffs (see EPM organization chart in Annex IV-1).

- 4.6 Administrative and financial management expenses are shared by all EPM utilities and allocated to each in proportion to its share in the make-up of selected parameters, such as net fixed assets, net worth and operating income and expenses, which are revised on a regular basis. AyA's share of expenses is 17%.
- 4.7 Outside audits of EPM are performed by a unit attached to the Medellin Comptroller General's Office under the direction of a deputy auditor designated by the Comptroller General of Medellin and by an independent auditing firm responsible for attesting to the soundness of the financial statements and for issuing a separate opinion on compliance with the contractual obligations of IDB and IBRD loan contracts. Contracts for outside auditing services are awarded through closed bidding for two-year periods. Moreover, since October of 1991, EPM has had its own internal auditing unit reporting directly to the Office of the General Manager, whose main purpose is to ensure the smooth operation of its internal control system and guarantee its effectiveness. Its internal and external auditing systems are operating efficiently. EPM will present the project's annual financial statements to the Bank throughout execution and the borrower's financial statements for the life of the contract, audited by a firm of independent public accountants acceptable to the Bank. 13/
- 4.8 To optimize the use of its resources, EPM operates out of a single fund system under which any of its utilities may secure funds from another utility showing a cash surplus. These loans are, by nature, short-term loans bearing short-term market interest rates. EPM employs a unified meter-reading, billing and collection system designed to maximize the efficiency of customer billing and collection operations. The entire system is computerized, from meter reading operations to the issue of bills and the monitoring of payments. Moreover, 99% of all payments to EPM are made through outside establishments such as banks, supermarkets, chain stores and corporations. 14/
- 4.9 EPM is required by law to turn over a percentage of its gross income from each of its utilities to the municipality of Medellin: (water supply: 1.99%; sewerage: 2.47%; power: 4.43% and telecommunications: 3.42%). Moreover, since January of 1993, pursuant to a decision by the MMC, it is also required to make a contribution to the Instituto para el Manejo Integral de la Cuenca

13/ See Recommendations.

14/ Meters in both urban and rural facilities are read monthly (with the exception of certain remote rural facilities far away from urban centers, which are read quarterly but billed monthly). These operations are recorded on portable terminals previously programmed for meter reading routes. These terminals are also used to record any changes detected in the facilities and any observations by the meter reader prompted by these facilities.

del Río Medellín y sus Quebradas Afluentes - Mi Río [Integrated Watershed Management Agency for the Medellín River and its Tributaries] ^{15/} in an amount equal to a percentage of its municipal contributions. This percentage will gradually be raised to the equivalent of 10% of the value of the contributions.

- 4.10 EPM has a computerized accounting system allowing for the performance of financial controls by utility, type of account, cost category and area of responsibility. It has been employing accounting methods with full adjustments for inflation since 1992 in compliance with Ministry of Finance regulations.
- 4.11 EPM establishes consolidated monthly and annual financial statements and separate statements for each utility. EPM budgets are drawn up for four-year periods (on an annual basis), are reviewed each year and are approved by its Board of Directors. Budget performance statements are presented monthly. Financial planning operations cover a ten-year span, with projections revised on a yearly basis.
- 4.12 Under current legislation, EPM is not subject to income taxes and related surtaxes. However, it is responsible for collecting value added taxes on telecommunications services.
- 4.13 Since 1991, EPM has been a shareholder (51% interest) in Gases de Antioquia [the Antioquia gas company] whose purpose is to supply gas to the Medellín metropolitan area and in Empresas Públicas de Medellín Celular [a cellular telephone company], in which it holds a 35% interest, looking to extend its sphere of operations to natural gas and mobile cellular telephone service. It is also planning to form a semipublic enterprise with private investors to be known as Transmetano S.A. for construction and operation of the Sebastopol-Medellín gas pipeline (in which it would hold a 33% interest).

2. Gerencia de Acueductos y Alcantarillado [Water and Sewerage Utility]

- 4.14 AyA is responsible for the development and implementation of water supply and sewerage service development plans, as well as for service operation and maintenance. To accomplish this, it has a roster of 1,288 employees, including 134 professional, 233 technical and 286 administrative staff members and 635 laborers. It has 3.5 employees for every 1,000 service connections, including corresponding administrative and support personnel. This ratio is very good, with a good ratio defined as 6:1,000. AyA has an

^{15/} "Mi Río" is an independent municipal agency whose basic functions include watershed afforestation and health education, improving water engineering structures and removing debris and refuse from stream beds and from the Medellín River.

engineering division, a water supply and treatment division and a distribution division enabling it to discharge its functions, along with an operations control unit. The operations of each division are discussed in detail in Annex IV-1.

3. Conclusions of the institutional analysis

- 4.15 The institutional analysis of EPM in general and of AyA in particular and the Bank's long and very positive experience with the executing agency indicate that both EPM and AyA have the capability to execute as well as to operate and maintain project works in keeping with high performance standards.

B. Financial analysis

- 4.16 The financial analysis was based on financial statements, balance sheets, funds flow statements and financial indicators for the period 1988-1992 and projections for the period 1993-2002 established in constant 1992 currency.

1. Pricing considerations

- 4.17 Water charges collected by AyA are binomial, consisting of a fixed charge established based on the diameter of the service connection and a variable rate reflecting monthly usage. Rates for residential water usage are established based on a matrix consisting of a scale of monthly usage levels (0 to 20 m³, 21 to 40 m³ and over 40 m³) and of the six socioeconomic groups in which the general population is classified for social stratification purposes. Rates for industrial, commercial, government and other nonresidential customers are the same for all usage levels, with the only variation being in the fixed charge assessed based on the service connection diameter. No waivers of water and sewerage charges are granted to any natural or juristic person (Decree 394 of 1987).
- 4.18 As of December of 1992, water charges stood at 40% of the long-run average incremental service cost, compared with 42% for sewerage charges (charges are adjusted monthly based on the consumer price index). Rates are scheduled to be raised this year to reflect a real 5% increase and by the same percentage again next year (these rate hikes do not apply to commercial and industrial customers). ^{16/} Sewerage charges are set at 50% of the corresponding water charge.

^{16/} The Junta Nacional de Tarifas [National Rate Control Board] Decisions 144 and 129 of 1992 established a regulated free-pricing system for water and sewerage service with charges set by the boards of directors of the enterprises providing these services.

- 4.19 AyA charges are consistent with IDB sector policies. Moreover, it is recommended that AyA review the rate structure, update its computations of long-run marginal cost rates and submit a plan for implementing the recommendations. 17/

2. Historical financial performance

- 4.20 AyA reported US\$43 million in operating income for 1988, representing 15% of the aggregate income figure reported by EPM (US\$292 million), with an increase to US\$74 million in 1992, while its share of aggregate EPM income (US\$478 million per EPM's consolidated financial statement) remained constant. AyA showed a US\$2 million operating loss for 1988 (EPM showed an operating profit of US\$57 million corresponding to 20% of its income), but had a US\$28 million profit by 1992, corresponding to 39% of its income (EPM's consolidated financial statement showed a US\$192 million profit corresponding to 40% of its income). The improvement in fiscal year net income from zero in 1988 (US\$73 million for EPM) to US\$16 million for 1992 (US\$151 million for EPM) was equally noteworthy. This positive financial performance was achieved as a result of the growth in income from real rate increases 18/, adjustments in the rate schedule for residential water usage and efforts to curb spending (see Annex IV-2).
- 4.21 AyA reported US\$367 million in net fixed assets at December 31, 1988, representing 22% of the figure reported by EPM. Its net fixed assets at December of 31, 1992, were US\$556 million, representing 28% of the corresponding figure for EPM (US\$1,998,000,000). A number of large-scale facilities such as Río Grande were placed in service during the course of this period, and fixed assets were revalued in 1992 (see Annex IV-2).
- 4.22 AyA reported US\$141 million in long-term debts at December 31, 1988 (corresponding to 19% of the total for EPM), compared with US\$247 million at December 31, 1992, corresponding to 37% of the total for EPM. AyA debts in foreign exchange at December 31, 1992, included US\$221 million in IDB loans (US\$284 million for EPM) and US\$22 million in IBRD loans (US\$251 million for EPM). Its net worth at December 31, 1988, stood at US\$180 million (US\$791 million for EPM), compared with US\$284 million (US\$1,326,000,000 for EPM) at December 31, 1992 (see Annexes IV-2).

17/ See Recommendations.

18/ Junta Nacional de Tarifas de Servicios Públicos [National Public Utility Rate Control Board] Decision 14 of 1988 established a monthly indexing system for public utility rates and approved real one-time 5% rate increases for the years 1989, 1990 and 1991. It also increased the rate for sewerage service from 30% to 50% of the corresponding water charge, effective as of 1991. Decision 88 of 1990 revamped the rate schedule for residential water usage.

- 4.23 AyA's debt-to-equity ratio for 1988 was 53%, rising to a high of 72% in 1991, reflecting loans raised to finance investments made over the period from 1985 to 1992, falling back down to 52% in 1992 as a result of the revaluation of its fixed assets (the combined debt-to-equity ratio for all EPM utilities for the same three years was 58%, 54% and 44% respectively). AyA's debt service coverage increased from 1.3 in 1989 to 2.1 for 1992. For EPM, this same indicator increased to 2.2 in 1992 after having dropped to 1.1 in 1989.
- 4.24 AyA's share of investments jumped from 9% in 1989 to 77% in 1992 (in which year investments fell off by US\$14 million and internal cash generation rose by US\$10 million).
- 4.25 The rate of return on AyA's fixed assets in service (after revaluation) jumped from 1.7% in 1989 to 6.5% in 1992 as a result of rate adjustments and gains in efficiency.
- 4.26 Its collection efficiency for the period 1988-1992 remained stable at around 98% of billings. This excellent payment record is attributed mainly to effective EPM customer service and collection policies.

3. Projected financial performance

- 4.27 AyA is expected to increase its net fixed assets (after revaluation) by around 47% (121% for EPM) over the projection period through US\$524 million in investments (US\$3,426,000,000 for EPM). Even so, its long-term debt should decline from US\$247 million in 1992 down to US\$150 million by the year 2002 (with long-term EPM debt reduced from US\$664 million in 1992 to US\$610 million). Net internal cash generation by AyA for the projection period is estimated at US\$305 million, corresponding to 58% of the value of investments.
- 4.28 AyA is expected to generate an estimated US\$891 million in income over the projection period, including US\$9.6 million from a special fee charged to industrial polluters whose effluents would be treated at the San Fernando WTP. Industries whose effluents had levels of BDO and SS in excess of 300 mg/l would be charged a special fee (fee = $\$/m^3$ + $\$/kg$ BDO + $\$/kg$ SS). The financial projections make no provision for incremental income from the treatment of wastewater generated by other customers connected to the sewerage system. Nevertheless, AyA will need to revise its current charging system for sewerage service to adjust these charges to reflect corresponding wastewater treatment costs. 19/

19/ See Recommendations.

- 4.29 The company's principal performance indicators predict improvements in different elements of its financial position. Its debt-to-equity ratio would drop from 49% in 1993 to 31% by the year 2002 (from 38% to 21% for EPM). Its share of investments, estimated at 60% for 1993, would initially fall off to 34%, only to surge to a high of 94% in 1999, subsequently falling back down to 67% for the year 2002, including investments for the second phase of the Medellín River sanitation program (US\$219 million over the period 1999-2002) and other works included in its regular investment program. Debt service coverage is expected to increase from 2.1 in 1993 to 2.5 by the year 2002 after dropping to 1.5 in the interim, without endangering its ability to meet any ongoing investment commitments in any way.
- 4.30 Operating profits are expected to plunge from 26% down to 9% and the rate of return on net fixed assets in service is expected to fall off from 3.5% in 1993 to a scant 1.1% by the year 2002, in large part due to an anticipated 50% real increase in administrative expenses over the projection period, without any real rate increases after the 5% hike in 1994. This surge in administrative costs is justified by the need to compensate for previous lags and to continue to maintain an effective personnel policy allowing it to compete with the private sector for high-level professionals. EPM has indicated that it is already feeling the effects of having to compete for qualified personnel.

4. Financial impact of possible new legislation

a. Changes in EPM's legal status

- 4.31 There is a bill in Congress affecting public utilities serving residential customers which, if passed into law, would mean a change in EPM's legal status, converting it into a state industrial and commercial enterprise, which would give it an even greater degree of independence. These changes could have an impact on its labor regime which, in principle, should not affect its ability to meet its obligations.

b. Tax treatment

- 4.32 Until now, EPM has been exempt from income taxes and related surtaxes. Under the new proposed legislation for public utilities serving residential customers, all such utilities would be subject to national and local taxes. However, investments to improve service and expand service coverage made by utility companies over the course of a given fiscal year using internally generated funds would be deductible from their gross income for purposes of these taxes. Payments on loans used to finance expansions and improvements in service would also be tax deductible in the fiscal year in which they are made.

- 4.33 According to the financial projections for AyA, this company would have no tax base for the duration of the projection period.

c. Proposed legislation on contributions to public utility regulatory commissions

- 4.34 Under this proposed legislation, all entities subject to regulation, supervision and inspection by boards and commissions would be subject to contributions equal to 2% of operating expenses to defray the cost of the regulatory services furnished by each such board and commission. For AyA, this would mean US\$5.8 million in expenses over the period from 1995 to the year 2002.

d. Social security bill

- 4.35 The bill in Congress seeking to reform the social security system would change the manner in which EPM handles employee health coverage and pension plans. Both these benefits are currently furnished directly by EPM with its own funds. The proposed legislation would require they be managed by outside firms or funds.
- 4.36 The passage of this bill would lower AyA's actuarial valuation by approximately US\$48 million for the projection period, ^{20/} which would improve company profits (its average profit margin for the period 1993-2000 would increase from 2% to 2.8%). However, gross internal cash generation would drop by an average of US\$3.5 million per year.

C. Conclusions from the financial analysis

- 4.37 EPM's consolidated financial position and that of each of its utilities is quite sound. The financial projections developed for AyA indicate that it should have no problem meeting its existing financial obligations and any obligations to be assumed in regard to the proposed project loan. Any impact the aforementioned new legislation might have on its flow of funds could be neutralized by: (a) short-term credit; (b) a 3% real rate increase in the year 1996; (c) an 18% hike in sewerage rates in the year 1999; (d) an increase in investment financing with long-term loans; (e) adjustments in the investment plan; or (f) a combination of these measures.

^{20/} Company reserves for health care and pension costs are updated each year. The difference between the new value and the amount covered through the end of the previous year would represent a fiscal year expense.

V. PROJECT FEASIBILITY

A. Technical feasibility

- 5.1 The project is considered feasible and fully justified from the technical standpoint. This stance is supported by the following major factors:
- a. The project addresses pressing needs to expand and upgrade sanitation infrastructure for the Medellín metropolitan area, in keeping with national and departmental government and EPM Board of Directors priorities.
 - b. The basic engineering designs for the WTP and intercepting sewer mains have already been completed, as have 45% of the designs required for the global multiple-works program, allowing for accurate cost estimates and the preparation of corresponding bidding documents and conditions.
 - c. The project cost was computed based on real unit costs on the domestic and world markets and includes reasonable provisions for contingencies and price escalation.
 - d. The execution schedule effectively reflects required performance periods for all scheduled activities. Accordingly, the proposed five-year disbursement period is considered both realistic and feasible.
 - e. The consolidation of contracting procedures into 29 bid packages should foster adequate international and local competition, giving firms of different sizes and with different capabilities an opportunity to compete for contracts.
 - f. The coordination unit should have the necessary number and quality of technical personnel to enable it to effectively oversee project implementation, duly assisted by a specialized firm in the case of the construction of the San Fernando WTP.
 - g. The coordination unit has ample experience in the design and supervision of water supply and sewerage works, as demonstrated in the development of the sanitation system. Designs for the WTP are being prepared by a consortium of firms with extensive experience in this area. Other designs, both for potable water and for sanitation works, are being prepared by domestic consulting firms, with all remaining designs to be prepared by AyA's engineering division, and are scheduled to be completed prior to July of 1995, which should allow for the timely commencement of scheduled works.

- h. Potable water and sewerage systems and the WTP are currently and will continue to be operated and maintained directly by EPM. The training plan for AyA staff should improve its ability to operate, maintain and supervise these facilities effectively.

B. Environmental impacts

- 5.2 The project will have a positive effect on environmental and sanitary conditions in the Aburrá valley, with improvements in the quality of life and health of the population. The treatment of wastewater at the San Fernando WTP will reduce by approximately 50 tons/day the discharge of organic materials into the Medellín River. The WTP will significantly improve levels of dissolved oxygen and BDO of a 15 km segment of the river that passes through the center of Medellín. The construction of the collectors parallel to the ravines will result in important improvements in sanitary conditions in many of the poorer neighborhoods, reducing illnesses, expanding recreational areas, and eliminating bad odors.
- 5.3 The intercepting sewer mains to be extended from the center of Medellín to the site of the proposed WTP in Bello will improve the river's quality in the densely populated, predominantly low-income, northern zone of Medellín. The construction of the intercepting sewer mains as well as the purchase of the land for the plant site (not included in the project's budget) will represent important initial investments related to the WTP in Bello, expected to be constructed in the period 1999-2004. The new residential connections, though not a significant number, will extend water and sewage services to less accessible, low-income areas. Finally, the investments to reduce the level of unaccounted-for water should result in a reduction in the use of potable water, and the resultant conservation of a scarce resource.
- 5.4 Measures have been incorporated to reduce the possible negative environmental effects of the operation. 21/ Contractors will be required to follow EPM's procedures to diminish disruptions that might result from construction. Efforts will be made to reduce the odors from the operation of the WTP. Though the plant will improve the quality of the wastewater dumped into the river, it will produce sludge (estimated at 72 tons/day when the plant is in full operation in 1999) that must be carefully disposed of. An initial plan for disposal of sludge, which includes the alternative selected on the basis of technical, economic and environmental criteria, will be presented for the consideration of the Bank prior to first disbursement and the final proposal will be presented during the second semester of 1995. Such proposal will incorporate the conclusions of the environmental impact study. 22/

21/ See Recommendations.

22/ Condition precedent to first disbursement and Recommendation.

- 5.5 Though the collectors and intercepting sewer mains will improve the sanitary conditions in the ravines and in a part of the river, they will also increase the collection of wastewater which will be dumped into the river. When the proposed network of four WTPs is operative, most of the waters captured by the collectors and intercepting sewer mains will pass through the plants before being discharged into the river.
- 5.6 A negative impact of the project could derive from the need to resettle approximately 140 families living along the bank of the river. Some of these families may choose to accept monetary compensation for their present dwelling, while others will need to be resettled. The resettlement of these families will require the selection, purchase and clearing of land, the provision of basic services, housing construction and moving services. Prior to the first disbursement of the loan, EPM will present a preliminary resettlement plan, which will be updated each semester, incorporating significant community participation. EPM has a good record in resettling displaced families, particularly in connection with hydroelectric projects. 23/

C. Institutional and financial feasibility

- 5.7 The project analysis and the Bank's positive experience with other projects conducted by the same executing agency demonstrate that AyA has the institutional capability to execute and maintain the project. EPM's consolidated financial position and that of AyA are both sound, and the financial projections indicate that this should continue to be the case throughout the period studied. The projections show that AyA would have the resources required to furnish local counterpart funding on schedule and that it would have no difficulty in meeting the higher debt service requirements resulting from the project. EPM's present financial reporting and control systems are adequate, as are its budgeting and financial projection systems.

D. Economic feasibility

- 5.8 The economic analysis of the project was conducted in two stages. The first stage verified that selected alternatives for the major sewerage components, namely the intercepting sewer mains and San Fernando WTP, represent least-cost solutions. This study did not extend to the water supply component since its subcomponents all involve materials, equipment and works which do not leave room for a wide range of technical alternatives. Economic costs and benefits were evaluated based on market prices subject to shadow price adjustments, using a 12% discount rate, with all prices expressed in December 1992 values. The second stage of the

23/ See Resolution and Recommendations.

analysis established the feasibility of the water supply and sewerage components based on a cost-benefit analysis.

1. Least-cost analysis

- 5.9 The study of construction alternatives for the eastern intercepting sewer main in the north end of Medellín examined two alternate routes: (a) along the banks of the river at a cost of Col\$3,729,000,000, involving the resettlement of approximately 140 families; and (b) along an inner-city street at a cost of Col\$9,641,000,000, requiring a 160 m extension of the intercepting sewer main and the installation of a pumping station, but avoiding the need to displace any households. The least-cost alternative selected as a result of this study was construction of the sewer along the banks of the river.
- 5.10 The study of the San Fernando WTP examined fifty possible combinations involving different numbers of plants ranging from a minimum of three to a maximum of nine plants. The 48 highest-cost combinations were discarded and the two remaining alternatives continued to be analyzed. Since the difference in cost between the two alternatives was negligible for economic feasibility purposes, the four-plant alternative including two secondary treatment plants in Itaguí (San Fernando) and Bello and two primary treatment plants in Girardota and Barbosa was chosen based on an analysis of corresponding advantages and disadvantages. The only plant scheduled for construction in this phase of work is the San Fernando plant.
- 5.11 In addition to the original alternatives contemplated in the master plan, to define the second phase of the expansion plan the option of discarding the Bello plant by extending the intercepting sewer mains up to the spillway channel for the Tasajera power plant was considered. Comparisons with the original alternative found all options to be extremely similar based on an analysis of corresponding cost-effectiveness indicators. A final decision in this regard will be deferred until the environmental impact, social and engineering studies have been completed and can furnish more precise information on the costs and benefits of each of these alternatives.
- 5.12 The following alternatives were studied for purposes of the final disposal of sludge generated by the San Fernando WTP: (a) disposal in a separate sanitary landfill; (b) joint disposal with the city's solid wastes; (c) composting, based on the static pile method; and (d) composting, based on the "windrow-static pile" method. Of the different options examined, solid waste disposal in the municipal sanitary landfill was found to be, by far, the most economical alternative. The present value of the cost of this solution is US\$2 million, with the second lowest-cost option coming in at US\$17 million.

2. Cost-benefit analysis

a. Water supply component

- 5.13 The water supply component is comprised of the following three main elements: (a) the Home Improvement Program (HIP), including extension of the distribution system and the construction of 11,250 house connections for potable water and sewerage service in districts on the outskirts of the Medellín metropolitan area; (b) procurement of equipment and civil works to upgrade service to nearly 90,000 households connected to the water supply system, including 38,000 low-income families; and (c) a program involving the realignment of nine water system service areas designed to reduce service losses.
- 5.14 The benefits generated by this component were assessed as a function of willingness to pay on the part of corresponding customers using the SIMOP model. The analysis of all subcomponents yielded a net present value (NPV) of Col\$37,865,000,000 or US\$51.3 million, with an EIRR of 19.3%. The feasibility of individual subcomponents was established by calculating their marginal contribution to overall feasibility which, in the case of the service area realignment program, was valued at Col\$18,825,000,000 or US\$25.5 million, with an EIRR of 24.9%. The HIP and service upgrading component contribution is Col\$19,040,000,000, with an EIRR of 15.7%.
- 5.15 The cost-benefit analysis for the meter replacement subcomponent considered the benefits in the form of significant savings in potable water production and distribution and sewage treatment costs. This benefit was compared against the reduction in the consumer's surplus as a result of lower consumption levels and the economic costs of this subcomponent, yielding an NPV of Col\$2,052,000,000, with an EIRR of 18%.

b. Sewerage component

- 5.16 The target population for the sewage collection subcomponent was estimated at 626,000 inhabitants for the year 1994, increasing to 778,000 inhabitants by the year 2007, by which time the capacity of the collectors should be saturated.
- 5.17 The economic feasibility of this subcomponent was established through a two-stage process, with the first stage consisting of a separate cost-benefit analysis for the collectors and the second stage conducting a comprehensive appraisal of the component as a whole, extending to the effluent control system in addition to the collectors, whose economic feasibility had already been established separately. The use of this procedure is predicated upon the fact that materialization of the benefits of cleaning up the ravines depends on the simultaneous construction of effluent control systems and collectors.

- 5.18 The separate cost-benefit analysis was based on a sample of collectors, with greater precision in cost estimates. The sample included the Ana Díaz, La Bermejala, La García, La Iguana, La Loca, La Rosa, La Madera, La Sucia and La Maruchenga collectors. The project benefit was defined as the willingness to pay displayed by target households, which was estimated at Col\$1,825/month based on a socioeconomic survey for contingent valuation. The findings from this analysis were used to set a cut-off value (Col\$42,607/project beneficiary) above which a new collector would not be economically feasible.
- 5.19 The cost-benefit analysis for the entire wastewater collection subcomponent considered the costs of selected collectors, utilizing the cost-effectiveness index and including the cost of effluent control systems. The estimated EIRR for the component as a whole was 30.3%, with an NPV of Col\$8,687,000,000, produced by an aggregate benefit of Col\$16,655,000,000 and a cost of Col\$8,927,000,000.
- 5.20 The treatment component would service a population of 605,000 inhabitants. Its benefits were estimated as follows: (a) for households serviced by the treatment plant: based on a willingness to pay valued at Col\$2,665 per month according to the contingency evaluation survey, applied to a sample of 1,200 inhabitants of Medellín, Itagüí, Envigado and Bello; (b) for the population of Medellín situated downstream from the treatment plant: based on 40% of the established value for willingness to pay (this percentage represents the relative improvement in river quality as a result of project execution according to the water quality model); and (c) for industry: benefits were defined as equal to the marginal treatment cost of Col\$34.28/m³. This analysis yielded an NPV of Col\$5,757,000,000, with an EIRR of 14%. Using 30% of the established value for willingness to pay as the basis for computing benefits accruing to the population downstream from the WTP would reduce the project rate of return to 12%.

E. Distributional impact assessment

- 5.21 Households with incomes of up to one monthly minimum wage (Col\$81,900) currently pay a monthly charge of Col\$750 for water and sewerage service, which represents less than 1% of their income. Rate increases of roughly 5% in real terms are scheduled for the years 1993 and 1994 to help finance the project cost; the impact on the household budgets of families in this socioeconomic group would be minor.
- 5.22 The distributional impact of subcomponents subject to cost-benefit analyses was estimated based on conventional methods, identifying and measuring net benefits accruing to low-income groups as a percentage of total benefits going to the private sector, including benefits associated with the labor used for project construction, operation and maintenance purposes. Low-income groups were defined

as having an annual per capita income of up to Col\$655,561. ^{24/} The resulting distributional impact coefficient was 64.9%.

F. Social impact and participation of women

- 5.23 The project will improve the living conditions and health of the vast majority of the population in the Aburrá valley. Those who will benefit most include low-income segments who reside in areas where sewage is dumped directly into the ravines and those living along the banks of the Medellín River. Important benefits will accrue to residents living higher up in the mountains who do not have water and sewer connections.
- 5.24 The project has no provisions focusing specifically on women. Given the project's high percentage of low-income beneficiaries, and the traditionally important role of women heads of households in this group, it is likely that women will be important beneficiaries of the project.

G. Natural disasters

- 5.25 The design of the project takes into account the Bank's policy on natural disasters, focusing in the Aburrá valley on the possible damage caused by earthquakes, mudslides and flooding. The water and sewer system has been constructed to allow for flexibility to minimize the effect of any seismic activity. Water storage tanks are located in flat areas with adequate drainage and which require limited excavation. The San Fernando WTP will be constructed in a level zone in which there are no risks of mudslides, nor is there a significant possibility of flooding as a canal exists in this portion of the river that has a capacity ten times higher than the normal level of the river.

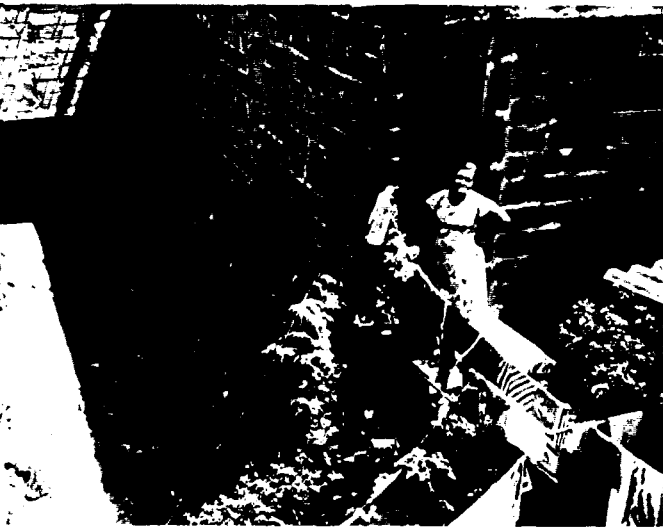
H. Project risks

- 5.26 Though the preparation of most of the final designs for the specific components in the operation require additional work, it is not expected that this will delay project execution beyond the five-year period contemplated. The budget for the plant was reviewed in August 1993, and the figures presented seem reasonable in comparison with similar projects financed recently by the Bank. The final designs for the intercepting sewer mains are incomplete as the extensions to Bello were recommended by the Bank and accepted by EPM in June 1993. Contingencies exist in the project budget for these items, and if the actual costs increase substantially, EPM could use internally generated resources to assure project completion.

^{24/} Based on figures for June of 1993 furnished by the Bank's Economic and Social Development Department (DES).

I. Recommendation

- 5.27 Based on a comprehensive analysis of all of the components contemplated in this operation, the project team recommends approval by the Bank of the proposal considered in this document.



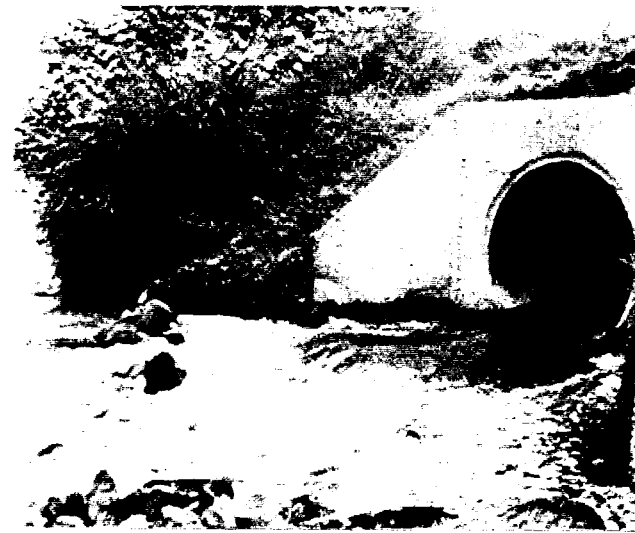
Houses constructed on top of gorges
Casas construidas encima de las quebradas



"La Madera" Gorge being used as a garbage dump
Quebrada La Madera utilizada como basurero



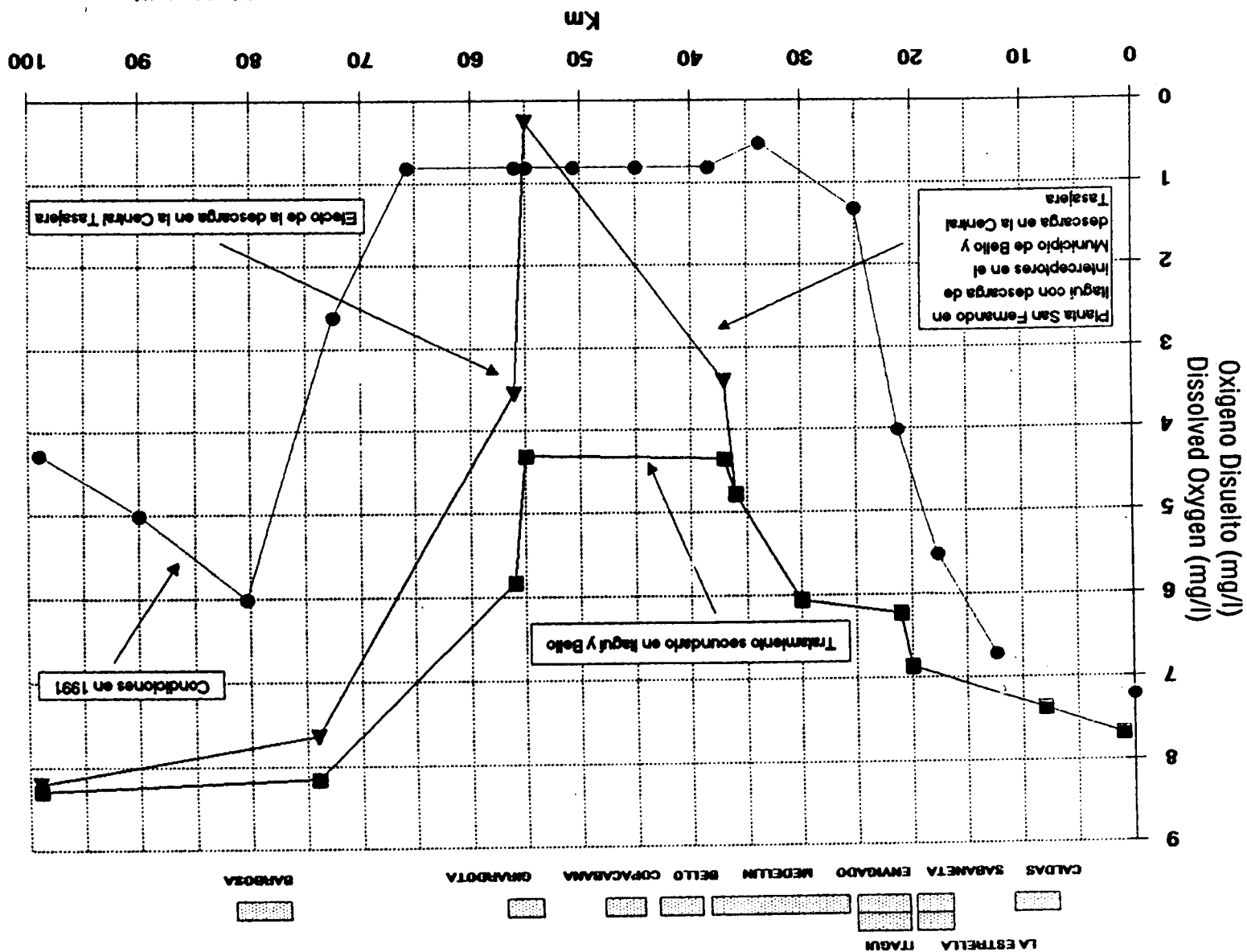
Medellin River at Km. 27 (Colombia Bridge)
Rio Medellin al Km. 27 (Puente Colombia)

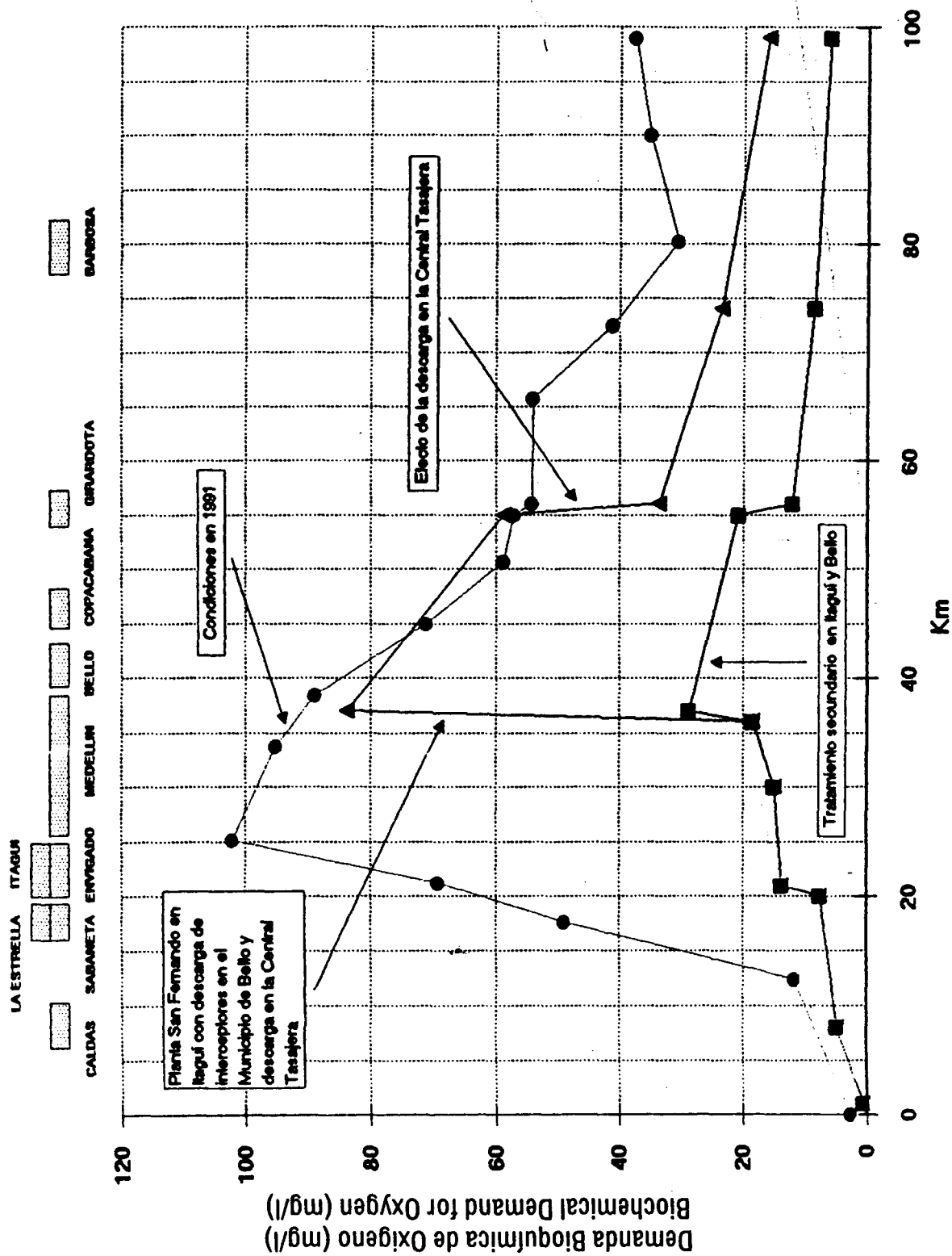


Interceptor,
currently discharging into the Medellin River,
will be connected to the
San Fernando treatment plant

Interceptor
descargando al Rio Medellin
que se conectará a la planta
de tratamiento de San Fernando

Efecto del tratamiento de las aguas residuales en el Oxígeno Disuelto del Río Medellín
 Effect of the treatment of waste waters on the level of dissolved Oxygen in the Medellín River

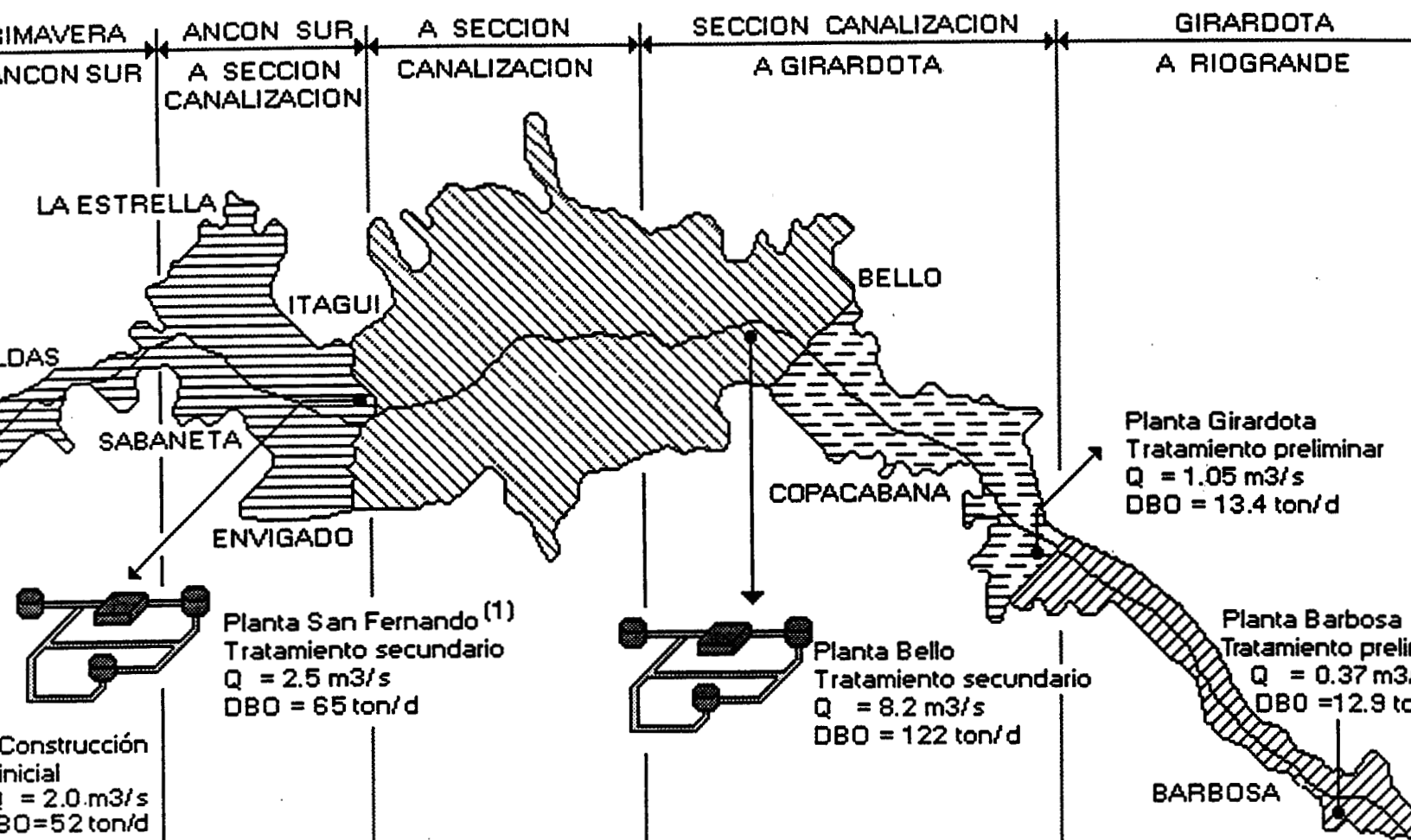




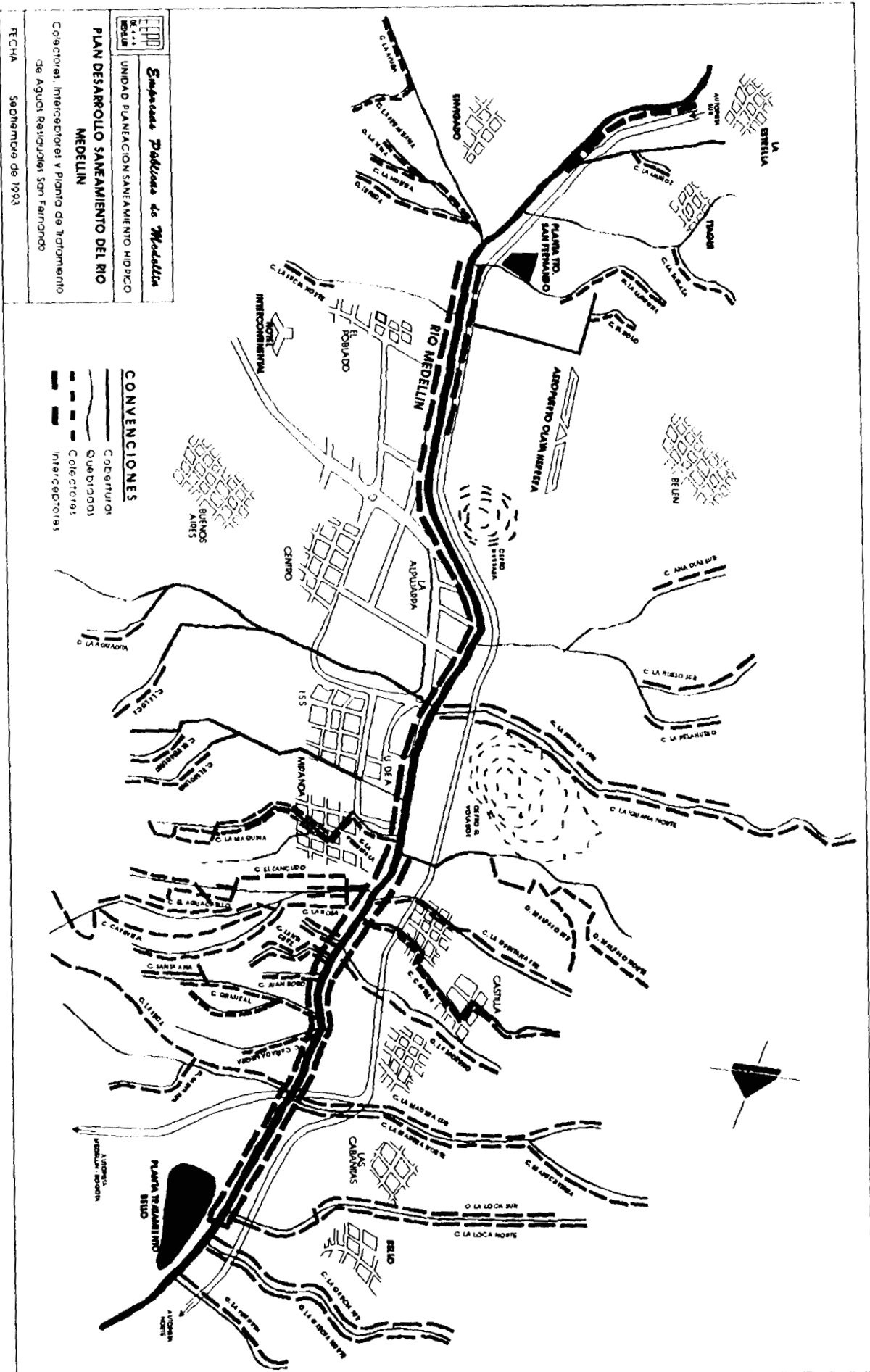
Efecto del tratamiento de las aguas residuales en la Demanda Bioquímica de Oxígeno (DBO) del Río Medellín
Effect of the treatment of waste waters on the level of Biochemical Demand for Oxygen (BDO)



Perspectiva general sobre sistema de co'lección y tratamiento de las aguas residuales en el Valle de Aburrá
 Overview of the master plan for collection and treatment of waste waters in the Aburrá valley

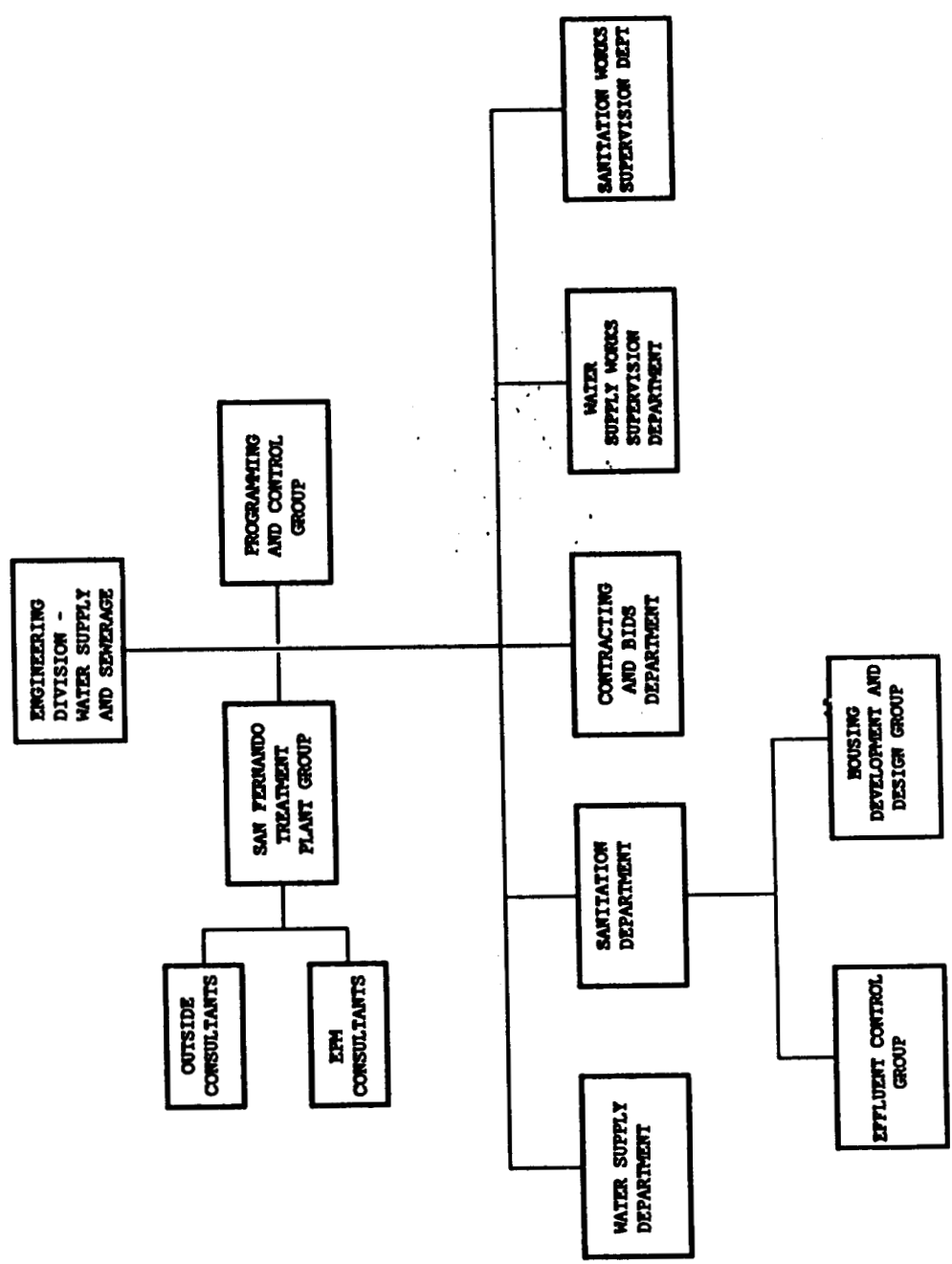


Alternativa para colección y tratamiento aguas residuales en el Valle de Aburrá

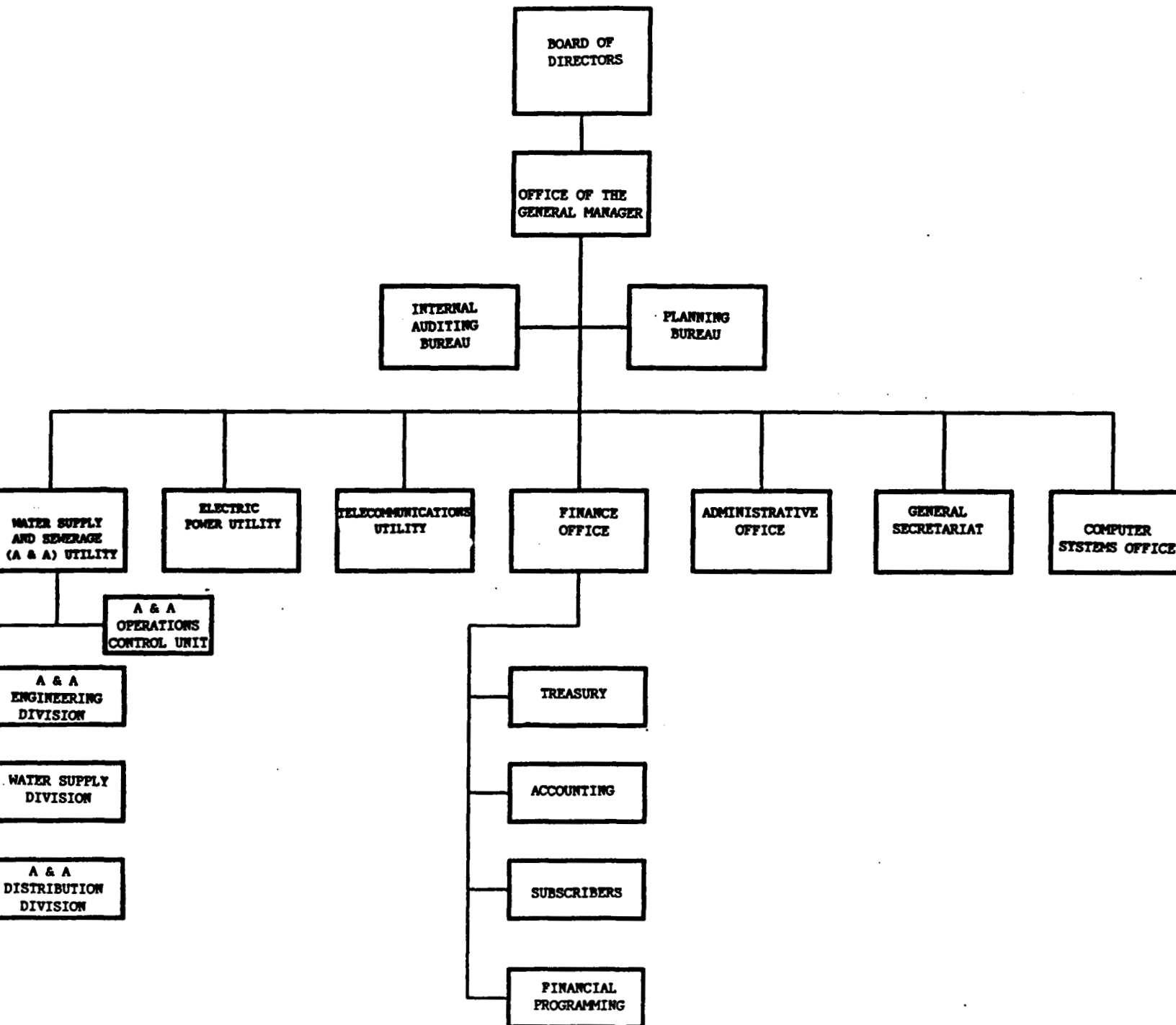


EMPRESAS PUBLICAS DE MEDELLIN

PROJECT COORDINATION UNIT



PRESAS PUBLICAS DE MEDELLIN



RESPONSIBILITIES OF EPM'S DIVISIONS

The Engineering Division is in charge of: (a) preparing or contracting and supervising the design of projects related to the expansion or improvement of the systems to collect, convey, treat, pump, and distribute water supply and the collection and treatment of wastewater; (b) controlling industrial and domestic effluents; (c) preparing, processing, and evaluating bids and contracts for the procurement of goods and services, and conducting technical and administrative supervision of the project design contracts and execution of civil works for expanding or improving water supply systems and the collection and treatment of wastewater; and (d) preparing and updating technical guidelines for the design and construction of such systems.

The Water Supply and Treatment Division is in charge of collecting, conveying, pumping, and treating water, in order to supply it to users under optimal conditions for consumption. It manages the system through the control center and designs and executes the programs to maintain and repair damaged equipment, civil works, and networks. In addition, it prepares and updates operation and maintenance manuals for the pertinent systems.

The Distribution Division handles, updates, and controls the plans for the systems, takes care of maintaining and repairing the water distribution systems, collection of wastewater, storm drains, and water measuring equipment, and measures the water pressure and flow.

The main functions of the Operations Control Unit are to conduct operations and maintenance efficiency studies, establish and monitor performance parameters and rates, study and improve office procedures, methods, and systems, and prepare and update procedural guidelines and responsibilities.

PERCENTAGE PARTICIPATION OF THE UTILITIES IN EPM

	ENERGY	WATER AND SEWER	TELECOM- MUNICATIONS	TOTAL
Operating income	69	15	16	100
Gross profit from operations	66	15	19	100
Gross cash generation	61	19	20	100
Investment	56	25	19	100
Debt service	67	18	15	100
Plant in service	56	33	11	100
Long-term liabilities	50	37	13	100
Net worth	70	22	8	100

PROPOSED RESOLUTION^{1/}

REPUBLIC OF COLOMBIA. LOAN /OC-CO TO EMPRESAS PÚBLICAS DE MEDELLÍN
(Medellín River Sanitation)

The Board of Executive Directors

RESOLVES:

That the President of the Bank, or such representative as he shall designate, is authorized, in the name and on behalf of the Bank, to enter into such contract or contracts as may be necessary with Empresas Públicas de Medellín ("EPM"), as Borrower, and the Republic of Colombia, as Guarantor, for the purpose of granting the former a financing to cooperate in the execution of activities to improve the quality of life, health, and environmental conditions for the population of the Aburrá Valley and provide for the institutional strengthening of the Borrower, hereinafter referred to as the "Project". This financing shall be subject substantially to the following conditions:

1. Amount and Currencies: Up to US\$130,000,000, or its equivalent in other currencies, except that of the Republic of Colombia, which are part of the ordinary capital resources of the Bank, to pay for goods and services acquired through international competition in the member countries of the Bank and for such other purposes as may be specified in the loan contract. Payments of amortization and interest shall be made in the currency or currencies specified by the Bank, in a quantity equivalent to the corresponding amount owed, calculated in units of account in terms of dollars of the United States of America, in accordance with provisions to be included in the loan contract.
2. Source of Funds: The ordinary capital resources of the Bank.
3. Guarantee: Joint and several guarantee of the Republic of Colombia.
4. Credit Fee: 0.75% per annum on the undisbursed portion of the financing, which fee shall commence to accrue 60 days after the

^{1/} The provisions contained in this Appendix I and Appendices II and III will be final only when the Board of Executive Directors has approved the loan proposal.

date of the loan contract and payable in dollars of the United States of America on the same dates as the interest.

5. Amortization: The Borrower shall amortize the loan in a period of 25 years from the date of the loan contract, by means of semiannual, consecutive and, insofar as possible, equal installments. The first installment shall be paid on the first interest payment date, six months after the date scheduled for the last disbursement of the financing.
6. Interest: The Borrower shall pay interest semiannually on the daily outstanding balances of the loan. The first payment shall be made six months after the date of the loan contract. The Bank shall determine the rates of interest to be applied during the life of the loan, in accordance with the lending rate policy of the Bank. At the request of the Borrower, resources of the financing may be used to pay interest during the period of disbursement thereof.
7. Physical Initiation and Disbursement: The term for physical initiation of the works included in the multiple-works component shall expire four years after the effective date of the loan contract and the term for disbursement of the financing shall expire five years after the same date.
8. Special Conditions:
 - (a) The execution of the Project and the utilization of the resources of the loan shall be carried out in their entirety by the Borrower.
 - (b) The resources of the loan shall be used to participate in the execution of a Project the total cost of which is estimated at the equivalent of US\$232,000,000. Consequently, the loan contract shall contain the appropriate provisions to ensure that such additional resources as may be necessary, in addition to the loan, for the complete execution of the Project shall be duly provided, in an amount estimated at the equivalent of US\$102,000,000, in accordance with a schedule of investments satisfactory to the Bank.
 - (c) Prior to the first disbursement of the financing, the Borrower shall present to the satisfaction of the Bank: (i) an initial proposal on the disposal of sludge generated by the San Fernando treatment plant; and (ii) a preliminary plan for the resettlement of families that may be affected by the construction of the intercepting sewer main on the northeastern bank of the Medellín River.

- (d) The Borrower and the Guarantor shall take appropriate measures acceptable to the Bank in order that the rates for the drinking water and sewerage services produce revenues at least sufficient to cover all operating expenses of the system, including those related to administration, operation, maintenance, and depreciation of its revalued fixed assets. If the application of the foregoing does not generate sufficient resources to cover the timely service of the debt of the Borrower related to drinking water and sewerage and to finance a reasonable proportion of its expansion program, necessary measures shall be adopted, which may include, *inter alia*, reduction of expenses, expansion of markets, reduction of losses, and rate increases, to obtain the additional resources required to achieve that purpose.
- (e) In the acquisition of machinery, equipment, and other goods related to the Project and in the awarding of construction contracts, the system of public bidding shall be followed in each case in which the value of such acquisitions exceeds the equivalent of US\$250,000 or the value of such contracts for the execution of works exceeds the equivalent of US\$1,000,000. The bidding shall be subject to the procedures to be appended as an annex to the loan contract.
- (f) Notwithstanding paragraph (f) above, the Borrower may execute works by force account up to an amount equivalent to US\$2,600,000, which will consist of the installation of the wastewater treatment plant equipment, the Tesoro-Las Brisas pumping station, and other operation and maintenance equipment in pumping stations and water purification plants, provided that such works have been approved by the Bank.
- (g) The Bank shall establish such inspection procedures as it deems necessary to assure the satisfactory execution of the Project and the Borrower and the Guarantor shall extend all cooperation which is required for the most effective accomplishment of this purpose. From the amount of the financing, the sum of US\$1,300,000 shall be allocated for credit to the income accounts of the Bank to meet expenses of general inspection and supervision.

RECOMMENDATIONS

- A. It is recommended that the following conditions, to be met to the Bank's satisfaction, be included in the loan contract and guarantee contract, as appropriate, in addition to those set forth in the proposed resolution:
1. Unless the parties agree otherwise, prior to issuing each call for public bids, or if there is no need for public bids, prior to the acquisition of the goods or the initiation of the works, the Borrower shall submit to the Bank: (a) the general plans, specifications, budgets, and other documents needed for the acquisition or construction and, where applicable, the specific requirements and other documents needed for the call for bids; and (b) in the case of works, evidence that: (i) it has the legal possession, easements, or other pertinent rights to the lands required for their construction and to the waters required for the Project; (ii) it has the water discharge permits required for operating the works constructed; and (iii) all the legal requirements relating to conservation of the environment and natural resources have been complied with.
 2. The Borrower shall: (a) assure that the works and equipment involved in the Project will be adequately maintained in accordance with generally accepted technical standards in order to guarantee that the Project goes into operation on the scheduled date and that it operates properly; and (b) submit to the Bank, during the 10 years following the date on which the Project becomes operational, and within the first quarter of each calendar year, a report on the condition of such Project works and equipment and the annual maintenance report for that year, in accordance with the provisions set forth in Section VI of Appendix III. Said report shall contain information regarding the change in the levels of dissolved oxygen and suspended solids in the waters of the Medellín River, and an assessment of the Project's environmental impact. If the inspections conducted by the Bank from the beginning of the execution of the Project or the reports it receives reveal that actual maintenance is below the agreed-upon levels, the Borrower shall take appropriate action to have the deficiencies fully corrected.
 3. The Borrower shall submit to the Bank for its consideration:
 - (a) a plan for the monitoring of the environmental impact of the multiple works to be submitted within six months of the effective date of the loan contract, and another for the treatment plant and intercepting sewer mains, to be submitted within 12 months of the same date. Such plans

will include the methodologies and indicators to be used to evaluate the impacts of the Project on the land, soil, air, and health of the workers during construction of the works and operation thereof. In addition, they will recommend measures for control or mitigation of the negative environmental impacts that shall be taken into consideration in the design of the works.

- (b) unless the Bank and the Borrower agree otherwise, within six months after the effective date of the loan contract, a report containing the conclusions of a study to improve monitoring of industrial discharges; and within six months following submission of said report, a plan to improve control of discharges and to reduce industrial wastewater pollution in keeping with the design parameters of the Project's collection and treatment system.
- (c) progress reports, which shall include: (i) a description of the physical, financial, and technical objectives reached during the preceding six-month period; (ii) information about the training program for treatment plant operation and about the resettlement plan; (iii) the percentage of unaccounted for water, which within the fifth year of Project execution shall have been reduced to no more than 30%; and (iv) the results of monitoring environmental impact and the actions taken to reduce pollution from industrial wastewater, in accordance with the plan mentioned in clause 3(b) above. The progress report for the second half of each year shall include a plan of execution for the following year. The final plan for disposal of sludge from the San Fernando plant, referred to in clause 8(c) of Appendix I shall be attached to the progress report for the second half of 1995. The last progress report shall be submitted within three months following completion of Project execution and shall include a comparison of the objectives of the Project, the expected results, and the results achieved, and a comparison between the originally proposed execution schedule and the actual schedule.
- (d) within 24 months after the effective date of the loan contract, the terms of reference for the study to be undertaken by the Borrower regarding rate review and adjustments that shall include information regarding long-term marginal costs and the pertinent rate structure. One year after the approval of such terms of reference, the Borrower shall submit a report with the results of the study, the financial projections for a period of ten years, and a plan to implement the recommendations regarding the rate structure, the latter shall be in accordance with the policies of the Government of Colombia.

- (e) within 42 months of the effective date of the loan contract, a report containing the conclusions of the studies relating to the second phase of the Medellín River Sanitation Project, including the identification of the components that will be part of such phase, and the possible sources of financing and schedule of execution thereof. Final conclusions shall be reached only after environmental and social impact studies and engineering studies have been completed, which shall provide greater precision in determining the costs and benefits of each of the alternatives.
 - (f) six months before the San Fernando treatment plant is scheduled to become operational, an operations and maintenance manual that includes information regarding the safety of the plant and the health of its workers. The manual shall emphasize the need to avoid interruptions in the operation of the plant and to take steps to reduce unpleasant odors during the wastewater treatment process.
- 4. The financial statements of the Project, during its execution, and those of the Borrower, during the life of the loan contract, shall be presented to the Bank annually audited by an independent public accounting firm acceptable to the Bank.
- B. The loan contract shall contain an annex substantially similar to Appendix III, The Project.

THE PROJECT

(Annex A to the Loan Contract)

I. Purpose

- 1.01 The purpose of the Project is to improve the quality of life, health, and environmental conditions of the population of the Aburrá Valley through the execution of the Medellín River Sanitation Project, which includes among its principal works the construction of a wastewater treatment plant, the construction of complementary collectors, intercepting sewer mains, and water supply systems. Moreover, the Borrower, Empresas Públicas de Medellín ("EPM"), will be strengthened through an institutional strengthening program that will include training regarding the operation of the treatment plant to be built.

II. Description

- 2.01 To accomplish the objectives described in the above paragraph, the following activities will be executed: (a) construction of a secondary wastewater treatment plant, with an initial capacity of 2 m³/second; (b) construction of 102 km of collectors parallel to the mountain streams that flow into the Medellín River and 29 km of interceptor sewer mains along the Medellín River; (c) construction of 71 km of sewers for control of discharges; (d) construction of 2,500 storm drains and 250 overflows; (e) 11,250 residential drinking water and sewer connections, 14,750 residential connections, and construction of 66 km of sewers and 82 km of drinking water systems; (f) acquisition and installation of 156,000 drinking water meters, spare parts for 150,000 water meters, and equipment to control water pressure; (g) construction of four storage tanks; (h) acquisition of 69,000 covers for drinking water meter boxes and 400 km of copper pipe; (i) realignment of nine water supply system service areas; (j) maintenance works at the Piedras Blancas dam; (k) construction of drinking water distribution systems; (l) acquisition of operating and maintenance equipment; (m) replacement of 103 km of drinking water distribution lines; (n) construction of three operations and maintenance centers; (o) institutional strengthening program; and (p) complementary activities related to the preparation of designs for the second phase of the wastewater treatment master plan (1999-2004). The above figures are understood to be approximate in accordance with the operational requirements of the entire system.

III. Cost of the Project and financing plan

3.01 The estimated cost of the Project is the equivalent of US\$232 million, in accordance with the following investment categories and sources of financing:

COST AND FINANCING OF THE PROJECT BY CATEGORY (in US\$ thousands - constant prices)				
CATEGORY	BANK	IFM	TOTAL	%
1. Administration	-	8,665	8,665	3.7
1.1. Engineering and administration 1/	-	6,000	6,000	2.6
1.2. Work supervision	-	2,665	2,665	1.1
2. Direct costs	85,260	74,150	159,410	68.7
A. Specific component	42,710	20,000	62,710	27.0
2.1. Treatment	35,150	12,110	47,260	20.4
2.1.1. Civil works	13,150	8,960	22,110	9.5
2.1.2. Equipment and assembly	22,000	3,150	25,150	10.9
2.2. Wastewater interceptor sewer mains	7,560	7,890	15,450	6.6
B. Global component	42,550	54,150	96,700	41.7
2.3. Sanitation	16,600	27,060	43,660	18.8
2.3.1. Collection	8,150	17,880	26,030	11.2
2.3.2. Transmission	8,450	9,180	17,630	7.6
2.4. Water supply system	25,950	27,090	53,040	22.9
2.4.1. Collection and treatment	5,630	1,230	6,860	3.0
2.4.2. Distribution	20,320	25,860	46,180	19.9
3. Associated costs	3,810	3,500	7,310	3.2
3.1. Future plan and institutional development	2,500	1,500	4,000	1.7
3.2. Computer systems	915	-	915	0.4
3.3. Training program	495	-	495	0.2
3.4. Resettlement of families northeastern community	-	2,000	2,000	0.9
4. Unallocated 2/	14,615	15,325	29,940	12.8
4.1. Contingencies	5,600	3,860	9,460	4.0
4.2. Cost escalation	9,015	9,465	18,480	8.0
5. Finance charges	28,215	2,360	30,575	13.2
5.1. Interest	24,915	-	24,915	10.8
5.2. Credit fee	-	2,360	2,360	1.0
5.3. Inspection and supervision	1,300	-	1,300	0.6

TOTAL	188,000	102,000	292,000	100.0
PERCENTAGES	56%	44%	100%	
<u>1/</u> Includes financing from FONADE in an amount equivalent to US\$3,196,000. <u>2/</u> Excludes global component B.				

IV. Procurement

- 4.01 (a) When goods to be procured or services to be contracted for the Project, including those related to any form of transportation or insurance, are to be financed in whole or in part with foreign exchange from the financing, the procedures and specific requirements for the bidding or other forms of contracting shall permit the unrestricted participation of goods and services from member countries of the Bank. Consequently, no conditions that would prevent or restrict the offer of goods or the participation of contractors from such countries shall be established in such procedures or specific requirements.
- (b) When sources of credit other than the resources of the financing or the local counterpart are to be used, the Borrower may agree with the creditor upon the procurement procedure to be followed. However, upon the Bank's request, the Borrower shall demonstrate the reasonableness of both the price agreed upon or paid for the purchase of the goods and services and the financial conditions of the credits. The Borrower shall also demonstrate that the quality of the goods is in conformity with the technical requirements of the Project.
- (c) For the purposes of section 3.04 of Annex B of the loan contract, "Tender Procedures", the system of prequalification or the registry of bidders shall be utilized in tender procedures for the construction of the San Fernando wastewater treatment plant, the interceptor sewer mains, and improvements to the Piedras Blancas dam.

V. Consulting services

- 5.01 In the selection and contracting of consulting services financed in whole or in part with resources from the financing: (a) the procedures agreed upon with the Bank shall apply; and (b) no conditions or stipulations may be established that would restrict or prevent the participation of consultants from the Bank's member countries.
- 5.02 With respect to consulting services financed with resources of the local counterpart, the Bank reserves the right to review and approve, prior to the Borrower proceeding with the corresponding hire, the names and background of the firms or individual consultants selected, their terms of reference and the agreed fees.

VI. Maintenance

- 6.01 The purpose of the maintenance shall be to preserve all the works of the Project in the operating conditions contemplated by the parameters of the original designs, at a level compatible with the services they should provide.

- 6.02 The first annual maintenance report shall correspond to the fiscal year subsequent to that in which the Project went into operation.
- 6.03 The annual maintenance report shall include: (i) details of the organization responsible for maintenance, the personnel involved, and the number, type, and condition of the maintenance equipment; (ii) the location, size, and condition of the repair, storage, and maintenance facilities; (iii) information pertaining to the resources to be allocated for maintenance during the current year and the amount to be allocated in the budget during the following year; and (iv) a report on the status of maintenance, based on the evaluation system established by the Borrower.

VII. Rates

- 7.01 For purposes of Clause 8(c) of Appendix I, the percentage of the investment plan of the Empresa de Acueducto y Alcantarillado (Water and Sewer Enterprise) of the Borrower to be funded each year by rate revenues from water supply and sewerage service must be at least 45% calculated as a ratio of net internal generation of funds to the total investment program.
- 7.02 Internal generation of funds is defined as total operating revenues, minus operational costs, not including depreciation or other non-cash charges. Net internal generation of funds shall mean internal generation of funds less debt service (not including capitalized finance charges) plus contributions to be made by the Borrower's Empresa de Acueducto y Alcantarillado to the Municipality of Medellín.