

**LAKE MANAGUA AND CITY OF MANAGUA ENVIRONMENTAL IMPROVEMENT PROGRAM
STAGE I**

(NI-0027)

EXECUTIVE SUMMARY

BORROWER AND GUARANTOR:	Republic of Nicaragua	
EXECUTING AGENCIES:	Instituto Nicaragüense de Acueductos y Alcantarillados [Nicaraguan Water and Sanitation Authority] (INAA), as executing agency, with the Ministry of Health (MINSA) and Instituto Nicaragüense de Estudios Territoriales [Nicaraguan Institute for Territorial Studies] (INETER) participating as coexecuting agencies. The Lake Managua Commission will serve as a forum for inter-agency coordination, discussions, and problem-solving.	
AMOUNT AND SOURCE:	IDB:	US\$15,000,000
	<u>Parallel cofinancing:</u>	
	Federal Republic of Germany:	US\$25,000,000
	Nordic Development Fund:	US\$ 5,000,000
	Local counterpart:	<u>US\$ 2,000,000</u>
	Total:	US\$47,000,000
FINANCIAL TERMS AND CONDITIONS (IDB FINANCING):	Amortization period:	40 years
	Disbursement period:	4 years
	Interest rate:	1% during the grace period (10 years), 2% thereafter
	Inspection and supervision:	1%
	Credit fee:	0.5% of the undisbursed balance
COFINANCING:	Nordic Development Fund:	
	Amortization period:	40 years
	Disbursement period:	4 years
	Interest rate:	No interest
	Inspection and supervision:	0.75%
	Credit fee:	0.50%
OBJECTIVES:	The objective of the program is to help improve the environmental conditions and quality of life of residents of Managua. This is a long-term program, to be carried out in stages. The specific objectives of this first stage are: (i) clean-up and drainage of the strip of the lakeshore facing the city, which	

is presently a focus of infection for waterborne and vector-transmitted contagious diseases that affects the entire population, but mainly the inhabitants of the lakeshore area; (ii) rehabilitation and modernization of the city's sanitary sewerage services, which will bring about a substantial reduction in the discharges of municipal sewage (currently dumped directly into the lake) by means of its collection, interception and treatment, with a view to improving environmental and sanitary conditions and restoring the aesthetic qualities and recreation potential of the lake; (iii) education and community participation in campaigns to control diseases and vectors; and (iv) development and execution of a plan to monitor the human and environmental health indicators of the lake and the lakeshore area.

DESCRIPTION:

Accomplishment of the program's objectives will require execution of various actions that will contribute jointly to achievement of the general objective. To this end the following three components will be financed:

1. Rehabilitation and modernization of Managua's sanitary sewer system. The program will finance priority investments for the first stage of the Managua Sanitary Sewerage Master Plan. This will serve to prevent the surface flow of wastewater and the formation of sewage deposits on the lakeshore with the resultant negative impacts on residents' health; it will also make expansion of household connections feasible, while the treatment employed will prevent discharges of raw sewage into the lake, thereby improving the quality of the water in the bay fronting the city and making it available for recreational use. This component comprises: (i) sewer mains, including both rehabilitation and construction of main sewers; (ii) intercepting structures, which includes sewer lines and low-load pumping stations for carrying effluents to treatment sites; and (iii) treatment facilities, consisting of 67 hectares of facultative (aerobic-anaerobic) lagoons for biological treatment of effluents, and ancillary facilities.

The direct capital cost of this component is US\$35.6 million (not including finance charges or escalation and contingencies). Up to US\$21.5 million of this amount would be obtained through parallel cofinancing from the Federal Republic of Germany for the treatment facilities.

2. Environmental sanitation of the shores of the lake fronting Managua, at a cost of US\$2.8 million. The investments envisaged in this component are aimed at achievement of the objective of reducing the incidence of vector-borne diseases, especially malaria. The actions planned form part of a comprehensive control strategy which includes: elimination of Anopheles mosquito breeding grounds by drainage and clearing of marshes, leveling of low-lying areas, and construction of facilities for draining rainwater into the lake, together with biological control of mosquito larvae and a program of community education and participation.
3. Program monitoring and environmental evaluation plan (US\$0.85 million). The purpose of this component is to define and evaluate the parameters that affect the environmental health of Lake Managua, especially the processes causing eutrophication, as a planning tool for short- and medium-term management actions. It comprises a plan for periodic monitoring and evaluation of biological, physical and chemical parameters in action in the lake and its catchment basin; formulation and validation of predictive mathematical models for fecal coliform bacteria, eutrophication, heavy metals and solids; and execution of annual epidemiological and entomological evaluations.

**ENVIRONMENTAL
CLASSIFICATION:**

The Environment Committee, at its meeting of July 14, 1994, classified this as a Category III operation. The environmental summary was approved on February 13, 1996.

POVERTY TARGETING:

The program will benefit the entire population of Managua (estimated at 880,000 in 1995) either directly or indirectly; however, its direct impact will center on the 120,000 people living on the shore strip facing the lake. They constitute the neediest of the city's population with the highest level of unmet basic needs; they live in permanently unhealthy conditions and include a large percentage of families with incomes below the urban average. The Bank has set the poverty threshold for Nicaragua at 264 córdobas per capita per month; 40% of Managua's population is below this line. Fifty percent of the lakeshore population is classified as poor and 18.4% have per capita incomes below 100 córdobas. The program accordingly meets the two criteria set out in the Eight Replenishment document for investments connected with poverty alleviation. Because it has

environmental protection and sanitation objectives, the program is classified as a social and environmental protection program.

BENEFITS:

The three components of the program will produce benefits that will include: (i) improvement in health conditions along the lakeshore and in the waters of the lake, through reduction of the incidence of the agents that transmit malaria and other diseases such as dengue fever, cholera, parasitic infections and diarrhea; depending on the effectiveness of the measures taken, a reduction of between 60% and 90% in the number of malaria cases is expected; and (ii) an improvement in the quality of the lake water, as a result of the significant reduction in the amount of raw sewage discharged into the lake. The quality indicators achievable will be consistent with the standards for non-contact recreational use; it will be feasible to reach higher quality levels in future stages. The program will also facilitate the urban development plan for downtown Managua, by enabling the sanitary rehabilitation of the city core together with economic revitalization of the waterfront area. Likewise, the work to be done on the main sanitary sewer system will enable expansion of household connections and an increase in the percentage of the population served by this system, which is an essential general sanitation facility for the city of Managua.

RISKS:

The risks associated with this operation are connected with: (i) the importance of uninterrupted support for the program from the participating institutions; (ii) the need for proper use to be made of data obtained from the monitoring and evaluation, in order to be able to plan the development of subsequent more advanced stages of environmental sanitation and rehabilitation; and (iii) the need for proper operation and maintenance of the treatment facilities. In order to minimize the likelihood of problems in this respect, the following steps have been taken: (i) a simple coordination structure has been designed, which is accepted and known by the executing agencies, namely the Lake Managua Commission, is an inter-agency body which will contribute the coordination and consultation elements necessary for effective execution and monitoring; (ii) support will be furnished for a process of structural reforms in the water and sanitation sector that will make for greater levels of efficiency in the operation of the services; (iii) provision has been made to ensure that the executing agency will have sufficient revenues to guarantee sustainable operation and

maintenance; and (iv) provision is included for training the executing agency's technical personnel in the proper operation of the treatment systems.

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

The main objective of the Bank's strategy in Nicaragua is achievement of sustained economic growth with equity, with an essential requirement for accomplishment being maintenance of economic stability and consolidation of structural reforms. The four main instruments of this strategy are: (i) easing of the country's financial situation by reduction of the external debt; (ii) support for development of the private sector, especially in agriculture, which drives the Nicaraguan economy, and reactivation of production for export; (iii) contributing to reduction of poverty and development of human capital; and (iv) promoting of sustainable natural resources management and protection of the environment. On the basis of this strategy, the Bank and the national authorities have agreed on a lending program that includes an environmental sanitation and protection operation designed to benefit the residents of the Managua metropolitan area.

**CONTRACTUAL CONDI-
TIONS PRECEDENT
TO THE FIRST
DISBURSEMENT:**

In addition to the standard contractual conditions for this type of operation, the following conditions are to be included in the loan contract. Prior to the first disbursement, the borrower shall demonstrate to the Bank:

- a. that it has signed an agreement with INAA for transferring to that agency the proceeds of the financing, the functions that will fall to it as executing agency for the program (paragraph 3.4), and the obligation to contribute the counterpart funds that are its responsibility (paragraph 3.17);
- b. that it has formalized the designation of MINSA and INETER as coexecuting agencies responsible for the execution of the lakeshore improvement and monitoring plan components, respectively, and that these institutions have signed agreements with INAA for inter-agency coordination of the program (paragraph 3.4); and
- c. that it has obtained the necessary commitments for the additional funding offered by the Government of the Federal Republic of Germany and by the Nordic Development Fund (paragraph 2.8).

**OTHER SPECIAL
CONTRACTUAL
CONDITIONS:**

- a. No later than six months after the effective date of the loan contract, INAA, in coordination with the Lake Managua Commission, is to submit, to the Bank's satisfaction, the final plan for the resettlement of the families affected by the program works (paragraph 5.16(a)); and before starting construction of works that will involve resettlement, INAA is to demonstrate to the Bank that such resettlement has been satisfactorily effected (paragraph 3.24).
- b. Before opening competitive bidding for works, INAA shall have contracted the consulting firm to be responsible for supervision of the respective works (paragraph 3.8).
- c. In the 12 months following the effective date of the loan contract, INAA shall hire the consultants who are to develop the lake water quality model, in accordance with terms of reference agreed with the Bank (paragraph 2.17). INAA will publish water quality indicators for the lake each month in a local newspaper of wide circulation (paragraph 2.11).
- d. INAA, MINSA, INETER, and the Bank, in coordination with the Lake Managua Commission, shall hold at least one annual meeting before October 31 of each year during the program execution period, to review the progress achieved during the preceding period and to plan and agree on the activities of the coming year. The progress achieved will be measured against the performance benchmarks agreed on. The second such annual meeting will be expanded to a mid-term review (paragraph 3.19).
- e. INAA agrees to take the necessary measures to ensure that its activities generate sufficient resources to cover its operating expenses, to carry out the investments necessary for the replacement of its assets and for the payment of its debt (paragraph 4.29).
- f. Among the necessary measures referred to in paragraph (e) above, INAA shall apply: (i) before December 31, 1997, in accordance with Tariff Decree 32-95, the new tariff structure contained in the National Tariff Study of January 1995; and (ii) before December 31, 1998, long-run marginal cost tariffs, in accordance with the long-run marginal cost studies to be made in 1996 and 1997 (paragraph 4.17).

- g. The collection levels of balances due for services provided by INAA shall be at least 83% for 1997, 85% for 1998, and 86% thereafter (paragraph 4.23).
- h. From the effective date of the loan contract and until one year after the last disbursement, INAA shall follow the investment plan agreed with the Bank and shall not assume any new financial obligations without the Bank's consent (paragraph 4.18).

Pursuant to Part III, Section 2(a), of the Regulations of the Board of Executive Directors, this operation must be submitted for consideration by the Committee of the Whole.

I. FRAME OF REFERENCE

A. Economic recovery and the situation of the environmental protection and sanitation sectors

- 1.1 In addition to the substantial achievements in terms of the peace process and strengthening of the democratic system, the structural measures adopted by the Nicaraguan government in the past six years have produced results that are apparent in an incipient economic recovery.
- 1.2 The transformation strategy for the economy consists in seeking sustained and equitable economic growth, assigning the private sector an essential role as the engine of economic activity, and making the market primarily responsible for resource allocation. The purpose of the reforms implemented is to strengthen the function of the State as facilitator of economic and social development, with responsibility for protecting the most vulnerable groups, establishing appropriate regulatory frameworks, and providing basic infrastructure, of both the production and the service categories.
- 1.3 Within this context, the government, with the support of the Bank and other cooperation agencies, is taking steps to: (i) improve the delivery of basic services in health, education and sanitation; (ii) improve the performance and promote the decentralization of public utilities, which include water supply and sanitation; (iii) protect the environment and improve natural resource management; and (iv) reduce extreme poverty.
- 1.4 The biggest challenge currently facing Nicaragua is achieving economic growth with equity. The reduction of widespread poverty is a high priority for the country; this situation is both cause and effect of the poor health status of the population. The nation's unsatisfactory health indicators reflect the poor environmental conditions, which in turn are closely correlated with income levels. In short, in Nicaragua the problems of poverty and degradation of the environment are closely related.
- 1.5 The incidence of waterborne diseases and diseases transmitted by water-related vectors is especially high. The national coverage percentages for water and sewerage services - 60% and 20% respectively - explain why communicable diseases associated with deficiencies in or absence of these basic services continue to be the main cause of morbidity and mortality.

B. Environmental setting of the city of Managua and Lake Managua

- 1.6 The city of Managua is located on the shores of the lake of the same name; hence the environmental importance of the lake itself and of its catchment basin. Around 1.12 million people (26% of the

country's population) live in the southern subbasin (825 km²), in which Managua is located; in this part of the basin, groundwater — on which the city depends for household and industrial uses — is readily replenished. The city is built on a plain of volcanic deposits overlying numerous tectonic faults, some of which are active. Downtown Managua was destroyed by an earthquake in 1972 and the city has not yet recovered from the damage then caused to its infrastructure.

- 1.7 The entire lake basin measures 6,700 km², the lake itself occupying 1,016 km². It is a closed basin without surface outlets except in times of exceptional precipitation. The lake's drainage channel is also partially obstructed. The water is saline, and the species that live in the ecosystem are adapted to this situation. There are various species of fish, some of them of commercial value, but they cannot be eaten at present because of the health hazards from pollution. Arsenic and mercury levels in fish flesh are particularly high.
- 1.8 The lake and the urban area within its zone of influence are subject to the action of numerous pollutants. Because of its location in relation to the city the lake is the receiving body for the city's domestic wastewater, waste generated by industries, trash that is dumped in stormwater conveyances, and sediment carried by surface runoff. As a result, the lake has lost its aesthetic and recreational value for the city. In Miraflores Bay across from the city, the water has a high fecal coliform content, with considerable floating material and also oils and grease that produce foul smells so that, in short, the quality of the water makes it unusable for recreational purposes and detrimental to health and urban development.
- 1.9 The lake has entered into a process of environmental decline or eutrophication, triggered by the interaction of various factors in a manner that is complex and has not yet been fully studied. The process is influenced by, among other things, nutrients in sediment entrained by rainfall or non-point inputs. Contributing to the problem are point-source inputs from Managua's sewage, laden as it is with nitrogenous compounds and phosphatic detergents, which promote the proliferation of algae and deprive the water of the oxygen necessary for the vital processes of the lake ecosystem.

C. Health problems of Managua

- 1.10 The urban population of the municipality of Managua numbers 880,000, according to 1995 census data, and is expected to grow to 1,780,000 by the year 2020. Most of the city's residents are directly exposed to health hazards. Environmental conditions such as lack of sanitation and socioeconomic circumstances such as poverty and poor hygiene create favorable conditions for transmission of gastrointestinal, respiratory and vector-borne diseases; the extensive aquatic habitats on the northern edge of the city,

some of them immediately adjacent to densely populated areas, are breeding grounds for mosquitoes that transmit malaria and other diseases. Despite control efforts of the Ministry of Health, the incidence of malaria in Managua has risen at an average annual rate of 44% over the past five years, with around 20,000 cases reported in 1995.

- 1.11 The closer the urban settlements are to the lake, i.e. basically along the lakeshore strip, the greater the health problems. The quality of services declines, the number of squatters with makeshift housing increases, and the incidence of malaria, cholera, dengue fever and diarrhea rises. Around 120,000 of the city's inhabitants live in a 2-km-wide strip parallel to the lakeshore, in the highest-risk area.
- 1.12 At the present time about 1,390 liters per second, or around 120 million liters per day, of wastewater is discharged directly into the lake. The sanitary sewer system is of the conventional type; it operates by gravity and covers 65% of the city but only serves 50% of the population. The system is at the end of its useful life, its pipes having seen some 50 years' service, and is plagued by obstructions caused by sediments and rainwater infiltration. The mains are partially destroyed, especially in the last sections; sewage accumulates in depressions in the land and ultimately runs into the lake at 28 points. In various parts the effluent is diverted and used to irrigate vegetable crops grown for the Managua market, with the consequent health hazard to consumers.

D. Factors that have prevented solution of the problems

- 1.13 Various circumstances have combined to bring about the present state of affairs and have prevented steps being taken to correct the situation. In the first place, the 1972 earthquake profoundly changed Managua's urban structure and the delivery of basic public utilities. The country subsequently adopted a centralized economic system for a period of 10 years, with inefficient resource allocation and distribution; during this period the quality and coverage of drinking water and sewerage services deteriorated markedly.
- 1.14 The political and social disturbances of the past decade sparked a considerable influx of population into Managua from conflict-torn rural areas, causing a pronounced surge in demand for services. Unregulated squatter settlements sprang up following illegal take-overs of vacant land, with makeshift dwellings and without services, or else with services obtained through unauthorized hook-ups.
- 1.15 The central government and the municipal authorities are now embarked on the complicated task of regularizing and bringing order into these settlements on the legal and other fronts. An important step in this direction was the approval, in October 1995, of the Law on Stabilization of Ownership.

E. Long-range view of the solution to environmental problems of Lake Managua and the city of Managua

- 1.16 Taking care of Managua's environmental and social problems is an inter-agency task that involves central government agencies and the city government. As regards the management and planning of water and land use, the entire basin has to be considered the basic planning unit. Accordingly, in 1991, the government established the Lake Managua Basin Commission as an inter-agency body for planning and coordinating environmental rehabilitation actions.
- 1.17 The analysis of the problems described indicated that the environmental sanitation and recovery work is of a long-term nature and will require both simultaneous and sequential actions. The following priority areas were identified: (i) rehabilitation and modernization of the sanitary sewerage system, including treatment of both household sewage and industrial effluents; (ii) clean-up and improvement of the lakeshore, with emphasis on control of vector-borne diseases; (iii) improvement of solid-waste management; (iv) study of the factors causing the lake's environmental decline and monitoring of recovery indicators; and (v) reduction of erosion and of the carrying off of sediments.

F. Priority action areas

- 1.18 In the short term, the first four action areas are those that most directly affect the health and welfare of Managua residents and need immediate attention. The program presented in this document is designed to resolve the problems of: (i) sanitary sewerage and sewage treatment; (ii) lakeshore clean-up and improvement; and (iii) modeling of water quality and monitoring of environmental recovery indicators.

G. Related activities addressed in other programs

- 1.19 As explained further on, solid-waste management has been the subject of a separate study with assistance from the Japanese government, together with the financing of the resulting measures.
- 1.20 The phenomena of erosion and sediment carry-off were analyzed as part of the preparation of this operation; as a result, an agro-forestry management and soil conservation component for critical areas of the southern watershed were included in a Bank forestry development loan (NI-0025). As for the rehabilitation of the city's primary drainage system, although this was studied as part of the preparation for the operation, it is not included in this stage because its cost would exceed the financing available and it is not one of the activities requiring immediate action.
- 1.21 The study of industrial effluents made as part of the preparation complemented studies begun by the Ministry of the Environment and Natural Resources (MARENA) with assistance from the Danish

International Development Agency (DANIDA), and resulted in an analysis and characterization of the effluents of 64 industries. In June 1995 measures for control of these effluents were announced through Decree 33-95: Provisions for Control of Pollution resulting from Discharges of Household, Industrial and Agricultural Effluents.

- 1.22 The audits performed by MARENA and the studies made by consultants concluded that the majority of the industries would be able to comply with the provisions within a reasonable timeframe, which was specified in the decree. Six industries will require technical assistance to meet the effluent standards; it is considered that MARENA will be able to provide this assistance with DANIDA bilateral aid.
- 1.23 The studies made also indicated that the level of the lake will have to be controlled, both to be able to build the sewage lagoon dikes on the shore in safety, and to prevent rises in water level during periods of exceptionally heavy rainfall from flooding the shores, with the resultant harm to sanitation and public health along the lakeshore. A level-regulation structure will accordingly be built at Tipitapa that will free up the lake's natural outflow channel that is currently obstructed by the Pan American Highway. The financing for this structure has been included at the government's request in the road rehabilitation and improvement program (NI-0068) recently approved by the Bank.

H. Regulatory and institutional framework of the water and sanitation sector

- 1.24 Nicaragua recently set in place the foundations of a regulatory framework for the environmental and sanitation sectors: in April 1996, the General Environmental Law was approved, while a draft version of a General Water Law is also under preparation, with DANIDA assistance, and will be completed by the end of 1996. In addition, the legislature is considering a Draft Law on Water Supply and Sewerage Services, with support from the Bank, to restructure and modernize the sector.

1. Instituto Nicaragüense de Acueductos y Alcantarillados
[Nicaraguan Water and Sanitation Authority] (INAA)

- 1.25 INAA is the autonomous public agency responsible for planning the execution and operation of Nicaragua's municipal water supply and sanitary sewer systems.
- 1.26 The country's water and sanitation sector is being restructured with Bank support. The National Assembly is studying the above-mentioned draft law on water and sewer services, which will separate regulatory functions from service delivery. The law will modify the structure of the present INAA to eventually create a regulatory agency and a business enterprise, the latter being

Empresa Nicaragüense de Acueductos y Alcantarillado [Nicaraguan Water and Sewerage Enterprise] (ENACAL). A reform of the tariff structure is also under way and steps are in progress that will lead to regionalization and ultimately privatization of the services.

2. Other institutions

- 1.27 In addition to INAA, the following agencies participate in the sector: (i) the Ministry of Health, with responsibility for control of water quality and application of sanitation and epidemiological control measures; (ii) the Ministry of the Environment and Natural Resources (MARENA) which, with the assistance of local governments, is responsible for protecting water resources, especially water sources and bodies of water that receive effluents; (iii) the municipalities, which with INAA's support handle the administration of water supply and sanitation in the scattered rural sector; and (iv) Instituto Nicaragüense de Estudios Territoriales [Nicaraguan Institute for Territorial Studies] (INETER), which is responsible for maintaining the inventory of the country's natural resources.

I. Bank operations in the sector

- 1.28 A drinking water and sewerage systems rehabilitation program approved at the beginning of 1992 (loans 675/OC and 881/SF) is currently under way in Nicaragua. The proceeds of the financing have been used to replace and rehabilitate infrastructure and improve the quality of services, especially water supply, and for institutional strengthening, through personnel training and improving of business performance. Funds from the financing have been used to help produce studies such as the Managua Sanitary Sewerage Master Plan, with a planning horizon running up to the year 2020, the first stage of which forms part of the proposed program; studies on tariffs and on valuation of fixed assets, and studies on regionalization and prioritization of investments.
- 1.29 The above-mentioned operation was approved under near-emergency conditions. The initial lack of final designs and specifications for works execution, plus the shortage of qualified technical personnel, caused delays in implementation. These problems were eventually overcome with the active intervention of Bank personnel; the operation is currently proceeding normally and will be completed at the end of 1997. The Bank's financing has benefited Managua and 20 other cities.
- 1.30 The public utilities reform program (933/SF) is supporting the restructuring of the water and sanitation sector in the way mentioned above; it is described in chapter IV of this proposal.

J. Operations of other international agencies in the sector

1.31 The chief complementary activities in the sector covered by the proposed program are:

- a. Program for Improvement of Solid-Waste Management. The feasibility study was prepared by the Office of the Mayor of Managua, with assistance from the Japanese government through the Japanese International Cooperation Agency (JICA). Japan has indicated its intention to finance essential works for the improvement of solid-waste management, such as a new sanitary landfill.
- b. A water and sanitation program being prepared by the World Bank, in coordination with the IDB, complements investments and measures of the rehabilitation program and the present operation. It will have a works component and an institutional support component. The works will include household connections for water and sewer service in Managua squatter settlements, and improvements in water distribution networks. The institutional support will include help in implementing measures envisaged in the Bank's public utilities reform program, through strengthening of the commercial, financial and operating areas.
- c. With technical assistance from the City of Amsterdam, the Office of the Mayor of Managua has prepared a plan for the rehabilitation and urban development of downtown Managua.

1.32 The above experiences and assistance have been taken into account in the design and dimensioning of the program proposed herein.

K. Bank strategy

1.33 The objective of the Bank's strategy in Nicaragua is achievement of sustainable economic growth with equity. Instruments for accomplishing this strategy are the improved delivery of services in health, basic education, sanitation and environmental protection and sustainable management of natural resources. The program proposed herein is consistent with this strategy.

L. Results expected from the program

1.34 The program described in the next chapter will focus on solving the critical aspects outlined. The following are the expected results:

- a. Clean-up and improvement of the lakeshore zone fronting the city, with a substantial reduction of the incidence of cases of malaria and other vector-borne diseases.

- b. Rehabilitation and modernization of the main sanitary sewer system to upgrade the service and accommodate additional connections to the system.
- c. Treatment of sewage so that it can be discharged into the lake at a level of effluent quality that permits non-contact recreational use and urban improvement of the central part of the city.
- d. A monitoring and modeling system for the environmental conditions of the lake.

II. THE PROGRAM

A. Objectives

- 2.1 The objective of the program is to improve the environmental conditions and quality of life of the inhabitants of Managua. As described in the preceding chapter, a large part of the environmental problems of the city of Managua and of the lake derives from the deficiencies of the present sanitary sewerage system and the lack of sewage treatment, which pollute the environment and generate unhealthy conditions which affect large segments of the population and especially the poorest groups who live along the lakeshore strip.
- 2.2 The importance of taking steps to correct these deficiencies and the reason for assigning high priority to this stage of the program is that without these sanitation works and measures it will not be possible to reduce the high incidence of malaria and other diseases, which is currently rising alarmingly from year to year. At the same time, and in addition to their health benefits, these actions will contribute to the environmental recovery of the lake, which will benefit the entire population since it will make walks and recreational visits enjoyable and will help revitalize downtown Managua.
- 2.3 The program here presented is designed to solve the problems described. To this end the following specific objectives have been set: (i) improvement of health conditions by reducing and controlling household and industrial sources of effluent pollution; (ii) upgrading sanitary sewer services; and (iii) restoring the lake's recreational uses.
- 2.4 To achieve these objectives, execution of the following components is proposed:
 - (i) rehabilitation and modernization of sanitary sewer services and sewage treatment;
 - (ii) clean-up and improvement of the lakeshore fronting the city;
 - (iii) development of a plan for modeling the quality of the lake water and monitoring environmental health trends and indicators.
- 2.5 These components form an integrated approach to help resolve the environmental problems that are making life difficult for the people of Managua, and focus on taking care of the priority problems identified by those involved, as determined by means of

surveys. The findings of these surveys are consistent with those of studies conducted by consultants and Nicaraguan institutions.

B. Description of the subprograms or components

1. Rehabilitation and modernization of Managua's sanitary sewer system and sewage treatment (US\$35.6 million)

- 2.6 This component covers the scope of work and targets proposed for the first stage of the Managua Sanitary Sewerage Master Plan. It includes sewage collection, conveyance or interception, treatment and disposal. The collection works consist in reconstruction of the portions of the sewer mains (45 km) that are currently in worst shape and which form the basis of the modular system and presently discharge at 28 different points; the interception and conveyance of sewage flows from these lines, which will be done by means of construction of seven intercepting sewers (19 km) to convey the flows, mainly by gravity, to two treatment sites; pressure pipes (3 km) and six low-load pumping stations with a total installed capacity of 292 kW for support at sites where gravity flow is not possible; and construction of facultative (aerobic-anaerobic) sewage treatment lagoons (67 ha) for removal of solids, floating material, oils and greases and to eliminate bacteria and other fecal pathogens and reduce the biochemical oxygen demand.
- 2.7 Execution of the component will rehabilitate the system for continuation and expansion of the service; it will eliminate lateral flows along the shores of the lake with their negative health impacts and remove a major source of pollution while enabling recreational use of the lake in accordance with the standard proposed by MARENA for this body of water. This standard (Decree 33-95), which corresponds to non-contact recreational use, is consistent with the country's economic conditions and degree of relative development and compares favorably with criteria and standards applied in other developing countries.
- 2.8 The direct cost of the sewer mains and intercepting sewers, including pressure pipes and pumping stations, is US\$13.9 million. The Bank's loan will help finance these investments, in conjunction with a parallel loan from the Nordic Development Fund (NDF). The treatment system, made up of the facultative ponds and their discharge facilities, has a direct capital cost of US\$21.5 million, including resettlement and environmental mitigation measures, and will be funded by the Government of the Federal Republic of Germany through a parallel financing facility.
- 2.9 In addition to reconstructing and modernizing a dilapidated system, the component will enable progressive increasing of sewer service coverage. The Managua Sewerage System Master Plan calls for the present 50% coverage ratio to rise to 72% by the year 2020. The Bank's funds will be concentrated on rehabilitation of the main or intake structures of the sanitary sewer system; expansion of

household connections is not included in this stage. These will be financed (i) with the beneficiaries' own resources, in the case of new urban developments; (ii) with funding from the Emergency Social Investment Fund (FISE); and (iii) in the case of the low-income settlements to be legalized, by means of a water and sanitation program being prepared in parallel as a complementary operation by the International Development Association of the World Bank Group.

2. Clean-up and environmental improvement of the city of Managua lakeshore (US\$2.8 million)

- 2.10 This component is designed to reduce the incidence of malaria and other diseases. This will be achieved by implementation of an integrated control plan that will complement the measures routinely carried out by MINSA, and includes the following specific actions: (i) drainage and elimination of around 170 vector mosquito breeding grounds by means of ditching, maintenance, clearing and grading; construction of six structures for safe discharge of rainwater flows into the lake, thereby preventing water from spreading over the shore area; (ii) biological vector control, by means of production and application of biolarvicides (*Bacillus sphaericus*); (iii) entomological and epidemiological monitoring; and (iv) health education actions. These measures are expected to reduce malaria cases by between 60% and 90%.

3. Water quality modeling and monitoring plan (US\$0.85 million)

- 2.11 This component will make it possible to develop a water quality model for Lake Managua and monitor the findings in order to evaluate, in the short term, the benefits of the treatment of household sewage and industrial effluents in terms of reduction of fecal coliform bacteria and other pollutants of household and industrial origin. It will also make for a better understanding of the interaction of the physical, chemical and biological parameters that are at work in the lake and are influencing the eutrophication/oxygenation, sedimentation and salinization processes. INAA will publish the lake's water quality indicators for the public's information.
- 2.12 Through development and validation of a predictive-type mathematical model, the modeling process will make it possible to answer questions such as: what will be the status of the eutrophication process of the lake, following the collection and treatment of effluents; what would be appropriate eutrophication control measures and how could they be built into long-term management plans; what would be the effect of controlling sediment discharges into the lake by reducing erosion and its impacts on photosynthesis processes; what are the natural sources of the arsenic in the lake and what control measures are possible; how long will it take to remove mercury from the ecosystem now that the industrial source of mercury pollution has been eliminated; and when will it be possible

to lift the restrictions and health recommendations concerning consumption of fish from Lake Managua.

- 2.13 In short, this activity will provide essential information for decision-making on sanitation and management actions for the Lake Managua basin in the short and long term and criteria for the preparation of a second stage.

C. Status of preparation of the program

- 2.14 The technical and economic feasibility studies have been completed together with the environmental assessment of the program, and the working drawings or final designs for putting the works out to bid are well along.

1. Managua sanitary sewer system

- 2.15 As part of the feasibility study six technical alternatives were studied and the least-cost one was selected. The final or working designs for this component will be ready in July 1996; international bidding will then be possible, in modules suited to the different cofinancing arrangements involved. The packages will include construction plans, technical specifications and bidding documents.

2. Clean-up and environmental improvement of the city of Managua lakeshore

- 2.16 The studies conducted have made it possible to identify the locations, by neighborhood or sector, that will require ditching, clearing and grading to eliminate mosquito breeding haunts. A detailed inventory of these sites is available, with the investment budget, together with a breakdown of the budget and actions necessary for producing larvicides, for health education campaigns, and for entomological and epidemiological monitoring. In addition, the contracts have been awarded for the final engineering drawings for the discharge structures for the six stormwater channels that flow into the shore area. These designs will be ready by the end of 1996.

3. Water quality modeling, monitoring and evaluation

- 2.17 Detailed terms of reference are to hand for the consultant services needed for water quality modeling, sampling, and the obtaining of information for the modeling work, concerning oxygenation/eutrophication, fecal coliforms, heavy metals and limnographic data.

D. Cost and financing of the program

1. Total cost

2.18 The total cost of the program is estimated at US\$47 million, as set out in Table II.1:

INVESTMENT CATEGORIES INVESTMENT COSTS BY CATEGORY AND SOURCE OF FINANCING (US\$000)						
CATEGORIES	FSO	KfW	NDF	LOCAL	TOTAL	%
1. ADMINISTRATION	582	1,047	115	771	2,515	5.4%
1.1 Supervision	582	1,047	115	0	1,744	3.8%
1.2 Executing unit	0	0	0	771	771	1.6%
2. SANITARY SEWERAGE	11,053	20,497	2,276	140	33,966	72.2%
2.1 Structures	11,053	19,894	2,276	0	33,223	70.6%
2.2 Resettlement	0	603	0	140	743	1.6%
3. SHORE CLEAN-UP	0	0	2,187	505	2,692	5.7%
3.1 Works	0	0	2,187	0	2,187	4.7%
3.2 Inputs	0	0	0	153	153	0.3%
3.3 Labor	0	0	0	152	152	0.3%
3.4 Health education	0	0	0	200	200	0.4%
4. MODELING PLAN AND MONITORING	734	0	0	116	850	1.8%
4.1 Equipment	234	0	0	0	234	0.5%
4.2 Lab. analysis	0	0	0	116	116	0.2%
4.3 Studies	500	0	0	0	500	1.1%
5. PPF REPAYMENT	1,500	0	0	0	1,500	3.2%
SUBTOTAL	13,869	21,544	4,578	1,532	41,523	88.2%
6. UNASSIGNED	585	3,456	366	402	4,809	10.2%
6.1 Contingencies	44	2,174	139	329	2,686	5.7%
6.2 Cost escalation	541	1,282	227	73	2,123	4.5%
7. FINANCE CHARGES	546	0	56	66	668	1.5%
7.1 Interest	396	0	56	0	452	1.0%
7.2 Credit fee	0	0	0	66	66	0.2%
7.3 Insp. and supervision	150	0	0	0	150	0.3%
TOTAL	15,000	25,000	5,000	2,000	47,000	100.0%
Funding as % of program	31.9%	53.2%	10.6%	4.3%	100.0%	

III. EXECUTION OF THE PROGRAM

A. General coordination

- 3.1 The Lake Managua Basin Commission will serve as a forum for inter-agency coordination and discussion and the resolving of problems encountered during execution.
- 3.2 The government established this Commission in 1991, by Decree 25. One of its chief mandates was preparation of an action plan for the environmental recovery of Lake Managua and the coordination of the actions envisaged.
- 3.3 The decree establishing the Commission was amended in May 1996 as part of the analysis of this program, in order to include representatives of the institutions that would eventually participate in the current and subsequent stages. This ensures that all the agencies involved will participate in the discussions. The Commission is attached to the Office of the President of the Republic, which ensures its authority for the needed coordination and facilitates its work.

B. Implementation arrangements

- 3.4 The program will be carried out by three institutions: (i) INAA, which will execute the sewage collection, conveyance and treatment component, together with the discharge structures for rainwater flows; (ii) MINSA, which will do the work needed for ditching, grading and clearing of the shore area and will run the environmental education campaign and the entomological and health-condition monitoring; and (iii) INETER, which will be responsible for the environmental monitoring and the modeling work. In addition, INAA, which has prior experience with the Bank, will ensure the timely execution of the program as a whole, coordinating the work plans and execution with the other institutions and acting as liaison with the Bank. INAA will sign coordination agreements with the other two institutions for this purpose.
- 3.5 INAA. This agency has a specialized executing unit staffed with three engineers (one of whom acts as unit chief) plus support personnel. Currently this unit is satisfactorily executing the rehabilitation program for drinking water and sewerage systems. It reports to the Minister-Director and is also supported by the existing Region III (Managua) structure and by the Finance Directorate.
- 3.6 The rehabilitation program presently being financed by the Bank will complete its activities in 1997, when the specific execution work for the sanitary sewerage component of the program proposed here will be started. The present executing unit would therefore

continue operating, with these new responsibilities, since it already has the qualified personnel needed and possesses the experience for executing the proposed component.

- 3.7 The unit will process all the tender calls and disbursements for the program. It will compile pertinent information from the two coexecuting institutions, prepare the consolidated financial statements and reports required by the Bank, and act as a channel of communication for the general execution of the program.
- 3.8 Works supervision. The executing unit will also have the services of a specialized firm for technical supervision and quality control of the works and of the environmental mitigation measures. Before bids are sought on the works for which public bidding is mandatory, the unit must have contracted the consulting firm to be responsible for supervision.
- 3.9 MINSA. The ditching, maintenance and clearing works in the shore area, and also the environmental education actions, will be carried out by force account and through the offices of the local comprehensive health care systems (SILAIS), under the Hygiene and Epidemiology Directorate (DGHE). MINSA will receive advances of funds directly, together with the counterpart funds, and will transfer them to DGHE. DGHE will channel them directly to the local offices as needed for execution of the work to be done. These offices will hire small contractors to do the work, in accordance with national regulations, in the same way as they do for the other similar sanitation works they are currently carrying out, for which they have developed a flexible and expeditious system with adequate controls.
- 3.10 The director of DGHE will be responsible for the execution of this component and will be the chief liaison person with INAA. DGHE will consolidate the investments made by the SILAIS and will submit them to the Bank for justification and replenishment of the advances, and also to INAA for eventual consolidation in the program financial statements.
- 3.11 INETER. The actions envisaged in the program monitoring and modeling plan, which include sampling and analysis work and establishment and operation of the limnigraphic network, will be carried out under the responsibility of the Hydrology Department of the Directorate of Water Resources (DRH). This directorate is currently performing similar activities and has the capacity to do what is required. Because of their greater technical complexity, the development and validation of predictive mathematical models will be contracted out to a specialized consulting firm which will do the work under the coordination and supervision of INETER. DRH will provide all the information required by the Bank to INAA for consolidation with the other components.

C. Cofinancing

- 3.12 Due to limitations on the availability of FSO resources for Nicaragua, the government has turned to the international donor community to obtain cofinancing for the present program: (i) the Nordic Development Fund (NDF) has confirmed its intention to provide the equivalent of US\$5 million and (ii) the Government of the Federal Republic of Germany has confirmed its intention to partially finance the program through parallel cofinancing.
- 3.13 For the cofinancing of this operation Germany's Ministry for Economic Cooperation has suggested reprogramming DM 15 million of the funds not used for buyback of Nicaragua's commercial debt, to which a complementary soft loan will be added.
- 3.14 The Canadian International Development Agency (CIDA) and the Swiss Development Cooperation Agency (COSUDE) have also expressed interest in cofinancing the program.

D. Flow of funds

- 3.15 The proceeds of the Bank's loan, plus NDF and local counterpart funds, would finance the investments in: (i) the sewage collection and conveyance subcomponent; (ii) the lakeshore clean-up component; and (iii) the monitoring and modeling component.
- 3.16 The Federal Republic of Germany's contribution would finance the investments in the sewage treatment subcomponent through a parallel cofinancing facility. If necessary, Germany's contribution to this subcomponent would be supplemented by one of the other donors that have expressed interest.
- 3.17 In order to expedite arrangements and the independent execution of the components, disbursements of the Bank's financing would be channeled directly to each separate institution, as will be counterpart funds, which will be included in each institution's individual budget.

E. Monitoring and evaluation of the program by the Bank

- 3.18 The overall administration of the program will be handled by the project team, and regular supervision will be performed by the Bank's Country Office in Nicaragua. Annual administration and monitoring meetings will be held.

1. Annual monitoring and review meetings

- 3.19 As of the first year of execution, the Lake Managua Commission, the executing agency, the coexecuting institutions and the Bank will meet at least once a year, before October 31, to analyze the progress made on the program over the preceding period and to plan the activities for the coming year. The progress achieved will be

evaluated by comparison against the agreed benchmarks detailed in Annex I-1 (Logical Framework). The second of the annual meetings will be more thorough, in the nature of a mid-term review.

2. Ex post evaluation

- 3.20 The borrower did not consider an ex post evaluation to be necessary since the program will be continuously monitored and compliance with its objectives reviewed at annual meetings held for the purpose.

F. Other execution procedures

1. Works contracting and procurement of goods

- 3.21 No exceptions to the Bank's procurement policy are proposed. The procurement of goods and services and the contracting of works for rehabilitation of the sanitary sewerage system will be done in accordance with the procedures set forth in Annex B to the loan contract. Prequalification (registration) of firms will be required for the works to be financed with IDB funds. Annex V-5 presents the tentative procurement plan for the program. International competitive bidding will be obligatory for goods procurement in excess of US\$250,000 and for works contracts of a value exceeding US\$1,500,000. These thresholds are justified by the nature of the works and services and the experience gained by INAA in the water supply and sewerage systems rehabilitation program.
- 3.22 Calls for bids for construction work and procurement of goods that will be paid for from the parallel cofinancing will be subject to the provisions of the agreements that Nicaragua will sign with the providers of the cofinancing.
- 3.23 Calls for bids for construction work and procurement of goods that will be financed exclusively with local counterpart funds, or whose value is below the above-mentioned thresholds, will be conducted in accordance with Nicaragua's current legal requirements, which specify public bidding when the amount exceeds the equivalent of about US\$120,000 and permit restricted calls for proposals for smaller amounts, this being compatible with the basic principles required by the Bank.

2. Rights-of-way

- 3.24 Before the competitive bidding process may be initiated, the Bank must be satisfied as to the legal possession, easements, resettlements, or other rights in respect of the land on which the works will be carried out. No difficulties are expected in this connection, since the program entails primarily rehabilitation works. Moreover, in most cases the routing of the intercepting sewers has taken existing rights-of-way into account.

3. Advance of funds

- 3.25 Once the loan has been declared eligible for disbursement, and at the borrower's request, it is recommended that an advance of funds of up to 10% of the total amount of the loan be granted, to enable the executing agency and the coexecuting institutions to provide advances to the firms with whom they conclude contracts.

G. Investment schedule

- 3.26 The program execution period will be four years. A tentative disbursement schedule based on this period has been drawn up and is in the program files.

IV. THE BORROWER AND THE EXECUTING AGENCY

A. The borrower

- 4.1 The borrower will be the Republic of Nicaragua. Instituto Nicaragüense de Acueductos y Alcantarillados [Nicaraguan Water and Sanitation Authority] (INAA) will be the principal executing agency, with the Ministry of Health (MINSA) and Instituto de Estudios Territoriales de Nicaragua [Nicaraguan Institute for Territorial Studies] (INETER) as coexecuting agencies. Funds will be transferred by the Government of Nicaragua to INAA in the form of a loan and to the other two central government agencies as budget appropriations.

B. The executing agency

- 4.2 INAA is a decentralized State agency, created in 1979, that administers the nation's water and sewer systems. It has legal status, its own assets and capital, and legal capacity to acquire rights and enter into obligations. It operates through a central system, six regions, and one special zone.

C. Ongoing institutional reforms

- 4.3 Since the early 1990s the government, with support from the international community, has set about to transform what had been a centralized economy with a heavy measure of State involvement into a free-market model. This has meant shifting the State's role from an operator of businesses to a policy-setting and regulatory entity, and the concomitant restructuring of institutions and public services to improve their efficiency and management. In that connection, the Bank is taking part in a public administration reform program and a program for public utilities reform, which includes the water and sewerage sector.
- 4.4 The package of reforms in the water supply and sewerage sector will be carried through in two stages. The first includes setting in place a new legal structure for regulation and institution-strengthening. The second involves decentralization and transfer of service delivery operations to local governments and private enterprise. The new legal regulatory framework for the production and distribution of water and for sewage collection, treatment, and final disposal are set out in the Draft General Law on Water and Sewerage Services, which is currently before the Environment and Natural Resources Committee and the Infrastructure Committee of the National Assembly. According to the working agenda of those legislative committees, their opinions should be ready for discussion by the full Assembly in July 1996.

- 4.5 The regulatory agency will be responsible for administering and enforcing the law and, to that end, for regulating and overseeing the nation's water and sanitation sector. It will likewise issue standards and specifications for the design, construction, operation, maintenance, and administration of systems; regulate tariffs; in coordination with or by delegation of MARENA, enforce regulations governing the discharge of industrial waste into the public sewer system; and, in coordination with MINSA, enforce drinking water quality standards.
- 4.6 Other duties of the regulatory body will be to develop and conduct processes for awarding water and sewerage concessions, and to approve development plans presented by concession-holders.
- 4.7 The planned Empresa Nicaragüense de Acueductos y Alcantarillado [Nicaraguan Water and Sewerage Enterprise] (ENACAL) will operate as a self-sufficient public utility, delivering water and sewer services in accordance with the government's sectoral planning guidelines, with oversight by the regulatory agency. Some of its responsibilities will eventually be handed over to municipal or private concession-holders, by region or by municipality.
- 4.8 At a second stage of the reforms, ENACAL will be decentralized and the process of passing on its functions and responsibilities to local operators (municipal or private concessionaires), operating by region or by municipality, will begin. The Bank is supporting this reform process through studies such as a regionalization study now under way, which will examine the feasibility of local enterprises or operators.

D. Institutional achievements

- 4.9 An institutional assessment of INAA conducted as the rehabilitation program was being prepared revealed a number of institutional shortcomings on the technical and administrative fronts. These were addressed through institution-strengthening measures shared between the Bank and the Canadian International Development Agency. Those efforts were followed by specific actions, using Project Preparation Facility (PPF) funding, to satisfy conditions agreed to for the public enterprise reform loan for the restructuring of INAA.
- 4.10 The institution-strengthening component of the rehabilitation program was carried out in its entirety. It included consulting services for fixed-asset revaluation, upgrading of financial management systems, acquisition of equipment, and a tariff study that is to lead to long-run marginal cost pricing.
- 4.11 INAA also has improved its internal organization and reduced its staff. Its current ratio of employees per 1,000 connections is comparable to that of water companies that are run like private businesses. Virtually all of INAA's technical and administrative

staff took part in a training program. With strengthened administrative and financial controls and the better quality of information being generated in the agency, indicators now can be established to identify problem areas and take the necessary action.

E. Organization

- 4.12 With its revamped structure (which will be echoed in ENACAL in the future), INAA is divided into the following units headed by managers: the **Administrative Department**, in charge of procurement, personnel, and general services; the **Planning Department**, which prepares plans and programs as well as prefeasibility and feasibility studies for new investments; the **Finance and Business Department**, which handles accounting, budgeting, tariff matters, and marketing; and two technical areas: the **Wells and Shops Department** and the **National Technical Standards Department**, which in future will operate under the rules set by the regulatory agency. INAA also has an **executing unit** for the IDB-funded rehabilitation program, which will remain in place to execute the sewerage component of the program proposed herein, since the rehabilitation program is nearing completion.
- 4.13 Four INAA support departments provide audit, external relations, legal, and organization and systems services. The organization and systems unit produces manuals and procedures and is in charge as well of programming and computer services.

F. Tariffs

- 4.14 The Bank's analysis of the water and sewerage sector when preparing the water and sewerage system rehabilitation program revealed the shortcomings in INAA's tariff system. As part of the institution-strengthening component, the following services were engaged: (i) a firm to study, analyze, and propose new tariffs based on long-run marginal costs; and (ii) individual consultants to draft a tariff decree on that basis.
- 4.15 A financial model and a tariff model devised can be used to calculate equilibrium tariffs and to prepare income statement and cashflow forecasts, taking into account the projects included in the investment plan. As an interim solution, the consultants proposed a simplified rate structure that would do away with cross-subsidies and bring in tariff increments, eventually reaching financial equilibrium. At a second stage, when more information was available, a long-run marginal cost pricing system would be designed and implemented.
- 4.16 INAA has brought in a series of gradual, across-the-board tariff increments aggregating about 18% for 1994 and 10.5% for 1995. This has achieved financial equilibrium with no adjustment in the tariff

structure itself. The agency experienced problems in applying the tariff models: in the absence of an agreed investment plan or staff trained in applying the models, it was unable to produce reliable projections or determine equilibrium tariffs. To address these constraints, staff were given training and the models were adjusted to build in the capital projects envisaged in the investment plan. INAA is now in the process of engaging new consulting services to follow up on this matter and structure tariffs on the basis of long-run marginal cost.

- 4.17 In sum, the current tariff strategy is first of all to maintain the real value of effective 1995 year-end tariffs. To that end, starting in January 1996, monthly adjustments are being made to keep pace with inflation, and a program is under way to implement the new simplified tariff structure recommended by the consultants. A study of long-run marginal cost pricing is being conducted as well. Such marginal-cost tariffs are to be set in place in late 1997, which is concordant with the Tariff Decree that is part of the changes pursued in the public utilities reform program funded by the Bank.

G. Sectoral planning

- 4.18 INAA has drawn up a program with a 10-year horizon, addressing the following areas: (i) the urban sector; (ii) the urban fringe and concentrated rural sector; and (iii) the dispersed rural sector, with its community-administered services. In the planning exercise INAA took into account proposals and projects put forward by cities and communities outside the capital as well as water and sewerage needs of settlements in Managua, and needs for urban expansion. Other elements taken into consideration were the donor community's indications of funding possibilities and INAA's capacity to absorb and carry out the investment projects. The plan worked out strikes a balance between needs and possibilities, and between the requirements of Managua and those of the rest of the country. The investment plan for urban areas for the period 1996 to 2002 has been discussed, examined, and agreed upon by INAA, the World Bank, and the IDB. It is included in the financial projections along with potential sources of funding; provision will be made for it to be amended only with the consent of the World Bank and the IDB.

H. Financial analysis

- 4.19 INAA's operating efficiency has improved since 1992 as a result of its institutional strengthening and with the support of the IDB-funded rehabilitation program for the sector. To reorganize its financial management INAA set up a Finance and Business Department, which includes accounting, budgeting, marketing, and treasury services. With the improved financial and operating ratios that are possible with the new systems in place, INAA's executive can take steps to make the agency run better. After the asset

restatement exercise (validated by specialized consultants) its asset values stood US\$42 million higher.

- 4.20 Despite the major strides made by INAA in the past two years, it still requires strengthening in the personnel area, and in three other specific areas: the commercial area, which needs overhauling and bolstering (provided for in the World Bank's water and sanitation program); the Finance and Business Department, to improve general INAA administrative and financial oversight; and the area of systems implementation and improvements to monitor its business performance.
- 4.21 Studies now being commissioned using funds from the rehabilitation program being financed by the Bank deal with: (i) tariffs, to continue with the program to structure and implement long-run marginal cost tariffs; (ii) revamping of the billing and collection system; (iii) training of staff to operate new systems; and (iv) consulting services for studies on regionalization of services.
- 4.22 The following ratios give an idea of INAA's achievements in terms of improving services and business performance:

URBAN SECTOR ONLY	MANAGUA		NATIONAL	
	1992	1995	1992	1995
Water supply (coverage)	66%	83%	70%	79.5%
Sewer service (coverage)	46%	53%	30%	32.4%
Unaccounted-for water	43%	39%	41%	45.0%
Collection efficiency			72%	81.0%

- 4.23 INAA has been profitable since 1992, thanks to tariff adjustments and expanded coverage. Under the terms of the utilities reform loan, the agency has pledged to the Bank that it will raise the coverage ratio to 83% by 1996, 85% by 1997, and 86% thereafter.
- 4.24 The financial projections prepared include the INAA investment plan agreed on with the Bank for the period 1997 to 2004. The plan's US\$331 million cost is to be defrayed by grants for smaller ongoing projects or commitments (41%), and project funding from the IDB (41%) and the World Bank (17%). Japan is a major donor, accounting for 17% of the total plan funding.
- 4.25 The only investments planned at the moment other than the operation described in this document are: (i) the World Bank's water and sanitation program, currently in the appraisal stage; (ii) the program of priority investments in mid-sized cities, which is being developed by consultants funded by the IDB; and (iii) a second

stage of the program proposed herein, which would expand the sewer system. In short, 46% of the investment plan involves projects envisaged for future years (1997 onward), while operations now under way account for 54% of the total. The plan is considered to be reasonable and workable, inasmuch as it responds to the need to upgrade and expand water and sanitary sewer services, and according to the financial projections worked out and the evaluation of INAA's institutional capabilities, the agency has the absorption and execution capacity required to carry through the plan.

- 4.26 The financial projections assume a modest increase of 3% in the population having access to public water systems - which is less than the actual increases posted in the last three years - and a 10% increase in sewer-service coverage. The bulk of the investments in water supply systems are to repair or rebuild structures, reduce losses associated with unaccounted-for water, legalize household connections, and develop new production wells. Investments for sewerage systems are to overhaul the systems and hook up new users. Apart from maintaining real tariff values, the effective average tariff is expected to increase by at least 1% yearly once the new tariff structure is in place. Although outlays for rehabilitation of the systems are expected to bring down operating and maintenance costs, current cost levels were used for purposes of this exercise.
- 4.27 According to the projections, INAA would post a positive cashflow over the next 10 years (the projection period) and would generate enough funds to service its obligations and replace its assets. Beginning in 1998-99, it could place surpluses in medium- and long-term financial investments to that end. The financial statements likewise show that through 1999 the agency will post net earnings equal to 2.7% to 8.7% of total revenues, but in three of the subsequent four years it would report small losses, equivalent to 0.3% to 0.7% of total revenues. From 2005 onward it will again be profitable.
- 4.28 The aforementioned losses will stem from payments of interest on INAA's debt, which will begin to rise in 2000 and peak in 2004. The agency's financial situation will again turn around that year, thanks to the new projects being financed by the IDB and World Bank that will expand services and boost revenues.
- 4.29 The annual losses projected in the scenario described above could be easily absorbed by accumulated 1996-1999 earnings. However, they can also be offset in other ways: (i) by reducing operating costs by about 1.3% through improvements and overhaul of systems; (ii) through an additional 0.5% increase in the effective average tariff; and (iii) through net income generated by expanding water and sewer service coverage equal to the amount of the losses. INAA has agreed to take steps necessary to ensure that the funds generated by its operations are sufficient to honor its future

obligations. The financial projections, including several sensitivity scenarios, are available in the EN2 technical files.

I. Coexecuting agencies

1. Ministry of Health

a. Organization

- 4.30 The Ministry of Health (MINSA) is charged with developing and carrying through national health policies, plans, and programs. This includes environmental sanitation campaigns and surveillance of the quality of public water systems. Among the measures it takes to that end are the clean-up of unhealthy sites or foci.
- 4.31 One of the Ministry's five technical units is the Hygiene and Epidemiology Directorate, which is responsible for identifying and cleaning up sites posing health problems. It does so through 17 units known as "local comprehensive health care systems" (SILAIS) and their local health posts.

b. Operation of SILAIS

- 4.32 The SILAIS report directly to the Minister of Health, and represent the Ministry at the departmental level. They are headed by a director-general and staffed by two or three doctors and support personnel, who manage and oversee the operation of health posts.
- 4.33 In the proposed program, these organizations would be responsible for trenching, grading, and clean-up work to clear weeds from the lakeshore for the drainage of swampy areas.
- 4.34 MINSA has a flexible system in place for its dealings with the SILAIS. When the budget is approved, it channels funds to those units, which then pass money on to each health post, which expends it directly.

c. Finances

- 4.35 MINSA has the highest budget of any government agency - US\$78 million in 1995, which is expected to rise to US\$85 million in 1996. It sends 69% of the total budget to the SILAIS.
- 4.36 The SILAIS and health posts in Managua accounted for about US\$10 million in spending, US\$3 million of it for operating expenses. The component that forms part of the proposed program represents an annual expenditure of only US\$200,000, which would be absorbed in MINSA current expenditures, with the same systems and controls as are in place at present.

2. Instituto Nicaragüense de Estudios Territoriales

- 4.37 The Nicaraguan Institute for Territorial Studies (INETER), an agency of the Ministry of Construction and Transportation, is responsible for studies, classification, and inventorying of the country's ground and surface water resources. It also is in charge of earthquake monitoring, volcanology, meteorology, and geodesic and other mapping. Just over one third of its 422 employees (36%) are university graduates in technical disciplines; 53% are mid-level technical officers, and 11% are administrative staff.
- 4.38 INETER has three support areas: (i) administration and finance; (ii) project planning, and (iii) graphics; and five technical departments: (i) geodesics and mapping; (ii) geophysics; (iii) physical planning and geography; (iv) meteorology, and (v) water resources. The last two areas will be involved in the environmental monitoring elements of the proposed program, and will help gather limnigraphic data (to record lake water levels) and meteorological data, and perform chemical analyses as required for the modeling and monitoring component.
- 4.39 The proposed activities are concordant with INETER's functions, and the agency is not expected to need additional staff for this purpose.

V. FEASIBILITY

A. Technical feasibility

1. Sanitary sewer system and sewage treatment

- 5.1 To come up with different technical solutions to Managua's sewer problems, the existing sewer system was carefully surveyed and assessed. Six technical alternatives were examined; the one selected was the least-cost option.
- 5.2 The solution chosen makes the best use of the city's topography to convey sewage through sewer mains and interceptors to the two treatment sites. Criteria taken into account for the siting of intercepting structures were the need to reduce the risk of damage in the event of earthquakes, have sewage carried by gravity as much as possible, and keep diameters small, so large volumes of effluent would not be conveyed over long distances.
- 5.3 Detailed studies were done of discharges of industrial sewage into Lake Managua. Using a 1994-95 MARENA inventory of potential pollution sources, data on 61 industries, grouped into 32 categories, were updated and analyzed. On the basis of the studies produced by an inter-agency commission and consultants' recommendations, Decree 33 setting limits for discharges was issued in 1995.
- 5.4 The working hypothesis as the studies began was that industrial discharges were a major source of pollution of Lake Managua. However, after the effluents of the industries in question were analyzed and preliminary modeling was done, it was concluded that the impact of such discharges was in fact relatively slight. The maximum-discharge rules give industries a reasonable length of time in which to comply with the standards, and most of them should be able to achieve the required reductions relatively inexpensively, with no need for financial or technical assistance from the government.
- 5.5 Most heavy-metal concentrations are within the limits considered acceptable for public health and the aquatic habitat, with the notable exception of mercury. Though the source of mercury pollution has been cut off, there are still high residue levels in the lake's ecosystem. Accordingly, the monitoring plan provides for analysis and time and spatial modeling for this element as well as for naturally-occurring arsenic.
- 5.6 The treatment alternatives considered thus centered on the removal of floating material, oils and grease and the reduction of fecal coliforms and biochemical oxygen demand (BOD) by building: (i) three outfalls from three to four kilometers long, to discharge into the lake through diffusers; (ii) ditches and biological

filters; (iii) a single outfall; (iv) facultative (aerobic-anaerobic) lagoons at three treatment sites; or (v) facultative lagoons at two sites.

- 5.7 The solutions involving sewer outfalls were discarded because of technical problems with the required infrastructure foundations (the thick sediment on the lake bottom gives it zero bearing capacity), and because the lake is too shallow for the proper hydraulic operation of discharge pipes. Moreover, if the studies of the eutrophication of the lake were to subsequently reveal a need to remove nutrients, this would not be possible if sewage were being treated through outfalls. The biological filter option was discarded for cost reasons.
- 5.8 This left the option of facultative lagoons. It was found that for the proposed project, such ponds would be a very efficient means of removing bacteria and reducing the BOD, because of a combination of favorable climatic conditions and the large area of land available on the floodplain on the shores of the lake. The opportunity cost of this land, all of which lies below 42 meters above sea level, is low, because it is floodprone, insalubrious, and of marginal interest for urban development. Furthermore, because this is national public property, there would be no financial cost to the executing agency.
- 5.9 The design criteria adopted for discharge of the treatment units - 5,000 fecal coliforms/100 ml and BOD of 90 mg/l - will meet the quality standards set in Decree 33-95 for the discharge of liquid waste from sewer systems into receiving bodies. The treatment option using facultative lagoons likewise will allow treated effluents to be conveyed to wetlands that can be developed on the shores of the lake to the east of the city, if modeling studies should suggest in future a need to remove all point-source nutrients. And treated effluent could be used safely for the irrigation of crops other than vegetables.

2. Clean-up and improvement of the lakeshore

- 5.10 The lakeshore clean-up component was designed taking into account the cause-and-effect relationships revealed in the May 1995 socio-economic survey which documented a positive correlation between distance of dwellings from the lake and percentages of reported cases of malaria. The survey likewise showed the high priority accorded by residents to resolving the problem of mosquitoes that are malaria vectors, and the generally-held view that an improvement in health and sanitary conditions was something the population required urgently.
- 5.11 Studies carried out by the Ministry of Health's Malaria Control Center, which were reviewed and validated by consultants, conclusively demonstrate that a comprehensive approach is needed to resolve health and sanitation problems in the lakeshore area.

Elements of such an approach are (i) reducing opportunities for contacts between residents and mosquitoes, (ii) destruction of adult mosquitoes, (iii) destruction of larvae, (iv) destruction of breeding grounds, (v) destruction of Plasmodium, and (vi) community involvement and education. The program proposed herein includes actions to address three of those elements: destruction of mosquito larvae, destruction of breeding grounds, and community involvement and education. The other three are pursued by the Ministry of Health as part of its regular operations.

5.12 It has been concluded that the program is technically viable, on the following grounds:

- a. A number of different technical solutions to sanitary sewerage and sewage treatment problems were examined, and the least-cost option was selected.
- b. The proposal for improving the lakefront environment takes a comprehensive, synergetic approach to the factors that are contributing to health and sanitation problems, and includes a program to involve residents.
- c. A careful environmental monitoring and evaluation plan will be carried out to provide feedback for management of the program, including information needed to plan future stages.

B. Environmental feasibility

5.13 The proposed program would be viable from an environmental standpoint, its objectives being to improve the quality of life of residents of the city of Managua, and particularly those living along the shores of Lake Managua. The environmental feasibility analysis described here refers to investments in the first stage.

5.14 Most of the major environmental impacts of this program would be extremely positive, but to guard against the possibility of undesirable side effects of any of the program's activities, the Nicaraguan government prepared an environmental impact assessment (EIA). This study analyzed the potential impact of the various alternatives examined, identified the negative impacts of the recommended alternative, and proposed suitable mitigating measures. Pursuant to Bank policy, the document was made available for public review in Nicaragua and also through the Bank's Public Information Center before the start of the analysis mission. The environmental report prepared on the basis of the EIA was approved by the Bank's Environment Committee on February 13, 1996.

5.15 The following are the most important positive impacts the program is expected to have on the environment:

- a. Through environmental sanitation works on the lakefront, it will reduce the incidence of vector-borne diseases like malaria.
- b. It will help reduce cases of waterborne diseases like cholera, parasitic infections, and dysentery.
- c. It will improve water quality in Lake Managua, which then can be used for non-contact recreational uses, and will reduce contamination of the aquatic biota.

5.16 The negative environmental effects or risks identified are minor or intermediate in scale, and can be averted or minimized through simple, known measures. The following is a summary of these impacts and recommended mitigating measures for the construction and operating phases.

- a. The need to resettle about 53 families now living in floodprone areas that are the site for the sewage treatment lagoons and apparatus to regulate water levels in the lake. The EIA includes a preliminary resettlement plan, based on a quick social assessment of the affected population, which envisages the payment of compensation to these families for their dwellings and also for their farm plots. Two relocation alternatives were examined: (i) acquisition of farm land separately from dwellings, and (ii) acquisition of land encompassing both farmed land and dwellings. Those relocated will be given construction materials and technical assistance to build new dwellings, contributing their own labor. Provision is being made for the payment of residential water and electricity hook-ups. Underlying the resettlement strategy and arrangements for continuity in farming operations of these families is a hydroponics plan, in which vegetables would be grown in hygienic conditions using improved seeds, nutrients, and irrigation water, with technical assistance. The definitive resettlement plan will be developed in accordance with Bank guidelines at the final-design stage.
- b. The risk that the facultative lagoons could become breeding grounds for mosquitoes and emit foul odors, if these ponds are not maintained and operated according to the rules. To avert this risk, technical personnel would receive training, and measures have been built into the design of the lagoons themselves to minimize the likelihood of such problems.
- c. The risk that operation of the lagoons will produce stabilized sludge. Though this problem would not arise until the second phase of the program (the ponds are to be desludged after they

have been operating for 5 to 10 years), provisions for adequate final disposal have been made.

- d. The need to compensate 42 farmers who do not live on the site of the lagoons but are illegally using raw sewage from broken sewer pipes along the lakeshore for vegetable-growing operations. Here it is not a matter of resettlement but of finding a way for these farmers to continue with their subsistence operations in more hygienic conditions, and without putting consumer health at risk. Compensation will be provided by way of the hydroponics program mentioned above.
- 5.17 A monitoring program has been built into the proposed operation, to record and assess progress and problems arising during its implementation. This program would (i) check on sewage treatment facilities to ensure that they are operating efficiently, (ii) monitor water quality in Lake Managua, and (iii) monitor the occurrence of waterborne and vector-borne diseases.
 - 5.18 The estimated cost of all of these mitigating measures has been included in the program budget.

C. Socioeconomic feasibility

- 5.19 The economic appraisal encompassed a period of 25 years, for a long-term program comprising four investment phases. It looked at the Sewerage Master Plan as a whole plus complementary measures to improve the environment of Lake Managua and the lakeshore area.
- 5.20 The first phase of investments would take four years. The works projects envisaged for that phase would clean up the lakeshore area and improve water quality in the lake for non-contact recreational uses. Outlays planned for the later phases would help the sewer and sewage treatment systems accommodate the growing population, so as to maintain environmental quality levels.

1. Method for evaluating benefits of the program

- 5.21 The contingent-valuation approach was chosen to gauge the benefits that can be expected to accrue from the proposed program. Using this method, a value can be assigned to nonmarketed environmental goods, and econometric calculations are used to determine the population's willingness to pay for an environmental change – in this case, the improvement of Lake Managua and the area along its shore. The referendum approach was used in this exercise, whereby interviewees are quoted a price that they would need to pay to obtain the environmental benefits to be afforded by the program, and are asked whether or not they would be willing to pay that amount. The survey was designed to be administered to a representative sample of 1,400 heads of household in Managua.

- 5.22 Two other socioeconomic polls were conducted before the above-mentioned survey was carried out. The first explored environmental and health problems of Managua residents generally, while the second focused on lakeshore residents and their particular problems and needs. The issue of greatest concern to the population with respect to the lake and the lakeshore area generally was the unhealthy condition of these areas at present. Another major problem mentioned was mosquitoes and the risk of contracting diseases such as malaria and dengue fever. Virtually all those surveyed felt that the lake is a unique asset of Managua from which they draw personal benefit, and they wish to see it restored and preserved.
- 5.23 Focus groups were organized for the willingness-to-pay survey to adjust the questionnaire and establish a suitable range of bid values and the specific payment mechanism to be used. One advantage in this survey was that the entire population are aware of and understand the problem and the benefits they stand to gain from the program; this makes the exercise less subjective than is often the case with such surveys, when respondents are asked to quantify environmental benefits without fully understanding them.
- 5.24 The assessment of benefits of the proposed program was based on an estimate of residents' willingness to pay for a package of environmental improvements, namely (i) healthier conditions on the shores of Lake Managua, which would lower the risk of malaria, diarrhea, and cholera, and (ii) better recreation possibilities for boaters and those visiting the waterfront, even though at this first stage people would be unable to swim in the lake or fish for food.

2. Findings of the econometric estimate of willingness to pay

- 5.25 Using the survey findings, an econometric model was developed to estimate the likelihood that an individual would or would not agree to pay a stated price to secure the benefits of the program. Generally, an individual's willingness to pay (WTP) was determined by income level, age, education, distance of home from the lake, and whether or not the individual frequented the lake or waterfront area. The parameters estimated from these variables were statistically significant, as were the expected signs.
- 5.26 According to the estimated parameters, average WTP is C\$29.6 (US\$3.9) per month per family. This is an approximation of the average economic value ascribed by the population overall to the restoration of the lake and clean-up of its shores. The phrasing of the survey question was designed to capture in estimated WTP both health and sanitation benefits and benefits in the form of recreation opportunities and improved appearance of the lake and surrounding area. These benefits are not mutually exclusive; both would ensue simultaneously from the project. The WTP elicited is 1.5% of average household income.

- 5.27 The findings of this survey and of the two previous socioeconomic polls confirm that residents of every socioeconomic stratum are strongly interested in the project and agree with its objectives.

3. Summary of the cost-benefit appraisal

- 5.28 The average WTP estimate was used as a basis for calculating the overall benefits of the project. Residents of Managua are considered to be the program's beneficiaries. Population projections were done using estimates in the 1995 National Census and the Report on Future Land Use in the Study Area, with projections to the year 2020. The estimated present value of benefit streams discounted at 12% is US\$65.5 million.
- 5.29 The cost streams for the program involve (i) rehabilitation and expansion of sewer mains and intercepting sewers; (ii) treatment facilities; (iii) environmental impact mitigation measures; and (iv) improvement of the lakefront area, including construction of discharge structures, leveling, trenching and cleaning, and a health and education campaign run by the Ministry of Health to prevent disease. Also included are operating and maintenance costs, recurrent expenditures, and capital costs for subsequent stages of the Sewerage Master Plan. The present value of costs of the program is US\$47.4 million. Accordingly, the program would yield a net economic benefit of US\$15.5 million in present value, with an internal rate of return of 16.2%.
- 5.30 According to the analysis, the value that the population ascribes to the program exceeds its costs, and the program thus is economically feasible. Other benefits not captured in WTP are those that would accrue to residents from the eventual expansion of the sewer system. For one thing, without these sewer rehabilitation and expansion works, the water supply and sanitation project being prepared by the World Bank could not be carried through. Likewise, the program will help set the stage for urban renewal projects that can revitalize downtown Managua. While the project is not itself a revenue-generating venture, the general contribution it will make to the economy by virtue of its social and environmental impacts will in the long run keep economic costs down.

4. Impact of the program on health and sanitary conditions

- 5.31 One important impact of the program will be its contribution to the control of waterborne diseases, which are contracted when the population comes into contact with sewage and mosquitoes. Low-income residents of Managua, most of them living along the shores of Lake Managua, are at greatest risk. Unfortunately, the information available at present does not provide a full picture of causes and effects of these problems or an assessment of the toll they take; information of the required quantity and quality would be obtained from the proposed monitoring activities. Nevertheless, according

to the technical designs for the project, measures to clean up the lakeshore could reduce malaria cases by 60% to 90%.

- 5.32 Malaria is one of Managua's most serious health problems. The area of highest incidence is the two-kilometer strip around the lake that is home to about 120,000 people. From 1,000 to 4,700 cases of malaria were reported in Managua between 1977 and 1992. In 1993 and 1994 the figures jumped to between 10,000 and 15,000, and 20,000 were reported in 1995. According to the socioeconomic survey and MINSA statistics, there are at least 7,000 cases each year in areas close to the lake. From 1987 to 1993, between two and four residents died each year from malaria; the death toll in 1994 and 1995 was 10 and 5, respectively.
- 5.33 As part of the analysis, an estimate was made of the savings the program would generate by lowering morbidity and mortality levels associated with malaria and thereby averting losses in productivity and income. Using very conservative assumptions, economic losses in terms of losses averted (the value of lost labor productivity) for the 1996-2020 period came to US\$3.7 million in present value, discounted at 12%. This estimate does not capture the overall health benefits of the program: apart from reducing malaria cases, the program would bring down levels of other diseases, but the reduction could not be quantified owing to an absence of causality data. Nor does the productivity (wage) loss method capture the value of the quality of human life in an unhealthy environment. These elements are best assessed by the contingent-valuation survey of willingness to pay.
- 5.34 The Ministry of Health also estimates that the project could help save some US\$450,000 a year in malaria treatment and control measures, US\$750,000 for diarrhea, and US\$450,000 for cholera, taking into account strictly the population living around the lake, and conservative reductions in the occurrence rate of each disease. Without the project, and with population growth, such costs would be much higher. In fact, outbreaks of malaria between 1990 and 1995 have necessitated drastic increases in MINSA expenditures.

5. Distributional impact of the program

- 5.35 The proposed project will afford direct and indirect benefits to the entire population of Managua, but its direct impact will be felt primarily by those living along or close to the lakefront. The household income of a large percentage of those residents is below the national average, and many are unable to satisfy the most basic needs.
- 5.36 The Bank's poverty threshold for Nicaragua is C\$264 monthly per capita. By that standard, 50% of those living around Lake Managua would be classified as poor. Some 18.4% of this population earn less than C\$100 a month. On average, the population living around the lake is poorer than the population of Managua and other

Nicaraguan cities, and on a par with poverty levels in the country as a whole (50.3%). About 40% of residents of the city of Managua live below the poverty line. The lakeshore clean-up component of the program includes activities targeted directly to the poor, through education campaigns and social outreach work to prevent disease.

D. Institutional viability

- 5.37 Under the implementation arrangements devised, the program's three components can be carried out separately, though they would be coordinated by the three participating agencies. INAA's executing unit has experience with and the capacity to carry out projects with the Bank, particularly for the preparation of calls for bids, supervision of project execution, and application of procurement rules. INAA likewise has experience in carrying through projects cofinanced by the Nordic Development Fund and Germany's KfW, which are two prospective cofinanciers for this operation. The Ministry of Health, for its part, is experienced in initiatives of the type being proposed for its component of the program. The cost of that component is less than the Ministry's regular budget for activities to improve health conditions and control malaria.

E. Financial feasibility

- 5.38 The proposed operation would not increase the coverage of sewer services, but rather would rehabilitate an obsolete system that is operating poorly. In that sense, the operation is akin to a replacement of depreciated or amortized assets. For that reason, its financial feasibility cannot be analyzed separately, but needs to be looked at in the context of institutional performance and viability. From that standpoint, according to the financial projections and analysis, the new tariff policy is the chief positive element for the sustainability of the agency's financial situation. A second element would be the results of the rehabilitation work financed by the Bank, to improve distribution systems and cut down on losses from unaccounted-for water, thereby raising revenues. Under the assumptions and conditions described, INAA's finances will remain stable, and it will be able to honor its financial obligations.

LOGICAL FRAMEWORK
Program for environmental improvement of Lake Managua and the city of Managua
NI-0027

OBJECTIVE	INDICATORS	MEANS OF VERIFICATION	ASSUMPTIONS
<p>the quality of life of Managua residents</p>	<ul style="list-style-type: none"> ● Sustained reduction of 60%-90% in morbidity index for malaria (benchmark: 20,000 cases in 1995) ● Increase in number of persons visiting waterfront 	<ul style="list-style-type: none"> ● Annual reviews; data from monitoring ● Bank PCR 	<ul style="list-style-type: none"> ● Continuing priority accorded by the government ● Political and social stability
<p>the health and living conditions and recreation opportunities for residents</p>	<ul style="list-style-type: none"> ● 60%-90% reduction in malaria cases in Managua ● Not more than 3,000 fecal coliform/100 ml in Lake Managua; biochemical oxygen demand not greater than 90 mg/100 ml 	<ul style="list-style-type: none"> ● Official statistics ● MINSA monitoring ● Specific studies (PAHO, WHO) ● In situ measurements 	<ul style="list-style-type: none"> ● Political commitment by the government and participating agencies ● Continuing support from civil society
<p>COMPONENTS Improvement of Managua urban environment Rehabilitation of sanitary sewerage system; sewage treatment plant Water supply plan and water quality modeling</p>	<ul style="list-style-type: none"> ● Elimination of 170 mosquito breeding grounds along lakeshore ● Construction of six stormwater discharge structures ● Construction of 45 km of sewer mains ● Construction of 19 km of intercepting sewers ● Laying of 3 km of pressure pipes ● Installation of six pumping plants ● Construction of 67 ha of sewage treatment lagoons ● Complete evaluation of chlorophyll and dissolved oxygen levels, with recommendations for control of nutrients, As, Hg, solids; calibrated model and criteria for watershed management 	<ul style="list-style-type: none"> ● Indicators from epidemiological and entomological surveillance program. MINSA reports ● Bank supervision ● Periodic progress reports ● Final report on consultants' findings. Positive comparison between model predictions and data recorded and analyzed 	<ul style="list-style-type: none"> ● Effective community participation ● Timely allocation of counterparty resources ● Construction by MCT of water level regulating works in Tipitapa. Call for bids conducted effectively ● Timely receipt by INETER of resources for measuring, analyzing, sampling

COMPONENT: REHABILITATION OF SEWER SYSTEMS, AND SEWAGE TREATMENT

OBJECTIVE	INDICATORS	MEANS OF VERIFICATION	ASSUMPTIONS
<p>the ment and the quality of Managua s</p>	<ul style="list-style-type: none"> ● Increase in number of persons visiting waterfront ● Sustained reduction of 60%-90% in morbidity index for malaria (benchmark: 20,000 cases in 1995) 	<ul style="list-style-type: none"> ● Lake being used for recreational purposes ● Urban development in downtown Managua expedited 	<ul style="list-style-type: none"> ● Political and social stability
<p>the health and on ons</p>	<ul style="list-style-type: none"> ● Not more than 3,000 fecal coliform/100 ml ● < 600 E. coli/100 ml ● Improvement in appearance, odor ● 60%-90% reduction in malaria cases in Managua, in synergy with lakeshore improvement component 	<ul style="list-style-type: none"> ● MARENA verification that Lake Managua water meets standards for non-secondary-contact recreational use 	<ul style="list-style-type: none"> ● Adequate coordination with Lake Managua Commission
<p>ENTS y sewer rehabilitated operation treatment operating</p>	<p>Quality of treated effluent:</p> <ul style="list-style-type: none"> ● BOD not over 90 mg/l ● Not over 80 mg/l total suspended solids ● Not over 10 mg/l oils and grease ● COD not over 180 mg/l ● Not over 1 mg/l settleable solids ● < 3 mg/l methylene-blue-active substances 	<ul style="list-style-type: none"> ● MARENA verification that treated effluents meet standards for discharge into receiving body ● Collection of 120 million l/day of sewage, conveyance to treatment sites, discharge 	<ul style="list-style-type: none"> ● Timely availability of counterpart resources ● NDF funding feasible for pipes and pumping equipment
<p>ES ing of sewer tion of oting sewer system in on on of ive lagoons</p>	<ul style="list-style-type: none"> ● Construction of 45 km of sewer mains ● Construction of 19 km of intercepting sewers ● Laying of 3 km of pressure pipes ● Installation of six pumping plants ● Construction of 67 ha of lagoons 	<ul style="list-style-type: none"> ● Acceptance of works by supervising engineers, INAA, Bank, cofinanciers ● Fourth quarter of 2000 	<ul style="list-style-type: none"> ● Construction of water-level regulating works in Tipitapa (MTC97) ● Availability of cofinancing for sewage lagoons ● Bids awarded for lagoons, fourth quarter 1997 ● Bids awarded for sewer mains and intercepting sewers, first quarter 1997 ● Loan contract ratified and effective, fourth quarter 1996

COMPONENT: CLEAN-UP AND IMPROVEMENT OF LAKESHORE

OBJECTIVE	INDICATORS	MEANS OF VERIFICATION	ASSUMPTIONS
the quality of the ment for residents	<ul style="list-style-type: none"> ● Reduction in morbidity index for malaria 	<ul style="list-style-type: none"> ● MINSA statistics ● PAHO and WHO reports 	<ul style="list-style-type: none"> ● Preventive health policy a continuing priority
health and sanitation ns	<ul style="list-style-type: none"> ● 60% reduction of incidence of malaria in Managua (benchmark: 20,000 cases in 1995) 	<ul style="list-style-type: none"> ● Statistics of health posts (SILAIS) 	<ul style="list-style-type: none"> ● Adequate community pro and motivation
ENT o and improvement of e	<ul style="list-style-type: none"> ● 170 mosquito breeding grounds eliminated Year 4 (2000) 	<ul style="list-style-type: none"> ● Bank supervision ● INAA/MINSA reports 	<ul style="list-style-type: none"> ● Help of affected commun clean-up campaigns ● Maintenance of improved
ES of aquatic vegetation and ance of cleaned-up areas rhood group assistance an-up stormwater drainage discharging into Lake a ry storm drainage canals d maintained	<ul style="list-style-type: none"> ● Clearing of aquatic vegetation (75 ha) ● Trenching, cleaning and maintenance of 7.5 km of stormwater channels ● Leveling of 14 ha depressions ● Construction of six stormwater discharge structures, in operation (2.1 km) (Cauce Occidental, Oriental, Bello Horizonte, Primavera, Waspan, Américas IV) ● Establishment of MINSA Bacillus sphaericus laboratory, in operation ● Monthly applications of bio-larvicide Year 4 (2000) 	<ul style="list-style-type: none"> ● MINSA annual entomological monitoring report ● MINSA annual epidemiological surveillance report 	<ul style="list-style-type: none"> ● Timely availability of cou resources ● NDF funding feasible for out discharge structures

COMPONENT: MONITORING AND EVALUATION

OBJECTIVE	INDICATORS	MEANS OF VERIFICATION	ASSUMPTIONS
groundwork for of future stages of mental sanitation and activity	<ul style="list-style-type: none"> ● Use of information obtained to define policies, issue regulations, and set achievable water quality standards for Lake Managua 	<ul style="list-style-type: none"> ● Studies completed ● Regulations proposed ● Management decisions adopted 	<ul style="list-style-type: none"> ● An operational environmental regulatory framework ● Environmental protection and sanitation a continuing priority for the population
a reliable instrument sion-making on ment of Lake a	<ul style="list-style-type: none"> ● Model findings match observed trends and parameters 	<ul style="list-style-type: none"> ● Runs of model 	<ul style="list-style-type: none"> ● Continued involvement and interest on the part of government and civil society, especially the academic community
ENTS ing plan and Lake a water quality g	<ul style="list-style-type: none"> ● Runs of the adjusted model, calibration, format, documentation ● Completion of technology-transfer workshop 	<ul style="list-style-type: none"> ● Consultants' final report discussed and approved by Lake Managua Commission, INETER, INAA, and Bank 	<ul style="list-style-type: none"> ● Support and information received by consultants as and when needed ● Consistent, reliable lab results
ES gic measurements variable modeling ynamic model of lake on oliform model s/oxygen model uspended solids model riation model Hg in analysis in fish	<ul style="list-style-type: none"> ● Installation and operation of limnigraphs — Sinecapa, Viejo, San Antonio, Cauce Oriental, and Cauce Occidental rivers ● Parameter determination eutrophication/oxygen model and calibration of model for 1997 ● Data available for 1998, 1999, 2000 ● Determination of sediment age ● Stratification of Hg.C in sediment ● Fecal coli/E. coli ● Coliform in sediment ● Hg in fish and in sediment; As in fish ● Determination of As, Cd, Cu, Zn, Cr, Ni in sediment ● Hiring of consultants for quality modeling 	<ul style="list-style-type: none"> ● Initial report work program and timetable ● Quarterly progress reports ● First annual report: temporal/spatial distribution of coliforms; validation of treatment ● Report year 2: evaluation dissolved oxygen and chlorophyll-A with and without treatment. As and Hg models ● Final report, 2.5 years: final adjustments to model, format, documentation 	<ul style="list-style-type: none"> ● Loan eligible for disbursement ● NDF loan eligible ● Local counterpart available

Program for environmental improvement of Lake Managua and the city of Managua
Further details of indicators for "GOAL"

OBJECTIVES	INDICATORS	CUMULATIVE TARGETS				
		Year 0: 1995	Year 1	Year 2	Year 3	Year 4
Improve environmental conditions for Managua residents	<ul style="list-style-type: none"> Sustained reduction (60%-90%) in malaria morbidity index 	20,000 cases				12,000 cases
	<ul style="list-style-type: none"> Water quality: Lake Managua, Miraflores Bay: Not more than 3,000 fecal coliforms/100 ml; E. coli < 600/100 ml 	1.90E+06 8.0E+05/100				3.0 E+03; < 600/100 ml
	<ul style="list-style-type: none"> Quality of effluent discharged into receiving body: Total coliform Fecal coliform E. coli BOD5	2.06E+07; 1.12E+07; 8.74E+06; 306 mg/l				5.0 E+03; 600/100 ml 90 mg/l

TENTATIVE PROCUREMENT PLAN

N PROCUREMENT ITEMS	FINANCING			METHOD	PREQUALIFICATION	ESTIMATED PUBLICATI DATE
	IDB	LOCAL	OTHER			
ULTING SERVICES						
of construction — sewer mains, t sewers US\$500,000	IDB 100%			ICB	YES	First half 1
ity modeling US\$500,000	IDB 100%			ICB	YES	First half 1
MENT						
our) US\$84,000	IDB 100%				NO	
s (five) US\$234,000	IDB 100%			ICB	NO	First half 1
WORKS						
ion of sewer mains, construction of g sewers	IDB 100%			ICB	YES	First half 1
arge works US\$2.2 million			NDF 100%	(*)		First half 1
lagoons US\$19.9 million			KfW 100%	(*)		Second half
pes and pumping plants lion			NDF 100%	(*)		Second half

International competitive bidding
g limited to special markets; scope of call for bids to be defined by cofinancier

PROPOSED RESOLUTION

NICARAGUA. LOAN No. ____/SF-NI TO THE REPUBLICA DE NICARAGUA
(The Lake and City of Managua Environmental Improvment Program)

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 the República de Nicaragua, as Borrower, for the purpose of granting it a financing to cooperate in the execution of the Lake and City of Managua Environmental Improvment Program. Such financing will be for the amount of up to US\$15,000,000, or its equivalent in other currencies, except that of Nicaragua, which are part of the resources of the Bank's Fund for Special Operations, and will be subject to the "Special Contractual Conditions" and the "Terms and Financial Conditions" of the Executive Summary of the Loan Proposal.