21.4 Economic Cost Benefit Analysis

21.4.1 Assumptions

(1) Construction Schedule

Construction of new Panama-Colon Highway is assumed to be implemented in the following schedule:

Table 21.4.1 Construction Schedule

Section	Construction Period
A-1,2,3	1995-----1999
S-1	1997-----2001
S-2	2000------2004

(2) Project Life

Project life is assumed to be the period between 1995 to 2030, during which the project cost will be amortized.

(3) Toll Charge

No toll charge is assumed in the economic analysis. This is because the economic benefit is calculated on a basis of willingness to pay of drivers and passengers that is not affected by the imposition of toll charge.

(4) Discount Factor

Capital cost of investment represents the discount factor of economic analysis, and is assumed to be 12 percent.

(5) Salvage Value

Land is assumed to be a single cost item of project that can be reused for the different purpose at the end of project. Thus, the land cost is evaluated as a salvage value at the end of project period.

(6) Economic Benefit after the year 2010

Economic benefit of each road section (A-1,2,3; S-1,2) is calculated based on the demand forecast of the years of 2000 and 2010 shown in Table 21.2.12. Evaluation of economic benefit after the year 2010 is conservative so that the economic benefit may not increase through the rest of years.

Table 21.4.2 Cash flow of Economic Cost-Benefit

Year	Construct Cost A-1,2,3	S-1	S-2	Maintenance Operation	Total Cost	Economic Benefit	Net Benefit
1995	32,943			0	32,943		-32,943
1996	18,973			0	18,973		-18,973
1997	23,717	21,275		0	44,992		-44,992
1998	23,717	26,897		0	50,614		-50,614
1999	28,460	33,621		0	62,081		-62,081
2000		33,621	12,492	388	46,501	108,096	61,595
2001		45,224	14,098	388	59,710	113,325	53,615
2002			17,622	585	18,207	147,337	129,130
2003			17,622	585	18,207	158,511	140,304
2004			21,146	585	21,731	169,686	147,955
2005				730	730	279,903	279,173
2006				730	730	305,759	305,029
2007				730	730	351,614	330,884
2008				730	730	357,470	356,740
2009				730	730	383,325	382,595
2010				730	730	409,181	408,451
2011				730	730	409,181	408,451
2012				730	730	409,181	408,451
2013				730	730	409,181	408,451
2014				730	730	409,181	408,451
2015				730	730	409,181	408,451
2016				14,141	14,141	409,181	395,040
2017				730	730	409,181	408,451
2018				730	730	409,181	408,451
2019				730	730	409,181	408,451
2020				730	730	409,181	408,451
2021				730	730	409,181	408,451
2022				730	730	409,181	408,451
2023				730	730	409,181	408,451
2024				730	730	409,181	408,451
2025				14,141	14,141	409,181	395,040
2026				730	730	409,181	408,451
2027				730	730	409,181	408,451
2028				730	730	409,181	408,451
2029				730	730	409,181	408,451
2030				730	-56,105	409,181	465,286
				Cost(12%)	243,984	Benefit	1,367,245
				EIRR	37.03%	B/C	5.60

21.4.2 Result of Economic Benefit Cost Analysis

Table 21.4.2 shows the outlay of economic benefit and cost throughout the project life. Construction costs of three road section and necessary Table 21.4.2 maintenance cost are shown in the second column to fifth column. Total cost in the sixth column shows a large cost outlay in the first ten years because of road construction, and in the years of 2015 and 2025 because of road overlay. Negative figures in cost outlay at the end of project period is due to the salvage value of the project.

Economic benefit in Table 21.4.2 consists both distance saving and time saving. Alcalde Diaz section (A-1,2,3) reveals a large benefit outlay during the early period of project, and the addition of Colon section (S-2) generates the largest economic benefit. Thus, net benefit turns out to be positive even during the construction period from the sixth year of construction, and produces a large amount of economic surplus throughout the project life.

Table 21.4.3 shows the summary table of economic benefit cost analysis based on the economic benefit of vehicle operating cost and time savings. The results show that the economic internal rate of return (EIRR) and economic benefit cost ratio (B/C) of all routes are substantially high, and the resulting net present

value of project reaches more than three times of economic cost. Although each road section reveals very high economic feasibility, Alcalde Diaz section shows higher EIRR and B/C ratio than Sabanitas section.

Table 21.4.3 Results of Economic Benefit-Cost Analysis (Distance and Time Savings inclusive)

	Routes		
	Alcalde Diaz (A-1,2,3)	Sabanitas (S-1,2)	All Routes
EIRR(%)	41.0	31.1	37.0
B/C*	6.6	4.7	5.6
NPV*(mil,balboas)	597	523	1,120

*B/C ratio and NPV are caluculated at 12% discount rate.

Table 21.4.4 shows the economic benefit cost outlay based on the vehicle operating cost saving alone, and Table 21.4.5 shows the summary of results corresponding to previous summary table. The results show that the economic feasibility of all routes is lowered substantially with low EIRR and B/C ratio. Net present value with 12 percent discount rate turns out to be negative. Alcalde Diaz section alone maintains the economic feasibility by 12.6 percent EIRR and the B/C ratio above unity with the assumed discount rate.

Table 21.4.5. Results of Economic Benefit-Cost Analysis (Distance Savings Alone)

(Unit ; Mill Balboas)

	Alcalde	Sabanitas	All Routes
EIRR (%)	12.6	5.3	8.9
B/C*	1.07	0.45	0.72
NPV*	8	-77	-70

* B/C and NPV are calculated at 12% discount rate.

Table 21.4.4 Cash Flow of Economic Cost-Benefit(Distance Saving)

(Unit; 1,000 Balboas)

Year	A-1,2,3	Construct Cost S-1	S-2	Maintenance Operation	Total Cost	Economic Benefit	Net Benefit
1995	32,943			0	32,943		-32,943
1996	18,973			0	18,973		-18,973
1997	23,717	21,275		0	44,992		-44,992
1998	23,717	26,897		0	50,614		-50,614
1999	28,460	33,621		0	62,081		-62,081
2000		33,621	12,492	804	46,917	12,936	-33,981
2001		45,224	14,098	804	60,126	14,644	-45,482
2002			17,622	1,096	18,718	18,541	-177
2003			17,622	1,096	18,718	20,424	1,706
2004			21,146	1,096	22,242	22,308	66
2005				1,258	1,258	37,366	36,108
2006				1,258	1,258	40,508	39,250
2007				1,258	1,258	43,651	42,393
2008				1,258	1,258	46,793	45,535
2009				1,258	1,258	49,936	48,678
2010				1,258	1,258	53,078	51,820
2011				1,258	1,258	53,078	51,820
2012				1,258	1,258	53,078	51,820
2013				1,258	1,258	53,078	51,820
2014				1,258	1,258	53,078	51,820
2015				1,258	1,258	53,078	51,820
2016				18,662	18,662	53,078	34,416
2017				1,258	1,258	53,078	51,820
2018				1,258	1,258	53,078	51,820
2019				1,258	1,258	53,078	51,820
2020				1,258	1,258	53,078	51,820
2021				1,258	1,258	53,078	51,820
2022				1,258	1,258	53,078	51,820
2023				1,258	1,258	53,078	51,820
2024				1,258	1,258	53,078	51,820
2025				18,662	18,662	53,078	34,416
2026				1,258	1,258	53,078	51,820
2027				1,258	1,258	53,078	51,820
2028				1,258	1,258	53,078	51,820
2029				1,258	1,258	53,078	51,820
2030				1,258	-55,577	53,078	108,655
				Cost(12%)	247,057	Benefit	177,391
				EIRR	8.94%	B/C	0.72

21.4.3 Sensitivity Analysis

On a basis of the above assumptions, the base case of analysis is done. Then the sensitivity to changes of external factors will be examined. Those factors subject to change are as follows:

a) Construction cost -20% -10%, +10% +20%
b) Transport Demand -20% -10%, +10% +20%

Table 21.4.6 shows the sensitivity of economic benefit cost analysis to the change of construction cost, while Table 21.4.7 shows that to the change of traffic demand. Changes of those external factors cause the changes of economic feasibility indices, but does not alter the economically viable status of project. An increase of construction cost by 20 percent nor a decrease of traffic demand by 20 percent from base case will cause substantial changes in EIRR and B/C ratio. Figure 21.4.1 is a schematic presentation of sensitivity analysis (EIRR) corresponding to the above Tables.

Table 21.4.6 Sensitivity Analysis (Changes of Construction Cost)

	Changes in Construction Cost				
	-20%	-10%	Base	+10%	+20%
EIRR(%)	41.8	39.2	37.0	35.1	33.5
B/C*	7.0	6.2	5.6	5.1	4.7
NPV*(mil.balboas)	1,171	1,147	1,120	1,099	1,075

*B/C ratio and NPV are calculated at 12% discount rate.

Table 21.4.7 Sensitivity Analysis (Changes of Traffic Demand)

	Changes in Traffbic Demand				
	-20%	-10%	Base	+10%	+20%
EIRR(%)	32.7	34.6	37.0	39.0	40.9
B/C*	4.5	4.9	5.6	6.2	6.7
NPV*(mil,balboas)	850	948	1,120	1,260	1,397

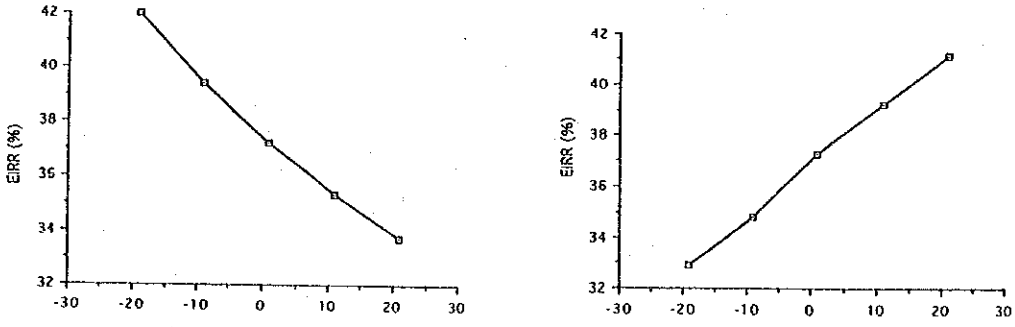
*B/C ratio and NPV are calculated at 12% rate.

21.5 Interpretation for Results

The result of economic benefit cost analysis (base case) shows that 367 million Balboas investment on the new Panama-Colon Highway project will generate 1,120 million Balboas of net benefit. The benefit will be born in terms of transport cost saving and opportunity cost of passengers due to the shortening of travel time and distance. The investment efficiency is evaluated at the ratio between benefit and cost that proves 1 Balboa investment will generate more than 5 Balboas of economic benefit.

Although overall economic viability of project is good, the Alcalde Diaz section reveals very prosperous economic feasibility. This prosperity of Alcalde Diaz section is maintained even if the economic benefit is devaluated by excluding time saving benefit.

The result of economic analysis is rather insensitive to the changes of construction cost and transport demand. Large percentage changes of those factors have not changed the economically viable status of project. In conclusion, economic feasibility of the project is very high and a use of the new highway will increase economic welfare of Panama.



1) Construction Cost Change 2) Traffic Demand Change

Figure 21.4.1 Sensitivity of Economic IRR

22 FINANCIAL EVALUATION

22.1 Financial Position of the Republic of Panama

The debt situation of the Republic of Panama has not improved substantially over the years; foreign borrowing has reached 4,000 million Balboas and internal borrowing has reached 1,000 million Balboas. The funds required for the Project is expected to be 390 million Balboas or 8 percent of the total debt. It may be confronted with the debt reducing been accumulated at 1,000 million Balboas.

Table 22.1.1 Debt Situation of Republic

(Unit;million Balboas)

	1987	1988	1990	1991	1992
Total Debt	4,834	4,806	5,110	4,937	4,926
Foreign	3,731	3,771	4,008	3,922	3,824
Domestic	1,103	1,035	1,101	1,015	1,102

22.2 Financial Position of Ministry of Public Works (MOP)

The annual budget of MOP has increased from 14 million Balboas to 108 million Balboas during last 7 years. In the early years of this period, the MOP budget was affected by the cash starvation of the Republic due to the political and economic crisis. In 1991, the MOP budget is said to become normal at a level of 53 million Balboas. A large amount of MOP budget (25%) is spent on rehabilitation and maintenance program of existing roads, and only a small percentage is spent on construction of new asphalt roads as shown in Table 22.2.1. No budget for a constructing a new highway road has made during the period.

Table 22.2.1 MOP Investment Expenditure, 1987-93

Items	1987 (,000B)	(%)	1990 (,000B)	(%)	1991 (,000B)	(%)	1992 (,000B)	(%)	1993* (,000B)	(%)
A.Construction of Asphalt Road	842	6%	815	6%	11,728	22%	7,645	17%	6,150	6%
B.Construction of Drainage	629	4%	4,475	33%	297	1%	1,218	3%	2,470	2%
C.Rehabilitation & Maintenance of Existing Road	5,781	40%	3,160	23%	33,185	63%	28,381	61%	26,989	25%
[Panama/Colon Isthmian Road]	[171]		[--]		[418]		[1051]		[2605]	
D.Construction & Rehabilitation of Street and Avenues	5,212	36%	3,990	30%	5,952	11%	8,488	18%	12,570	12%
E.Construction & Rehabilitation of Bridges	0	0%	1,049	8%	1,747	3%	591	1%	2,730	3%
F.Administration	92	1%	-**	-**	-**	-**	-**	-**	-**	-**
G.Others	2,046	14%	0	0%	2	0%	1	0%	57,270 (Rural road)	53%
Total	14,602	100%	13,489	100%	52,911	100%	46,322	100%	108,180	100%
(Increment)			-8%		292%		-12%		134%	

Note* :Investment Expenditure of 1993 is in a budget basis, and the others are implemented.
Note**:Administration cost is included in the other expenditure items.
Source:Internal information of MOP

22.3 External Loans and Lending Terms

Example of possible fund sources for the Project are listed in Table 22.3.1. OECF has a most attractive loan scheme of 3 percent interest with a 7-year grace period and a 20-year repayment period. On the other hand, the Panamanian bank has the highest interest rate of 9.72 percent for short-term loans (1 year) and 10.24 percent for long-term (1 to 5 years). International development bank, such as the World Bank, provide 7.5 percent loans with a 5-year grace period and a 20-year repayment period.

Table 22.3.1 Possible Fund Sources for the Project

Source of financing	InterestRate	Grace	Totalterm	Conditions
US Export-Import Bank(suppliers credit)	7.00 %	3 yrs.	12 yrs.	85 % of value of equipment
Japan Export-Import Bank(suppliers credit)	4.90 %	0 yrs.	10 yrs.	85 % of value of equipment MITI Insurance
Commercial Banks	6.75 %	5 yrs.	10 yrs.	10 % of value of equipment
Equipment Banks	6.75 %	3 yrs.	5 yrs.	5 % of value of equipment
Development Banks	7.50 %	5 yrs.	20 yrs.	Required Panamanian Gov't Guarantee; Economically feasible project
OECF/ODA Loans	3.00 %	7 yrs.	20 yrs.	Panamanian Operating Equity; EIRR between 10-20 %
Panamanian Bank(Short Term)	9.72 %	-- yrs.	1 yrs.	Loan for Industry (June 1993)
(Long Term)	10.24 %	-- yrs.	1-5 yrs.	Loan for Industry (June 1993)

22.4 Toll Scheme

Toll scheme is a one of the possible measure to recover the investment cost of the Project.

In Panama, there has been existed one toll highway that between Arrijan and La Chorraila. It charges 50 cents for one way ride of 20 kilometes. The new Panama -Colon Highway subject to this study is 46.4 kilometers in length, and a whole road network including this highway will generate economic benefit of 108 million Balboas for 158 million PCU (passenger car unit) in the year 2000. This means that every car in the network will provide 68 cents on average from the existence of new Panama-Colon Highway. The economic benefit to passenger cars that would directly benefit from its ride on a new highway will be much more than from the existing highway.

Thus, the 2.00 Balboas toll rate is assumed for one ride on the new highway in a base case of analysis; and then other toll rates, 1 Balboa and 3 Balboas are used to examine the sensitivity of the results.

In the traffic assignment process, drivers search for the shortest route to a destination by travel time. Traffic volumes on the toll road were calculated based on toll impedance. Traffic volume assignment effected by toll rate is shown in Table 22.4.1.

Table 22.4.1 Traffic Assignment in 2000 and 2010

Traffic Assignment (2000)

Toll Rate	Alcalde Diaz	Sabanitas	
		Buena vista	Colon
0	8,300	17,700	18,200
1	7,800	7,100	7,100
2	5,400	1,400	1,400
3	3,500	0	0

Traffic Assignment (2010)

Toll Rate	Alcalde Diaz	Sabanitas	
		Buena vista	Colon
0	27,800	33,600	47,000
1	24,100	28,500	35,400
2	21,600	20,200	19,100
3	18,300	16,600	15,400

22.5 Financial Benefit Cost Analysis

22.5.1 Construction Cost and Schedule

Table 22.5.1 Construction Cost and Schedule

Route	Foreign	Local	Total	Years
A-1,2,3	73,396	61,948	135,344	1995-1999
S-1	104,314	61,985	166,300	1997-2001
S-2	53,570	34,719	88,289	2000-2004
Total:	231,280	158,653	389,933	

22.5.2 Assumptions

(1) Transport Capacity

Transport capacity of highway is assumed to be 55,500 PCU for 4 lane road. This capacity restriction limits the income from toll revenues.

(2) Loan Condition

Long term loan interest assumes that a foreign portion of project cost (59%) is obtained from the foreign loan of the lowest interest, and a local portion (41%) is procured by the Panamanian local bank.

	Interest (%)	Grace Period (Years)	Lending Term (Years)
Long Term	6.0	7	20
Short Term	9.72		

(3) Toll Rate

2 Balboas for 1 PCU is assumed.

22.5.3 Results

Table 22.5.2 shows the results of benefit cost analysis construction costs for three segments of highway are allocated during the 10 years period from 1995 to 2004. At the end of project life, only land is evaluated as a salvage value. Interest during the construction is added in the project cost. Toll rate is assumed at 2 Balboas, and the subsequent toll revenues

are calculated. Net benefit between toll revenues and project cost brings the following results:

Table 22.5.2 Results of Financial Benefit-Cost Analysis

	Routes		
	Alcalde Diaz (A-1,2,3)	Sabanitas (S-1,2)	Total
FIRR(%)	7.83	null	4.86
B/C*	0.6	0.2	0.4
NPV*(mil,balboas)	-60	-139	-199

*B/C ratio and NPV are calculated at 12% discount rate.

The B/C ratio of all routes at 12 percent discount rate is substantially low, so that the toll revenue will be insufficient to cover the project cost. Consequently, FIRR is very small and the net present value (NPV) becomes negative. This is because of Sabanitas section that will not produce positive net benefit at any discount rate.

Table 22.5.5 through 6 examines the net income of operation and its consequent fund cash flow, based on the amortization schedule of project investment shown in Table 22.5.5.

Positive operating income that accrues from toll revenues minus maintenance and operation cost is born in the year 2000, and the amount of Table 22.5.3, Table 22.5.4, Table 22.5.5, Table 22.5.6, income increases up to 66.6 million Balboas through the years. Repayment for long term debt and short term debt brings negative net incomes during the years from 1995 to 2013. Since 2014, the net income turns out positive, except for the year of the overlay work in 2016.

Due to the negative operating incomes through the years, the operating entity needs to borrow the short term loan for its operation and maintenance. In the first year of project, it will borrow 1,888 thousand Balboas, and increase up to 213 million Balboas that is nearly twice the MOP's yearly budget in 1993. Accordingly, the cash balance will not brings any surplus till the year of 2026.

Table 22.5.3 Cash Flow of Financial Benefit-Cost Analysis (All Routes)

Year	Construct Cost A-1,2,3	S-1	S-2	Maintenance Operation	Total Cost	Toll Revenue	Net Revenue
1995	33,967				33,967	0	-33,967
1996	20,935		2,038	0	22,973	0	-22,973
1997	26,169	22,628	3,294	0	52,091	0	-52,091
1998	26,169	29,678	6,222	0	62,269	0	-62,269
1999	31,402	37,349	9,585	0	78,336	0	-78,336
2000		37,349	13,742	13,710	0	64,801	7,796	-57,825
2001		44,818	15,671	16,775	821	78,085	9,202	-68,883
2002			19,589	20,405	821	40,815	12,537	-28,587
2003			19,589	21,580	1,130	42,299	14,907	-27,392
2004			23,507	22,755	1,130	47,392	17,278	-30,115
2005				24,166	1,130	25,296	21,295	-4,202
2006					1,332	1,332	23,834	22,503
2007					1,332	1,332	26,373	25,042
2008					1,332	1,332	28,912	27,581
2009					1,332	1,332	31,452	30,120
2010					1,332	1,332	33,991	32,659
2011					1,332	1,332	36,530	35,198
2012					1,332	1,332	39,069	37,737
2013					1,332	1,332	41,608	40,276
2014					1,332	1,332	44,147	42,815
2015					1,332	1,332	46,686	45,354
2016					18,923	18,923	49,225	30,302
2017					1,332	1,332	51,764	50,433
2018					1,332	1,332	54,303	52,972
2019					1,332	1,332	55,632	54,301
2020					1,332	1,332	56,765	55,434
2021					1,332	1,332	57,898	56,567
2022					1,332	1,332	59,032	57,700
2023					1,332	1,332	60,165	58,833
2024					1,332	1,332	61,298	59,966
2025					18,923	18,923	62,431	43,508
2026					1,332	1,332	64,564	63,232
2027					1,332	1,332	64,697	63,365
2028					1,332	1,332	65,830	64,499
2029					1,332	1,332	66,600	65,268
2030					1,332	1,332	66,600	65,268
				Cost(12%)		333,471	Benefit	134,186
				EIRR		4.86%	B/C	0.40

Table 22.5.4 Amortization Schedule (Base Case)

	Borrowing Construction (A)	principal	Redemption Interest	Total 6.00%	Outstanding Balance (B)
1995	33,967	0	2,038	2,038	33,967
1996	20,935	0	3,294	3,294	54,902
1997	48,797	0	6,222	6,222	103,699
1998	56,048	0	9,585	9,585	159,747
1999	68,751	0	13,710	13,710	228,498
2000	51,091	0	16,775	16,775	279,589
2001	60,489	0	20,405	20,405	340,078
2002	19,589	1,698	21,478	23,176	357,969
2003	19,589	2,745	22,489	25,234	374,813
2004	23,507	5,185	23,588	28,773	393,135
2005		7,987	23,109	31,096	385,147
2006		11,425	22,423	33,848	373,722
2007		13,979	21,585	35,564	359,743
2008		17,994	20,564	38,558	342,739
2009		17,983	19,485	37,468	342,756
2010		18,963	18,348	37,311	305,793
2011		20,138	17,139	37,277	285,655
2012		20,138	15,931	36,069	265,517
2013		20,138	14,723	34,861	245,378
2014		20,138	13,514	33,652	225,240
2015		20,138	12,306	32,444	205,102
2016		20,138	11,098	31,236	184,964
2017		20,138	9,890	30,028	164,826
2018		20,138	8,681	28,819	144,688
2019		20,138	7,473	27,611	124,550
2020		20,138	6,265	26,403	104,411
2021		20,138	5,056	25,194	844,273
2022		18,440	3,950	22,390	65,833
2023		17,393	2,906	20,299	48,440
2024		14,593	2,009	16,602	33,487
2025		12,151	1,280	13,431	21,336
2026		8,713	757	9,470	12,623
2027		6,159	388	6,547	6,464
2028		3,134	200	3,334	3,330
2029		2,155	71	2,226	1,175
2030		1,175	0	1,175	0

Table 22.5.5 Income statement (Base Case)

('000B)

	Toll Revenue (C)	Maintenance & Operation (D)	Operating Income (C)-(D)	Non-Operating Expenses Amort.	Interest (Long) 6%	(Short) 9.72%	Total (F)	Net Income (E)-(F)	Accumulated Balance
1995	0	0	0	0	2,038	0	2,038	-2,038	-2,038
1996	0	0	0	0	3,294	99	3,393	-3,393	-5,431
1997	0	0	0	0	6,222	264	6,486	-6,486	-11,917
1998	0	0	0	0	9,585	579	10,164	-10,164	-22,081
1999	0	0	0	0	13,710	1,073	14,783	-14,783	-36,864
2000	7,796	821	6,975	0	16,775	1,792	18,567	-11,592	-48,456
2001	9,202	821	8,381	0	20,405	2,355	22,760	-14,378	-62,834
2002	12,537	1,131	11,406	1,698	21,478	3,054	26,230	-14,824	-77,658
2003	14,907	1,131	13,776	2,745	22,489	3,774	29,008	-15,232	-92,890
2004	17,278	1,131	16,147	5,185	23,588	4,514	33,287	-17,141	-110,031
2005	21,295	1,332	19,963	7,987	23,109	5,347	36,443	-16,480	-126,511
2006	23,834	1,332	22,502	11,425	22,423	6,148	39,996	-17,494	-144,005
2007	26,373	1,332	25,041	13,979	21,585	6,999	42,563	-17,521	-161,527
2008	28,912	1,332	27,580	17,004	20,564	7,850	45,418	-17,838	-179,365
2009	31,452	1,332	30,120	17,983	19,485	8,717	46,185	-16,066	-195,431
2010	33,991	1,332	32,659	18,963	18,348	9,498	46,809	-14,150	-209,581
2011	36,530	1,332	35,198	20,138	17,139	10,186	47,463	-12,265	-221,846
2012	39,069	1,332	37,737	20,138	15,931	10,782	46,851	-9,114	-230,960
2013	41,608	1,332	40,276	20,138	14,723	11,225	46,086	-5,810	-236,770
2014	44,147	1,332	42,815	20,138	13,514	11,507	45,159	-2,345	-239,114
2015	46,686	1,332	45,354	20,138	12,306	11,621	44,065	1,289	-237,826
2016	49,225	18,933	30,292	20,138	11,098	11,558	42,794	-12502	-250,328
2017	51,764	1,332	50,432	20,138	9,890	12,166	42,194	8,238	-242,090
2018	54,303	1,332	52,971	20,138	8,681	11,786	40,585	12,386	-229,703
2019	55,632	1,332	54,300	20,138	7,473	11,164	38,775	15,526	-214,178
2020	56,765	1,332	55,433	20,136	6,265	10,409	36,812	18,621	-195,556
2021	57,898	1,332	56,566	20,138	5,056	9,504	34,698	21,868	-173,688
2022	59,032	1,332	57,700	18,440	3,950	8,441	30,831	26,868	-146,820
2023	60,165	1,332	58,833	17,393	2,906	7,135	27,434	31,398	-115,422
2024	61,298	1,332	59,966	14,953	2,009	5,610	22,572	37,394	-78,029
2025	62,431	18,933	43,498	12,151	1,280	3,792	17,223	26,275	-51,754
2026	64,564	1,332	63,232	8,713	757	2,515	11,985	50,246	-1,508
2027	64,697	1,332	63,365	6,159	388	73	6,620	56,745	55,237
2028	65,830	1,332	64,498	3,134	200		3,334	61,164	116,401
2029	66,600	1,332	65,268	2,155	71		2,226	63,043	179,444
2030	66,600	1,332	65,268	1,175	0		1,175	98,893	278,336

Table 22.5.6 Fund Cash Flow Statement (Base Case)

	Operating Income	External Borrowing (long)	(Short)	Total Sources (J)	Const'n Cost	Debt Services Amort.	(long)	(Short)	Total Uses (K)	Cash Balance (J)-(K)
1995	0	33,967	2,038	36,005	33,957	0	2,038	0	2,038	0
1996	0	20,935	5,431	26,366	20,935	0	3,294	2,137	5,431	0
1997	0	48,797	11,917	60,714	48,797	0	6,222	5,695	11,917	0
1998	0	56,048	22,081	78,129	56,048	0	9,585	12,496	22,081	0
1999	0	68,751	36,864	105,615	68,751	0	13,710	23,154	36,864	0
2000	6,975	51,091	48,456	106,522	51,091	0	16,775	38,656	55,431	0
2001	8,381	60,489	62,834	131,704	60,489	0	20,405	50,811	71,216	0
2002	11,406	19,589	77,658	108,653	19,589	1,698	21,478	65,888	89,064	0
2003	13,776	19,589	92,890	126,255	19,589	2,745	22,489	81,432	106,666	0
2004	16,147	23,507	110,031	149,684	23,507	5,185	23,588	97,404	149,684	0
2005	19,963		126,511	146,474		7,987	23,109	115,378	146,474	0
2006	22,502		144,005	166,508		11,425	22,423	132,659	166,508	0
2007	25,041		161,527	186,568		13,979	21,585	151,004	186,568	0
2008	27,580		179,365	206,945		17,004	20,564	169,377	206,945	0
2009	30,120		195,431	225,550		17,983	19,485	188,082	225,550	0
2010	32,659		209,581	242,239		18,963	18,348	204,929	242,239	0
2011	35,198		221,846	257,044		20,138	17,139	219,766	257,043	0
2012	37,737		230,960	268,697		20,138	15,931	232,628	268,697	0
2013	40,276		236,770	277,048		20,138	14,723	242,185	277,046	0
2014	42,815		239,114	281,929		20,138	13,514	248,277	281,929	0
2015	45,354		237,826	283,180		20,138	12,306	250,735	283,179	0
2016	30,292		250,328	280,620		20,138	11,098	249,384	280,620	0
2017	50,432		242,090	292,522		20,138	9,890	262,494	292,522	0
2018	52,971		229,703	282,674		20,138	8,681	253,855	282,674	0
2019	54,300		214,178	268,478		20,138	7,473	240,867	268,478	0
2020	55,433		195,556	250,990		20,138	6,265	224,587	250,990	0
2021	56,566		173,688	230,255		20,138	5,056	205,060	230,255	0
2022	57,700		146,820	204,520		18,440	3,950	182,130	204,520	0
2023	58,833		115,422	174,255		17,393	2,906	153,955	174,254	0
2024	59,966		78,029	137,994		14,953	2,009	121,032	137,994	0
2025	43,498		51,754	95,252		12,151	1,280	81,821	95,252	0
2026	62,232		1,508	63,740		8,713	757	54,269	63,739	0
2027	63,365		0	63,365		6,159	388	1,581	8,128	55,237
2028	64,498		0	64,498		3,134	200	0	3,334	61,164
2029	65,268		0	65,268		2,155	71	0	2,225	63,043
2030	65,268	34,800	0	100,068		1,175		0	1,175	98,893

22.6 Sensitivity Analysis

Sensitivity of the results to the external changes such as in toll rates, construction costs and interest rate on long term loan is examined. The following variations are made for the analysis.

Toll rates (Balboa):	1.0,	(2.0),	3.0	
Construction cost:	-20%,	-10%,	+10%,	+20%
Long term interest:	5%,	(6%),	7%	

Parenthesis indicates the base case of analysis. The results are shown in Figures 22.6.1 to 4.

(1) Toll Rate Change

Reduction of toll charge from 2.00 Balboas to 1.00 Balboa is not feasible. This reduction does not generate any positive financial internal rate of return for the project. On the other hand, an increase of toll charge from 2.00 to 3.00 will improve the FIRR from 4.9 percent to 6.7 percent. The improved FIRR becomes close to the long term interest of international development banks like the World Bank (WB) and the Inter-American Development Bank (IDB). However, the further increase of toll charge may effect marginally to the improvement of FIRR. This is because of decreasing rate of improvement of FIRR observed in the diagram of Figure 22.6.1.

With 2.00 Balboas toll rate, net income of project that includes the amortization and interest payment as well as the operational income of toll road becomes negative again in the following year, the positive net income starts to accumulate to cancel the previous debt accumulation since 2017. As a result, debt accumulation is completely paid out in the year 2027 as shown in Figure 22.6.2.

A decrease of toll charge 1.00 Balboa generates no positive net income; and consequently, debt accumulation expands indefinitely. An increase of toll charge, on the other hand, shortens the period of negative net income, and produces the positive net income much earlier than the case of 2.00 toll; net income becomes positive in 2011 and debt is cleared in 2019.

(2) Construction Cost Change

Change in FIRR is linearly proportional to the changes of construction cost. Twenty percent decrease in construction cost improves FIRR from 4.9 percent to 6.4 percent, while twenty percent increase worsens FIRR to 3.8 percent as shown in Figure 22.6.1.

Figure 22.6.3 shows the corresponding outlays of net income and debt accumulation during the project period. Twenty percent decrease of construction cost will generate a positive net income in the year 2011, and clears a debt accumulation in 2019.

On the other hand, an increase of construction cost by 20 percent will makes net income positive in very late year of project (2020), and never clears the debt during the project period.

(3) Change in Long Term Interest

A change of long term interest of loan is also effective to FIRR. An increase of interest from 6 percent to 7 percent reduces FIRR from 4.9 percent to 4.7 percent as shown in Figure 22.6.1. On the other hand, a decrease of interest from 6 percent to 5 percent improves FIRR to 5.2 percent. Although the increment of interest from 6 percent to 7 percent by an arrangement of lending sources, the resulting balance sheet of project drastically worsens so that debt is cleared in the very last year of project.

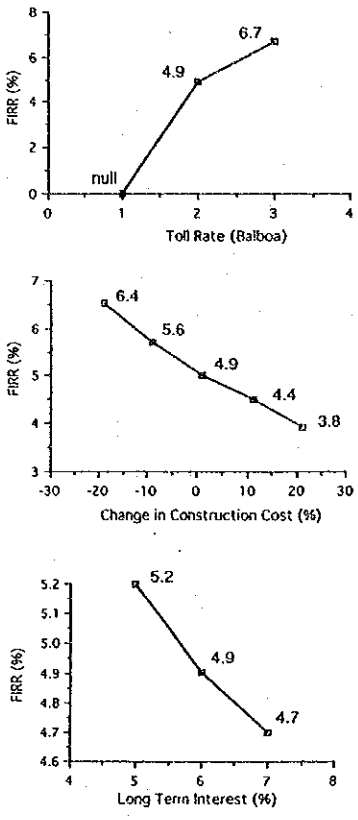
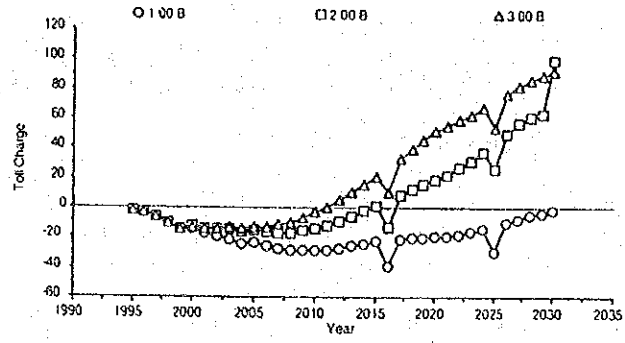
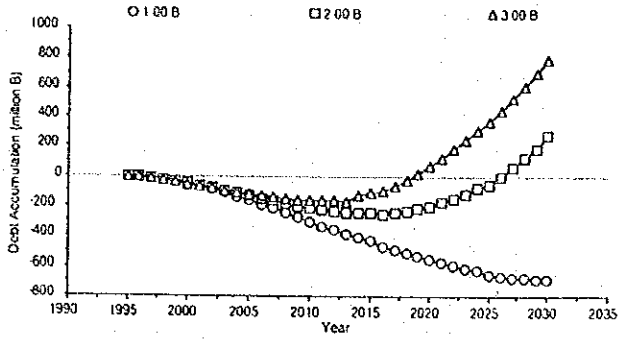


Figure 22.6.1 Sensitivity of FIRR

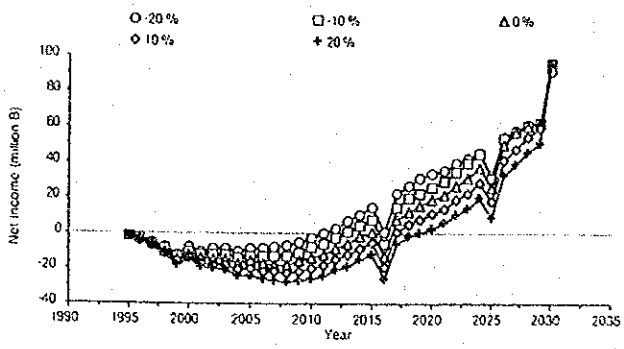


(1) Sensitivity of Net Income

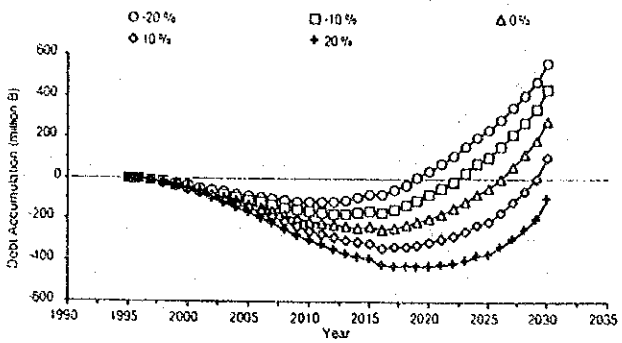


(2) Sensitivity of Debt Accumulation

Figure 22.6.2 Sensitivity of Cash Balance to Toll Charge

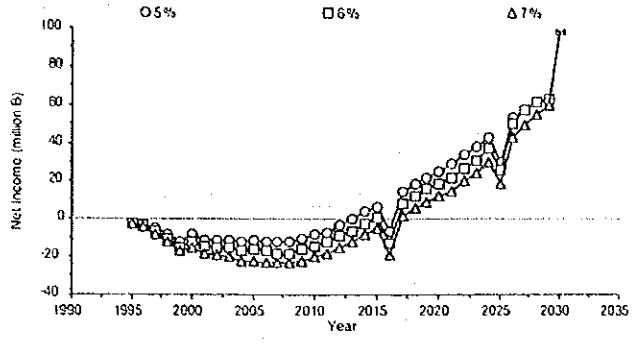


(1) Sensitivity of Net Income

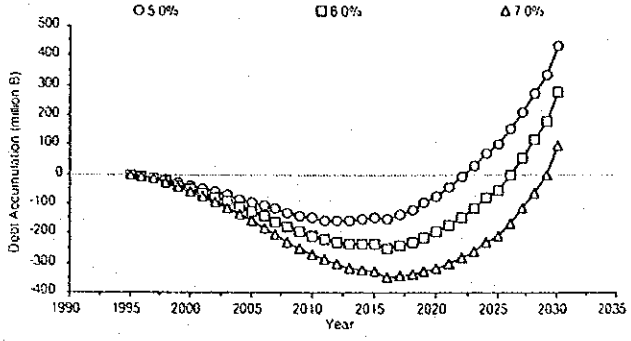


(2) Sensitivity of Debt Accumulation

Figure 22.6.3 Sensitivity of Cash Balance to Construction Cost



(1) Sensitivity of Net Income



(2) Sensitivity of Debt Accumulation

Figure 22.6.4 Sensitivity of Cash Balance to Long Term Interest

22.7 Interpretation of Results

Financial benefit cost analysis shows the low profitability of toll road scheme for the Panama-Colon Highway project. The profit level and balance sheet during the project period is not attractive enough to invite the private enterprise to the project. The low profitability is caused by the Sabanitas section that dose not bring a positive net benefit. Alcalde Diaz Section solely maintains the fair profit level for the project.

23 SOCIAL AND ECONOMIC IMPACT ASSESSMENT

Economic value of this project is substantially high. This is mainly because of the benefit accrued from passenger's time saving by the improved Panama-Colon Highway. It may be suggested that a significant activation of Panamanian economy will be taken place after the commencement of highway services.

(1) Inventory Cost Saving

This section discusses the direct and indirect benefits of the project that has not been quantified in the benefit cost analysis. The possible direct and indirect benefits of project described below;

1) Direct Benefit of project

- a) Passenger Time Saving
  - Opportunity to work*
  - Opportunity to leisure
  - Opportunity to education
  - Inventory cost saving
- b) Vehicle Operating Cost
  - Energy Saving*
  - Maintenance Saving*
  - Accident Saving

2) Indirect Benefit of Project

a) Repercussion Effect
b) Development opportunity in Colon area
c) Reservation of alternative transport mode for the Panama Canal (land bridge)

Note: The benefit under * is incorporated in the calculation of benefit of project in economic benefit cost analysis.

Direct benefit consists of time saving and vehicle operating cost saving. Time saving will be resulted in more activities of travelers such as work, study, leisure, etc. Wage income accrued from time saving is properly incorporated in an economic benefit in the benefit cost analysis.

However another important benefit that should have been incorporated in an evaluation of economic impact is inventory cost of transported commodity. Transport time saving will directly reduce the period of inventory. This is very important in a Panama-Colon context, because a large number of warehouses of imported commodities are located in Colon Free Trade Zone (FTZ), and a large number of imported commodities are re-exported to Panama. Colon FTZ reported that 283 million US dollars or 7.2 percent of total commodities are reexported to Panama itself in 1991.

Since Panama City is a largest commodity market in the country and is very neighbor to Colon City, a major portion of re-export was brought to Panama City. If the reduction of inventory cost is reflected in a market price of commodity, a disposable income of consumer in Panama City will be greatly saved and a further demand will be stimulated. Thus, the reduction of inventory cost will help the economic growth of Panama.

(2) Energy Saving

In the congested road, the fuel consumption per hour is very high and vehicles cannot earn much mileage. However, the Panama-Colon Highway will improve the vehicle speed so that the fuel consumption can be substantially reduced. If the congestion level is expected to be lower than the most economical vehicle speed (40 km per hour) and the improved highway increases the vehicle speed, the reduction of fuel consumption will be taken place. One publication suggests that vechicles used in the Caribbean region proves more than ten percent improvement of fuel consumption from 20 kilometers per hour to 40 kilometers per hour of vehicle speed.

Energy saving of fuel consumption is a primary one of Vehicle Operating Cost saving, and has already incorporated in the economic benefit cost analysis. Shorter Vehicle Operating Cost of travel saves the fuel consumption, and eventually reduces the transport cost.

(3) Accident Reduction

On the existing Panama-Colon Highway, a lot of accidents occur every year, actually two accidents per day occurred in 1992, because of its poor road structure such as narrow 2-lane carriageways, steep gradients, short radius curvatures, etc. In the case of the existing highway will not be improved and traffic volume will be increased much more than the present, traffic accident will increase tremendously. However, after the construction of the new highway, the reduction of traffic accidents will be remarkable decreased, because of the vehicle will be operated on the 4-lane dual way with the full access control as well as the installation of traffic devices and so on.

Addition to the increase of safety, the smooth and fluent vehicle operation will create the comfort of the drivers and passengers on the new highway.

(4) Creation of New Jobs (Employment Effect)

The project will create a number of jobs during the construction period. The number of new employment will be accrued from direct employment of construction laborers and indirect employment of relating industries than constructor due to the large construction expenditures.

Following table shows the umber of direct employment during the construction period. The project will continue 10 years period,

and create 1,639 thousands man/day new jobs annually in total. Among them, 681 thousands jobs are for unskilled laborers and 958 thousands jobs are for skilled persons.

Alcalde Diaz section requires 622 thousands laborers in total which include 351 unskilled laborers. On the other hand, Sabanitas section requires 1,017 thousands labors among which 330 thousand unskilled laborers are involved.

Indirect employment in other industry sectors than construction will be estimated from the multiplier effect of construction expenditure. Traditionally, construction sector in Panama has a weak multiplier effect on the other industry, but commercial service and financial sectors. Thus , the most number of indirect employment will be created in those sectors.

Table 23.1.1 Creation of New Jobs (Construction Laborer)
(Unit:1000 Man Day)

	Skilled	Unskilled	Total
Alcalde Diaz	271	351	622
Sabanitas	687	330	1,017
Total	958	687	1,639

(5) Multiplier Effects of Construction

Multiplier effect of construction expenditure is also an important effect of the project. It is caused by an industry linkage of economy in which an input of industry leads to outputs of other relating industries. This type of benefit is categorized as an indirect benefit of project, but is not included in the benefit cost analysis. Expenditure of construction will induce a production of other industries, and revenues of those industries are further repercussioned through the industrial linkages of economy. Although construction industry in Panama is not said have a strong linkage to other industries, the industries of commerce, finance and service will receive measurable multiplier effects. Total expenditure of project is estimated 402 million balboas, and 41 percent of total expenditure is expected to be spent locally. This local expenditure will stimulate the production of other industries than construction. A coefficient of multiplier is estimated in MOCECA report (Modelo de Coherencia del Istmo Centroamericano), and is 0.797 times of original expenditure.

Thus,

402 million balboas x 41 % x 0.797 = 131 million Balboas.

The amount of 131 million Balboas is a inducted production for Panamanian economy by the project expenditure, and will probably create more than ten thousand of local employment in addition to the project employment.

(6) Regional Development

The project surely opens an access to the development opportunity for the Colon area that has been behind the major development scene in Panama. Shortening the travel time from Panama City makes possible more frequent visits of international tourists to Colon area, and gives Colon City geographically better advantage of industrial location. On the other hand, people in Colon area will be able to commute to Panama City for higher income jobs and better education. This will contribute to reduce a income disparity of people between Panama City and Colon City in a long run. Thus, the development of new highway increases the possibility of economic growth of Colon City.

(7) Reservation of Alternative Transport Modes.

Last of all, it should be mentioned that the Panama-Colon Highway will reserve an alternative transport mode for the Panama Canal. In 1992, Panama Canal Commission reported that passages of full container ship and container/breakbulk ship accounted to 1,712 transits with a laden carriage of 25 million long tons (16 percent of total laden). Commission for the Study of Alternatives to the Panama Canal (1993) estimated a substantial increase in those cargo tonnage in the future. The Panama Colon Highway will be reserved as a supplement for transisthmian transport of the Panama Canal.

24 CONCLUSION AND RECOMMENDATIONS

(1) Concept of New Highway

In order to serve the balanced economic development of the cities of Panama and Colon as Twin Cities, it will be necessary to construct a new highway alongside the existing Panama-Colon Highway by the 2010.

The new Panama-Colon Highway should provide high speed mobility (110 km/h design speed), secure a high standard of traffic service and safety (four lane road with full access control), and should be planned paying attention to preservation of the natural and social environment.

The new Panama-Colon Highway should have two principal functions;

1) To serve the direct passenger and goods movement between the cities of Panama and Colon on each ocean side.

2) To serve daily commuter traffic between the city centers and suburban areas such as the Alcalde Diaz area and the Sabanitas area.

(2) Project Magnitude

The total length of the project sections of the new Panama-Colon Highway subject to the feasibility study is 46.4 km (20.2 km for Alcalde Diaz section, 26.2 km for Sabanitas section). The project sections include seven interchanges and two service areas.

The total project cost is estimated at 402.8 million balboas at 1993 prices, of which the Alcalde Diaz section costs 138.6 million balboas and Sabanitas section costs 264.1 million balboas.

(3) Implementation Schedule

The construction of the Alcalde Diaz section should be completed by the year 1999 and the Sabanitas section should be completed by 2004.

However, as a premise of the Study, the Corredor Norte project should proceed ahead of the new Panama-Colon Highway Project.

Although the Chagres section was not studied in the feasibility study stage, it is recommended that it should be completed by 2010.

(4) Environmental Impact Assessment

As a result of the environmental impact study the possibility of

occurrence of water contamination in the Sabanitas section and traffic noise problems in the Alcalde Diaz section exists, but only if countermeasures are not taken. Therefore adequate countermeasures are planned in the study so that impacts will be minimized and good environmental conditions maintained.

(5) Economic Evaluation of the Project

The economic internal rate of return (EIRR) derived from implementation of the two project sections is estimated at 37.0%, confirming a high economic return. The benefit-cost ratio at a discount rate of 12% is estimated at 5.6.

(6) Possibility of Introduction of Toll System

According to the result of the project financial analysis with a two balboas toll for passenger cars in each section, the financial internal rate of return (FIRR) is estimated at 4.9%. In spite of various calculation premises, this figure is not favorably high. However the introduction of a toll system should be considered from the viewpoint of the beneficiary pays principle, even if the toll revenue would not cover the full cost of construction, maintenance and operation of the new highway.

(7) Financing of Necessary Funds

Since implementation of the whole project will necessitate a huge investment, it is necessary to seek appropriate fund resources for the investment. Concerning the foreign currency portion of the investment, external funds under favorable conditions (less than 5% interest rate) should be obtained. Regarding the local currency portion, creation of local fund collection system such as a motor fuel tax, a vehicle registration tax and an urban development tax are recommended.

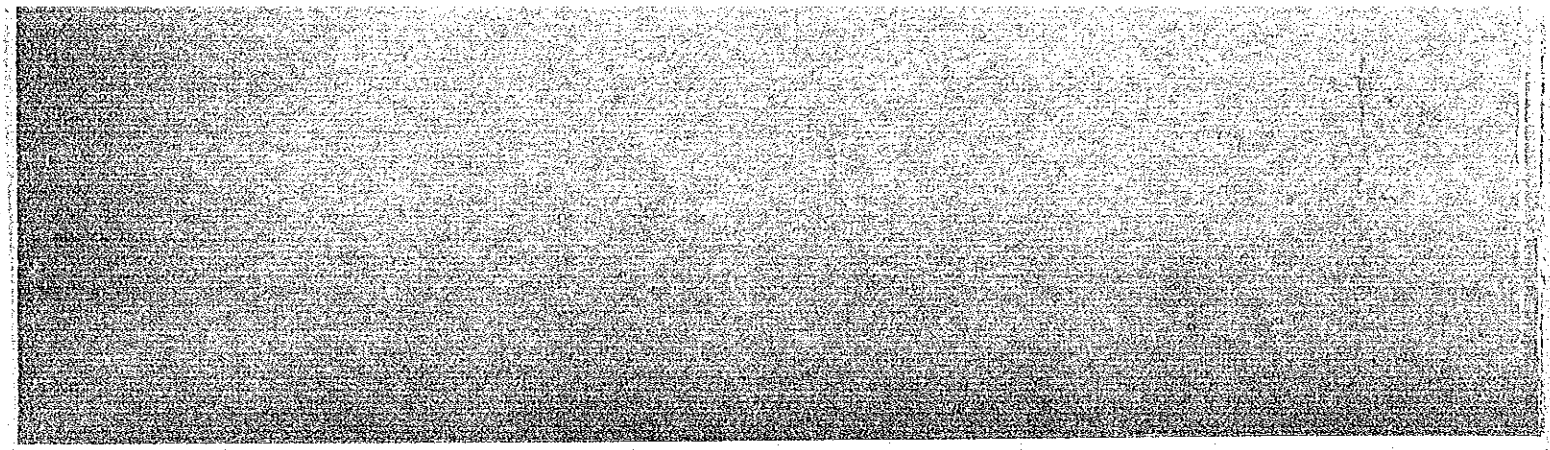
(8) Operation and Organization of the Project

Considering the magnitude of the project and the possibility of introduction of a toll system, the Ministry of Public Works (MOP) should establish a new department for the construction, operation, administration, and promotion of the project.

(9) Further Studies

Since housing areas in Alcalde Diaz have been developing, the right of way of the new Panama-Colon Highway may become occupied by the sprawl of housing development. Therefore a detailed design study should be commenced as soon as possible to identify the right of way.

A feasibility study of the Chagres section should be conducted when the other two project sections advance.



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