8.4.3 Discussion on Computation Results

In this Project, it is planned that 2 m^3/sec of sewage will be intercepted from the Colector Surco after completion of the Phase I facilities. The sewage discharge from the Surco Outfall is projected to vary as shown in TABLE 8-5 as a result of sewage discharge increase and interception by this Project, in which case around 3.3 m^3/s of sewage will be discharged to the sea from Colector Surco upon completion of Phase I project in 1992.

TABLE 8-5 Projected Sewage Discharge Quantity

(unit: m^3/sec)

Year	1990	91	92	93	94	95	96	97	98	99	2000
Sewage Discharge	5.00	5.15	5.30	5.45	5.60	5.75	5.90	6.05	6.20	6.35	6.50
Interception	-	-	2.00	2.00	2.00	4.00	4.00	4.00	4.00	4.00	4.00
Net Discharge	5.00	5.15	3.30	3.45	3.60	1.75	1.90	2.05	4.20	2.35	2.50

In the year 2000, the target year of this Project, Colector Surco will have a sewage discharge of 6.5 m^3/s in accordance with the increase of population in the drainage area.

However, with the facilities that would intercept 4 m^3/s of sewage to be completed by the year 2000, sewage discharge to the sea will be reduced to only 2.5 m^3/s.

Simulation results both in cases of discharge conditions with the Project and without the Project are shown in FIGURE 8-5 for different phases of the Project.

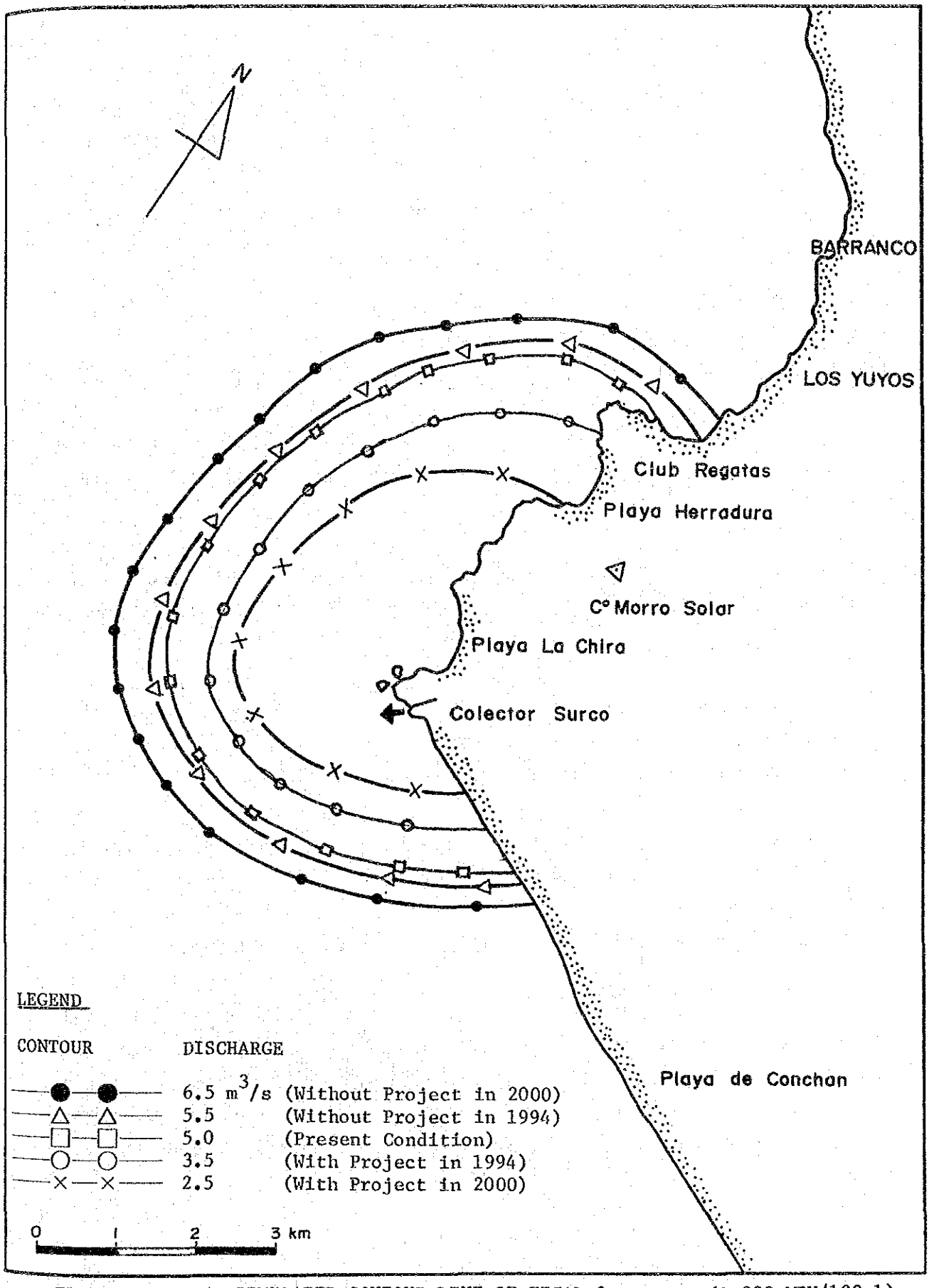


FIGURE 8-5 SIMULATED CONTOUR LINE OF FECAL COLIFORMS (1,000 MPN/100ml)

From the view point of preservation of the coastal areas in terms of maintaining good environmental condition that is suitable for swimming, Peruvian law sets the maximum limit of fecal coliforms at 1,000 MPN/100ml.

With the present sewage discharge volume of 5.0 m^3/s, simulation results show coliform distribution higher than 1,000 MPN/100ml in the swimming areas of La Chira, Herradura and Club Regatas. Even in Agua Dulce which is located north of Club Regatas, fecal coliform concentration ranges from 500 to 1,000 MPN/100ml.

In case of a 2.5 m^3/s sewage discharge (reduction of sewage discharge by 4.0 m^3/s in the year 2000), La Chira will remain unsuitable for swimming but Herradura, Club Regatas and Agua Dulce can be recovered as good swimming areas.

Reduction of the sewage discharge by 4.0 m^3/s will therefore significantly effect the preservation of the coastal areas in good environmental conditions.

Treatment of the remaining 2.5 m^3/s sewage volume in Colector Surco before disposal to the sea should also be seriously considered to easily keep the coastal area in good condition.

The quality of sea water in the area is expected to be maintained at present level at worst, if the Project is implemented on schedule. If the project will not materialize, the sea water pollution will spread farther to the north and condition in Agua Dulce will ultimately aggravate.

If the treatment of even 1 m^3/s of sewage is effected the limiting contour line will recede to the point near Club Regatas and will not reach Agua Dulce by the year 2000. However, if the Project is implemented on schedule, the sea water pollution condition in the area north of Club Regatas will not exceed the present level for many years after the year 2000.

CHAPTER 9

PROJECT EVALUATION

CHAPTER 9 PROJECT EVALUATION

9.1 Implementation Program

9.1.1 Implementation Plan

As the construction of the sewerage system is one of the important public works, it is imperative that a reliable construction work be ensured within the shortest period practical. In view of this, the Project implementation plan is phased into two stages, Phase I and Phase II, targeting 1992 and 1995, respectively, based on the following considerations:

- A two phase implementation program will be appropriate from the view point of size of investment.

- The assumptions made for the implementation periods of each phase are one year detailed design and two years construction.

- Detailed design stages include financial procurement, such as loan application with lending agency.

- Construction stages include tendering and construction supervision by consultant and SEDAPAL.

As mentioned in the previous sub-section, based on the consideration of environmental impact, technical and financial aspects, Alternative E1 plan is recommended for this Project.

This construction program has been divided into three interrelated components: the wastewater intake facilities, conduit system and sewerage treatment plants.

(1) Implementation Schedule of Phase I

Phase I aims to convey the sewage from the intake point to San Bartolo Plain and a new treatment plant which is planned to be constructed beside the existing San Juan Sewage treatment plant with high elevation transmission line.

In this phase, construction works are to be commenced immediately after the completion of detailed design work at the beginning of 1991 and have to be completed around the end of 1992.

Construction of each component is planned to be divided equally between each year.

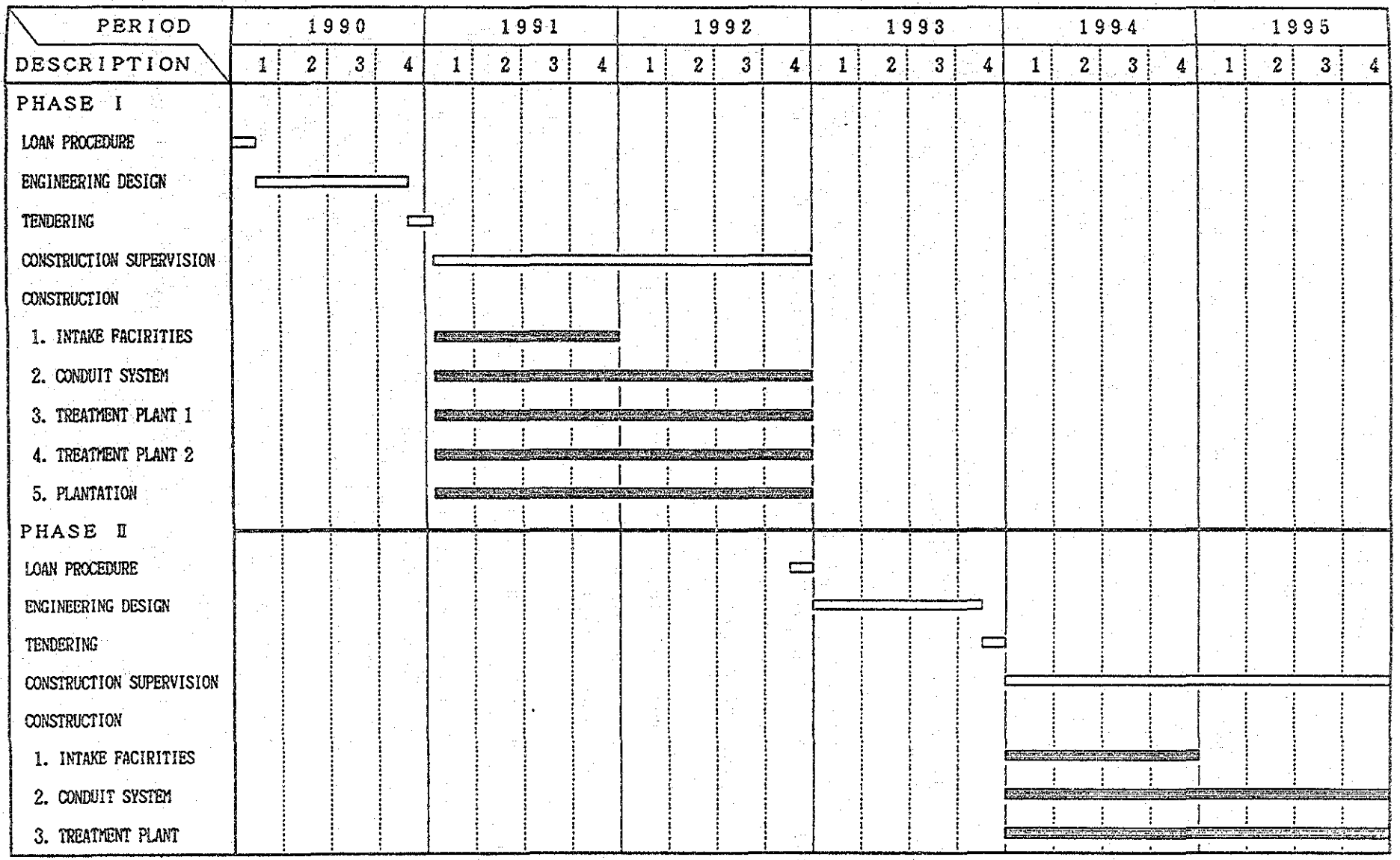
(2) Implementation Schedule of Phase II

Phase II aims to convey the sewage from the intake point to San Bartolo Plain and treat the sewage at San Bartolo Plain through the stabilization pond method with low elevation transmission line.

Assuming a two-year period for the construction work as in the case of Phase I, it is required to commence the construction work at the beginning of 1994 for completion around the end of 1995.

Construction of each component is also planned to be divided equally between each year except plantation work for new sewage treatment plant construction.

The implementation plan of the project is shown in FIGURE 9-1.



NOTE : CONSTRUCTION WORKS
OTHER WORKS

FIGURE 9 — 1

Implementation Plan

9.1.2 Capital Investment Schedule

(1) Project Cost and Currency Allocation

In the preceding Chapter 7, Preliminary Engineering Design of Alternatives, the estimated construction cost for the civil works, installation of the equipment, contractor's profits and overhead, and all related construction works are divided into direct items and indirect items. Project cost, however, includes other associated costs such as engineering fee and contingency.

In the estimation of other associated costs, engineering fee includes the costs for both detailed engineering design and construction supervision services.

It is assumed that eight percent of direct construction costs will be needed for the engineering services, approximately five percent is considered to be needed for the detailed design and the remaining three percent for the construction supervision services.

As contingency allowance, five percent of foreign currency portion of total construction cost including indirect cost and 10 percent of its local currency portion are estimated.

The total project cost including other associated costs is divided into the local currency component and foreign component. The local currency component includes cost of labor and materials actually paid in the local currency. Namely, it comprises the costs for local labor and materials locally manufactured or produced, including local handling and transportation charge for imported materials and domestic consumer tax.

The foreign currency component represents the costs to be paid in foreign currency such as those of imported materials and equipment.

TABLE 9-1 shows the proposed project cost summary divided into foreign and local currency portion.

TABLE 9-1 SUMMARY OF PROJECT COST

(Unit : Dollar 1,000)

Items	Total Value	Foreign Currency Portion	Local Currency Portion
1. Intake Facilities	620	312	308
2. Conduit System	71,661	37,480	34,181
3. Treatment Plants	19,892	5,708	14,184
4. Plantation	61	0	61
Sub Total	92,234	43,500	48,734
5. Engineering Services			
D/D	3,640	2,366	1,274
C/S	2,427	1,577	849
6. Contingency	7,458	2,372	5,086
Total	105,759	49,816	55,943

Note : D/D is Detailed Design
C/S is Construction Supervision

(2) Investment Schedule

The project will be commenced in 1990 and completed in 1995. Capital investment of project cost by each year will be made as stated in TABLE 9-2, which is based on the Implementation Plan and graphically indicated in FIGURE 9-2.

TABLE 9-2 Disbursement Schedule

(Unit : Dollar x 100

Year	Construction Cost			Engineering Cost							Sub-Total			Contingency			Grand Total		
				Design			Supervision			Plant. Cost									
	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	L.C.	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
Total	43,500	48,673	92,173	2,366	1,274	3,640	1,577	849	2,427	61	47,444	50,857	98,301	2,372	5,086	7,458	49,816	55,943	105,759
1990	0	0	0	1,147	617	1,764	0	0	0	0	1,147	617	1,764	57	62	119	1,204	679	1,883
1991	11,323	11,953	23,276	0	0	0	382	206	588	46	11,705	12,205	23,910	585	1,220	1,806	12,290	13,425	25,716
1992	11,150	11,781	22,931	0	0	0	382	206	588	15	11,532	12,002	23,534	577	1,200	1,777	12,109	13,202	25,311
1993	0	0	0	1,220	657	1,876	0	0	0	0	1,220	657	1,876	61	66	127	1,281	722	2,003
1994	10,583	12,538	23,121	0	0	0	407	219	625	0	10,990	12,756	23,746	549	1,276	1,825	11,539	14,032	25,571
1995	10,444	12,402	22,846	0	0	0	407	219	625	0	10,851	12,620	23,471	543	1,262	1,805	11,393	13,882	25,275
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: 1.Contingency : Foreign currency portion is 5 % of foreign currency portion of total construction cost
: Local currency portion is 10 % of loreign currency portion of total construction cost
2.Engineering Cost (Design) = 5 % of the direct construction cost
3.Engineering Cost (Supervision) = 3 % of the direct construction cost
4.F.C.: Foreign Currency
5.L.C.: Local Currency

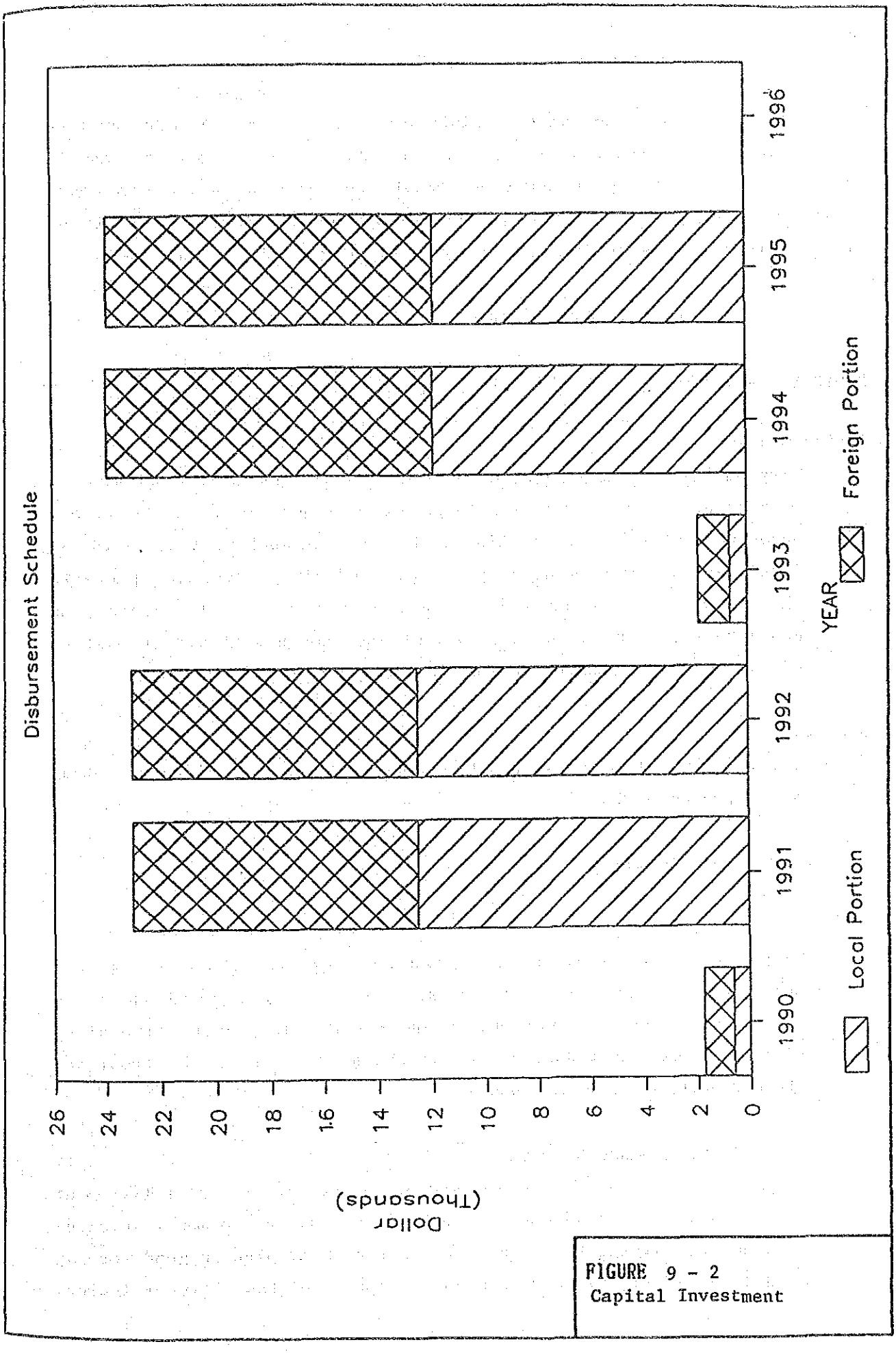


FIGURE 9 - 2
Capital Investment

9.2 Organizational and Managerial Aspect

After reviewing the existing administrative organization more or less related to the proposed sewerage project as stated in previous sections, it is considered necessary to newly establish the local sewerage management office of SEDAPAL. The proposed organization consists of the treatment plant division and sewer division as shown in FIGURE 9-3.

The major tasks of each division are described as follows:

Southern Lima Sewerage System Office

Office Manager:

Responsible as the head of new office for the operation and management of total sewerage system in proposed project system. He coordinates each division and section including personnel administration as disciplinary development of the staff and gives adequate orders to the division chiefs under full comprehension of the divisions. He has a duty to report the development and progress of the activities of the office to SEDAPAL Head Office as required.

Secretary:

Assists office manager in handling documentation and filing and other miscellaneous works.

- Treatment Plant Division

Chief:

Responsible for the management and administration of the overall operation and maintenance of the wastewater treatment plant to ensure adequate treatment of wastewater and sludge and proper disposal of effluent. He has a duty to report the activities of the treatment plant operation to office manager.

Chief and Staff of Each Section:

Responsible for overall control and operating activities of treatment functions to ensure adequate quality and desired volume of treated wastewater, keeping the facilities of treatment plan in good working condition and achievement of proper disposal of the effluent includ-

ing the preparation of the operating records in accordance with the operational instructions.

Laborers:

Clean the various equipment in the wastewater treatment facilities for proper function of the equipment including premises of the plant.

- Sewer Division

Chief:

Supervises activities necessary in keeping sewers and intake facilities in efficient working order administering the technicians and other laborers to be involved in all maintenance and repair works.

Section Head:

As an assistant to the division chief, responsible for the direct control and supervision of routine maintenance and emergency repair crews to ensure that cleaning activities are performed to keep the sewers and intake facilities in satisfactory conditions.

Technician:

To be in charge of inspection and repair of intake facilities and sewer for the maintenance in accordance with the preventive maintenance program.

Laborers:

Undertake the cleaning activities of sewers and intake facilities, such as grit chamber under the control of technician.

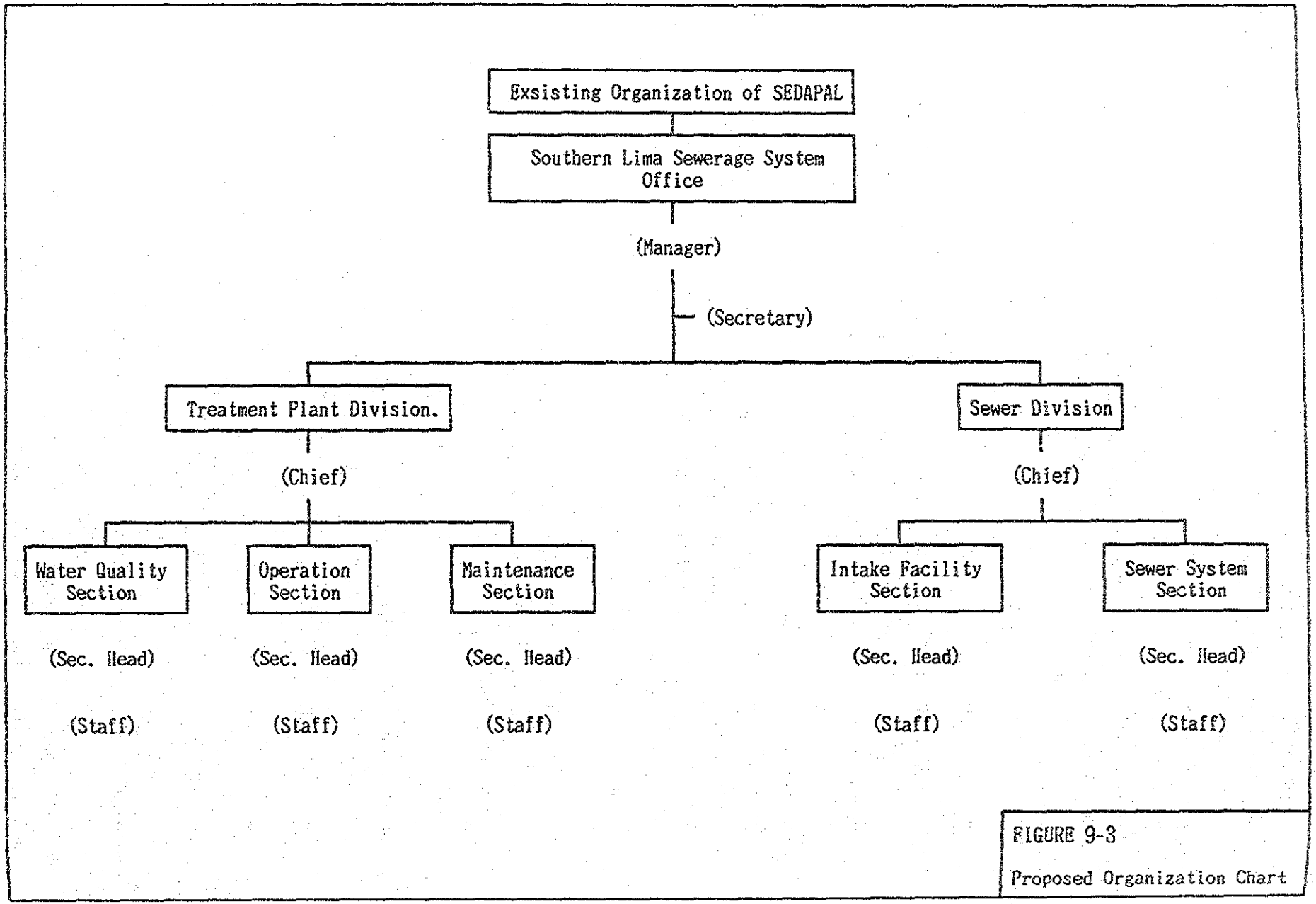


FIGURE 9-3

Proposed Organization Chart

9.3 Financial Analysis

The financial plan study for the proposed sewerage system has been carried out to guide SEDAPAL in the viable implementation of the Project with due consideration to existing financial practices, and potential funding sources to meet the estimated capital costs for construction and recurrent costs for operation.

9.3.1 Present Financial Situation

The present financial situation of the SEDAPAL, the agency which will undertake the financial management of the proposed sewerage project, has been reviewed as requirement of the financial plan study. SEDAPAL is a corporation which is administratively, technically, economically and financially independent from the Central Government. Its objective is to execute the state policy regarding development, control, operation and maintenance of potable water and sewerage service in the Province of Lima and the Province of Callao.

SEDAPAL's main functions are to secure, treat and distribute water for residential, industrial and commercial consumption, from which services its income is principally derived. Service rates are established by a resolution passed by the Comision Reguladora de Agua Potable y Alcantarillado (CORTARA).

SEDAPAL also obtains income from minor sources like various services requested by its users (sales of connections, internal repairs, openings, etc.), from closures and reopenings, and financial income. The collective economic importance of these services, however, is much less than that of the sales of the service itself. It is important to note that income from rates (fee for new urban rehabilitation and /or connections to the system) are considered capital allotment and are used exclusively to finance investment projects.

During 1988, SEDAPAL produced net incomes on account of water supply and sewerage services amounting to I/. 6,584,406,638, and I/. 232,711,123 on account of associated activities, representing 96.59% and 3.41% of the total income, respectively. (In 1987, these were I/. 1,387,812,555 and I/.

62,975,525; 95.66% and 4.34%, respectively).

Detail distribution of income as to the classification of users according to the consumption type is shown in TABLE 9-3.

TABLE 9-3 Income Distribution during 1988

	Users		Income	
	No.	%	Amount(x I/.1000)	%
Household	733,689	82.0	3072,064	40.9
Corporated	80,762	9.0	87,674	1.2
Commercial	67,415	7.5	1,491,496	19.8
Industrial	7,589	0.9	556,817	7.4
National	4,267	0.5	447,640	5.9
Own Source	931	0.1	375,959	5.0
Industrial Sewer			552,757	7.4
Collateral Services			232,711	3.1
Sub Total			6,817,118	90.7
Financial			594,818	7.9
Others			105,983	1.4
Total	894,653	100.0	7,517,919	100.0

The budget for expenses is prepared and disbursed according to guidelines. Operation and maintenance costs are covered with SEDAPAL's own resources.

The Profit and Loss statement of SEDAPAL for past 3 years are presented in TABLE 9-4.

TABLE 9-4 Profit and Loss

(Unit: x I/.1,000)

Calender Year	1986	1987	1988
Net sales			
Water and Sewer Service	666,363	1,387,813	6,584,407
Collateral Service	21,413	62,976	232,711
Other Operating Service	12,720	23,791	95,324
TOTAL INCOME	700,496	1,474,580	6,912,442
Treatment, Production and Service Cost	371,217	1,045,303	12,026,218
GROSS PROFIT(LOSS)	329,279	429,277	(5,113,776)
Sales Expenses	109,812	158,913	1,166,157
Administrative Expenses	260,710	488,975	4,496,916
Allotments to SENAPA	18,017	40,440	146,720
GROSS OPERATIVE PROFIT(LOSS)	(59,260)	(259,051)	(10,923,569)
Other Income and Expenses			
Financial Income	37,996	57,713	594,818
Financial Expenses	64,868	282,603	6,088,781
Extraordinary Losses	3,962	820	7,594
PROFIT (LOSS) of THE FISCAL YEAR	(90,094)	(484,761)	(16,425,126)

9.3.2 Funding Arrangements

Major fund requirements are categorized into the construction capital cost and recurrent cost for annual operation and maintenance of the system, including debt service, depreciation and other miscellaneous expenses.

1) Funds for the Construction Costs

Out of the total capital costs, the foreign currency portion is financed by the international lending agency while the local currency portion is financed by government subsidies, SEDAPAL's own equity or loan.

Such international loans are normally provided to finance only the foreign currency portion of the project costs. However, in certain cases, a part of local currency portion is also financed by international loan when such is desirable.

If the funding capability of the executing agency is not sufficient, the subsidy from the central government to the possible extent may be desirable and softer loans with low interest and longer period of repayment should be sought.

a. Loan from the international lending agencies

International loans are broadly categorized into the multilateral and bilateral loans. Example of multilateral loans are those loans from the World Bank and Inter-American Development Bank. Interest on such loans presently ranges from 6-8 percent per annum and repayment period is normally 20 years with grace period of about five years. Bilateral loans are exemplified by loans from West Germany, France or Japan with very concessionary terms, for example, low interest rates of 2-3 percent per annum and long maturity periods (up to 30 years) including extended grace period of up to 10 years.

b. Government Subsidy

The subsidy from the central government shall be allocated under the construction category for the construction of public utilities such as sewerage system and irrigation, water supply and other infrastructure development undertakings.

Sewerage system development projects are intended to provide the community with benefits such as enhanced public health and economic development, thus they should be encouraged by the government through allocation of substantial amount of subsidy.

c. Domestic Loan and Retained Profit

The local currency portion of capital costs are normally financed by the domestic commercial bank and retained profit including depreciation. SEDAPAL borrows funds for such suppose from commercial banks with guarantee by the central government. In Peru the terms and conditions of such loan are not fixed.

TABLE 9-5 shows loan conditions of international lending agencies.

TABLE 9-5 Loan Conditions

Agency	Interest Rate	Duration (Grace Period) Year	Charge
IBRD	7.74%	15-20 (3-5)	Front-end Fee: ——— Commitment Charge: 0.75%
IDA	0%	40 (10) or 35 (10)	Service Charge: 0.75% Commitment Charge: ———
IDB	8.1%	15-25 (4-6)	Commitment Charge: 0.75% Inspection Fee: 1% of loan amount
ADB	6.37%	10-30 (2-7)	Commitment Charge: 0.75%
OECF *	2.74%	28.8 (9.6)	———

* Average condition of 1988.

2) Funds for the recurrent costs

These funds are normally required after the construction of the system to meet the annual costs including operation and maintenance costs, and debt service payment if any loan is provided. There are established practices in developed countries that such recurrent costs are met by the users of the system who receive the benefits through the collection of sewerage use charges directly or by imposing surcharge on water rate.

The water rate surcharge is service charge related to water consumption which is calculated by adding a fixed rate to metered water consumption, as the volume of waste discharge is closely related to water consumption which is accurately metered. This method is widely employed in the world including Japan. Another benefit of this method is that the collection of charges can be made without difficulty in combination of billing procedure for water supply already in existence. The collection of the charge is enforceable by cutting off the water supply in the event of non-payment.

9.3.3 Alternative Financing Plan

The financial plans are developed based on the capital disbursement schedule and funding arrangements, the latter being considered as one of the most decisive factor for the financial viability of the project. The funding arrangement which will not impose unbearable burden upon SEDAPAL is most desirable, subject to the availability of sufficient fund or loan with lenient condition.

The following five alternatives considered for funding arrangement are assessed as to their financial impact on SEDAPAL as well as individual consumer in order to select appropriate funding arrangement for the Project.

Alternative 1: Total project costs is financed by the international lending agencies (IBRD).

Alternative 2: The foreign currency portion equivalent to 47,444 thousand dollars is financed by bilat-

eral loan and local currency portion of 50,857 thousand dollars is financed by the international lending agencies.

Alternative 3: The foreign currency portion equivalent to 47,444 thousand Dollars is financed by international lending agencies and local currency portion of 50,857 thousand Dollars is financed by equal contribution of bilateral loan and government subsidy.

Alternative 4: The whole of foreign currency portion and a part of local currency portion equivalent to 20,333 thousand Dollars (approximately 70 percent of the total project cost) is financed by bilateral loan and 30,524 thousand Dollars is financed by contribution of government subsidy.

In the alternative plans above, the conditions of the loan are assumed as follows:

International Loan (IBRD):

20 year repayment period including 6 year grace period with 8 percent interest per annum.

Bilateral Loan :

30 year repayment period including 10 year grace period with 2.5 percent interest per annum.

Such government funding contribution can also be justified by the prospective increase of socio-economic benefits to be derived from the proposed project as manifested in the project economic analysis.

Summarized fund arrangements for each alternative plan are shown in TABLE 9-6.

TABLE 9-6 Funds Arrangements

(Unit : Dollar x 1,000)

Funds Plan	Source of Fund		
	International Loan	Bilateral Loan	Government Subsidy
Alternative 1	98,301		
Alternative 2	50,857	47,444	
Alternative 3	47,444	25,428.5	25,428.5
Alternative 4		67,777	30,524

The source of capital costs and subsequent recurrent costs including debt services and operation and maintenance costs are indicated in alternative funding plans in TABLE 9-7 and the funding burden to be imposed on SEDAPAL in each alternative is highlighted in FIGURE 9-4.

As clearly shown in this figure, alternatives 3 and 4 appear more agreeable since required funds from SEDAPAL in successive years are less than other alternatives. Although there is no significant difference in graphic indication between alternatives 3 and 4, alternative 4 imposes less initial funding burden on SEDAPAL during construction stage and operation period.

Alternative 4 is, therefore assumed as a recommendable funding arrangement. The further financing analysis are made based on this alternative to identify the various factors necessary for making the project financially viable.

TABLEs 9-8 to 9-10 show the detail debt service alternative 4 financing plan and TABLE 9-11 shows summarized project cost and funding allocation of alternative 4.

In Appendix 23, show details of debt services for each alternative plans are shown.

TABLE 9-7 Capital and Annual Costs Cash Outlay

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Alternative 1														
Capital Costs														
Subsidy														
Foreign loan(1)	1,764	23,910	23,534	1,876	23,746	23,471								
Foreign loan(2)														
Recurrent Costs														
O/M costs	0	0	0	122	122	122	154	154	154	154	154	154	154	154
Debt Service	141	2,054	3,937	3,987	4,628	5,262	5,262	5,262	7,864	7,864	9,896	9,896	9,896	11,924
Total	141	2,054	3,937	4,110	4,751	5,385	5,416	5,416	8,018	8,018	10,050	10,050	10,050	12,078
Alternative 2														
Capital Costs														
Subsidy														
Foreign loan(1)	617	12,205	12,002	657	12,756	12,620								
Foreign loan(2)	1,147	11,705	11,532	1,220	10,990	10,851								
Recurrent Costs														
O/M costs	0	0	0	122	122	122	154	154	154	154	154	154	154	154
Debt Service	78	1,347	2,596	2,646	3,287	3,921	3,921	3,921	5,255	5,255	7,234	7,234	7,234	9,212
Total	78	1,347	2,596	2,768	3,409	4,043	4,075	4,075	5,409	5,409	7,388	7,388	7,388	9,366
Alternative 3														
Capital Costs														
Subsidy	309	6,103	6,001	329	6,378	6,310								
Foreign loan(1)	1,147	11,705	11,532	1,220	10,990	10,851								
Foreign loan(2)	309	6,103	6,001	329	6,378	6,310								
Recurrent Costs														
O/M costs	0	0	0	122	122	122	154	154	154	154	154	154	154	154
Debt Service	99	1,188	2,261	2,303	2,772	3,235	3,235	4,431	4,431	5,924	5,924	5,924	7,386	7,386
Total	408	7,291	8,262	2,754	9,272	9,667	3,389	4,585	4,585	6,078	6,078	6,078	7,540	7,540
Alternative 4														
Capital Costs														
Subsidy	126	7,188	7,059	134	8,047	7,970								
Foreign loan(1)														
Foreign loan(2)	1,638	16,722	16,475	1,742	15,699	15,501								
Recurrent Costs														
O/M costs	0	0	0	122	122	122	154	154	154	154	154	154	154	154
Debt Service	41	459	871	918	1,342	1,760	1,760	1,760	1,694	1,694	3,058	3,058	3,058	4,348
Total	167	7,647	7,930	1,174	9,511	9,852	1,914	1,914	1,848	1,848	3,212	3,212	3,212	4,502

Note : Foreign loan(1) is loan from international lending agency
Foreign loan(2) is bilateral loan

TABLE 9-7 Capital and Annual Costs Cash Outlay (Cont'd)

(Unit : Dollar x 1000)

Year	2004	2005	2006	2007	2008	2009	2010
Alternative 1							
Capital Costs							
Subsidy							
Foreign loan(1)							
Foreign loan(2)							
Recurrent Costs							
O/M costs	154	154	154	154	154	154	154
Debt Service	11,924	11,924	11,924	11,924	11,924	11,924	11,924
Total	12,078	12,078	12,078	12,078	12,078	12,078	12,078
Alternative 2							
Capital Costs							
Subsidy							
Foreign loan(1)							
Foreign loan(2)							
Recurrent Costs							
O/M costs	154	154	154	154	154	154	154
Debt Service	9,212	9,212	9,212	9,212	9,212	9,212	9,212
Total	9,366	9,366	9,366	9,366	9,366	9,366	9,366
Alternative 3							
Capital Costs							
Subsidy							
Foreign loan(1)							
Foreign loan(2)							
Recurrent Costs							
O/M costs	154	154	154	154	154	154	154
Debt Service	7,386	7,386	7,386	7,386	7,386	7,386	7,386
Total	7,540	7,540	7,540	7,540	7,540	7,540	7,540
Alternative 4							
Capital Costs							
Subsidy							
Foreign loan(1)							
Foreign loan(2)							
Recurrent Costs							
O/M costs	154	154	154	154	154	154	154
Debt Service	4,348	4,348	4,348	4,348	4,348	4,348	4,348
Total	4,502	4,502	4,502	4,502	4,502	4,502	4,502

Note : Foreign loan(1) is loan from international lending agency
Foreign loan(2) is bilateral loan

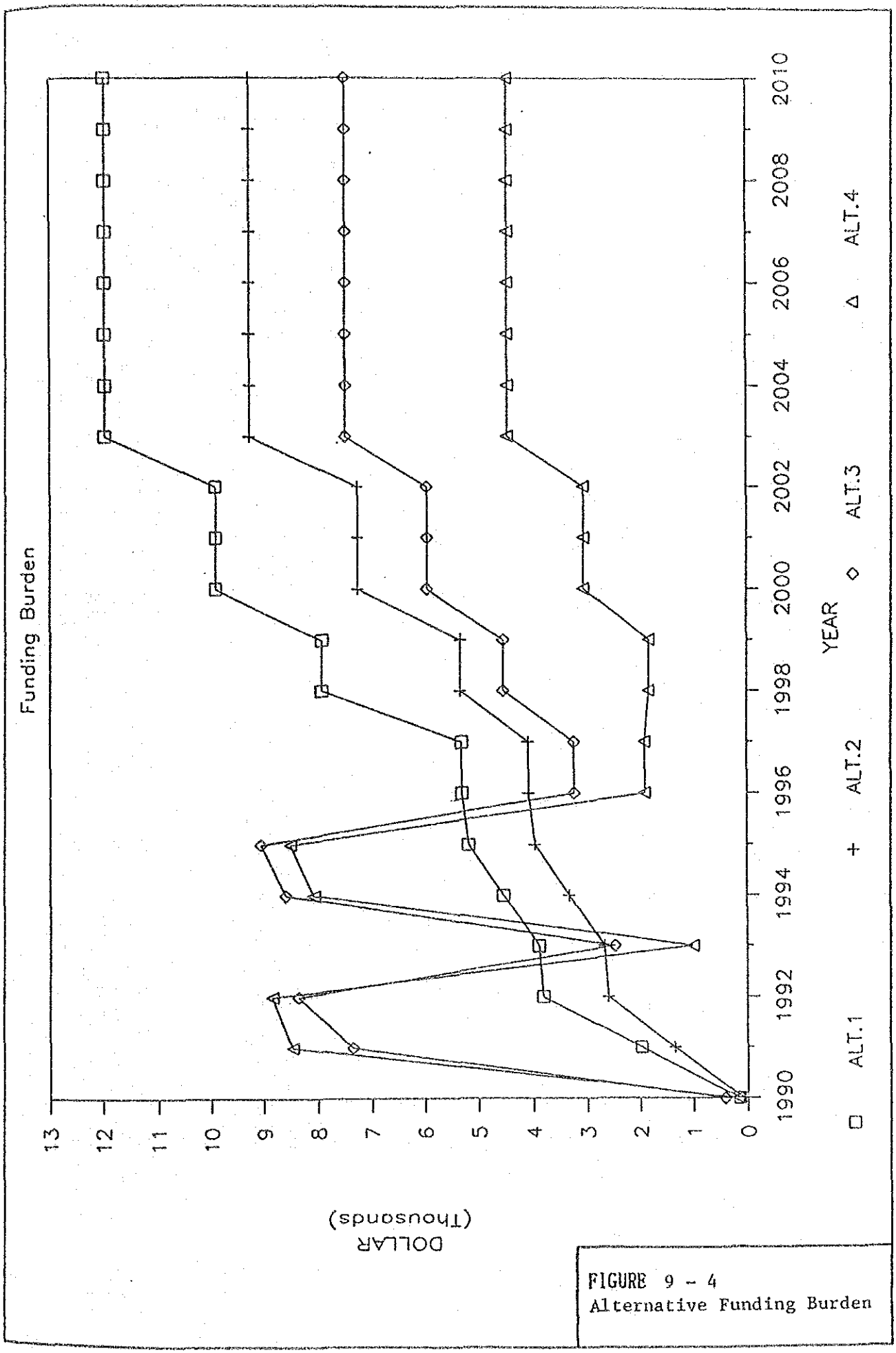


FIGURE 9 - 4
Alternative Funding Burden

TABLE 9-8 Debt Services for Phase I (Alternative 4)

Condition of Amortization

Loan Amount	34,835 Dollar x 1000
Interest Rate(year)	2.5 %
Repayment Period	30 years
Grace Period	10 years

(Unit : Dollar x 1000)

Year	Capital	Interest	Total Annual Repayment	Balance of Capital
1990	0	41.0	41.0	1,638.0
1991	0	459.0	459.0	18,360.0
1992	0	870.9	870.9	34,835.0
1993	0	870.9	870.9	34,835.0
1994	0	870.9	870.9	34,835.0
1995	0	870.9	870.9	34,835.0
1996	0	870.9	870.9	34,835.0
1997	0	870.9	870.9	34,835.0
1998	0	870.9	870.9	34,835.0
1999	0	870.9	870.9	34,835.0
2000	1,363.7	870.9	2,234.6	34,835.0
2001	1,397.8	836.8	2,234.6	33,471.3
2002	1,432.7	801.8	2,234.6	32,073.5
2003	1,468.5	766.0	2,234.6	30,640.8
2004	1,505.3	729.3	2,234.6	29,172.3
2005	1,542.9	691.7	2,234.6	27,667.0
2006	1,581.5	653.1	2,234.6	26,124.1
2007	1,621.0	613.6	2,234.6	24,542.6
2008	1,661.5	573.0	2,234.6	22,921.6
2009	1,703.1	531.5	2,234.6	21,260.1
2010	1,745.6	488.9	2,234.6	19,557.1
2011	1,789.3	445.3	2,234.6	17,811.4
2012	1,834.0	400.6	2,234.6	16,022.1
2013	1,879.9	354.7	2,234.6	14,188.1
2014	1,926.9	307.7	2,234.6	12,308.3
2015	1,975.0	259.5	2,234.6	10,381.4
2016	2,024.4	210.2	2,234.6	8,406.4
2017	2,075.0	159.5	2,234.6	6,382.0
2018	2,126.9	107.7	2,234.6	4,307.0
2019	2,180.1	54.5	2,234.6	2,180.1
2020	0.0	0.0	0.0	0.0
2021	0.0	0.0	0.0	0.0
2022	0.0	0.0	0.0	0.0
Total	34,835.0	17,323.3	52,158.3	

TABLE 9-9 Debt Services for Phase II (Alternative 4)

Condition of Amortization

Loan Amount	32,942 Dollar x 1000
Interest Rate(year)	2.5 %
Repayment Period	30 years
Grace Period	10 years

(Unit : Dollar x 1000)

Year	Capital	Interest	Total Annual Repayment	Balance of Capital
1990	0	0.0	0.0	0
1991	0	0.0	0.0	0
1992	0	0.0	0.0	0
1993	0	47.0	47.0	1,742.0
1994	0	470.9	470.9	17,441.0
1995	0	889.4	889.4	32,942.0
1996	0	889.4	889.4	32,942.0
1997	0	889.4	889.4	32,942.0
1998	0	823.6	823.6	32,942.0
1999	0	823.6	823.6	32,942.0
2000	0	823.6	823.6	32,942.0
2001	0	823.6	823.6	32,942.0
2002	0	823.6	823.6	32,942.0
2003	1,289.6	823.6	2,113.1	32,942.0
2004	1,321.8	791.3	2,113.1	31,652.4
2005	1,354.9	758.3	2,113.1	30,330.6
2006	1,388.7	724.4	2,113.1	28,975.7
2007	1,423.5	689.7	2,113.1	27,587.0
2008	1,459.0	654.1	2,113.1	26,163.5
2009	1,495.5	617.6	2,113.1	24,704.5
2010	1,532.9	580.2	2,113.1	23,208.9
2011	1,571.2	541.9	2,113.1	21,676.0
2012	1,610.5	502.6	2,113.1	20,104.8
2013	1,650.8	462.4	2,113.1	18,494.3
2014	1,692.0	421.1	2,113.1	16,843.5
2015	1,734.3	378.8	2,113.1	15,151.5
2016	1,777.7	335.4	2,113.1	13,417.1
2017	1,822.1	291.0	2,113.1	11,639.4
2018	1,867.7	245.4	2,113.1	9,817.3
2019	1,914.4	198.7	2,113.1	7,949.6
2020	1,962.3	150.9	2,113.1	6,035.2
2021	2,011.3	101.8	2,113.1	4,072.9
2022	2,061.6	51.5	2,113.1	2,061.6
Total	32,942.0	16,624.7	49,576.7	

TABLE 9-10 Debt Services (Alternative 4)

(Unit : Dollar x 1000)

Year	Capital	Interest	Total Annual Repayment	Balance of Capital
1990	0	41	41	1,638
1991	0	459	459	18,360
1992	0	871	871	34,835
1993	0	918	918	36,577
1994	0	1,342	1,342	52,276
1995	0	1,760	1,760	67,777
1996	0	1,760	1,760	67,777
1997	0	1,760	1,760	67,777
1998	0	1,694	1,694	67,777
1999	0	1,694	1,694	67,777
2000	1,364	1,694	3,058	67,777
2001	1,398	1,660	3,058	66,413
2002	1,433	1,625	3,058	65,016
2003	2,758	1,590	4,348	63,583
2004	2,827	1,521	4,348	60,825
2005	2,898	1,450	4,348	57,998
2006	2,970	1,377	4,348	55,100
2007	3,044	1,303	4,348	52,130
2008	3,121	1,227	4,348	49,085
2009	3,199	1,149	4,348	45,965
2010	3,279	1,069	4,348	42,766
2011	3,361	987	4,348	39,487
2012	3,445	903	4,348	36,127
2013	3,531	817	4,348	32,682
2014	3,619	729	4,348	29,152
2015	3,709	638	4,348	25,533
2016	3,802	546	4,348	21,823
2017	3,897	451	4,348	18,021
2018	3,995	353	4,348	14,124
2019	4,094	253	4,348	10,130
2020	1,962	151	2,113	6,035
2021	2,011	102	2,113	4,073
2022	2,062	52	2,113	2,062
Total	67,777	33,948	101,725	

TABLE 9-11 Project Cost, Disbursement Schedule and Funding Allocation of Alternative 4

a. Project Cost and Disbursement Schedule

(Unit : Dollar x 1,000)

Year	Foreign Portion	Local Portion	Total
1990	1,147	617	1,764
1991	11,750	12,205	23,910
1992	11,532	12,002	23,534
1993	1,220	657	1,876
1994	10,990	12,756	23,746
1995	10,851	12,620	23,471
Total	47,444	50,857	98,301

b. Funding allocation

(Unit : Dollar x 1,000)

Year	Bilateral Loan	Government Subsidy	Total
1990	1,638	126	1,764
1991	16,722	7,188	23,910
1992	16,475	7,059	23,534
1993	1,742	134	1,876
1994	15,699	8,047	23,746
1995	15,501	7,970	23,471
Total	67,777	30,524	98,301

9.3.4 Revenue Plan

1) Sewerage Charge

The revenue which is required to be raised by the executing agency to meet the annual cash requirements normally include the operation and maintenance costs as well as debt service if a certain loan is made to finance the capital costs.

Most of the required revenue is raised by collecting sewerage charges from the individual beneficiaries.

As mentioned in the previous sub-section, SEDAPAL's sewerage tariff system is expressed as surcharge on water rate. If consumer does not have water supply connection to the SEDAPAL system, independent sewerage rate is adopted.

The following TABLE 9-12 shows the Tariff Structure of SEDAPAL.

TABLE 9-12 Monthly Tariff Structure

(Unit : Inti)

Rate (I/./M3)	1985 Dec.	1986 Dec.	1987 Dec.	1988 Dec.
Domestic	1.28	2.13	3.78	57.54
0-10	0.55	1.15	1.92	22.50
11-30	1.11	2.07	3.48	36.50
31-50	1.84	3.45	5.76	76.50
51-80	2.30	4.26	7.20	97.50
over 80	3.04	5.52	9.24	131.50
Commercial	2.52	5.00	8.40	131.50
Industrial	3.15	5.80	9.72	131.50
Government	1.51	3.22	5.40	69.00
Institute	0.49	0.75	1.32	15.00
Sewerage	1.78	3.34	5.03	34.60

2) Projected Sewerage Charge Revenue

Estimated revenue from sewerage charge which is summarized in TABLE 9-13 and detail in Appendix 21, is based on the following conditions and assumptions:

(1) Surcharge rate of domestic sewerage charge is 35% of average domestic water tariff.

(2) Other wastewater charge is 35% of commercial water tariff, i.e., 131.5 Intis/m^3/month x 0.35 = 46 Intis/m^3/month.

(3) Industrial sewage charge is 57.5 Intis/m^3/month.

(4) Above sewerage charges and surcharge rate will remain unchanged until year 2010.

(5) Subject population is restricted within the Surco Drainage Area.

(6) Exchange rate is I/.500 to US$.

TABLE 9-13 Income from Sewerage Charge

(Unit : Dollar x 1000)

Year	Domestic	Others	Total
1990	4,305	2,658	6,963
1991	4,504	2,677	7,181
1992	4,712	2,697	7,409
1993	4,929	2,715	7,644
1994	5,152	2,734	7,886
1995	5,383	2,735	8,136
1996	5,623	2,773	8,396
1997	5,872	2,793	8,665
1998	6,129	2,813	8,942
1999	6,396	2,833	9,229
2000	6,672	2,853	9,525

3) Ability to Pay

The ability to pay is commonly expressed as the ratio of the proposed sewerage charge to the total income of potential benefihciry households. The maximum limit of the ratio usually adopted for sewerage charge in developing countries is about two percent.

TABLE 9-14 shows the average monthly income per capita in Metropolitan Lima. Noticeably, monthly incomes are increasing in accordance with the domestic inflation rate. Using M.U.C exchange rate, the income of minimum charge, public sector and private sector, would amount to 50 dollars, 150 to 200 dollars, and 200 to 250 dollars per month, respectively.

TABLE 9-14 Average Monthly Income per Capita

Period	Minimum Charge		Public Sector		Private Sector	
	(Inti)	(Dollar)	(Inti)	(Dollar)	(Inti)	(Dollar)
1988.1	2,200.0	66.67	8,093.3	245.25		
2	2,200.0	66.67	8,093.3	245.25	15,563.6	471.62
3	3,520.0	106.67	11,280.5	341.83		
4	3,520.0	106.67	11,280.5	341.83	20,411.6	618.53
5	3,520.0	106.67	11,280.5	341.83		
6	3,520.0	106.67	11,280.5	341.83	24,547.4	743.86
7	6,020.0	182.42	17,493.4	530.10	31,091.0	942.15
8	6,020.0	182.42	17,493.4	530.10	34,762.0	1,053.39
9	15,050.0	60.20	27,493.4	109.97		
10	15,050.0	60.20	48,663.4	194.65	51,481.1	205.92
11	21,070.0	42.14	86,129.9	172.26	72,197.7	144.40
12	21,070.0	45.14	100,841.6	201.68	89,346.8	178.69
1989.1	28,000.0	40.00	132,147.9	188.78		
2	36,000.0	39.13	166,433.3	180.91	142,180.8	154.54
3	49,000.0	40.83	226,292.7	188.58		
4	60,000.0	36.59	286,044.4	174.42	378,858.8	231.01
5	84,000.0	41.48	286,044.4	141.26		
6	108,000.0	45.09	286,044.4	119.42	593,884.0	247.93
7	140,000.0	48.59	407,555.6	141.46		

TABLE 9-15 shows expenditure of household.

TABLE 9-15 Expenditure of Household

(Unit : %)

Items / Year	1978	1986	1988
Foods and Beverages	44.9	46.9	51.4
Clothing	7.3	11.9	11.2
Rent, Fuel, Light and Water	15.6	8.9	4.6
Housing	7.0	6.3	8.0
Medical Expenses	2.6	3.9	3.2
Communications	9.8	8.6	9.1
Recreation	7.4	7.3	6.6
Miscellaneous	5.4	6.2	5.9
Total	100.0%	100.0%	100.0%

Source : INSTITUTO NACIONAL DE ESTADOSTOCA, INE

If the proposed sewerage charge is below two percent of household income, the owners of such households are considered capable of paying such charges.

The ratio of the unit sewerage charge for domestic users to average monthly income is calculated as follows:

A. Unit sewerage charge 20.14 Intis/m^3/month

B. Per Capita Sewage Flow

D/S.H 210 l/capita/day

D/S.L 180 l/capita/day

C. Monthly Sewage Flow per Household

D/S.H 33.39 m^3/month

D/S.L 28.62 m^3/month

Average number of persons per household is assumed to be 5.3.

D. Monthly Sewerage Charge per Household in dollar

D/S.H 1.34 $/month

D/S.L 1.15 $/month

E. Average Monthly Income

Private Sector	211	$/month/capita
Public Sector	162	$/month/capita

F. Ratio D/E

Private Sector	0.64 %
Public Sector	0.71 %

* D/S.H : Direct Water Supply High Consuming Group
  D/S.L : Direct Water Supply Low Consuming Group

It can be seen from these figures that average sewerage charge is less than one percent of average monthly income of respondent, so this sewerage charge is considered within the ability and willingness-to-pay of consumers.

4) Water Sales for Agriculture

After completion of this Project, it is expected that irrigation and development of agricultural land area in San Bartolo Plain will be realized.

As shown below, about 4,300 ha of land can be developed in this area by using treated water of this Project. Water charge shall be collected from farmers in this area who will avail of the sewage effluent for irrgation.

Water sale revenue from the agricultural project is estimated based on the following conditions:

(1) Local water application rates for farm irrigation in the desert climate is 0.8 l/s/ha.

(2) Possible area for development as agricultural land.

Name of Place	Sewage Amount	Reclaimation Area	No. of Employment
Villa El Salvador	0.5 m^3/s	500 ha	1,000
San Bartolo	3.5 m^3/s	4,300 ha	9,000
Total	4.0 m^3/s	4,800 ha	10,000

(3) Required unit investment cost for irrigation project
1,250 $/ha

(4) Water sale revenue from agriculture
5% of gross sales of annual agricultural produce

(5) Share of water sale revenue
SEDAPAL Water sale revenue x 2/3
M.O.A. Water sale revenue x 1/3

SEDAPAL's share of this water sale revenue is credited as a financial benefit to this Project, the calculation for which is developed in TABLE 9-16.

9.3.5 Administrative Expenses of Project

As mentioned in the previous sub-section, SEDAPAL is administratively, technically, economically and financially independent from the central government. Therefore, in order that total financial independence can be achieved by the SEDAPAL in the future, administrative expenses of its head office, such as inventories, personal expenses and consignment fee shall be charged to the revenue of each project.

In view of the above, it is recommended that in the share allocation of administrative expenses shall be calculated based on service population and gross revenue of each project.

TABLE 9-16 Income from Agriculture

(Unit : Dollar)

Year	Investment Cost	O&M cost	Income	Net Benefit	: Water Sale Income	SEDAPAL 2/3	M.O.A. 1/3
1990	0	0	0	0	: 0	0	0
1991	0	0	0	0	: 0	0	0
1992	0	0	0	0	: 0	0	0
1993	2,875,000	0	0	-2,875,000	: 0	0	0
1994	0	13,215,800	0	-13,215,800	: 0	0	0
1995	0	13,215,800	31,422,600	18,206,800	: 1,571,130	1,047,420	523,710
1996	3,125,000	13,215,800	31,422,600	15,081,800	: 1,571,130	1,047,420	523,710
1997	0	27,580,800	31,422,600	3,841,800	: 1,571,130	1,047,420	523,710
1998	0	27,580,800	65,577,600	37,996,800	: 3,278,880	2,185,920	1,092,960
1999	0	27,580,800	65,577,600	37,996,800	: 3,278,880	2,185,920	1,092,960
2000	0	27,580,800	65,577,600	37,996,800	: 3,278,880	2,185,920	1,092,960
2001	0	27,580,800	65,577,600	37,996,800	: 3,278,880	2,185,920	1,092,960
2002	0	27,580,800	65,577,600	37,996,800	: 3,278,880	2,185,920	1,092,960
2003	0	27,580,800	65,577,600	37,996,800	: 3,278,880	2,185,920	1,092,960
2004	0	27,580,800	65,577,600	37,996,800	: 3,278,880	2,185,920	1,092,960
2005	0	27,580,800	65,577,600	37,996,800	: 3,278,880	2,185,920	1,092,960
2006	0	27,580,800	65,577,600	37,996,800	: 3,278,880	2,185,920	1,092,960
2007	0	27,580,800	65,577,600	37,996,800	: 3,278,880	2,185,920	1,092,960
2008	0	27,580,800	65,577,600	37,996,800	: 3,278,880	2,185,920	1,092,960
2009	0	27,580,800	65,577,600	37,996,800	: 3,278,880	2,185,920	1,092,960
2010	0	27,580,800	65,577,600	37,996,800	: 3,278,880	2,185,920	1,092,960

Note : M.O.A. is Ministry of Agriculture

About 34% to 35% of total served population is planned to be covered in this project area, the surco Drainage Area, and the surcharge rate of sewerage charge is 35% of average water tariff. So, approximately 12% of total administrative expenses of SEDAPAL would be charged to this project.

TABLE 9-17 shows yearly administrative expenses forecasting.

9.3.6 Cash Flow Statement

1) Cash Flow

TABLE 9-18 shows the projected cash flow from 1990 to 2010. Assumed Estimate conditions of each item considered in the cash flow are as follows.

a. Cash Inflow

- Government subsidy
  Capital contribution for investment cost of local currency portion.

- Loan
  Local and foreign loan disbursement is estimated based on the Alternative 4 financing plan.

- Sewerage charges
  Detailed estimation is shown in TABLE 9-12 and Appendix.

- Other income
  This income includes financial income, connections, repairs, service and other, and estimated two percent of total annual sewerage charge.

- Water Sales Income
  Water Sales for agriculture project.

TABLE 9-17 Share of SEDAPAL Head Office Expenses (Adominstration Expenses)

	Share of Project Area				: Projected Population				: Admin. Expense	
Year	(1) (C)/(B)	(1)*35%	(2) (D)/(B)	(2)*35%	: Total Popu. (A)	Served Popu. (B)	S.D.Area (C)	Serv. Popu. (D)	: *SEDAPAL (Dollar x 1000)	*PROJECT
1990	39.30%	13.76%	33.50%	11.73%	: 6,145,200	4,596,610	1,806,500	1,540,060	: 38,524	4,518
1991	39.24%	13.74%	33.63%	11.77%	: 6,295,900	4,797,476	1,882,700	1,613,270	: 39,469	4,645
1992	39.21%	13.72%	33.77%	11.82%	: 6,447,000	5,002,872	1,961,700	1,689,650	: 40,416	4,777
1993	39.15%	13.70%	33.90%	11.86%	: 6,597,700	5,218,781	2,043,300	1,768,950	: 41,361	4,907
1994	39.10%	13.69%	34.03%	11.91%	: 6,748,600	5,439,372	2,127,000	1,850,750	: 42,307	5,038
1995	39.07%	13.68%	34.17%	11.96%	: 6,899,300	5,664,325	2,213,200	1,935,450	: 43,251	5,173
1996	39.06%	13.67%	34.33%	12.01%	: 7,050,900	5,894,552	2,302,300	2,023,310	: 44,202	5,310
1997	39.07%	13.67%	34.50%	12.07%	: 7,202,200	6,129,072	2,394,400	2,114,500	: 45,150	5,452
1998	39.03%	13.66%	34.64%	12.12%	: 7,354,800	6,376,612	2,489,000	2,208,540	: 46,107	5,589
1999	38.97%	13.64%	34.75%	12.16%	: 7,507,500	6,636,630	2,586,600	2,305,940	: 47,064	5,723
2000	38.97%	13.64%	34.91%	12.22%	: 7,661,400	6,895,260	2,687,100	2,407,150	: 48,029	5,868
2001	38.97%	13.64%	34.91%	12.22%	: 7,661,400	6,895,260	2,687,100	2,407,150	: 48,029	5,868
2002	38.97%	13.64%	34.91%	12.22%	: 7,661,400	6,895,260	2,687,100	2,407,150	: 48,029	5,868
2003	38.97%	13.64%	34.91%	12.22%	: 7,661,400	6,895,260	2,687,100	2,407,150	: 48,029	5,868
2004	38.97%	13.64%	34.91%	12.22%	: 7,661,400	6,895,260	2,687,100	2,407,150	: 48,029	5,868
2005	38.97%	13.64%	34.91%	12.22%	: 7,661,400	6,895,260	2,687,100	2,407,150	: 48,029	5,868
2006	38.97%	13.64%	34.91%	12.22%	: 7,661,400	6,895,260	2,687,100	2,407,150	: 48,029	5,868
2007	38.97%	13.64%	34.91%	12.22%	: 7,661,400	6,895,260	2,687,100	2,407,150	: 48,029	5,868
2008	38.97%	13.64%	34.91%	12.22%	: 7,661,400	6,895,260	2,687,100	2,407,150	: 48,029	5,868
2009	38.97%	13.64%	34.91%	12.22%	: 7,661,400	6,895,260	2,687,100	2,407,150	: 48,029	5,868
2010	38.97%	13.64%	34.91%	12.22%	: 7,661,400	6,895,260	2,687,100	2,407,150	: 48,029	5,868

Note:
1. Total population is Lima plus Callao.
2. Served population is estemated by using future service ratio of SEDAPAL.
3. S.D. Area is Surco Drainage Area.
4. Adominstrative expenses include sales expenses
5. Adominstrative expenses are calculated by using average exchange rate , 147 I/. on 1988.

TABLE 9-18 Projected Cash Flow

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Cash Inflow														
Government Subsidy														
Capital Contribution	126	7,188	7,059	134	8,047	7,970								
Laon	1,638	16,722	16,475	1,742	15,699	15,501								
Foreign Loan	1,638	16,722	16,475	1,742	15,699	15,501								
Operating Revenue	7,102	7,325	7,556	7,797	8,044	8,298	8,564	8,838	9,121	9,414	9,717	9,717	9,717	9,717
Sewerage Charge	6,963	7,181	7,408	7,644	7,886	8,135	8,396	8,665	8,942	9,229	9,526	9,526	9,526	9,526
Domestic	4,305	4,504	4,712	4,929	5,152	5,382	5,623	5,872	6,129	6,396	6,673	6,673	6,673	6,673
Ohters	2,658	2,677	2,696	2,715	2,734	2,753	2,773	2,793	2,813	2,833	2,853	2,853	2,853	2,853
Ohter Income	139	144	148	153	158	163	168	173	179	185	191	191	191	191
Water Sale Income	0	0	0	0	0	1,047	1,047	1,047	2,186	2,186	2,186	2,186	2,186	2,186
Total Inflow	8,866	31,235	31,090	9,673	31,790	32,816	9,611	9,885	11,307	11,600	11,903	11,903	11,903	11,903
Cash Outflow														
Project Expenditures														
Local Portion	617	12,205	12,002	657	12,756	12,620								
Foreign Portion	1,147	11,705	11,532	1,220	10,990	10,851								
Amortization														
Principal	0	0	0	0	0	0	0	0	0	0	1,364	1,398	1,433	2,758
Interest	41	459	871	918	1,342	1,760	1,760	1,760	1,694	1,694	1,694	1,660	1,625	1,590
Operating Expenses	0	0	0	122	122	122	154	154	154	154	154	154	154	154
Adominstrative Expenses	4,518	4,645	4,777	4,907	5,038	5,173	5,310	5,452	5,589	5,723	5,868	5,868	5,868	5,868
Payment to SENAPA	209	215	222	229	237	244	252	260	268	277	286	286	286	286
Total Outflow	6,532	29,229	29,404	8,053	30,485	30,770	7,476	7,626	7,705	7,848	9,366	9,366	9,366	10,656
Net Cash Flow	2,334	2,005	1,686	1,620	1,305	2,046	2,135	2,259	3,602	3,752	2,537	2,537	2,537	1,247
Accumulated	2,334	4,340	6,025	7,645	8,950	10,996	13,131	15,390	18,992	22,744	25,280	27,817	30,354	31,600

TABLE 9-18 Projected Cash Flow (Cont'd) (Unit : Dollar x 1000)

Year	2004	2005	2006	2007	2008	2009	2010
Cash Inflow							
Government Subsidy							
Capital Contribution							
Loan							
Foreign Loan							
Operating Revenue	9,717	9,717	9,717	9,717	9,717	9,717	9,717
Sewerage Charge	9,526	9,526	9,526	9,526	9,526	9,526	9,526
Domestic	6,673	6,673	6,673	6,673	6,673	6,673	6,673
Others	2,853	2,853	2,853	2,853	2,853	2,853	2,853
Other Income	191	191	191	191	191	191	191
Water Sale Income	2,186	2,186	2,186	2,186	2,186	2,186	2,186
Total Inflow	11,903	11,903	11,903	11,903	11,903	11,903	11,903
Cash Outflow							
Project Expenditures							
Local Portion							
Foreign Portion							
Amortization							
Principal	2,827	2,898	2,970	3,044	3,121	3,199	3,279
Interest	1,521	1,450	1,377	1,303	1,227	1,149	987
Operating Expenses	154	154	154	154	154	154	154
Adominstrative Expenses	5,868	5,868	5,868	5,868	5,868	5,868	5,868
Payment to SENAPA	286	286	286	286	286	286	286
Total Outflow	10,656	10,656	10,655	10,655	10,656	10,656	10,574
Net Cash Flow	1,247	1,247	1,248	1,248	1,247	1,247	1,329
Accumulated	32,847	34,094	35,342	36,589	37,836	39,083	40,412

b. Cash Outflow

- Project expenditure
  In accordance with the capital disbursement schedule for Implementation plan.

- Amortization
  Alternative 4 financing plan is adopted in the debt service calculation.

- Operating Expenses
  Details are shown in TABLEs 7-3 to 7-10.

- Administrative expenses
  Head Office share of allocation for total administrative expenses.

- Payment to SENAPA
  Three percent of sewerage charges and others.

As clearly shown in this table, net annual revenue surpluses are forecasted enough cover throughout the operation and expenditures in the maintenance period, amortization cost and operating expenses.

The result of this cash flow statement reveals that the annual net cash flow will continuously raise profit surpluses with cumulative surplus increasing to 40,412 thousand Dollar in 2010.

This result may demonstrate the simple financial feasibility of this project.

As a sensitivity analysis, cash flow statement are also made on the assumption that government capital contribution is not applied to construction cost. The result of this study reveals, as shown in Appendix 23, that in construction period total 19,528 thousand Dollars come into fund shortage which shall be covered with SEDAPAL's own fund.

The cumulative deficit amount will be 5,244 thousand Dollar in 2000 and cumulative surplus is 9,888 thousand Dollar in 2010, respectively.

2) Unit Cost of Sewerage

As shown in TABLE 9-19, the unit cost before debt service which will register 0.02 Dollar per cubic meter in 2000 and 0.04 Dollar in 2010. The average unit sewerage cost from year 1990 to 2010 is 0.03 Dollar per cubic meter or equal to 15 Intis per cubic meter, which is almost 70 percent of average sewerage rate for domestic.

The unit cost after depreciation is shown in Appendix 23.

3) Depreciation

At the end of the project, it may reasonably be expected that some residual (or terminal) value will still exist, that is, the capital asset will not have been used up in the course of the project period, hence there will be a "residual asset". In this financial study, established project period is 21 years, from 1990 to 2010. The residual value is, therefore added to the benefit stream in the last year (2010).

TABLE 9-20 shows the depreciation of the project fixed assets of each sewerage system.

For calculating, following conditions are adopted.

Depreciation method : Straight - line method
Final Salvage value : 10 percent of investment Cost

Estimate economic life :

1. Pipeline System = 30 years

2. Treatment Plant = 30 years

3. Intake facilities = 30 years

Estimated economic life of facilities indicated above is the weighted average of each component. As shown in the TABLE 9-20, total salvage value in the year 2010 is 45,444 thousand Dollars.

TABLE 9-19 Unit Cost of Sewerage Treatment

(Unit : Dollar x 1000)

year	Treated Sewerage (cu.m/day)	Operating Expenses	Debt Service	Total Expenses	Unit Cost Sewerage ($/cu.m)
1990	0	0	41	41	-----
1991	0	0	459	459	-----
1992	0	0	871	871	-----
1993	172,800	122	918	1,040	0.02
1994	172,800	122	1,342	1,464	0.02
1995	172,800	122	1,760	1,882	0.03
1996	345,600	154	1,760	1,914	0.02
1997	345,600	154	1,760	1,914	0.02
1998	345,600	154	1,694	1,848	0.01
1999	345,600	154	1,694	1,848	0.01
2000	345,600	154	3,058	3,212	0.03
2001	345,600	154	3,058	3,212	0.03
2002	345,600	154	3,058	3,212	0.03
2003	345,600	154	4,348	4,502	0.04
2004	345,600	154	4,348	4,502	0.04
2005	345,600	154	4,348	4,502	0.04
2006	345,600	154	4,348	4,502	0.04
2007	345,600	154	4,348	4,502	0.04
2008	345,600	154	4,348	4,502	0.04
2009	345,600	154	4,348	4,502	0.04
2010	345,600	154	4,348	4,502	0.04
			Average Unit Cost (1990-2010):		0.03

TABLE 9-20 Depreciation

(Unit: Dollar x 1000)

	Phase I			Phase II					
	Pipe-Line System	Treatment Plant	Intake Facility	Pipe-Line System	Treatment Plant	Intake Facility	Yearly Total	Accum. Total	Salvage Value
1990	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0
1992	499	0	10	0	0	0	509	509	22,767
1993	997	379	10	0	0	0	1,386	1,895	44,312
1994	997	379	10	0	0	0	1,386	3,281	42,926
1995	997	379	10	576	0	8	1,971	5,252	64,076
1996	997	379	10	1,153	218	8	2,765	8,017	84,157
1997	997	379	10	1,153	218	8	2,765	10,783	81,391
1998	997	379	10	1,153	218	8	2,765	13,548	78,626
1999	997	379	10	1,153	218	8	2,765	16,313	75,861
2000	997	379	10	1,153	218	8	2,765	19,078	73,096
2001	997	379	10	1,153	218	8	2,765	21,843	70,331
2002	997	379	10	1,153	218	8	2,765	24,609	67,565
2003	997	379	10	1,153	218	8	2,765	27,374	64,800
2004	997	379	10	1,153	218	8	2,765	30,139	62,035
2005	997	379	10	1,153	218	8	2,765	32,904	59,270
2006	997	379	10	1,153	218	8	2,765	35,670	56,504
2007	997	379	10	1,153	218	8	2,765	38,435	53,739
2008	997	379	10	1,153	218	8	2,765	41,200	50,974
2009	997	379	10	1,153	218	8	2,765	43,965	48,209
2010	997	379	10	1,153	218	8	2,765	46,730	45,444
2011	997	379	10	1,153	218	8	2,765	49,496	42,678
2012	997	379	10	1,153	218	8	2,765	52,261	39,913
2013	997	379	10	1,153	218	8	2,765	55,026	37,148
2014	997	379	10	1,153	218	8	2,765	57,791	34,383
2015	997	379	10	1,153	218	8	2,765	60,557	31,617
2016	997	379	10	1,153	218	8	2,765	63,322	28,852
2017	997	379	10	1,153	218	8	2,765	66,087	26,087
2018	997	379	10	1,153	218	8	2,765	68,852	23,322
2019	997	379	10	1,153	218	8	2,765	71,617	20,557
2020	997	379	10	1,153	218	8	2,765	74,383	17,791
2021	997	379	10	1,153	218	8	2,765	77,148	15,026
2022	499	379	0	1,153	218	8	2,256	79,404	12,770
2023	0	0	0	1,153	218	8	1,379	80,783	11,391
2024	0	0	0	1,153	218	8	1,379	82,162	10,012
2025	0	0	0	576	218	0	794	82,957	9,217
2026	0	0	0	0	0	0	0	82,957	9,217
2027	0	0	0	0	0	0	0	82,957	9,217
2028	0	0	0	0	0	0	0	82,957	9,217
2029	0	0	0	0	0	0	0	82,957	9,217
2030	0	0	0	0	0	0	0	82,957	9,217

9.3.7 Financial Analysis

To determine the viability the project, all costs and benefits shall be transformed to their present values at eight percent discount rate. This is the rate assumed to represent the pertinent opportunity cost of capital. A low discount rate, however, is considered justified since the project shall benefit the rural consumers whose annual incomes are generally lower than urban consumers.

In this analysis the viability of project shall be measured by the following financial feasibility criteria:

$$B/C > 1$$

$$NPV > 0$$

where;

B - present value of benefits

C - present value of costs

B/C - ratio of benefits to costs

NPV - net present value or B - C

A B/C > 1, or an NPV > 0 at eight percent discount rate, indicates that the project is feasible, i.e. financial benefits exceed financial costs at the prevailing opportunity cost of capital, fence, the project is viable for implementation, TABLE 9-21 represents the tabulation and calculation of Financial Benefit and Cost for the Project. As clear in this table, NPV is 30,660 thousand Dollar and B.C. Ratio is 1.20 respectively.

Since these figures exceed financial feasibility criteria, the project is considered financial feasible. The undertaking of the project is therefore suggested itself to proceed positively on condition to repay the interest for borrowed capital.

Table 9-21 Financial Benefit and Cost

(Unit : Dollar x 1000)

year	Loan	Govern. Subsidy	Operating Income	Water Sale	Total Income	Capital Invest.	Operating Expenses	Debt Service	Total Expenses	Net Income	Present Value Benefit	Present Value Cost	Present Value Net Income
1990	1,638	126	7,102	0	8,866	1,764	4,727	41	6,532	2,334	8,866	6,532	2,334
1991	16,722	7,188	7,325	0	31,235	23,910	4,860	459	29,229	2,006	28,921	27,064	1,857
1992	16,475	7,059	7,556	0	31,090	23,534	4,999	871	29,404	1,686	26,655	25,209	1,445
1993	1,742	134	7,797	0	9,673	1,876	5,168	1,040	8,084	1,589	7,679	6,417	1,261
1994	15,699	8,047	8,044	0	31,790	23,746	5,307	1,464	30,517	1,273	23,367	22,431	936
1995	15,501	7,970	8,298	1,047	32,816	23,471	5,449	1,882	30,802	2,014	22,334	20,963	1,371
1996	0	0	8,564	1,047	9,611	0	5,716	1,914	7,630	1,981	6,057	4,808	1,248
1997	0	0	8,838	1,047	9,885	0	5,866	1,914	7,780	2,105	5,768	4,540	1,228
1998	0	0	9,121	2,186	11,307	0	6,011	1,848	7,859	3,448	6,109	4,246	1,863
1999	0	0	9,414	2,186	11,600	0	6,154	1,848	8,002	3,598	5,803	4,003	1,800
2000	0	0	9,717	2,186	11,903	0	6,308	3,212	9,520	2,383	5,513	4,410	1,104
2001	0	0	9,717	2,186	11,903	0	6,308	3,212	9,520	2,383	5,105	4,083	1,022
2002	0	0	9,717	2,186	11,903	0	6,308	3,212	9,520	2,383	4,727	3,781	946
2003	0	0	9,717	2,186	11,903	0	6,308	4,502	10,810	1,093	4,377	3,975	402
2004	0	0	9,717	2,186	11,903	0	6,308	4,502	10,810	1,093	4,053	3,680	372
2005	0	0	9,717	2,186	11,903	0	6,308	4,502	10,810	1,093	3,752	3,408	345
2006	0	0	9,717	2,186	11,903	0	6,308	4,502	10,810	1,093	3,474	3,155	319
2007	0	0	9,717	2,186	11,903	0	6,308	4,502	10,810	1,093	3,217	2,922	295
2008	0	0	9,717	2,186	11,903	0	6,308	4,502	10,810	1,093	2,979	2,705	274
2009	0	0	9,717	2,186	11,903	0	6,308	4,502	10,810	1,093	2,758	2,505	253
2010	0	0	9,717	2,186	11,903	0	6,308	4,502	-34,634	46,537	2,554	-7,431	9,984
Salvage Value									(-45,444)				
Total Present Value											184,066	153,406	30,660

B.C.Ratio is 1.20

9.4 Economic Analysis

9.4.1 Introduction

This section presents an evaluation of the anticipated economic benefits to be derived from the Project and economic cost.

Evaluation is concentrated mainly on such benefits, among others , as public health, improvement of living environment and economic contribution to the community. Regarding the economic evaluation of the project, the most preferable approach would be the quantification of economic benefits and costs. In many cases, however, there are many unquantifiable factors in infrastructure development projects, such as this sewerage project. But in this Study, all quantifiable benefits and costs are counted for analysis to the extent possible. Intangible factors are also considered.

The first step in the economic analysis is to adjust financial prices to economic values by eliminating direct transfer payments. Direct transfer payments are payments that represent not the use of real sources but only the transfer of claims to real resources from one party in the same economic society to another. In this Project, the largest transfer payments are direct government subsidies and credit transactions that include loans, receipts, repayments of principal and interest payments and tax. All these entries should be taken out before the financial accounts are adjusted to reflect economic values.

9.4.2 Economic Benefits of the Project

1) Benefit Pertinent to Health

Benefit pertaining to health which is one of the purposes for installing a sewerage system, involves both the community concerned and the individuals in the area. The anticipated benefits concerning health, viewed from public and individual standpoints, are detailed in the following paragraphs:

(1) Benefits from Public Health Standpoint

Health benefits that accrue to the community from the sewerage system has two aspects, namely: 1) the preventive effect brought about by the sewerage system reduces the burden on local and central governments concerned with disease prevention and patient treatment activities, and 2) the elimination of opportunities of contact with infected matters reduces incidence of diseases on the part of the individuals.

Regarding the first item above, budgetary and physical provisions of the governments will be reduced with respect to requirements of chemical disinfection for prevention of epidemics, and of hospitals together with necessary personnel, equipment and materials. Regarding the second items, details are presented in the next subsection.

(2) Individual Health Benefits

The provision of the proposed sewerage system will result in health benefits to individuals in the service area, such as reduction in the risk and incidence of water-borne diseases, consequent elongation of life span, reduced expenditure on medical care, reduction in income loss because of absence from work, and others.

It has been pointed out in Section 2.4 Public Health Conditions, that the mortality and morbidity rates associated with water-borne diseases in Lima are fairly high. For example, in 1988, water-borne diseases in infants had a rate of incidence of 5.3 per 1,000 and infectious intestinal diseases were the leading cause of child mortality in Peru.

Epidemiologic data were collected by CAMPOS[a]) for populations in districts generating sewage and those consuming food crops from the reuse site around the San Juan STP. These data shows that the most

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a) CAMPOS, M., Cuadro Epidemiologico de las Enfermedaedes Infecciosas Relacionadas a la Disposicion de Exeretas en Lima Metropolitana, Instituto de Medicina Tropical "Alexander Von Humboldt", Lima, 1984

prevalent diseases are (principal agents are rotaviru, enterotoxigenid and enteropathogenic E. Coli., campylobacter, salmonella and shigella): typhoid and paratyphoid fever, viral hepatitis, polio, and intestinal parasites such as entamoeba histolitica and giardia lamblia.

A comparative prevalence study conducted in the San Juan Experimental Area in the year 1980, revealed that 96 % of the farm workers involved in reuse of sewage for irrigation and their families are carriers of enteroparasites, a great majority of them multiple carriers. This contrasted with the statistics for a student population in a local school 1 km from the reuse site, in which intestinal parasite coverage was 75 %. The high carriage rate among agricultural workers is mainly due to the raw sewage used for irrigation which may also have some effects on the consumers of the products of these agricultural workers.

Reuse of treated sewage for agriculture needs to be carried out with extreme caution to avoid creating, in the reuse process, an additional link in the chain of transmission of enteric diseases.

In this Study, the plan involving the construction of a treatment plant beside the existing San Juan STP is expected to improve the sanitary environment and health condition around the treatment plant. Main beneficiaries will be the farm workers and their families as well as people who consume their products as their chances of contacting water-borne diseases will be lessened.

This is one of the benefits that could be derived from this Project. However, in order to obtain such kind of benefit, it is necessary to promulgate some rules prohibiting the use of raw sewage for agriculture in addition to the establishment of water quality standards.

According to TABLE 9-15, it is estimated that medical expenses is about three (3) percent of total household expenditure.

The following assumptions are made to calculate the savings in medical care cost as a result of the installation of the sewerage system.

a. The average rate of incidence of water-borne diseases is 2.2 per 1,000 persons in the Study Area on the basis of the records from 1980 to 1988, which are described in Section 2.4.

b. About 50 percent of the above cases is attributable to the non-provision of the adequate sewerage system.

c. Duration of hospitalization for treating these cases is two weeks on the average, and amount spent for medical care is about 6 Dollars per patient.

d. About 30 percent of the population is actually economically active or gainfully employed. The final figure for the cost of time lost due to illness was derived by taking the economically active portion of those afflicted by water-borne diseases by minimum daily salary of 3.9 Dollars and 15 days, which is based on the assumption that an average laborer of private sector earned 1,927.36 Intis (equivalent to 3.9 Dollars) per day in Lima Metropolitan area in December 1988, and was unable to work for an average of 15 days as described above.

The cost of the medical expenses was derived by multiplying the morbidity rate by the served population and the average expenditure for medical expenses of 6 Dollars.

The sum of the two economic costs related to health benefits was adjusted by 50 percent to account for the fact that not all water-borne diseases are caused by a poor sewerage system but may also be due to poor personal hygiene or lack of water supply system.

The economic values derived from health benefits is shown in TABLE 9-22.

These benefits are more quantifiable with due assumptions which are based on various available data. All possible means to translate such benefits into monetary terms were therefore exhausted.

TABLE 9-22 Economic Health Benefit

(Unit : Dollar x 1000)

Year	Served Population	Cost of Time Loss (A)	Medical Expenses (B)	Total Economic Loss	Reduction Due to Project
1990	1,806,500	69.7	357.7	427.4	----
1991	1,882,700	72.7	372.8	445.5	----
1992	1,961,700	75.7	388.4	464.2	----
1993	2,043,300	78.9	404.6	483.5	242
1994	2,127,000	82.1	421.1	503.3	252
1995	2,213,200	85.5	438.2	523.7	262
1996	2,302,300	88.9	455.9	544.7	272
1997	2,394,400	92.4	474.1	566.5	283
1998	2,489,000	96.1	492.8	588.9	294
1999	2,586,600	99.9	512.1	612.0	306
2000	2,687,100	103.7	532.0	635.8	318
2001	2,687,100	103.7	532.0	635.8	318
2002	2,687,100	103.7	532.0	635.8	318
2003	2,687,100	103.7	532.0	635.8	318
2004	2,687,100	103.7	532.0	635.8	318
2005	2,687,100	103.7	532.0	635.8	318
2006	2,687,100	103.7	532.0	635.8	318
2007	2,687,100	103.7	532.0	635.8	318
2008	2,687,100	103.7	532.0	635.8	318
2009	2,687,100	103.7	532.0	635.8	318
2010	2,687,100	103.7	532.0	635.8	318

Note : (A) 30 % x 2.2/1000 x S.P. x 3.9 Dollar x 15 Days

(B) 2.2/1000 x S.P. x 6 Dollar x 15 Days

2) Improvement in Living Environment

One of the primary purposes of the Project, as important as health improvement, is the enhancement of living conditions in areas where water and air pollution has been rapidly worsening in the recent years. This will be achieved by the construction of the currently planned sewerage system project, in the following forms:

(1) Improvement of Environment from Aesthetical Viewpoint

Unpleasant filthy conditions of the area around Cerro La Chira will be considerably eliminated by the proposed Project. Offensive smell emitted from the sludge and trash in sea water will likewise be eradicated. Thus in areas where human activities are most concentrated, pleasant living conditions that are essential for such an area will be greatly enhanced.

(2) Recreational Effect

Elimination or reduction of sea water contamination by sewage will render Chira Coast safer as well as more attractive for swimming, fishing, boating, and similar activities.

3) Contribution to Local Economy

The construction of the sewerage system will contribute substantially to the local economy in several ways.

Firstly, land value in the area will appreciate, and together with such an increase in land value, related properties will also rise in value. Also, the construction of the system will provide employment opportunities to the local people and will boost the sales of local materials and equipment. Some of the above benefits are quantifiable while others are not.

(1) Value Added to Land

Investment in sewerage facilities, like in other public utilities such as water supply, electricity and road improvement, have the effect of raising the intrinsic value of the parcels of land served

by such facilities. The value added per unit of land tends to equal or exceed pro rata share of the investment involved.

In the Project area, this benefit is considered especially significant because the San Bartolo Plain has presently no economic land value. It is expected that about 4,300 ha of agricultural land will be developed and irrigated using treated sewage. The value of the benefit is measured by the additional amounts buyers are willing to pay for properties on which physical improvements have been made. It is because the buyers realize the possible intensive use of land, not to mention the improved quality of amenity in the area.

Possible development agricultural areas in San Bartolo Plain as estimated by the Ministry of Agriculture are shown in TABLE 9-23.

TABLE 9-23 Developed Agricultural Area

Sewerage Project Construction phase	Area (ha)
Phase I	1,800
Phase II	2,500
Total	4,300

The adopted price of developed land is 6,000 Dollar per hectare.

On the basis of proportionate shares of this sewerage Project about 60 % of total increase in land values and increase during five years after completion of sewerage treatment plants have been attributed to the availability of sewerage system. This benefit is developed in TABLE 9-24.

(2) Intensified Land Use

When sewerage systems become available, together with other public utilities in general, the land in the area can be more intensively used, as the present Project is implemented. More people can be supported and more activities in industry, commerce and others can be conducted in the Project area. This Project will, therefore definitely contribute to the development of the area through intensified

TABLE 9-24 Economic Land Value Increase

(Unit : Dollar x 1000)

	Phase I			Phase II				
Year	Land Area (ha)	Increase Unit Land Price	Land Value Increase	Land Area (ha)	Increase Unit Land Price	Land Value Increase	Total	Increase Due to Project
1990	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0
1994	1,800	4000	7,200	0	0	0	7,200	4,320
1995	1,800	500	900	0	0	0	900	540
1996	1,800	500	900	0	0	0	900	540
1997	1,800	500	900	2,500	4000	10,000	10,900	6,540
1998	1,800	500	900	2,500	500	1,250	2,150	1,290
1999	1,800	0	0	2,500	500	1,250	1,250	750
2000	1,800	0	0	2,500	500	1,250	1,250	750
2001	1,800	0	0	2,500	500	1,250	1,250	750
2002	1,800	0	0	2,500	0	0	0	0
2003	1,800	0	0	2,500	0	0	0	0
2004	1,800	0	0	2,500	0	0	0	0
2005	1,800	0	0	2,500	0	0	0	0
2006	1,800	0	0	2,500	0	0	0	0
2007	1,800	0	0	2,500	0	0	0	0
2008	1,800	0	0	2,500	0	0	0	0
2009	1,800	0	0	2,500	0	0	0	0
2010	1,800	0	0	2,500	0	0	0	0

Note : Land price of first year is $ 4,000 per hectare.

Annual increase rate of land value is $ 500 per hectare.

land use but economic benefits in these terms cannot be immediately quantified.

(3) Public Revenue

Public tax revenue to the local and central governments will be increased in two ways. First, the appreciated land value will produce an increase in land tax revenue. On the other hand, commercial, residential, and other buildings will increase in number and improve in quality, thus making possible an increase in property tax. This benefit cannot readily be quantified, but it constitutes an important reliable tax source for the governments concerned.

(4) Employment and Local Products

During the construction period, the local economy will benefit through the employment of individuals for construction work and through the sale of locally made materials and supplies. The amount of investment for the Project is sizable. The Project after completion will also provide permanent employment opportunities for the operation and maintenance of the sewerage system.

These economic benefit of production for employment opportunity should be taken into account in the economic cost analysis by using the shadow pricing factor.

Some of the economic benefits, presently regarded as unquantifiable, may become quantifiable in the future when scientific tools useful for such evaluation are devised. Even at this stage where those benefits cannot be measured in monetary terms, the benefits justify, it is judged, the proposed investment for the Project. Further, the evaluation justifies that the investment is to be funded from sources of public and private beneficiaries, namely, the central and local provincial governments, the SEDAPAL, and the people in the area involved.

(5) Increase of Tourism Income

For the environmental improvement of this project, tourism income will increase in the Metropolitan Lima Area, especially around Chira Coast.

As mentioned in Chapter 2, there are several beach resorts in the southern part of Metropolitan Lima. Together with the ruins in the inland area, these beach resorts are the main spots of tourism industry in Peru.

In 1988, the number of tourists that visited the metropolitan area, including El Callao was 2,154,063, which consisted of 281,406 foreigners and 1,872,659 Peruvians. This figure shows an increase of 14.20 %, as compared with the previous year.

The average lengths of stay of some foreigners and Peruvians are 2.80 days/capita and 1.57 days/capita, respectively, with average of 1.73 days/capita.

The amount of money spent by each foreign tourist in the year 1988 averaged 1,211 Dollars.

In Peru, the summer season is from December to April. About 40 % of total tourists visit Lima during this period.

Along Chira coast, the lowering of the sea water contamination level is assumed to result in the increase of 1 % in the number of foreign tourists.

This incremental increase in economic benefit is estimated to amount to:

281,406 x 0.01 = 2,814.06 say 2,800 people per year
2,800 x 1,211 Dollars/capita = 3,390,800 Dollars per year

Summary of Economic Benefit is shown in TABLE 9-25.

TABLE 9-25 Summary of Economic Benefits

(Unit : Dollar x 1000)

Year	Health Benefit	Land Value	Tourism Income	Economic Water Value	Total Economic Benefit
1990	0	0	0	0	0
1991	0	0	0	0	0
1992	0	0	0	0	0
1993	242	0	1,696	0	1,938
1994	252	4,320	1,696	0	6,268
1995	262	540	1,696	806	3,304
1996	272	540	3,391	806	5,009
1997	283	6,540	3,391	806	11,020
1998	294	1,290	3,391	1,681	6,656
1999	306	750	3,391	1,681	6,128
2000	318	750	3,391	1,681	6,140
2001	318	750	3,391	1,681	6,140
2002	318	0	3,391	1,681	5,390
2003	318	0	3,391	1,681	5,390
2004	318	0	3,391	1,681	5,390
2005	318	0	3,391	1,681	5,390
2006	318	0	3,391	1,681	5,390
2007	318	0	3,391	1,681	5,390
2008	318	0	3,391	1,681	5,390
2009	318	0	3,391	1,681	5,390
2010	318	0	3,391	1,681	5,390

Benefits of the Project have so far been considered from the viewpoints of health, land value and contribution to the local economy. Some of the benefits were quantified, but most of them were treated as unquantifiable. Therefore, the benefits of the latter category have been elaborated in purely descriptive or qualitative manner. The calculations of the quantifiable benefits show that the monetary values to be gained in 15 years after the completion of the Project would be equal to 101 million Dollars. At present worth, this amount is equivalent to 41 million Dollars.

9.4.3 Economic Costs of the Project

The direct costs of the Project should be transformed into economic costs. For this purpose, the project cost and operating and maintenance costs are considered in the Study. These costs will be converted into economic cost using factors of shadow pricing.

The financial project costs explained in Section 9.3 was converted into economic costs by the following modifications:

1) Import duties and domestic consumer taxes are assumed to be 26,320 thousand Dollars for foreign portion and 4,202 thousand Dollars for the local portion of the project cost.

2) Shadow exchange rate factor of 1.3 (Details are shown in TABLE 9-26) was applied to the local currency component. A premium factor of 0.5 was applied to the percentage of unskilled labor portion, which is about 20 percent of local currency portion of project cost.

TABLE 9-26 Shadow Exchange Rate

(Unit: x 1,000,000 Dollars)

Year		1986		1987	
Import Amount	(A)	2,525	50.2 %	3,068	54.1 %
Import Tax	(B)	80 %		80 %	
Export Amount	(C)	2,509	49.2 %	2,605	45.9 %
Export Subsidy	(D)	20 %		20 %	
Total Trade Amount		5,034		5,673	

Shadow Exchange Factor is 1+(A x B)-(C x D)

1986: 1 + ((0.502 x 0.8) - (0.492 x 0.2)) = 1.303

1987: 1 + ((0.541 x 0.8) - (0.459 x 0.2)) = 1.341

Economic Costs of the Project and depreciation are shown in TABLE 9-27 and TABLE 9-28, respectively.

TABLE 9-27 Economic Project Cost

(Unit : Dollar x 1000)

Year	Financial Project Cost			Tax			Economic Project Cost		
	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
Total	47,445	50,857	98,302	26,320	4,202	30,522	21,125	33,376	54,501
1990	1,147	617	1,764	646	51	697	501	405	906
1991	11,705	12,205	23,910	6,595	1,013	7,608	5,110	8,007	13,117
1992	11,532	12,002	23,534	6,497	996	7,493	5,035	7,874	12,909
1993	1,220	657	1,877	666	54	720	554	431	985
1994	10,990	12,756	23,746	5,996	1,050	7,046	4,994	8,374	13,368
1995	10,851	12,620	23,471	5,920	1,038	6,958	4,931	8,286	13,217
1996	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0	0
2004	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0
2006	0	0	0	0	0	0	0	0	0
2007	0	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0	0

TABLE 9-28 Depreciation of Economic Project Cost

(Unit: Dollar x 1000)

	Phase I			Phase II					
	Pipe-Line System	Treatment Plant	Intake Facility	Pipe-Line System	Treatment Plant	Intake Facility	Yearly Total	Accum. Total	Salvage Value
1990	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0
1992	282	0	6	0	0	0	288	288	9,325
1993	565	237	6	0	0	0	808	1,096	25,836
1994	565	237	6	0	0	0	808	1,904	25,028
1995	565	237	6	332	0	5	1,145	3,049	35,105
1996	565	237	6	664	159	5	1,635	4,684	49,818
1997	565	237	6	664	159	5	1,635	6,319	48,183
1998	565	237	6	664	159	5	1,635	7,954	46,548
1999	565	237	6	664	159	5	1,635	9,589	44,913
2000	565	237	6	664	159	5	1,635	11,224	43,278
2001	565	237	6	664	159	5	1,635	12,859	41,643
2002	565	237	6	664	159	5	1,635	14,494	40,008
2003	565	237	6	664	159	5	1,635	16,129	38,373
2004	565	237	6	664	159	5	1,635	17,764	36,738
2005	565	237	6	664	159	5	1,635	19,400	35,102
2006	565	237	6	664	159	5	1,635	21,035	33,467
2007	565	237	6	664	159	5	1,635	22,670	31,832
2008	565	237	6	664	159	5	1,635	24,305	30,197
2009	565	237	6	664	159	5	1,635	25,940	28,562
2010	565	237	6	664	159	5	1,635	27,575	26,927
2011	565	237	6	664	159	5	1,635	29,210	25,292
2012	565	237	6	664	159	5	1,635	30,845	23,657
2013	565	237	6	664	159	5	1,635	32,480	22,022
2014	565	237	6	664	159	5	1,635	34,115	20,387
2015	565	237	6	664	159	5	1,635	35,750	18,752
2016	565	237	6	664	159	5	1,635	37,385	17,117
2017	565	237	6	664	159	5	1,635	39,020	15,482
2018	565	237	6	664	159	5	1,635	40,655	13,847
2019	565	237	6	664	159	5	1,635	42,290	12,212
2020	565	237	6	664	159	5	1,635	43,925	10,577
2021	565	237	6	664	159	5	1,635	45,560	8,942
2022	282	237	0	664	159	5	1,347	46,907	7,595
2023	0	0	0	664	159	5	827	47,734	6,768
2024	0	0	0	664	159	5	827	48,561	5,941
2025	0	0	0	332	159	0	490	49,052	5,450
2026	0	0	0	0	0	0	0	49,052	5,450
2027	0	0	0	0	0	0	0	49,052	5,450
2028	0	0	0	0	0	0	0	49,052	5,450
2029	0	0	0	0	0	0	0	49,052	5,450
2030	0	0	0	0	0	0	0	49,052	5,450

9.4.4 Economic Analysis

To determine the viability of the Project, all economic costs and benefits shall be transformed to their present value at eight (8) percent discount rate. This is the rate assumed to represent the pertinent opportunity cost of capital. A low discount rate, however, is considered justified since the Project will benefit the rural consumers whose annual incomes are generally lower than that of urban consumers.

In this analysis the viability of Project shall be measured by the following economic feasibility criteria:

EIRR
B/C > 1
NPV > 0
where: EIRR: Economic internal rate of return
B: Present value of benefits
C: Present value of costs
B/C: Ratio of benefits to costs
NPV: Net present value or B - C

The rate of return was computed based on the present value of cash inflow and outflow.

A B/C > 1, or an NPV > 0 at eight (8) percent discount rate, indicates that the Project is feasible, i.e., economic benefits exceed economic costs at the prevailing opportunity cost of capital, hence the Project is viable for implementation. TABLE 9-29 represents the tabulation and calculation of Economic Benefit and Cost for the Project. It can be seen in this table that the calculated EIRR is 9.67 percent, NPV is 5,717 thousand Dollars and B/C Ratio is 1.15.

Since EIRR exceeds the opportunity cost of capital of 8 percent and interest rate of international lending agencies, and the B/C and NPV also exceed economic feasibility criteria, the Project is considered to be feasible economically. The implementation of the Project is therefore strongly recommended, even if on condition to repay the interest on borrowed capital.

TABLE 9-29 Economic Benefit and Cost

(Unit : Dollar x 1000)

year	Land Value	Health Benefit	Tourism Income	Water Value	Total Income	Capital Invest.	Operat. Exp.	Total Exp.	Net Income	Present Value Benefit	Present Value Cost	Present Value Net Income
1990	0	0	0	0	0	906	0	906	-906	0	906	-906
1991	0	0	0	0	0	13,117	0	13,117	-13,117	0	12,145	-12,145
1992	0	0	0	0	0	12,909	0	12,909	-12,909	0	11,067	-11,067
1993	0	242	1,696	0	1,938	985	94	1,079	859	1,538	856	682
1994	4,320	252	1,696	0	6,268	13,368	94	13,462	-7,194	4,607	9,895	-5,288
1995	540	262	1,696	806	3,304	13,217	94	13,311	-10,007	2,248	9,059	-6,811
1996	540	272	3,391	806	5,009	0	118	118	4,891	3,157	75	3,082
1997	6,540	283	3,391	806	11,020	0	118	118	10,902	6,430	69	6,361
1998	1,290	294	3,391	1,681	6,656	0	118	118	6,538	3,596	64	3,532
1999	750	306	3,391	1,681	6,128	0	118	118	6,010	3,066	59	3,006
2000	750	318	3,391	1,681	6,140	0	118	118	6,022	2,844	55	2,789
2001	750	318	3,391	1,681	6,140	0	118	118	6,022	2,633	51	2,583
2002	0	318	3,391	1,681	5,390	0	118	118	5,272	2,140	47	2,093
2003	0	318	3,391	1,681	5,390	0	118	118	5,272	1,982	44	1,938
2004	0	318	3,391	1,681	5,390	0	118	118	5,272	1,835	40	1,795
2005	0	318	3,391	1,681	5,390	0	118	118	5,272	1,699	37	1,662
2006	0	318	3,391	1,681	5,390	0	118	118	5,272	1,573	35	1,539
2007	0	318	3,391	1,681	5,390	0	118	118	5,272	1,457	32	1,425
2008	0	318	3,391	1,681	5,390	0	118	118	5,272	1,349	30	1,319
2009	0	318	3,391	1,681	5,390	0	118	118	5,272	1,249	27	1,221
2010	0	318	3,391	1,681	5,390	0	118	-26,809	32,199	1,156	-5,752	6,908
Salvage Value								(-26,927)				
								Present Value		44,559	38,842	5,717

B.C.Ratio is 1.15 IRR is 9.67%

9.5 Sensitivity Analysis

Sensitivity anlysis is a technique to test systematically what happens to the earning capacity of this Project if events differed from the estimates made during planning. It is a means of dealing with uncertainty about future events and values. A sensitivity analysis is done by varying one element or a combination of elements and determining the effect of the change on the output, most often on the measure of project values.

A sensitivity test may be made, for example, to determine the effect of different fund rising on the capital investment for project construction.

In this Study, following elements shall be considered in sensitivity analysis and detail tables are shown in APPENDIX 23.

a) Capital contribution by government.
b) Sewerage charge.
c) Interest rate of foreign loan and fund allocation.
d) Without or delay of agricultural project.

9.5.1 Financial Sensitivity Study

The result of sensitivity studies are summarized as follows:

1) Cash flow analysis (in terms of accumulative surplus in 2010)

a) Basic Plan

Financing Plan : Alternative 4
Sewerage Charge : unchanged until year 2010.
Government Subsidy : 25,428,500 Dollars
Accumulative Surplus: 40,412,000 Dollars

b) Sensitivity Study A

Financing Plan : Alternative 4
Sewerage Charge : unchanged until year 2010
Government Subsidy : not applied
Accumulative Surplus: 9,888,000 Dollars

c) Sensitivity Study B

Financing Plan : Alternative 4
Sewerage Charge : unchanged until year 2010
Government Subsidy : not applied
Agricultural Project: without
Accumulative Surplus: - 21,671,000 Dollars

d) Sensitivity Study C

Financing Plan : Alternative 2
Sewerage Charge : unchanged until year 2010
Government Subsidy : not applied
Accumulative Surplus: - 31,045,000 Dollars

e) Sensitivity Study D

Financing Plan : Alternative 2
Sewerage Charge : increased by 5 percent every three years
Government Subsidy : not applied
Accumulative Surplus: 714,000 Dollars

f) Sensitivity Study E

Financing Plan : Alternative 4
Sewerage Charge : unchanged until year 2010
Government Subsidy : 25,428,500 Dollars
Agricultural Project: 3 years delay
Accumulative Surplus: 33,854,000 Dollars

2) Financial Criteria

	B/C	NPV (Dollars)
a) Basic Plan	1.20	30,660,000
b) Sensitivity Study A	1.04	6,381,000
c) Sensitivity Study B	0.96	-5,683,000
d) Sensitivity Study C	0.95	-9,659,000
e) Sensitivity Study D	1.08	13,957,000
f) Sensitivity Study E	1.18	26,964,000

In cases B and C, cumlative surpulus are ended in deficit and also financial criterias indicate negative financial feasibility of the project. In case D, net annual surplus are not enough to cover annual recurrent cost of project from 2000 (refer to APPENDIX 23). In these case, deficits shall be covered with SEDAPAL's own fund or rate of sewerage charge shall be increased to achieve a financial self-standing of SEDAPAL.

9.5.2 Economic Sensitivity Study

The result of sensitivity studies are as follows:

	EIRR	B/C	NPV (Dollars)
1) Basic Plan	9.67%	1.15	5,717,000
2) Sensitivity Study A	9.67%	1.15	5,717,000
3) Sensitivity Study B	6.88%	0.91	-3,562,000
4) Sensitivity Study C	9.67%	1.15	5,717,000
5) Sensitivity Study D	9.67%	1.15	5,717,000
6) Sensitivity Study E	8.83%	1.07	2,875,000

An economic sensitivity study indicates that the Project is economically feasible in all cases except for case B where the financing plan is Alternative 4, the charge is unchanged untill year 2010, goverment subsidy is not applied, and agricultural project is omitted.

9.6 Justification of the Project

In the case of projects related to transportation like airport facilities and port facilities, or public facilities projects such as power plants and waterworks, quantitative evaluation of benefits is obtainable with respect to increase in productivity, prevention of losses, etc.

On the other hand, with regard to generally unproductive or non-revenue producing infrastructure projects as sewerage systems, the evaluation of the benefit is quite difficult if such measurable variables like costs are to be used.

The present state of the sewerage system in Lima is as follows: The cityward drifting of population into Lima has considerably been on the increase since about 20 years ago and the trend continues even today. The sewage produced by the population of Lima has therefore likewise increase with some very adverse effects. Around one third (1/3) of this sewage is being discharged to the coast of Surco without any treatment resulting to progressive deterioration of the environmental conditions. Today the coast has become a terrible eyesore.

For this reason, the construction of the sewage treatment plant to protect the sea water against pollution has now become a subject of interest among the Lima inhabitants. In this regard, this Project is evaluated from the points of view of the necessity, the benefit, and the effect of its implementation, as follows:

(1) Improvement of Water Pollution at Surco and its Effect

Currently, as much as about 5.0 m^3/day of raw sewage is being discharge to the Pacific Ocean, polluting severely the recreation resort stretching from Pta. La Chira to the Club de Regatas. This condition has prompted the Ministry of Health of Peru to issue an ordinance to especially designate the resort as a restricted area unsuitable for swimming.

In view thereof, it is our strong belief that once this sewerage project is completed and the improvement of the environment has been attained through the elimination of the pollution source, the Costa Verde

(green coast) will surely regain the beautiful landscape it once had, hopefully in the immediate future. When that time comes, the coast will again be able to serve the people of Lima and surrounding regions as the most familiar recreation resort. In particular, people in the lower income brackets can again avail safety of the leisure and comfort of the popular coastal resort. Effects of the improvement in the sea water pollution condition are described in detail in Chapter 8.

(2) Greening of San Bartolo Plain into Agricultural Land and its Effect

1) Most suitable site for construction of the plant is found in San Bartolo.

As revealed in the Study, a sewage treatment plant is necessary in order to cut the volume of effluent to the Surco Outfall. It is also known after due consideration of applicable treatment methods that the stabilization pond system would be most favorable because this system does not need any mechanical nor electrical facilities.

In contrast, a mechanical treatment system requires mechanical and electrical facilities, which would entail huge amounts for payment of electric charges and replacement costs of facilities when the need arises.

The stabilization pond method requires 32 ha of treatment area for a planned sewage amount of 0.25 m^3/s and 450 ha for 3.5 m^3/s. It is therefore concluded that only the San Bartolo Plain can provide such a large area while it was impossible to find a site of suitable size on the right bank of the Rio Lurin.

2) Formation of Community in San Bartolo Plain with Greened Farmland in its Center

When the planned amount of 3.5 m^3/s or 3,00,000 m^3/day of sewage is supplied, it would enable the cultivation of 4,300 ha of farmlands, and provide employment to about 5,000 people in agriculture. This situation in expected to bring about a chain of economic repercussions in this community, such as the build-up of new communities around the farmland and together with it an anticipated brisk activities in the transport enterprise,

brokerage, agricultural chemicals, agricultural machinery and implements, fertilizer, and other business associated with agriculture and distribution of products.

Furthermore, the emergence of a large-scale farmland in the outskirts of the urban region of Lima city can probably bring about a very great social impact because the urban population, those in the lower income society particularly, would benefit from a plentiful supply of fresh and cheap farm products.

3) Impact on the Inhabitants of the Greening of San Bartolo Plain

The Republic of Peru has a land area three and a half times as large as Japan. It is divided into three major zones, namely; Costa (Coastal zones), Sierra (Mountainous areas), and Selva (Dense forest zones).

Lima has varied geographical features, being surrounded by sea, desert, and the denuded beige mountains. Climatic conditions in San Bartolo is unique in that the temperature and the duration of sunshine necessary for farm crops raising are plenty while the water indispensable for the plants to grow is practically nil. However, based on a successful evidence with the San Juan STP, even the San Bartolo Plain can be converted into an agricultural land covered with rich green once the treated water produced from the sewage treatment plant is used to irrigate the area. The greening of San Bartolo into a farmland will not only contribute to the promotion of health conditions through the generation of precious oxygen for the congested urban region of Lima city, but will also provide visual and emotional relaxation to the people.

It is also our firm belief that the development of 4,300 ha of new green zones is a matter of deep significance, a welcome deviation from the present global trend of diminution of forests. Forest cover worldwide is disappearing at fast rate of 38.6 ha/minute.

CHAPTER 10

CONCLUSION AND RECOMMENDATION

CHAPTER 10 CONCLUSION AND RECOMMENDATION

10.1 Conclusion

Outline and results of analysis of recommended plan are as follows:

(1) Target Year

The target year for the Project in this Study is year 2000.

(2) Study Area

Study Area covers the southern part of Lima, with the management of the sewage generated by Surco drainage area being specifically the objective of the Project (refer to FIGURE 3-1). The area in hectares of the Surco drainage area is as follows:

Year	Metropolitan Lima	Related 16 Districts	Surco Drainage Area
1989	282,000	43,000	12,200
2000	282,000	43,000	23,100

(3) Type of Sewerage System

Since the precipitation depth in the Study area is only around 30 mm a year, it was deemed appropriately to have sanitary sewage as sole subject of the Project.

(4) Planned Population

Present and future population in Metropolitan Lima and the Study Area are as follows:

Year	Metropolitan Lima	Related 16 Districts	Surco Drainage Area
1989	6,000,000	2,800,000	1,700,000
2000	7,600,000	3,600,000	2,700,000

(5) Planned Sewage Quantity

a. Unit Sewage Quantity

Domestic sewage (Daily Average in 1989 and 2000)

Direct Water Supply Service High Consumption Group (D/S.H) 210 lpcd

Direct Water Supply Service Low Consumption Group (D/S.L) 180 lpcd

Indirect Water Supply Service Group (I.D) 110 lpcd

Industrial Wastewater

1989: 0.323 m^3/s in total

2000: 0.355 m^3/s in total (0.323 x 110 %)

Other Wastewater

1989: 0.778 m^3/s in total

2000: 0.467 m^3/s in total (0.778 x 60 %)

b. Planned Sewage Quantity (Daily Average)

1989: 5.0 m^3/s

Estimation based on population:

Item	Unit	Domestic Sewage			Industrial & Other Wastewater	Total
		D/S.H	D/S.L	I.D		
Population	person	639,660	829,320	263,520		1,732,500
Unit Q	lpcd	210	180	110		
Sewage Flow	m^3/s	1.555	1.728	0.336	0.323 + 0.778	4.720

Estimation based on results of flow measurement:

May 31, 1989 5.370 m^3/s

February 25 to March 2, 1988 4.773 m^3/s

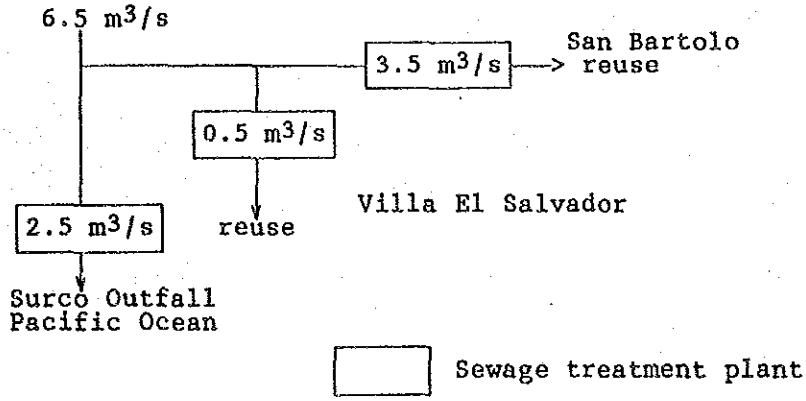
Qavg = (5.370 + 4.773) / 2 = 5.072 m^3/s

Therefore, 5.0 m^3/s was adopted for present sewage quantity.

2000: 6.5 m^3/s

Item	Unit	Domestic Sewage			Industrial & Other Wastewater	Total
		D/S.H	D/S.L	I.D		
Population	person	899,290	1,507,860	279,950		2,687,100
Unit Q.	lpcd	210	180	110		
Sewage Flow	m^3/s	2.186	3.142	0.356	0.355 + 0.467	6.506 say 6.5

c. Planned Sewage Flow Balance



(6) Planned Sewage Quality

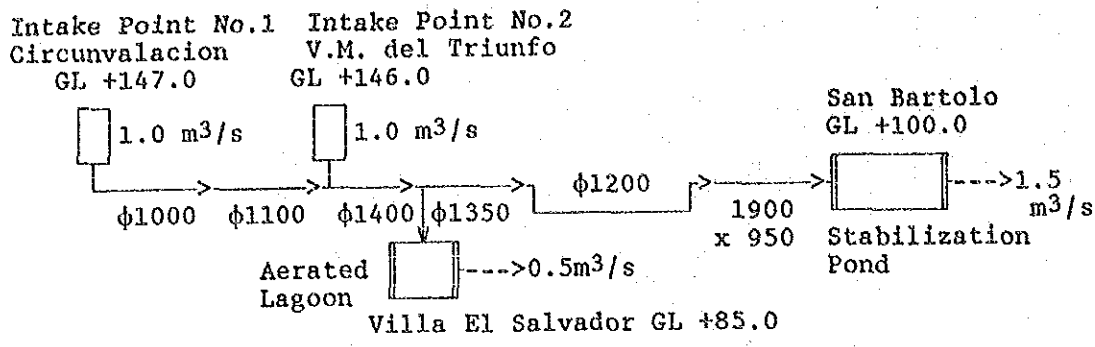
Item	Inflow	Treated Water	Removal Rate
BOD_5	250 mg/l	49 mg/l (Stabilization Pond)	80 %
		30 mg/l (Aerated Lagoon)	88 %
SS	250 mg/l	- mg/l (Stabilization Pond)	- %
		60 mg/l (Aerated Lagoon)	76 %

(7) Optimum Plan

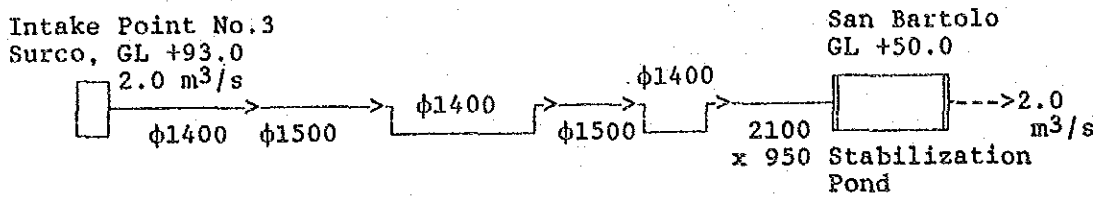
Out of 14 alternative plans, Plan E_1 was selected as the optimum plan. The outline of the optimum plan is as follows:

a. Outline of plan

Phase I



Phase II



b. Outline of facilities

- Intake facilities:

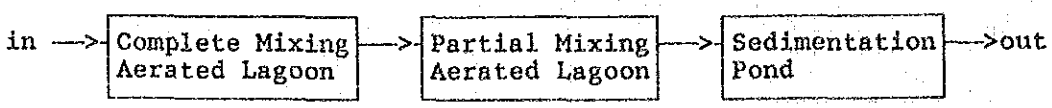
  Control Gates, Screens, Grit Chambers, and Flow Meters will be provided.

- Transmission facilities:

  Sewage will be transmitted by gravity. Gravity flow sections will be made of concrete pipes and open channel. Inverted siphon sections will be made of prestressed concrete pipes and cast iron pipes. Air valves and blow-off valves will be provided at places where necessary.

- Sewage treatment facilities:

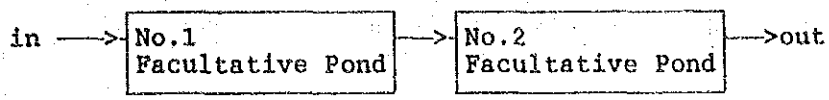
  The treatment method adopted for the site at Villa El Salvador is the Aerated Lagoon System.



Mechanical aerators will be provided on aerated lagoons. Detention time is set at 4 days for aerated lagoons and 1 day for sedimentation ponds. Required site area is:

$$30\ ha/m^3/s \times 0.5\ m^3/s = 15\ ha$$

The treatment method adopted for the site at San Bartolo is the Stabilization Pond System.



This treatment method does not require any power supply. Total detention time for No.1 and No.2 facultative ponds is set at 15 days. Required site area is:

$$130\ ha/m^3/s \times 3.5\ m^3/s = 450\ ha$$

c. Construction Cost

Estimated construction cost of the Project is summarized as follows:

(unit: 1,000 US$)

Phase	Direct Cost					Indirect Cost			Total
	Intake Facility	Conduit	Treatment Facility		Sub Total	Overhead	Others	Sub Total	
			C & A	Equip.					
Phase I	283	27,201	5,494	4,831	37,809	11,338	61	11,399	49,208
Phase II	226	31,563	5,976	-	37,765	11,328	-	11,328	49,093
Total	509	58,764	11,470	4,831	75,574	22,666	61	22,727	98,301

C & A: Construction cost for Civil and Architectural works.
Equip.: Cost for Mechanical and Electrical equipment.
Others: Cost for plantation.
The base date of cost estimation is October 26, 1989.
Exchange Rate: I/. 6,050.75 = US$ 1.00

d. Operation and maintenance cost

Estimated operation and maintenance cost of the project is summarized as follows:

(unit: US$/year)

Phase	Conduit	Treatment Facility		Total
		Labor	Power	
Phase I	1,888	31,200	89,261	122,349
Phase II	1,884	29,952	-	31,836
Total	3,772	61,152	89,261	154,185

(8) Project Evaluation

a. Improvement of water pollution at Surco

Currently, the sea area along the coasts stretching from Pta. La Chira to the Club Regatas is designated by the Ministry of Health as a restricted area unsuitable for swimming (refer to FIGURE 8-5).

In year 2000, the polluted sea area will recede by 3.0 km. Thus, the sea area in north of Playa Herradura will be improved as a pleasant recreational area.

b. Greening of desert into agricultural land

The expected area to be converted by the Project at the time of completion is as follows:

Name of Place	Sewage Amount	Reclaimation Area	No. of Employment
Villa El Salvador	0.5 m^3/s	500 ha	1,000
San Bartolo	3.5 m^3/s	4,300 ha	9,000
Total	4.0 m^3/s	4,800 ha	10,000

Turnover ratio of capital by agriculture benefit:

Irrigation area 4,300 + 500 = 4,800 ha

Capital cost of Project US$ 98,301,000

Capital cost for irrigation facilities 1,250 US$/ha

Capital cost per ha US$ 98,301,000 ÷ 4,800 ha + 1,250 US$/ha

= 21,729 US$/ha

Agriculture benefit (Sales of farm products - Production cost)

5,000 US$/ha/year

Therefore, turnover ratio is:

21,729 US$/ha ÷ 5,000 US$/ha/year = 4.3 year

c. Financial analysis

Assumption:

Financing:

around 70 % (67,777,000 US$) - bilateral loan

around 30 % (30,524,000 US$) - government subsidy

Cash inflow:

Government subsidy

Loan

Sewerage charges

Other income (2 % of sewerage charges)

Water sales income

Cash outflow:

Project expenditure (capital cost)

Amortization

Operating expenses

Administrative expenses

Payment to SENAPA (3 % of sewerage charges and others)

Results of analysis:

B/C ratio 1.20 (with discount rate of 8 %) > 1.0

NPV US$ 30,660,000 (ditto) > 0

d. Economic analysis

Assumption:

Benefits:

Health benefit

Increase of land value

Increase of tourism income

Economic water value (shadow exchange rate - 1.3)

Cash outflow:

Economic project expenditure (capital cost)