The Development of Long Term Traffic Demand Forecasts for the Panama Canal, 2001-2050

El Desarrollo de Pronósticos a Largo Plazo de la Demanda de Tráfico para el Canal de Panamá, 2001-2050

Richardson Lawrie Associates

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DESARROLLO DE PRONOSTICO LARGO PLAZO DE DEMANDA DE TRAFICO POR EL CANAL DE PANAMA

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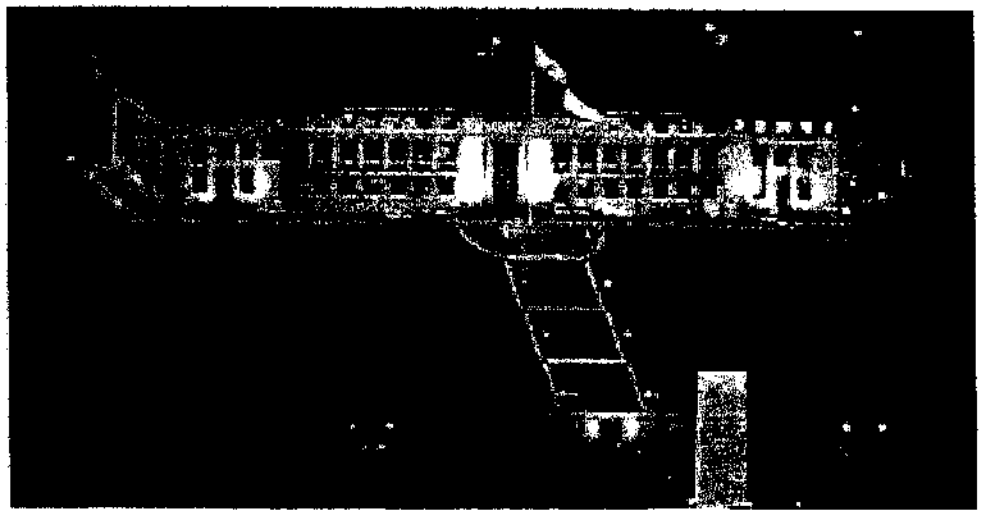

THE DEVELOPMENT OF LONG TERM TRAFFIC DEMAND FORECASTS FOR THE PANAMA CANAL, 2001-2050

PART 1

PREPARED FOR

AUTORIDAD DEL CANAL DE PANAMA
PANAMA CANAL AUTHORITY

by

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February 2001

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1 Executive Summary and Results

1.1 Introduction

This study provides a series of long term demand forecasts for the Panama Canal for the period to 2050 both for the Canal with its existing size restrictions and capacity constraints and for an expanded Canal. The study has two main purposes. Firstly, it is designed to provide a view of future demand which is totally independent from work previously done by ACP. In this respect its aim is to give a second opinion. It is also intended that this study should be seen as a building block for subsequent studies that are planned as part of the process for determining the feasibility of the proposed expansion of the Canal.

It is important that this study be placed in its proper context. The study terms of reference call for projections of potential toll revenue based on the existing toll structure. It should be recognised that this approach does not take into account potential future changes in toll pricing policies whose objectives may not be limited solely to economic considerations. In any event there will be some trades where the economics are such that higher toll levels could be sustained. Equally, there are some routes for which a marginal pricing policy would enable the Canal to capture more trade. In the absence of an integrated tolls pricing policy and marketing strategy this estimates cannot be used when assessing future investments.

One further consideration is the capacity of the current Canal in terms of the permitted daily maximum number of transits. On agreement with the Client, it has been assumed that this figure remains at the current level of 42 transits a day and, implicitly, ACP would undertake the necessary work to maintain transits at this level, incurring whatever costs were involved. No capacity constraints were assumed in the Expanded Canal Case.

There are some important and fundamental differences between the approaches to short and long term forecasting, in particular when one considers that the latter in this case covers a 50 year time span. For example, in the short term, currency fluctuations and the construction of new plant are significant factors in the determination of trade flows along with other economic indicators. They have to be taken into account but they are not necessarily the result of underlying structural changes. In sectors such as oil and chemicals it can be observed that as demand increases in importing regions, so initially do imports of finished chemicals and petroleum products. However a stage is eventually reached where the construction of new chemical plant or refineries becomes justified which has the result of causing a decline in the import of finished products. This changes the pattern and nature of trade but it is part of a cyclical development which is likely to be repeated several times over in the course of a 50 year time period. In other words short term fluctuations will continue but this does not detract from the fact that an underlying long term trend may also be apparent.

The study provides a base case forecast (Scenario 1) that reflects a continuation of economic trends and developments already in place plus structural developments that have taken place or are still seen to impact on specific trades. A risk analysis, (Scenario 2), has been developed which shows the potential impact of the introduction of global environmental protection and energy conservation policies as represented by the introduction of higher energy taxes. Scenario 2 also considers the potential impact of greater re-location of manufacturing to low cost production areas and the potential migration of labour that results.

Within each of these scenarios, three cases have been developed:

- Case 1 forecasts (Existing Canal) assume that the Canal remains at its existing dimensions and that transits are limited to a maximum of 42 vessels per day. Since the Canal is operating relatively close to capacity, it is clear that if trade were to continue to grow at its present rate a point would be reached in the future where potential demand for the Canal would exceed capacity. With the exception of cruise ships, for which bookings are accepted up to a year in advance, it is assumed that any reduction from potential demand to meet capacity constraints would be apportioned on the basis of the future mixes of vessels taking into account expected changes in trades and ship utilisation patterns. In order to determine potential demand RLA has assessed the future 'generic growth' in the demand for Panama Canal transits in existing trades. Estimates of generic growth are based on the assumption that the Canal remains at its existing dimensions and no account is taken of capacity constraints due to the limit in the number of vessels that can transit the Canal on any given day.

- Case 2 is referred to as the Expanded Canal case and assumes that a third set of locks is developed, permitting transits of vessels up to 180ft beam, 50ft draft and 1,265ft LOA. No capacity constraints in terms of the numbers of daily transits have been assumed.

- Case 3 is the Unrestricted Canal, which assumes no restrictions on either size or numbers of ships.

In line with the study terms of reference, it is assumed that Canal tolls remain at current levels in real terms. Estimates of Canal revenues have been limited to tolls and exclude additional fees.

The study commences with a review of historical trends in regional and global growth in GDP and population. Forecasts to 2050 have been compiled with reference to external forecasts prepared by or adopted, for example, by the UN, OECD, the International Energy Agency and the US Department of Energy.

These forecasts have been used to develop estimates of the generic growth in future trades. This part of the study relates to commercial cargo vessels and excludes passenger ships and other, non-specified, ship types which are both addressed in separate sections. Annual time series from FY1973/4 through FY1998/9 were compiled for each of the specified commodity groups by route. Actual data for the full fiscal year 1999/00 were not available in time to incorporate them in the study.

Forecasts have been developed with reference to regional economic/industry indicators and structural changes that have taken place in individual sectors. In other words forecasts have been developed through a combination of macro-economic forecasting and specific industry changes – often with reference to some major organisations involved in these sectors. Nevertheless in some cases the erratic nature of the data series has left little alternative but to adopt trend analysis techniques. However this last approach applies generally to the less important commodity groups. In order to relate trends in trade as closely as possible to economic indicators, data have been analysed on the basis of individual routes, routes grouped by a common destination, total north/southbound or groups of similar commodities as appropriate.

Forecasts for Case 1, the Existing Canal, have been made by first estimating the total numbers of transits that would result from the generic growth in demand for the Canal transits (see below for an outline of the methodology). For those years in which generic demand would exceed the current capacity of the Canal, and having determined the generic growth in the overall number of laden and ballast transits for all ship types, estimates of future passenger ship transits have been left unchanged on the assumption that these would

continue to have priority. In the absence from the terms of reference of a toll pricing strategy or clear trade preferences to determine the allocation of transits when demand exceeds capacity, laden and ballast transits for all other ship types have been reduced pro-rata with the overall cut in the number of transits required to meet the capacity constraint of the Canal.

Under Cases 2 and the 3, the Expanded and Unrestricted Canals, a review of potential 'by pass' trades has been undertaken. By pass trades are defined as those commodities that are shipped on routes which represent alternatives to the Panama Canal and which utilise vessels larger than can be accommodated by the present dimensions. They also represent trades where the economic advantages of using larger vessels - or other service factors - outweigh utilisation of the Panama Canal on what is a shorter route. By pass trades therefore relate to just three vessel types – that is, full container ships, dry bulk carriers and tankers. There are post Panamax cruise ships in existence but there are no by-pass routes, although a larger Canal would permit more positioning voyages. For all of the remaining ship types, vessel sizes are within the current Canal dimensions and are expected to remain so.

By pass trades have been identified for full container ships – principally the US landbridge – dry bulk carriers (iron ore and coal) and tankers (Orimulsion). For each relevant trade a detailed analysis has been undertaken to determine the size of the trade, likely future growth, the economics of these alternative routes versus those for an expanded or unrestricted Canal and other factors likely to persuade shippers to adopt one or other route. The potential impact of an enlarged Canal is analysed from 2010 onwards.

In order to translate cargo forecasts into projections of vessel transits and toll revenue RLA has developed a model, using Microsoft Access, which has in it the following major steps:

- The allocation of commodities by route into ship types;
- The consolidation of commodities by route and ship type into total trade by route and ship type;
- The allocation of trade by route and ship type into dwt size ranges;
- The conversion of trade in terms of cargo tons to laden transits in terms of deadweight by route, ship type and size;
- The translation of laden transits in dwt terms into numbers of ships and also PCUMS;
- The calculation of laden toll revenue from projections of PCUMS;
- The projection of ballast transits for commercial vessels in dwt terms by route, ship type and size, based on relationships to laden transits;
- The translation of ballast transits for commercial cargo vessels in dwt terms into numbers of ships and also PCUMS;
- The calculation of ballast toll revenue from commercial cargo ships from projections of PCUMS;
- The development of transit forecasts by size range and beam.

Projections of ballast transits for other, non-specific vessel types have been handled outside of the model since a large proportion of these on the ACP database have no deadweights and trends in transits – as might be expected - bear no relation to laden transits. Forecasts of these transits have therefore been based on an analysis of historical trends.

Forecasts of passenger ship transits have also been made outside of the main model. These have been based on:

- an analysis of full and partial transits – at a route level more detailed than specified in the terms of reference in order to capture the major cruise line itineraries;
- an extensive series of interviews with companies, agents and the Pier 6 cruise terminal at Colon;

- the identification of expected trends in the cruise sector; and
- developments in Panama which are likely to influence Canal transits relative to general sector trends.

The following sections summarise the assumptions and the results for Scenario 1. The final part, Section 1.9 describes the conclusions from Scenario 2.

1.2 Economic Outlook

Key economic assumptions with respect to GDP growth rates and population trends are shown in Table 1.2.1.

Table 1.2.1

Main Economic Indicators

Period	2000-2005	2005-2010	2010-2015	2015-2020	2020-2030	2030-2040	2040-2050
				Per Cent Per Annum Rate of Change			
GDP							
USA	3.2	2.1	1.9	1.9	1.5	1.5	1.5
Canada	3.1	2.6	1.7	1.7	1.5	1.5	1.5
Latin America	4.5	4.6	4.2	4.2	3.8	3.8	3.8
Europe incl FSU	3.0	2.6	2.5	2.5	2.3	2.3	2.3
Asia excl Middle East	3.9	3.7	3.4	3.4	2.9	2.9	2.9
Middle East	3.7	3.6	3.7	3.7	3.0	3.0	3.0
Africa	4.3	4.2	3.9	3.9	3.3	3.3	3.3
Oceania	3.2	2.2	2.0	2.0	2.0	2.0	2.0
World	3.4	2.9	2.8	2.8	2.4	2.5	2.5
Population							
GDP							
USA	0.9	0.8	0.9	0.8	0.3	0.3	0.3
Canada	1.2	0.6	0.6	1.1	0.4	0.4	0.4
Latin America	1.5	1.3	1.2	1.1	0.7	0.7	0.7
Europe incl FSU	0.2	0.1	0.1	0.0	-0.2	-0.2	-0.2
Asia excl Middle East	1.1	1.1	1.0	0.9	0.4	0.4	0.4
Middle East	2.2	2.1	2.1	1.8	1.1	1.1	1.1
Africa	2.3	2.1	2.1	1.9	1.3	1.3	1.3
Oceania	0.9	0.8	0.8	0.7	0.7	0.7	0.7
World	1.2	1.1	1.1	1.0	0.5	0.6	0.6

World GDP growth rates are assumed to decline steadily over the period from 2000 to 2020 – from around 3.4% per annum to 2.8% per annum – before flattening out at around 2.5% annually over the remainder of the forecast period. Generally economic growth in the developed world is expected to show a more marked slowdown than that in the developing countries. For the USA and Canada, average annual GDP growth rates over the next five years of around 3.2% are projected to ease to levels of around 1.5% per annum between 2020 and 2050. Figures for Latin America for the same periods are estimated at 4.5% and 3.8% per annum respectively and for Asia – excluding the Middle East – 3.9% and 2.9%. Economic growth rates for Europe, including the former Soviet Union (FSU) are projected at 3.0% per annum over the next five years, declining to 2.3% annually from 2020.

The rate of increase in the world's population is expected to roughly halve between now and the period from 2020, that is from 1.2% to 0.6%. The most marked slowdown will be in the developed economies within which the growth for the USA and Canada will fall from around

1.0% per annum to 0.3% per annum from 2020. For Europe as a whole, the population is expected to grow only marginally between 2000 and 2015 and after a period of stagnation is projected to begin to decline slightly from 2020. Population growth in Latin America, currently around 1.5% per annum is estimated to ease to around 0.7% from 2020, while that in Asia is projected to decline from 1.1% now to 0.4% per annum in the long term.

1.3 Generic Growth

Estimates of generic growth in future cargo flows for existing trades were made assuming no capacity constraints. The results are summarised in Table 1.3.1. Total cargo flows are projected to increase from 208 million tons in 2001 to 306 million tons by 2020 and to 431 million tons in 2050. In terms of average annual growth rates, this represents a gradual slowdown from 3.0% in the period from 2001 to 2005, to about 1.5% between 2010 and 2020 and around 1% from 2030.

Growth in passenger ship capacity is expected to slow – in line with international trends – from an estimated annual average of2.6% in the period from 2001 to 2020 to around 1% from 2020. This would still mean a near doubling of passenger ship capacity from 358,000 pax in 2001 to 621,000 pax in 2020, with a further increase to 824,000 pax by 2050.

Projections of total transits in terms of vessel dwt and PCUMS increase at similar growth rates to those for cargo flows, the latter increasing from 236 million net tons in 2001 to 344 million net tons in 2020 and 467 million tons in 2050. However, because of the underlying rising trend in the average vessel size transiting the Canal, growth in the numbers of transits are estimated to rise more slowly, from 15,354 in 2001 (equivalent to 42 ships per day) to 27,127 in 2050 (74 ships per day). In other words, demand for Canal transits is expected to exceed the daily limit of 42 vessels. The toll revenue that would accrue from these levels of transits would be $592 million in 2001, rising to $863 million in 2020 and $1,174 million in 2050.

1.4 The Existing Canal

If it is assumed that the maximum capacity of the Panama Canal is 42 vessels per day, covering all ship types, the opportunity for increasing future revenue in the absence of any toll increases becomes severely constrained. Cargo flows are estimated to reach just 223 million tons by 2020 – an increase of 14 million tons from 2001 – and 238 million tons by 2050 (Table 1.4.1).

Therefore, without even considering the amount of additional cargo that might be attracted by an enlarged Canal, in 2020 about 83 million tons of potential cargo on existing Canal routes – as defined by expected generic growth - would be diverted away from the Canal due to capacity constraints. In 2050, this figure would rise to 193 million tonnes.

As a result, growth in transits in terms of Dwt and PCUMS is projected at 0.5% per annum in the period through 2005, declining gradually to 0.2% per annum from 2020. Overall numbers of transits are estimated to rise to 15,340 in 2001 and remain broadly unchanged over the remainder of the period to 2005, although assuming passenger ships continue to receive priority, transits of these vessels would continue to increase at the expense of other ship types. With average vessel size ranges expected to continue increasing toll revenue would rise modestly from $592 million in 2001 to $639 million in 2020 and $673 million in 2050. These figures represent 'lost' revenue of $224 million and $500 million respectively compared with tolls based on the generic growth in the Canal transits.

Table 1.3.1

Scenario 1, Generic Growth in Existing Canal Trades

Trade	2001	2005	2010	2015	2020	2030	2040	2050
								000's Tons
Northbound	84,474	92,181	102,599	108,300	114,423	126,658	138,687	150,074
Southbound	123,883	142,403	160,945	175,600	191,820	221,316	250,714	280,745
Total	208,357	234,584	263,544	284,901	306,243	347,974	389,401	430,819
Dwt Laden Transits								'000 Dwt
Northbound	136,115	149,390	166,508	176,231	186,666	206,264	225,066	242,632
Southbound	177,168	204,783	232,398	254,516	275,955	317,492	358,306	399,819
Total	313,282	354,173	398,906	430,747	462,620	523,756	583,373	642,452
Dwt Ballast Transits								'000 Dwt
Northbound	31,828	36,367	41,007	45,054	48,908	56,057	63,208	70,418
Southbound	11,841	12,279	13,196	13,373	13,552	13,973	14,355	14,563
Total	43,669	48,645	54,203	58,427	62,459	70,030	77,563	84,981
Total Dwt Transits								'000 Dwt
Northbound	167,943	185,756	207,515	221,285	235,573	262,321	288,274	313,050
Southbound	189,009	217,061	245,594	267,889	289,507	331,465	372,662	414,382
Total	356,951	402,818	453,109	489,173	525,080	593,786	660,936	727,432
No. of Laden Transits								
Northbound	5,600	6,021	6,542	6,845	7,189	7,746	8,279	8,767
Southbound	6,092	7,047	7,989	8,704	9,399	10,746	12,042	13,352
Total	11,692	13,068	14,532	15,548	16,588	18,491	20,321	22,119
No. of Ballast Transits								
Northbound	1,776	1,924	2,077	2,203	2,324	2,556	2,782	3,005
Southbound	1,886	1,923	1,969	1,989	2,005	2,024	2,017	2,003
Total	3,662	3,848	4,046	4,192	4,329	4,580	4,798	5,008
Total No. of Transits								
Northbound	7,376	7,946	8,620	9,048	9,513	10,302	11,060	11,772
Southbound	7,978	8,970	9,958	10,693	11,404	12,769	14,059	15,354
Total	15,354	16,916	18,578	19,741	20,917	23,071	25,119	27,127
PCUMS for Laden Transits								000's Tons
Northbound	94,910	103,971	114,956	121,398	129,380	140,913	152,821	163,979
Southbound	113,353	131,496	149,096	162,691	175,819	201,467	226,604	252,330
Total	208,263	235,467	264,052	284,089	305,199	342,381	379,424	416,309
PCUMS for Ballast Transits								000's Tons
Northbound	18,059	20,514	23,034	25,207	27,290	31,152	35,004	38,870
Southbound	9,961	10,292	10,827	10,995	11,169	11,513	11,797	11,959
Total	28,021	30,806	33,861	36,202	38,459	42,665	46,801	50,829
Total PCUMS for Transits								000's Tons
Northbound	112,969	124,486	137,991	146,604	156,671	172,065	187,825	202,849
Southbound	123,315	141,788	159,923	173,686	186,988	212,980	238,401	264,289
Total	236,284	266,273	297,914	320,291	343,658	385,045	426,225	467,138
Tolls for Laden Transits								000's US$
Northbound	243,918	267,207	295,438	311,992	332,507	362,147	392,749	421,425
Southbound	291,318	337,944	383,176	418,117	451,854	517,771	582,372	648,489
Total	535,236	605,151	678,615	730,109	784,361	879,918	975,121	1,069,913
Tolls for Ballast Transits								000's US$
Northbound	36,841	41,849	46,990	51,422	55,672	63,550	71,408	79,295
Southbound	20,321	20,995	22,087	22,430	22,785	23,486	24,066	24,396
Total	57,162	62,845	69,077	73,851	78,457	87,036	95,474	103,691
Total Tolls for Transits								000's US$
Northbound	280,759	309,056	342,428	363,414	388,179	425,697	464,157	500,720
Southbound	311,639	358,939	405,264	440,546	474,639	541,257	606,438	672,884
Total	592,398	667,995	747,692	803,960	862,818	966,954	1,070,595	1,173,604

Annual Average Growth Rates	2001-2005	2005-2010	2010-2015	2015-2020	2020-2030	2030-2040	2040-2050
Cargo	3.0%	2.4%	1.6%	1.5%	1.3%	1.1%	1.0%
Dwt	3.1%	2.4%	1.5%	1.4%	1.2%	1.1%	1.0%
No. of Vessels	2.5%	1.9%	1.2%	1.2%	1.0%	0.9%	0.8%
PCUMS	3.0%	2.3%	1.5%	1.4%	1.1%	1.0%	0.9%
Tolls	3.0%	2.3%	1.5%	1.4%	1.1%	1.0%	0.9%

Table 1.4.1

Scenario 1, Case 1, Existing Canal

	2001	2005	2010	2015	2020	2030	2040	2050
Trade								000's Tons
Northbound	84,392	83,407	84,341	83,544	83,158	83,003	83,131	82,913
Southbound	123,764	128,848	132,304	136,231	139,408	145,036	150,281	155,106
Total	208,156	212,255	216,646	219,775	222,567	228,039	233,412	238,019
Dwt Laden Transits								'000 Dwt
Northbound	135,985	135,228	136,998	136,114	135,940	135,479	135,308	134,551
Southbound	176,999	185,427	191,330	196,735	201,060	208,779	215,708	222,067
Total	312,983	320,655	328,328	332,849	337,000	344,259	351,016	356,618
Dwt Ballast Transits								'000 Dwt
Northbound	31,797	32,905	33,710	34,755	35,544	36,736	37,888	38,904
Southbound	11,830	11,110	10,848	10,316	9,849	9,157	8,605	8,046
Total	43,627	44,015	44,557	45,071	45,393	45,893	46,492	46,950
Total Dwt Transits								'000 Dwt
Northbound	167,782	168,133	170,708	170,869	171,484	172,215	173,196	173,455
Southbound	188,828	196,537	202,177	207,051	210,909	217,936	224,312	230,112
Total	356,610	364,670	372,885	377,920	382,393	390,151	397,508	403,568
No. of Laden Transits								
Northbound	5,595	5,459	5,401	5,313	5,276	5,135	5,040	4,941
Southbound	6,086	6,399	6,616	6,781	6,916	7,162	7,375	7,573
Total	11,681	11,858	12,017	12,094	12,191	12,297	12,414	12,514
No. of Ballast Transits								
Northbound	1,774	1,741	1,708	1,699	1,689	1,675	1,667	1,660
Southbound	1,885	1,740	1,619	1,535	1,457	1,326	1,209	1,106
Total	3,659	3,482	3,326	3,234	3,146	3,002	2,876	2,767
Total No. of Transits								
Northbound	7,369	7,200	7,109	7,012	6,965	6,810	6,707	6,601
Southbound	7,971	8,139	8,234	8,316	8,373	8,488	8,583	8,680
Total	15,340	15,340	15,343	15,328	15,338	15,299	15,290	15,281
PCUMS for Laden Transits								000's Tons
Northbound	94,821	94,407	95,195	94,615	95,630	94,110	93,901	93,477
Southbound	113,251	119,775	124,232	127,820	130,713	136,187	141,250	146,226
Total	208,072	214,181	219,426	222,434	226,343	230,297	235,152	239,704
PCUMS for Ballast Transits								000's Tons
Northbound	18,042	18,562	18,935	19,445	19,834	20,415	20,982	21,475
Southbound	9,952	9,312	8,900	8,482	8,117	7,545	7,071	6,607
Total	27,994	27,874	27,836	27,926	27,951	27,960	28,053	28,082
Total PCUMS for Transits								000's Tons
Northbound	112,863	112,968	114,130	114,059	115,464	114,525	114,883	114,952
Southbound	123,203	129,087	133,132	136,301	138,831	143,732	148,322	152,833
Total	236,066	242,055	247,262	250,360	254,294	258,257	263,205	267,786
Tolls for Laden Transits								000's US$
Northbound	243,691	242,625	244,650	243,159	245,770	241,863	241,327	240,236
Southbound	291,055	307,820	319,276	328,496	335,933	350,000	363,013	375,802
Total	534,746	550,445	563,926	571,656	581,703	591,863	604,340	616,038
Tolls for Ballast Transits								000's US$
Northbound	36,806	37,866	38,628	39,667	40,461	41,647	42,803	43,809
Southbound	20,301	18,997	18,157	17,302	16,559	15,391	14,425	13,478
Total	57,107	56,863	56,785	56,970	57,020	57,038	57,229	57,287
Total Tolls for Transits								000's US$
Northbound	280,496	280,491	283,278	282,826	286,230	283,509	284,130	284,045
Southbound	311,357	326,817	337,433	345,799	352,492	365,391	377,439	389,280
Total	591,853	607,308	620,711	628,625	638,722	648,901	661,568	673,325

Annual Average Growth Rates	2001-2005	2005-2010	2010-2015	2015-2020	2020-2030	2030-2040	2040-2050
Cargo	1.1%	0.4%	0.3%	0.3%	0.2%	0.2%	0.2%
Dwt	1.3%	0.4%	0.3%	0.2%	0.2%	0.2%	0.2%
No. of Vessels	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
PCUMS	1.4%	0.4%	0.2%	0.3%	0.2%	0.2%	0.2%
Tolls	1.4%	0.4%	0.3%	0.3%	0.2%	0.2%	0.2%

1.5 By Pass Trades

1.5.1 Dry Bulk Trades

The following by pass trades have been identified:

- Coal from the US East Coast to Asia;
- Coal from Colombia to Asia;
- Coal from the West Coast of Canada to Europe;
- Iron ore from Venezuela to Asia; and
- Iron ore from the East Coast of Canada to Asia.

For all of these trades, the Panama Canal offers the shortest route but the ability to utilise larger vessels on alternative routes provides sufficient economies of scale to keep trade away from the Canal. For the Expanded Canal, total coal shipments captured from by pass trades would be equivalent to 6.4 million tons in 2020 and 11.3 million tons in 2050. This is in addition to the extra trade through the Canal that results from removing the capacity restrictions under Case 1. In the case of the Unrestricted Canal, the by pass trade captured would be 6.8 million tons and 11.8 million tons respectively. Iron ore cargoes attracted from by pass routes would be equivalent to 1.1 million tons in the Expanded Case and 4.5 million tons and 5.8 million tons in 2020 and 2050 respectively in the Unrestricted Case.

Other potential by pass trades were evaluated:

- Grains from the USA to Asia where, in theory at least, shipments via the US Pacific Northwest Coast (PNW) compete with those from the US Gulf;
- Iron ore from northern Brazil to Asia;
- Iron ore from Chile to Europe;
- Coal from the West Coast of Canada to Brazil;
- Soybeans from Brazil to Asia.

In the case of US grains there is little scope for switching cargoes from the US PNW to the US Gulf. Vessels sizes utilised out of the PNW are similar in size to those loaded from the US Gulf, shipments already tend to be moved via the nearest port and certain types of grain are only shipped from one or other location.

For the remaining four trades, the savings in mileages derived from utilisation of the Canal versus non-Canal routes are not sufficiently great to offset the impact of Canal tolls on overall freight costs.

Within the global fleet, the proportions occupied by each size range will generally shift toward the larger sizes. The average dwt of the larger vessels are also expected to increase while the commissioning of an Expanded or Unrestricted Canal would also impact on the average dwts and utilisation of those vessels at the high end of the ranges currently considered as Panamax.

1.5.2 Containerised Cargoes

The Asia/East Coast (EC) USA route is by far the most important Panama Canal container route, and by far the most important competition to the Canal on this route comes from West Coast (WC) USA ports and the intermodal rail landbridge. The landbridge has a larger share of ECUSA container cargo than the Canal, and dominates mid-west traffic.

A few minor routes also use the landbridge, though to a much lesser extent, and also may be affected by enlargement of the Canal.

The Canal also faces competition from the Suez routing for Asia/ECUSA cargoes. Other types of route competition have been proposed but none are plausible. Currently 6% of US bound traffic from Asia uses the Suez routing, but this could increase as the point of origin of cargo shifts from Japan and Korea to India and China. The New York and New Jersey Port Authorities aim to double the route's share of US bound traffic by 2010.

The US rail system is struggling to keep up with Asian volumes. There are growing issues of capacity at both the terminal railheads and on the network itself. There is an acknowledged need to extend the double stack network to accommodate the forecast growth in intermodal traffic, and there are plans to expand capacity. Immediately, however, shipping lines interviewed are responding either by using the Canal with Panamax vessels or developing the Suez routing for current trades. However, they would prefer to use larger vessels through the Canal if it were expanded, and this would generally dissuade them from expanding their use of the Suez routing.

Clearly, under Case 1, the Canal would lose share versus the landbridge due to capacity constraints but even just assuming generic growth in the Canal transits - and despite improvement of the intermodal option - we expect the Canal to gain share against the landbridge. The ability to use the same large vessels through the Canal on routes in one way or another associated with use of the landbridge - either east or westbound - accounts for further expected increases in containerised cargoes under the Expanded Canal.

Containership size is also a critical issue for ACP because it needs to be sure that the expanded Canal will not become obsolete shortly after it is built as a result of increases in vessel size beyond the 'new Panamax' size. We have examined a variety of future containership designs and deployment strategies, as well as considering present newbuilding activity.

We believe that the maximum vessel size will move to around 10,000 TEU in the short to medium term but that within 10-20 years the next step, to ships of up to 12,000 TEU will be taken as technical problems are solved. These will be used on Europe/Far East and the transpacific routes, with the other significant change being that more shuttle services will come into service in preference to transhipment hubs.

This maximum will be determined by absolute physical constraints at ports which cannot economically be overcome, for instance by building superhubs, by potential handling and vessel safety problems, by the need to use twin screws, and by shipping lines' reluctance to become totally dependent on single ports within port ranges.

As a consequence, for containerised cargoes, the by pass traffic that would be attracted through an Unrestricted Canal would be the same as that for the Expanded Canal case. Expansion of the Canal is projected to add a further 17.0 million tons of containerised cargoes in 2020 as compared with the generic growth in the Canal transits. In 2050 this would rise to 21 million tons.

1.5.3 Oil Trades

The patterns of oil flows into and out of the W.Hemisphere are such that enlargement of the Canal is unlikely to result in a significant change in the amounts of conventional crude oil and petroleum products being shipped through the Canal compared with the forecasts generic growth in the Canal transits. Shipments from the two potential sources of rising crude oil exports from the region – Mexico and Venezuela – are expected either to be

concentrated on routes which do not represent by pass trades or will continue to move to short haul destinations in the Americas via the Canal in Panamax vessels. In the latter cases, an enlarged Canal would simply permit the transit of slightly larger tankers without necessarily increasing the volumes of trade versus the generic growth in trade via the Canal. For these trades therefore expansion of the Canal would simply permit the passage of additional cargoes that might otherwise be excluded due to capacity constraints in the existing Canal. In other words an Expanded Canal would accommodate all of the generic trade growth.

The one potential growth area is Orimulsion from Venezuela. Currently some 1.5 million tons of Orimulsion are exported to Asia and although some quantities are currently still shipped in Panamax vessels via the Canal an increasing proportion of shipments are made in VLCCs of 280,000 dwt and above. It is estimated that future exports to Asia could reach up to around 15/16 million tons by 2020 but it is likely that these will be moved in either Suezmax (up to around 165,000 dwt) tankers or VLCCs. In any event, if the Canal remains at its existing dimensions it will not capture any of this additional business and will lose most if not all of its current Orimulsion trade in Panamax tankers.

Some of the additional quantities of Orimulsion are expected to be moved to countries located in S E Asia, for which the Panama Canal would still not represent the most economic route, even if it were enlarged. With an unrestricted Canal it is estimated that almost 12.5 million tonnes of Orimulsion could be diverted via the Canal in 2020 as compared with the generic growth in the trade via the Canal. However, since most of this would be likely to be moved in VLCCs, expansion of the Canal to accommodate a small Suezmax tanker of around 140,000 dwt – as in the Expanded Canal Case - would only attract an additional 1.9 million tons from 2010.

1.6 The Expanded Canal

Assuming the Canal was expanded from 2010, total trade in that year is estimated at 290 million tons and is projected to rise to 333 million tons in 2020 and 466 million tons in 2050 (Table 1.6.1). This represents increases of 110 million tons and 228 million tons in 2020 and 2050 respectively versus the Existing Canal after taking into account capacity constraints.

Total numbers of transits would reach 21,141 in 2020 and 27,268 in 2050 with total PCUMS in each of these years amounting to 373 million net tons and 506 million net tons. Toll revenue would reach $936 million in 2020 and $1,272 million in 2050.

1.7 The Unrestricted Canal

An Unrestricted Canal would be expected to attract little more cargo than the expanded Canal, about 4% more in 2020 and an additional 3% in 2050 (see Table 1.7.1). The total numbers of transits would reach 21,194 in 2020 and 27,322 in 2050, that is, not significantly greater than the Expanded Case since it is assumed that in the bulk shipping sectors an Unrestricted Canal would result in even larger vessels being used to transit the Canal and better capacity utilisation.

Total transits in terms of PCUMS are projected to be 378 million net tons in 2020 and 512 million net tons in 2050, resulting in total toll revenues of $951 million and $1,287 million respectively.

Table 1.6.1

Scenario 1, Case 2, Expanded Canal

	2010	2015	2020	2030	2040	2050
Trade						000's Tons
Northbound	112,025	118,219	124,768	137,924	150,523	162,192
Southbound	177,516	194,072	207,776	239,225	270,792	303,561
Total	289,540	312,291	332,543	377,149	421,315	465,754
Dwt Laden Transits						'000 Dwt
Northbound	181,420	192,075	203,319	224,575	244,438	262,630
Southbound	256,971	280,176	299,824	343,731	387,049	431,721
Total	438,391	472,251	503,143	568,306	631,488	694,351
Dwt Ballast Transits						'000 Dwt
Northbound	42,630	47,635	52,167	61,637	71,278	81,215
Southbound	13,318	13,499	13,679	14,106	14,485	14,678
Total	55,949	61,134	65,845	75,742	85,763	95,892
Total Dwt Transits						'000 Dwt
Northbound	224,050	239,710	255,485	286,211	315,717	343,844
Southbound	270,289	293,674	313,503	357,837	401,534	446,399
Total	494,340	533,384	568,988	644,048	717,251	790,244
No. of Laden Transits						
Northbound	6,632	6,930	7,268	7,814	8,332	8,803
Southbound	8,142	8,840	9,496	10,810	12,071	13,346
Total	14,774	15,770	16,764	18,624	20,403	22,149
No. of Ballast Transits						
Northbound	2,106	2,240	2,367	2,619	2,865	3,111
Southbound	1,974	1,994	2,010	2,029	2,022	2,008
Total	4,078	4,234	4,377	4,648	4,887	5,119
Total No. of Transits						
Northbound	8,737	9,170	9,635	10,433	11,198	11,915
Southbound	10,116	10,834	11,506	12,839	14,093	15,353
Total	18,852	20,004	21,141	23,272	25,291	27,268
PCUMS for Laden Transits						000's Tons
Northbound	125,106	132,225	140,799	153,501	166,185	177,863
Southbound	164,872	179,168	191,712	218,807	245,332	272,701
Total	289,978	311,392	332,511	372,308	411,517	450,564
PCUMS for Ballast Transits						000's Tons
Northbound	23,756	26,358	28,748	33,647	38,613	43,697
Southbound	10,970	11,133	11,300	11,638	11,915	12,063
Total	34,726	37,490	40,048	45,285	50,527	55,760
Total PCUMS for Transits						000's Tons
Northbound	148,862	158,582	169,547	187,149	204,798	221,560
Southbound	175,842	190,301	203,013	230,445	257,247	284,764
Total	324,704	348,883	372,559	417,594	462,044	506,324
Tolls for Laden Transits						000's US$
Northbound	321,523	339,817	361,853	394,498	427,095	457,108
Southbound	423,721	460,462	492,700	562,334	630,503	700,842
Total	745,244	800,279	854,553	956,832	1,057,598	1,157,950
Tolls for Ballast Transits						000's US$
Northbound	48,462	53,769	58,646	68,641	78,770	89,141
Southbound	22,379	22,711	23,053	23,742	24,306	24,609
Total	70,841	76,480	81,699	92,382	103,076	113,750
Total Tolls for Transits						000's US$
Northbound	369,985	393,586	420,498	463,139	505,865	546,249
Southbound	446,099	483,172	515,753	586,075	654,809	725,451
Total	816,085	876,759	936,252	1,049,214	1,160,674	1,271,700

Annual Average Growth Rates

	2005-2010	2010-2015	2015-2020	2020-2030	2030-2040	2040-2050
Cargo	4.3%	1.5%	1.3%	1.3%	1.1%	1.0%
Dwt	4.2%	1.5%	1.3%	1.2%	1.1%	1.0%
No. of Vessels	2.2%	1.2%	1.1%	1.0%	0.8%	0.8%
PCUMS	4.0%	1.4%	1.3%	1.1%	1.0%	0.9%
Tolls	4.5%	1.4%	1.3%	1.1%	1.0%	0.9%

1.8 A Comparison of Cases

Comparisons of the projections of total numbers of vessel transits, PCUMS and toll revenues for each of the above four cases under the base case Scenario 1 is shown in Table 1.8.1 and Figures 1.8.1 to 1.8.3. The figures represent estimates of Canal transits and revenue that could be expected if an enlarged Canal – Expanded or Unrestricted – were to be fully operational from 2010.

Comparing projections for the Expanded Case versus the Existing Canal with current capacity constraints, the total number of transits would be greater by 3,509 (23% in 2010), 5,804 (38%) in 2020 and 11,987 (78%) in 2050. Because of the larger vessel sizes transiting the Canal in the Expanded Case, which overwhelms the impact of improved cargo: dwt ratios for certain ship types and sizes, transits in terms of PCUMS would be up by 31% in 2010, 47% in 2020 and 89% in 2050. Similar percentage increases would be expected in toll revenues resulting in increases of $195 million in 2010, $298 million in 2020 and $598 million in 2050.

The development of an Unrestricted Canal would not be expected to attract significant additional business. In 2020 transits in terms of number of vessels and PCUMS net tonnage would increase versus the Expanded Case by just 0.3% and 1.6% respectively. Toll revenue would rise by $14.9 million. In 2050, numbers of transits and PCUMS net tonnage would show an increase of 0.2% and 1.2% respectively, while toll revenue would increase by $15.9 million.

1.9 Risk Analysis

The risk analyses undertaken consider the potential for both upward and downward revisions from the base case forecasts. As a major sensitivity to the base case a second scenario has been developed which takes into account a number of potential global structural changes that may take place and assesses their potential impact on trade, both internationally and through the Panama Canal.

A global equilibrium model of the world has been employed to study the main effects on international trade of the following structural changes:

- Generally reduced non-tariff barriers to world trade, implemented as a 30% general reduction in non-tariff barriers after 2010, and reduced barriers to trade in agricultural products to 40% of current levels from 2020. Within the next twenty years it is estimated that there a 70% chance of a general reduction in non tariff barriers in manufactures and a 40 to 45% of substantial cuts in non tariff barriers in agriculture. In 50 years these percentages rise to 80%.

- High global taxes on the use of fossil fuels, implemented as a 50% tax on oil and coal and a 20% tax on other fuels and a 20% increase in the efficiency of energy use in all types of economic activity. The chances of such developments having an impact over the next 10 to 15 years is put at 40%, rising to 80% twenty to thirty years out.

- High productivity growth in parts of the world due to efficient use of information and communications technology, implemented as a 2% increase in productivity in the USA from 2005, 1.5% in Europe from 2010, in Japan from 2015 and a 1% increase in Asia from 2030. It is estimated that there is a 60 to 70% chance that this will have a lasting impact.

Table 1.7.1

Scenario 1, Case 3, Unrestricted Canal

	2010	2015	2020	2030	2040	2050
Trade						000's Tonnes
Northbound	112,284	118,488	125,043	138,220	150,828	162,488
Southbound	183,584	203,257	221,705	253,684	285,738	318,966
Total	295,867	321,744	346,748	391,903	436,566	481,454
Dwt Laden Transits						'000 Dwt
Northbound	181,274	191,938	203,190	224,453	244,327	262,532
Southbound	262,661	289,088	313,980	358,252	401,802	446,547
Total	443,935	481,026	517,169	582,705	646,128	709,079
Dwt Ballast Transits						'000 Dwt
Northbound	42,522	47,517	52,343	61,819	71,448	81,346
Southbound	13,312	13,492	13,673	14,100	14,479	14,673
Total	55,834	61,009	66,016	75,919	85,927	96,019
Total Dwt Transits						'000 Dwt
Northbound	223,797	239,455	255,533	286,272	315,774	343,878
Southbound	275,972	302,580	327,652	372,352	416,281	461,220
Total	499,769	542,036	583,185	658,624	732,055	805,098
No. of Laden Transits						
Northbound	6,631	6,929	7,267	7,813	8,331	8,802
Southbound	8,156	8,865	9,549	10,864	12,127	13,400
Total	14,787	15,794	16,815	18,678	20,458	22,203
No. of Ballast Transits						
Northbound	2,103	2,239	2,368	2,620	2,866	3,112
Southbound	1,974	1,994	2,010	2,029	2,022	2,008
Total	4,077	4,233	4,378	4,649	4,888	5,119
Total No. of Transits						
Northbound	8,734	9,167	9,635	10,433	11,198	11,914
Southbound	10,129	10,859	11,559	12,893	14,148	15,408
Total	18,864	20,026	21,194	23,326	25,346	27,322
PCUMS for Laden Transits						000's Tons
Northbound	125,042	132,164	140,742	153,447	166,135	177,819
Southbound	167,167	182,770	197,520	224,773	251,398	278,796
Total	292,210	314,934	338,262	378,220	417,533	456,615
PCUMS for Ballast Transits						000's Tons
Northbound	23,707	26,305	28,824	33,726	38,685	43,752
Southbound	10,967	11,130	11,298	11,635	11,912	12,061
Total	34,674	37,435	40,122	45,361	50,598	55,813
Total PCUMS for Transits						000's Tons
Northbound	148,750	158,469	169,566	187,173	204,821	221,572
Southbound	178,134	193,900	208,818	236,408	263,310	290,857
Total	326,884	352,369	378,384	423,582	468,131	512,429
Tolls for Laden Transits						000's US$
Northbound	321,359	339,662	361,707	394,360	426,988	456,996
Southbound	429,620	469,718	507,627	577,667	646,092	716,505
Total	750,979	809,380	869,334	972,027	1,073,060	1,173,501
Tolls for Ballast Transits						000's US$
Northbound	48,363	53,662	58,800	68,801	78,918	89,255
Southbound	21,496	21,820	22,155	22,833	23,388	23,684
Total	69,859	75,482	80,956	91,633	102,307	112,939
Total Tolls for Transits						000's US$
Northbound	369,722	393,324	420,507	463,161	505,886	546,251
Southbound	451,116	491,538	529,783	600,499	669,481	740,190
Total	820,838	884,862	950,290	1,063,660	1,175,367	1,286,441
Annual Average Growth Rates						
	2005-2010	2010-2015	2015-2020	2020-2030	2030-2040	2040-2050
Cargo	4.8%	1.7%	1.5%	1.2%	1.1%	1.0%
Dwt	4.4%	1.6%	1.5%	1.2%	1.1%	1.0%
No. of Vessels	2.2%	1.2%	1.1%	1.0%	0.8%	0.8%
PCUMS	4.2%	1.5%	1.4%	1.1%	1.0%	0.9%
Tolls	4.6%	1.5%	1.4%	1.1%	1.0%	0.9%

Table 1.8.1

Comparison of Cases

	2001	2005	2010	2015	2020	2030	2040	2050
Generic Growth								
Total No. of Transits 000s	15354	16916	18578	19741	20917	23071	25119	27127
Total PCUMS 000s Tons	236284	266273	297914	320291	343658	385045	426225	467138
Total Tolls 000's US $	592398	667995	747692	803960	862818	966954	1070595	1173604
Existing Canal with Current Capacity Constraints								
Total No. of Transits 000s	15340	15340	15343	15328	15338	15299	15290	15281
Total PCUMS 000s Tons	236066	242055	247262	250360	254294	258257	263205	267786
Total Tolls 000's US $	591853	607308	620711	628625	638722	648901	661568	673325
Expanded Canal								
Total No. of Transits 000s			18852	20004	21141	23272	25291	27268
Total PCUMS 000s Tons			324704	348883	372559	417594	462044	506324
Total Tolls 000's US $			815561	876208	935677	1048601	1160029	1271029
Changes Versus Existing Canal With Capacity Constraints								
Total No. of Transits 000s			3509	4677	5804	7974	10000	11987
Total PCUMS 000s Tons			77442	98522	118265	159337	198839	238538
Total Tolls 000's US $			194851	247583	296955	399700	498461	597703
Unrestricted Canal								
Total No. of Transits 000s			18864	20026	21194	23326	25346	27322
Total PCUMS 000s Tons			326884	352369	378384	423582	468131	512429
Total Tolls 000's US $			820838	884862	950290	1063660	1175367	1286441
Changes Versus Existing Canal With Capacity Constraints								
Total No. of Transits 000s			3521	4699	5856	8028	10055	12042
Total PCUMS 000s Tons			79622	102008	124089	165325	204926	244643
Total Tolls 000's US $			200128	256236	311567	414759	513798	613115

Figure 1.8.1

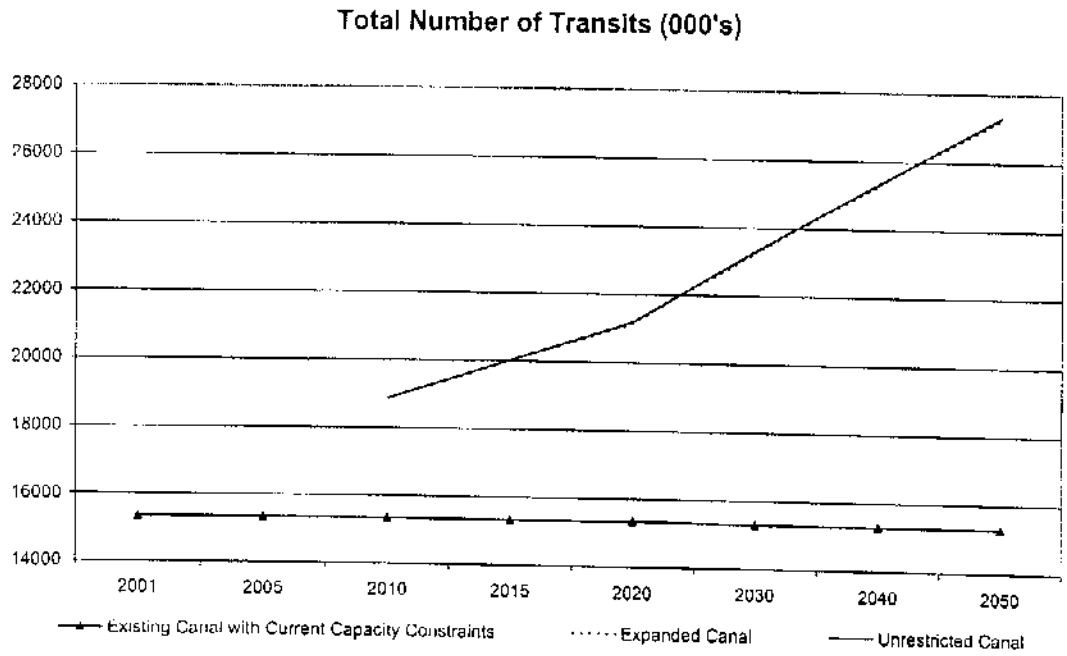


Figure 1.8.2

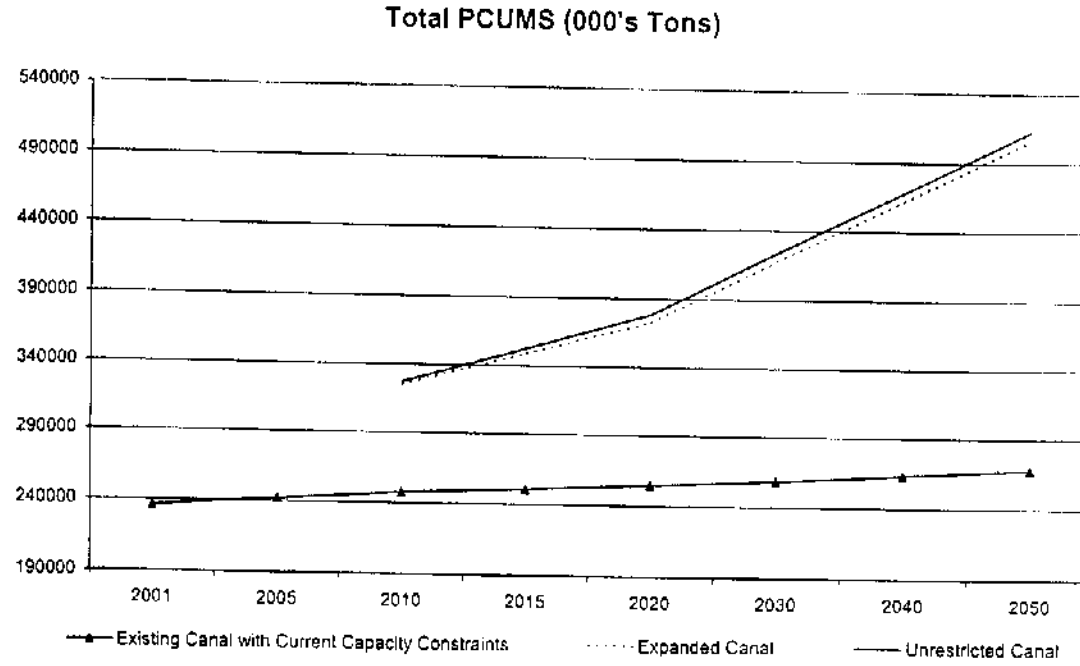
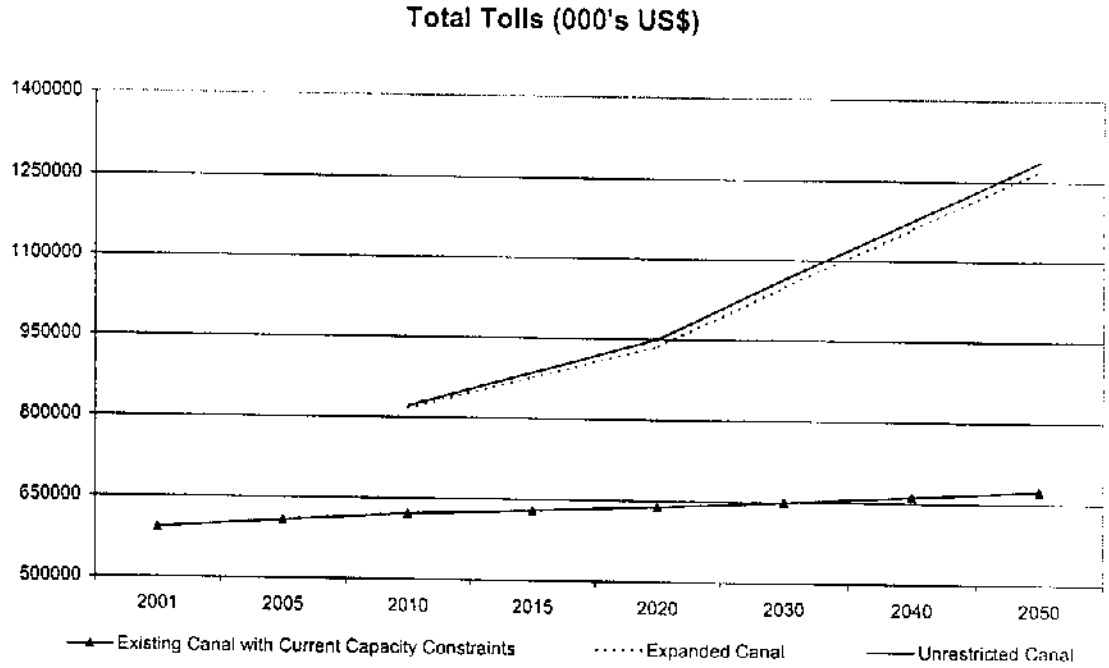


Figure 1.8.3



- Globalisation and fragmentation of world trade, with high foreign direct investments in Asia, implemented as a shift in the capital base in Asia, combined with technology shifts in sectors using semi-skilled and skilled labour intensively. This is just an amplification of the Scenario 1, where Asia is gaining competitive advantage in skilled and semi-skilled manufactured products. As a result the likelihood of seeing the impact of this effect over the next twenty years is put as high as 80 to 90%

The model used to develop Scenario 2 is fairly rich in economic relations, and the above changes induce a number of effects. The mechanisms involved work through changes in comparative advantage, but also changes in competition levels in sectors with imperfect competition. An underlying input-output structure captures some agglomeration effects, thus incorporating some effects of the so-called "new geography of trade". Model output has been converted to adjustment factors by using detailed statistics from the COMTAP database.

The dominating effects which influence trade flows through the Panama Canal are:

High US productivity from 2005 leads to high export performance and somewhat reduced imports 2005-2020 due to higher domestic production. The import reductions are found particularly for trade with Europe and Asia.

This trend is turned around from 2030 as the Asian economies attain higher productivity, leading to higher exports and somewhat lower imports, particularly in trades with the US.

The energy tax and increased energy efficiency reduces trades in energy dramatically. It also affects the steel industry, which reduces both the use of iron ore and coal. The increased energy efficiency increases economic growth, however, and creates more trade in manufactures, affecting particularly containerised goods and the residual group "all other cargoes". The model has an underlying input-output structure, so any direct effect on particular sectors (like the steel industry) will have secondary effects through reductions in sectors delivering to the steel industry.

The lower non-tariff barriers have a general positive effect on trade flows, and particularly after 2030, world trade in agricultural products increases substantially. This is mostly exports from third world countries to Europe, but also a notable increase in Asian imports due to the high barriers existing in some countries (particularly Japan).

The model output has been converted to adjustment factors from the generic growth (Scenario 1) forecasts. The overall effects on total trade projections for the Panama Canal are relatively small with reductions in industrial commodity trade flows being partly offset by increases in agricultural product trade flows. In 2010, the first time period, when it is assumed that these structural changes will begin to have an impact, there would be an overall increase in commodity trade flows 2.4 million tons, before taking into account the effect of by-pass trade. By 2050 the generic growth forecasts for Scenario 2 would be 13 million tons lower than that forecast under Scenario 1.

Looking at only the figures for generic growth, by 2050 total transits under Scenario 2 are 2% below the Scenario 1 numbers but this encompasses some substantial changes for individual ship types and also by direction. Under Scenario 2, northbound laden transits in 2050 increase by 4% compared to Scenario 1, while southbound the number of laden transits declines by 5%. The most notable differences for individual ship types are:

- Northbound and southbound increases for full containerships;
- Southbound reductions for both tankers and dry bulk carriers;
- Northbound increases for reefers.

Overall figures for Case 1 under Scenario 2 - the existing Canal - are little different from those under Scenario 1 since in both cases it is expected that the Canal would be capacity constrained The limitations of the existing Canal would be the determining factor for trade and transits under both Scenarios.

For the Expanded Canal, transits are marginally in excess of the Scenario 1, Expanded Canal case (that is varying between 0.3% and 1.3% annually) through 2030 but by 2050 transits are down by nearly 2%. For the Unrestricted Canal, in comparison with Scenario 1, the number of laden transits is marginally increased through 2030 and then declines by a total of 1.5% in 2050.