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ECONOMIC COMMISSION FOR LATIN AMERICA
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REVIEW OF ECONOMIC EVALUATION

of

PROPOSED NEW PORT

at

GEORGE TOWN, CAYMAN ISLANDS

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SECTION I

Some important considerations that seem to have been omitted in the economic evaluation of the proposed new port are identified and discussed in this section.

SIGNIFICANT DISCREPANCIES IN THE ECONOMIC EVALUATION OF PROPOSED NEW PORT AT GEORGE TOWN, GRAND CAYMAN

(1) Petroleum Traffic

It is not shown what part of the projected future volume of imports would be petroleum. The analysis is presented as though all future cargo imports will be served by the new port facilities, and this would be a valid basis for evaluating the project estimates only if the future volume of imports exclude the volume of petroleum to be imported. The effect on the economic analysis is significant because if petroleum imports are in fact included in the projections of future, then:

(a) the benefits and cost-savings accruing to the new port may have been over-stated since liquid petroleum imports should not be handled through the new port; and

(b) perhaps the proposed new port has been planned to handle more cargo than required, thus also over-stating the necessary cost of developing the new port.

(2) Port Operating Costs

The economic effect of new facilities versus old facilities on the cost of handling cargo has not been clearly demonstrated. No cost-savings due to a more efficient port have been included under "benefits". Alternatively the port operating cost includes only the "additional" cost due to new facilities, and this amount is estimated erroneously to be a fixed annual amount independent of the volume of cargo handled. Thus, an important element of benefit in the benefit-cost comparison has been obscured or omitted. These benefits comprise reduced cost of labour per ton of cargo and reduced cost of pilferage and damages per ton of cargo. These cost-saving should be identified in the summary of "Benefits", year by year, being directly linked to the amount of cargo handled. The total cost of port operations should be included in the summary of "Costs", year by year showing a relationship to the amount of cargo handled. (See analysis of probable port operating costs.)

(3) Value of Ships Time at Port

The analysis is silent about the loss of ships time due to adverse seas and swells under existing and future conditions. This economic cost should be identified and the extent that it is affected by new port facilities, if any, should be shown. (Perhaps the effect is nil, but this needs expression in order to remove doubts about whether the estimated savings of ships time in port has been made with due allowance for the adverse sea conditions.)

Regardless of the effect of adverse sea conditions, the analysis has apparently assumed that the new port facilities will eliminate all ship delays while waiting for a berth, but this is not true because ships will continue to arrive at random and consequently there will be some congestion and ships waiting time after new facilities have been acquired. The analysis also assumes for the 17-year period a fixed rate for the value of ships time in port (CI$833 per day at 1972 prices) but this is incorrect because ships will become larger and more expensive as soon as new port facilities can accomodate larger ships. Furthermore, ships will tend toward larger sizes after new facilities are completed. Thus, the economic benefit attributable to reduced ship waiting time needs re-examination and adjustment in the light of ship arrival patterns and the increasing value of ships time after new facilities permit larger ships to serve the port. (The result of such an exercise indicates reduced ships time in port to be substantially greater than is estimated in the Gochenour evaluation.)

(4) Estimated Port Capacity

The estimate of maximum capacity under existing conditions (75,000 tons) seems too high, based upon observed performances in 1972. (See analysis of probable port congestion where it is deduced the maximum capacity under existing conditions is about 62,000 tons.)

The estimates of the capacity of proposed new port facilities are not realistic for the intended mix of general cargo and container (ro-ro) traffic.

The cargo transfer rate during 1972, using the "very primitive" berth available was 3.6 tons per hour of ships time in port. However, this figure is quite misleading for the Roll-on/Roll-off ships time in port included one occasion when a ship was in port $5\frac{1}{2}$ days before unloading the containers and the reason for this delay could hardly be ship congestion; furthermore, throughout the year, the aggregate of ships time in port after the cargo had been handled, amounted to slightly more than one-third of total ship time at port. Why ships remained so long after completing cargo operations , or on one occasion for $5\frac{1}{2}$ days before commencing, was not explained. Rejecting these two inordinate categories of delay it is evident that the existing capability of the "very primitive" ro-ro berth is about 8 tons per hour. When new facilities comprising a proper berth and adequate aggregation space on shore have been provided, it is reasonable to expect that ro-ro cargo would move through the port at not less than 30 tons per hour of ships time in port, and that general cargo would move at no less than 15 tons per hour. If there were to be only one ro-ro berth and one general cargo berth, each utilized at 50 percent availability, the annual capacity would be:

One Ro-ro berth	= 30 x 8760 x 0.5	=	131,400 tons
One General Cargo berth	= 15 x 8760 x 0.5	=	65,700 tons
	Total	=	197,100 tons

Alternatively, the plan for 4 berths will permit handling the estimated future volume of cargo even if operational effectiveness were to be no greater than 15 tons per hour for ro-ro cargo and 7.5 tons per hour for general cargo. Since such indices of performance are distinctly lower than should be expected of a port having modern facilities, it is concluded that four berths are not required to serve the traffic projected to year 1990.

(5) Reduced Pilferage and Damage

Reduction in the amount of theft and damages to cargo which will result from having port facilities which make containers feasible, constitute an economic benefit that should be evaluated as a

credit to new port facilities. This is an important omission, as mentioned above under Port Operating Costs.

(6) Economic Life

The horizon chosen for the Benefit-Cost analysis is apparently based upon the assumption that the port facilities would become obsolete in 17 years. If this is a valid basis for the economic analysis, there should be a projection of the amounts of cargo requiring a port beyond year 1990, showing that the requirement is distinctly in excess of the capacity of the proposed new port. In view of (1) the difficulties involved in reliably projecting the future volumes of traffic beyond 17 years, and (2) in view of serious doubts about the future capacity of the new port as the form of cargo and the type of ships trend more and more toward containerization with the attendant increasing port capacity per ship berth, it would be preferable to make the economic analysis on either of these alternative bases:

(a) use an horizon compatible with the useful life of the principal structures involved, perhaps 40 years, or least 25 years and assume constant levels of both traffic and operating costs from the 17th year onward; or

(b) use the 17-year horizon, as has been done, and credit the project with the salvage value of port structures at the 17th year, based upon a realistic useful life of the structures. The useful life would be longer for some items than for others, perhaps 25 years would be a reasonable composite for all structures involved in the analysis.

SECTION II

The probable congestion that may be experienced when a new port has been achieved is analyzed in this Section. Based upon acceptance of Mr. Gochenour's projections of future traffic and upon the assumption that those projections exclude petroleum, and on the Adviser's judgement concerning future ship sizes and amounts of cargo they will carry, and the port's future operational effectiveness, conclusions are drawn concerning the number of berths required in the new port, and of the value of reduced ships turnaround time attributable to new port facilities.

ANALYSIS OF PROBABLE PORT CONGESTION AT THE PROPOSED NEW PORT AT GEORGE TOWN, GRAND CAYMAN

In order to assess the validity of the estimated benefits attributed to reduced ships time at port the following calculations have been made based upon the assumptions stated herein and the projections of future traffic contained in the Gochenour economic evaluation. An estimate of the number of ships that will visit the port is necessary. This estimate may be made on the basis of actual experience in 1972; the projected tonnages of traffic as presented in the Gochenour analysis; and the following assumptions:

(1) Ships will arrive at port in accordance with a random pattern, predictable by the Poisson distribution formula.

(2) The cargo projections contained in the Gochenour analysis exclude the tonnages of liquid petroleum that will be imported and handled through pipelines outside the new port.

(3) The amount of cargo brought per ship, on the average, will tend to increase at the rate of one percent per year, from the actual experience in 1972, except for a sharp rise of 50% in the year following completion of new facilities. It is assumed new facilities will be completed in 1975.

(4) The port's operational effectiveness will increase at an annual rate of two percent until new facilities are completed; rise to an index of ten tons per ship-hour in the year following completion of new facilities; and thereafter continue to improve at the rate of eight percent per year (due mainly to change from general cargo to container cargo.)

The calculated numbers of ships and the amounts of time they would spend in port, year by year, based upon the foregoing assumptions (2), (3) and (4) are presented in Table 1. The significance of the calculation is the demonstration that although the volume of cargo to be put through the port annually will increase by a factor of five, the average number of ships in port will decline and the probable maximum number present will become practically

level after the new port facilities have been completed.

The calculated amount of ships waiting time, expressed in ship-hours as well as in the percentage of ship-hours required; and also the percentage of berth utilization are presented in Tables 2 to Table 7, inclusive. In each table the computation is presented for two cases, the case of three ships being served simultaneously, or the case of the port having space to serve only two ships at one time.

Table 2 presents the actual traffic in 1972, based upon the actual number of ships and the observed turnaround time. The amount of ships time waiting for a berth is shown for either 3 berths or 2 berths, because actually the available berthing facilities could accomodate as many as three if the the ships were of suitable size or no more than two of larger sizes. The actual amount of time ships waited for a berth during the period, 14 December 1971 to 27 December 1972, slightly more than one year, was 2,828 ship-hours and additionally ships delayed their departure 1,927 ship-hours after completing cargo-handling operations, according to the port register. The reasons for delayed departure were not shown in the port register, but these cannot be considered as time spent waiting for a berth, of course. The actual amount of ships delay while waiting for a berth, 2,818 hours, is greater than would have been realized if 3 berths were available to all ships (1,877 hours) and less than would have been realized if only two berths were available to all ships (4,684 hours.) The computations presented in Table 2 are considered to confirm the actual ships waiting time experienced in 1972.

The traffic forecast for year 1975 (62,000 tons) could not be served by the existing port, under existing practices, even if any ship could be served by any one of the existing three berths if the port performance and related turnaround time improved no more than two percent per year, as assumed in (4) above. This fact is presented in Table 3. However, if the turnaround time could be reduced to 86.4 hours by working longer hours, the annual throughput could barely be handled by the existing port, again assuming that any ship could be served by any one of the existing three berths. The amount

of time lost waiting for a berth and the berth utilization under this condition is presented in Table 4. This leads easily to the conclusion that 62,000 tons is the maximum capacity of the existing port under particular constraints: (a) that any ship could be served at any berth; and (b) that the operational effectiveness would be increased from a turnaround time of 101.3 hours in 1972 to 86.4 hours in 1975. Although condition (a) is unrealistic and condition (b) is doubtful, these are nevertheless at least remote possibilities and thus the amount of ships waiting time entailed at this maximum capacity under existing conditions provides a basis for comparison with the amount of ship delay to be reasonably expected upon the completion of new port facilities which will permit more effective cargo handling operations.

Tables 5, 6 and 7 show the ship congestion that will result from the use of new port facilities and the improved cargo-handling effectiveness that these make possible in each of the year 1980, 1985 and 1990, respectively. The effect of increasingly greater volumes of cargo, larger ships and improved port performance upon ships waiting time and berth utilization is shown alternatively for either three berths or two berths.

The congestion that would be expected in years 1976, 1980, 1985 and 1990 in a new port having either three berths or two berths while handling only the estimated existing maximum throughput of 62,000 tons is presented in Tables 8, 9, 10 and 11 respectively, as a basis for demonstrating the reduction of ships time in port attributable to new facilities.

The annual amounts of ships waiting time saved on the future segment of the traffic that represents the maximum capacity of the port under existing conditions (62,000 tons) have been summarized in Table 12. The value of ships waiting time has been accepted from the Gochenour analysis for the 1972 situation, i.e. CI$833 per day or $34.71 per hour. The value of ships time in subsequent years has been escalated to reflect the fact that larger ships are more costly. A growth rate in this respect has been taken as one percent annually except for an increase of 50 percent in the year

when larger ships are first able to use new port facilities (1976). The demonstration in Table 12 shows that even though only two berths were to be provided in the new port, there would be a savings in ships waiting time of about CI$4,652,800 through year 1990, and that for three berths in the new port the savings on ships waiting time would be about CI$5,052,100. These amounts are substantially greater than the amount estimated in the Gochenour evaluation (CI$3,019,000).

TABLE 1

Year	Projected Traffic (long tons)	Tons Cargo per Ship (long tons)	Number of Ships	Port Performance Index (tons per hour)	Ship Turn-around Time (hours)	Average Number Ships at Port	Probable Maximum Number Ships in Port
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1972	34000	197.7	172	1.95	101.3	1.99	6
3	41538	199.7	208	1.99	100.4	2.38	7
4	50748	201.6	252	2.03	99.3	2.86	8
1975	62000	203.7	304	2.07	98.4	3.41	9
6	68356	305.5	224	10.0	30.6	0.78	4
7	75364	308.6	244	10.8	28.6	0.80	4
8	83090	311.6	267	11.7	26.6	0.81	4
9	91608	314.8	291	12.6	25.0	0.83	4
1980	101000	317.9	318	13.6	23.4	0.85	4
1	108122	321.1	337	14.7	21.8	0.84	4
2	115747	324.3	357	15.9	20.4	0.83	4
3	123908	327.5	378	17.1	19.2	0.83	4
4	132646	330.8	401	18.5	17.9	0.82	4
1985	142000	334.1	425	20.0	16.7	0.81	4
6	148299	337.5	439	21.6	15.6	0.78	4
7	154731	340.8	454	23.3	14.6	0.76	4
8	161519	344.2	465	25.2	13.7	0.73	4
9	168604	347.7	485	27.2	12.8	0.71	4
1990	176000	351.2	501	29.4	11.9	0.68	4

Notes to Table 1

(1) Source is Table 3 of Gochenour economic analysis.

(2) Actual value in 1972 based upon Plumlee analysis. 1973 onward are judgement values, based upon the assumption that actual tonnage in 1972 will increase at rate of one percent annually through year 1990, except for a sharp rise of 50 percent in the year following completion of new port facilities, which is assumed to be year 1976.

(3) Column (1) divided by column (2).

(4) Year 1972 is actual from Plumlee analysis. Subsequent years are judgement values based upon operational effectiveness improving at two percent annually until new port facilities are completed in 1975; increasing sharply in year 1976 to 10 tons per hour; and increasing thereafter at 8 percent annually.

(5) Actual turnaround time in 1972 from Plumlee analysis. Year 1973 onward column (5) = column (2) divided by column (4).

(6) Actual in year 1972 from Plumlee analysis. Year 1973 onward column (6) = column (3) times column (5) divided by 8,760 hours in one year.

(7) Based on assumption that ships will arrive at random. Determined by examination of Poisson distribution for the respective values in column (6), and excluding the "tail" of the distribution comprising less than one percent.

TABLE 2

SHIP CONGESTION ANALYSIS - GRAND CAYMAN - YEAR 1972 (ACTUAL)

ACTUAL SHIP ARRIVALS = 172. Average Turnaround Time = 101.3 hrs. Average Ships Present = 1.99										
PROBABLE SHIP DISTRIBUTION			WHEN PORT HAS THREE BERTHS				WHEN PORT HAS TWO BERTHS			
"n" Ships in Port at same time	Hours "n" Ships are in port	Berth-hours required	Berth-hours available	Hours when Berths are vacant	Hours when Berths are occupied*	Hours when Ships wait for Berth	Berth-hours available	Hours when Berths are vacant	Hours when Berths are occupied*	Hours when Ships wait for a Berth
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(4a)	(5a)	(6a)	(7a)
0	1198	0	3594	3594	0	0	2396	2396	0	0
1	2384	2384	7152	4768	2384	0	4768	2384	2384	0
2	2371	4742	7113	2371	4742	0	4742	0	4742	0
3	1572	4716	4716	0	4716	0	3144	0	3144	1572
4	783	3132	2349	0	2349	783	1566	0	1566	1566
5	311	1555	933	0	933	622	622	0	622	933
6	103	618	309	0	309	309	206	0	206	412
7	29	203	87	0	87	116	58	0	58	145
8	7	56	21	0	21	35	14	0	14	42
9	2	18	6	0	6	12	4	0	4	14
TOTAL	8760	17424	26280	10733	15547	1877	17520	4780	12740	4684
Annual throughput = 34000 tons			Berth utilization = $\frac{15547 + 1877}{26280}$ = 66.3%				Berth utilization = $\frac{12740 + 4684}{17520}$ = 99.5%			
			Ships waiting time = $\frac{1877}{17424}$ = 10.8%				Ships waiting time = $\frac{4684}{17424}$ = 26.9%			

* Occupied by ships that did not first have to wait for a berth.

TABLE 3

SHIP CONGESTION ANALYSIS - GRAND CAYMAN - YEAR 1975 (Case A)

PROJECTED SHIP ARRIVALS = 304. Average Turnaround Time = 98.4 hrs. Average Ships Present = 3.41.

PROBABLE SHIP DISTRIBUTION			WHEN PORT HAS THREE BERTHS				WHEN PORT HAS TWO BERTHS			
"n" Ships in Port at same time	Hours "n" Ships are in port	Berth-hours required	Berth-hours available	Hours when Berths are vacant	Hours when Berths are occupied*	Hours when Ships wait for Berth	Berth-hours available	Hours when Berths are vacant	Hours when Berths are occupied*	Hours when Ships wait for a Berth
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(4a)	(5a)	(6a)	(7a)
0	287	0								
1	984	984								
2	1679	3358								
3	1912	5736								
4	1633	6532								
5	1115	5575								
6	634	3804								
7	310	2170								
8	132	1056								
9	50	450								
10	17	170								
11	5	55								
12	2	24								
TOTAL	8760	29914								

This case is infeasible because average berth occupancy would be $\frac{304 \times 98.4}{8760 \times 3}$ = approximately 114%. At the projected cargo-handling rate the capacity of the port is 8760 x 3 x 2.07 = 54,400 tons. Probably the handling rate could be improved under existing conditions to handle 62,000 tons.

Annual throughput = 62000 tons	Berth utilization =	Berth utilization =
	Ships waiting time =	Ships waiting time =

* Occupied by ships that did not first have to wait for a berth.

TABLE 4

SHIP CONGESTION ANALYSIS - GRAND CAYMAN - YEAR 1975 (Case A-1)

PROJECTED SHIP ARRIVALS = 304 Average Turnaround Time = 86.4 hrs. Average Ships Present = 3.0

PROBABLE SHIP DISTRIBUTION			WHEN PORT HAS THREE BERTHS				WHEN PORT HAS TWO BERTHS			
"n" Ships in Port at same time (1)	Hours "n" Ships are in port (2)	Berth-hours required (3)	Berth-hours available (4)	Hours when Berths are vacant (5)	Hours when Berths are occupied* (6)	Hours when Ships wait for Berth (7)	Berth-hours available (4a)	Hours when Berths are vacant (5a)	Hours when Berths are occupied* (6a)	Hours when Ships wait for a Berth (7a)
0	436	0	1308	1308	0	0				
1	1308	1308	3924	2616	1308	0				
2	1962	3924	5886	1962	3924	0				
3	1963	5889	5889	0	5889	0				
4	1473	5893	4419	0	4419	1474	Could not be served by only two berths.			
5	883	4415	2649	0	2649	1766				
6	442	2652	1326	0	1326	1326				
7	189	1323	567	0	567	756				
8	71	568	213	0	213	355				
9	24	216	72	0	72	144				
10	7	70	21	0	21	49				
11	2	22	6	0	6	16				
TOTAL	8760	26280	26280	5886	20394	5886				

Annual throughput = 62,000 tons can be served if turnaround is improved (reduced) to 8760/304 = 86.4 hours.

Berth utilization = $\frac{5886 + 20394}{26280}$ = 100%

Berth utilization = $\frac{5886}{26280}$ = 22.4%

Berth utilization =

Berth utilization =

* Occupied by ships that did not first have to wait for a berth.

TABLE 5

SHIP CONGESTION ANALYSIS - GRAND CAYMAN YEAR 1980 (Case A)

PROJECTED SHIP ARRIVALS = 318. Average Turnaround Time = 23.4 hrs. Average Ships Present = 0.85

PROBABLE SHIP DISTRIBUTION			WHEN PORT HAS THREE BERTHS				WHEN PORT HAS TWO BERTHS			
"n" Ships in Port at same time	Hours "n" Ships are in port	Berth-hours re-quired	Berth-hours avail-able	Hours when Berths are vacant	Hours when Berths are occu-pied*	Hours when Ships wait for Berth	Berth-hours avail-able	Hours when Berths are vacant	Hours when Berths are occu-pied*	Hours when ships wait for a Berth
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(4a)	(5a)	(6a)	(7a)
0	3746	0	11238	11238	0	0	7492	7492	0	0
1	3182	3182	9546	6364	3182	0	6364	3182	3182	0
2	1352	2704	4056	1352	2704	0	2704	0	2704	0
3	383	1149	1149	0	1149	0	766	0	766	383
4	81	324	243	0	243	81	162	0	162	162
5	14	70	42	0	42	28	28	0	28	42
6	2	12	6	0	6	6	4	0	4	8
7										
8										
9										
TOTAL	8760	7441	26280	18954	7326	115	17520	10674	6846	595
Annual throughput = 101,000 tons			Berth utilization $= \frac{7326 + 115}{26280} = 28.3\%$				Berth utilization $= \frac{6846 + 595}{17520} = 42.5\%$			
			Ships waiting time $= \frac{115}{7441} = 1.55\%$				Ships waiting time $= \frac{595}{7441} = 8.0\%$			

* Occupied by ships that did not first have to wait for a berth.

TABLE 6

SHIP CONGESTION ANALYSIS - GRAND CAYMAN - YEAR 1985 (Case A)

PROJECTED SHIP ARRIVALS - 425. Average Turnaround Time - 16.7 hrs. Average Ships Present - 0.81

PROBABLE SHIP DISTRIBUTION			WHEN PORT HAS THREE BERTHS				WHEN PORT HAS TWO BERTHS			
"n" Ships in Port at same time	Hours "n" Ships are in port	Berth-hours required	Berth-hours available	Hours when Berths are vacant	Hours when Berths are occupied*	Hours when ships wait for Berth	Berth-hours available	Hours when Berths are available	Hours when Berths are occupied*	Hours when Ships wait for a Berth
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(4a)	(5a)	(6a)	(7a)
0	3896	0	11688	11688	0	0	7792	3792	0	0
1	3157	3157	9471	6314	3157	0	6314	3157	3157	0
2	1279	2558	3837	1279	2558	0	2558	0	2558	0
3	345	1035	1035	0	1035	0	690	0	690	345
4	70	280	210	0	210	70	140	0	140	140
5	11	55	33	0	33	22	22	0	22	33
6	2	12	6	0	6	6	4	0	4	8
7										
8										
9										
TOTAL	8760	7097	26280	19281	6999	98	17520	10949	6571	526
Annual throughput = 142,000 tons			Berth utilization = $\frac{6999 + 98}{26280}$ = 27.0%				Berth utilization = $\frac{6571 + 526}{17520}$ = 40.5%			
			Ships waiting time = $\frac{98}{7097}$ = 1.4%				Ships waiting time = $\frac{526}{7097}$ = 7.4%			

* Occupied by ships that did not first have to wait for a berth.

TABLE 7

SHIP CONGESTION ANALYSIS - GRAND CAYMAN - YEAR 1990 (Case A)

PROJECTED SHIP ARRIVALS = 501.			Average Turnaround Time = 11.9 hrs.				Average Ships Present = 0.68.			
PROBABLE SHIP DISTRIBUTION			WHEN PORT HAS THREE BERTHS				WHEN PORT HAS TWO BERTHS			
"n" Ships in Port at same time	Hours "n" Ships are in port	Berth-hours required	Berth-hours available	Hours when Berths are vacant	Hours when Berths are occupied*	Hours when ships wait for Berth	Berth-hours available	Hours when Berths are vacant	Hours when Berths are occupied*	Hours when ships wait for a Berth
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(4a)	(5a)	(6a)	(7a)
0	4436	0	13308	13308	0	0	8872	8872	0	0
1	3018	3018	9054	6036	3018	0	6036	3018	3018	0
2	1027	2054	3081	1027	2054	0	2054	0	2054	0
3	233	699	699	0	699	0	466	0	466	233
4	40	160	120	0	120	40	80	0	80	80
5	5	25	15	0	15	10	10	0	10	15
6	1	6	3	0	3	3	2	0	2	4
7										
8										
9										
TOTAL	8760	5962	26280	20371	5909	53	17520	11890	5630	332
Annual throughput = 176,000 tons			Berth utilization = $\frac{5909 + 53}{26280}$ = 22.7%				Berth utilization = $\frac{5630 + 332}{17520}$ = 34.0%			
			Ships waiting time = $\frac{53}{5962}$ = 0.9%				Ships waiting time = $\frac{332}{5962}$ = 5.6%			

* Occupied by ships that did not first have to wait for a berth.

TABLE 8

SHIP CONGESTION ANALYSIS - GRAND CAYMAN - YEAR 1976 (Case B)

PROJECTED SHIP ARRIVALS = 203.	Average Turnaround Time = 30.6 hrs.	Average Ships Present = .70

PROBABLE SHIP DISTRIBUTION			WHEN PORT HAS THREE BERTHS				WHEN PORT HAS TWO BERTHS			
"n" Ships in Port at same time	Hours "n" Ships are in port	Berth-hours required	Berth-hours available	Hours when Berths are vacant	Hours when Berths are occupied*	Hours when ships wait for Berth	Berth-hours available	Hours when Berths are vacant	Hours when Berths are occupied*	Hours when ships wait for a Berth
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(4a)	(5a)	(6a)	(7a)
0	4316	0	12948	12948	0	0	8632	8632	0	0
1	3055	3055	9165	6110	3055	0	6110	3055	3055	0
2	1082	2164	3246	1082	2164	0	2164	0	2164	0
3	255	765	765	0	765	0	510	0	510	255
4	45	180	135	0	135	45	90	0	90	90
5	6	30	18	0	18	12	12	0	12	18
6	1	6	3	0	3	3	2	0	2	4
7										
8										
9										
TOTAL	8760	6200	26280	20140	6140	60	17520	11687	5833	367

62,000 tons/yr. 305.5 tons/ship 10 tons/ship-hour from Table 1.	Berth utilization =	Berth utilization =
	Ships waiting time = 60 hours	Ships waiting time = 367 hours

* By ships not first waiting for a berth.

TABLE 9

SHIP CONGESTION ANALYSIS - GRAND CAYMAN - YEAR 1980 (Case B)

PROJECTED SHIP ARRIVALS = 195		Average Turnaround time = 23.4 hrs.				Average Ships Present = 0.52			
PROBABLE SHIP DISTRIBUTION			WHEN PORT HAS THREE BERTHS				WHEN PORT HAS TWO BERTHS			
"n" Ships in Port at same time	Hours "n" Ships are in port	Berth-hours required	Berth-hours available	Hours when Berths are vacant	Hours when Berths are occupied*	Hours when Ships wait for Berth	Berth-hours available	Hours when Berths are vacant	Hours when Berths are occupied*	Hours when Ships wait for a Berth
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(4a)	(5a)	(6a)	(7a)
0	5206	0	15618	15618	0	0	10412	10412	0	0
1	2709	2709	8127	5418	2709	0	5418	2709	2709	0
2	705	1410	2115	705	1410	0	1410	0	1410	0
3	122	366	366	0	366	0	244	0	244	122
4	16	64	48	0	48	16	32	0	32	32
5	2	10	6	0	6	0	4	0	4	6
6										
7										
8										
9										
TOTAL	8760	4559	26280	21741	4539	20	17520	13121	4399	160
62,000 tons annually 317.9 tons per ship 13.6 tons per ship-hour from Table 1			Berth utilization =				Berth utilization =			
			Ships waiting time = 20 hours				Ships waiting time = 160 hours			

* By ships not first having to wait for a berth.

TABLE 10

SHIP CONGESTION ANALYSIS - GRAND CAYMAN - YEAR 1985 (Case B)

PROJECTED SHIP ARRIVALS = 186.			Average Turnaround Time = 16.7 hrs.				Average Ships Present = 0.35			
PROBABLE SHIP DISTRIBUTION			WHEN PORT HAS THREE BERTHS				WHEN PORT HAS TWO BERTHS			
"n" Ships in Port at same time	Hours "n" Ships are in Port	Berth-hours required	Berth-hours available	Hours when Berths are vacant	Hours when Berths are occupied*	Hours when Ships wait for Berth	Berth-hours available	Hours when Berths are vacant	Hours when Berths are occupied*	Hours when ships wait for a Berth
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(4a)	(5a)	(6a)	(7a)
0	6149	0	18447	18447	0	0	12298	12298	0	0
1	2176	2176	6528	4352	2176	0	4352	2176	2176	0
2	385	770	1155	385	770	0	770	0	770	0
3	46	138	138	0	138	0	92	0	92	46
4	4	16	12	0	12	4	8	0	8	8
5										
6										
7										
8										
9										
TOTAL	8760	3100	26280	23184	3096	4	17520	14474	3046	54
62,000 tons/yr. 334.1 tons/ship 20.0 tons/ship-hour from Table 1			Berth utilization =				Berth utilization =			
			Ships waiting time = 4 hours				Ships waiting time = 54 hours			

*By ships not first having to wait for a berth.

TABLE 11

SHIP CONGESTION ANALYSIS - GRAND CAYMAN - YEAR 1990 (Case B)

PROJECTED SHIP ARRIVALS = 177.			Average Turnaround time = 11.9 hrs.				Average Ships Present = 0.24			
PROBABLE SHIP DISTRIBUTION			WHEN PORT HAS THREE BERTHS				WHEN PORT HAS TWO BERTHS			
"n" Ships in Port at same time	Hours "n" Ships are in port	Berth-hours required	Berth-hours available	Hours when Berths are vacant	Hours when Berths are occupied*	Hours when Ships wait for Berth	Berth-hours available	Hours when Berths are vacant	Hours when Berths are occupied*	Hours when Ships wait for a Berth
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(4a)	(5a)	(6a)	(7a)
0	6885	0	20658	20658	0	0	13772	13772	0	0
1	1657	1657	4971	3314	1657	0	3314	1657	1657	0
2	200	400	600	200	400	0	400	0	400	0
3	16	48	48	0	48	0	32	0	32	16
4	1	4	3	0	1	1	2	0	2	2
5										
6										
7										
8										
9										
TOTAL	8760	2109	26280	24172	2106	1	17520	15429	2091	18
62,000 tons/yr. 351.2 tons/ship 29.4 tons/ship-hour from Table 1.			Berth utilization =				Berth utilization =			
			Ships waiting time = 1 hour				Ships waiting time = 18 hours			

* By ships not having first to wait for a berth.

Notes to Tables 2 - 11, inclusive

Source:

Column (2) Computed from Poisson formula $8760\left(\frac{a^n e^{-a}}{\underline{n}}\right)$, in which n = number of ships present at any time; a = average number present during the year; e = 2.71828 the base of Naperian logarithms.

Column (3) Column (2) x Column (1).

Column (4) Column (2) x number of berths available, i.e. 3. (assessing the new port will provide three berths, one roll-on/roll-off berth and two general cargo berths.)

Column (5) Column (4) minus Column (3).

Column (6) The lesser of Column (3) or Column (4).

Column (7) Column (3) minus Column (4).

Columns 4a, 5a, 6a, and 7a based on there being only two berths available.

TABLE 12

VALUE OF REDUCED SHIP TIME IN PORT
(Based on 62,000 tons annual throughput in 1975 is maximum capacity under existing conditions).

YEAR	Ships Time waiting for a Berth to handle 62,000 tons under existing conditions (hours)	Ships Time waiting for a Berth if New Port has Three Berths (hours)	Ships Time waiting for a Berth if New Port has Two Berths (hours)	Value of Ships Time in Port (CI Dollars per hour)	Cost Saving attributed to New Port having Three Berths (CI$000)	Cost Saving Attributed to New Port having Two Berths (CI$000)
	(1)	(2)	(3)	(4)	(5)	(6)
1975	5886	-	-	35.8	0	0
6	5886	60	367	53.6	312.3	295.8
7	5886	46	298	54.2	316.5	302.9
8	5886	35	242	54.7	320.0	308.7
9	5886	26	197	55.3	324.0	314.6
1980	5886	20	160	55.8	310.6	319.5
1	5886	14	129	56.4	331.2	324.7
2	5886	11	104	56.9	334.3	329.0
3	5886	8	83	57.5	338.0	333.7
4	5886	6	67	58.1	341.6	336.1
1985	5886	4	54	58.7	345.3	342.3
6	5886	3	43	59.3	348.9	346.5
7	5886	2	35	59.8	351.9	349.9
8	5886	2	28	60.4	355.4	353.8
9	5886	1	22	61.0	359.0	357.7
1990	5886	1	18	61.7	363.1	362.1
					5,052.1	4,652.8

Notes to Table 12

(1) From Table 4.

(2) From Tables 8, 9 and 10.

(3) From Tables 8, 9 and 10.

(4) Based on 1972 value cited in Gochenour analysis Table 17, i.e. CI$833 per day at 1972 prices, escalated upward to reflect the larger and more expensive ships in subsequent years at the rate of one percent annually except for a rise of 50 percent in 1976 the first year following completion of new port facilities (See also Note (2) of Table 1).

(5) Column (1) less Column (2) x Column (4).

(6) Column (1) less Column (3) x Column (4).

SECTION III

Based upon reported actual operating costs in 1972, and on estimated future operating costs, the probable operating-cost-savings attributable to new port facilities are deduced and presented.

ANALYSIS OF PORT OPERATING COST FOR THE PROPOSED NEW PORT AT GEORGE TOWN, GRAND CAYMAN

The Gochenour economic evaluation does not identify reduced cost of handling cargo as a benefit attributable to the proposed new port facilities. Instead, the summary of port costs includes the estimated cost for labour to operate the new port which is additional to the cost of operating the old port. The estimate is based upon the reported actual labour cost of CI$135,000 in 1972 and the estimated future labour cost of CI$229,000, an increase of CI$94,000 a year which has been applied to each year from 1976 onward without regard to the amount of cargo handled. It is not correct to assume that port operating costs will be constant.

Validity of the estimated annual labour cost for operating the new port (CI$229,000) is certainly open to question, as is the estimate of additional cost of operating port equipment (CI$3,400). The cost of operating existing equipment is given as CI$60,080, and this implies an annual operating cost for fuel and maintenance of CI$3,928 at the same ratio used to estimate similar costs for the additional equipment. Thus, the stated estimate of labour cost plus the implied equipment cost indicate an annual cost for labour and equipment operation in the amount of CI$229,000 plus $3,400 plus $13,928 = CI$236,328, which is presumed to be applicable to year 1976, the first year after new port facilities would be completed.

Port operating cost should be expected to trend upward due to increasing unit costs of labour, materials and fuel and due to increasing volumes of cargo. However, within the capacity of the new port facilities, the rate of increase of port operating cost should be distinctly less than the rate of growth of cargo throughput. Annual increase in the amount of two percent may be a reasonable expectation, which would account for an increase from CI$236,328 in 1976 to CI$311,830 in 1990, representing unit costs per ton of cargo equal to CI$3.46 in 1976, and of $1.77 in 1990. The operating cost per ton of cargo handled by existing facilities in 1972 was apparently CI$135,000 plus

$3928 divided by 34,000 tons, which amounts to CI$4.09. The difference in cost-per-ton of operating cost in 1972, compared with years subsequent to the completion of new port facilities, is an economic benefit directly attributable to the new port. The evaluation of the reduced port operating cost for the period 1972 to 1990 is presented in Table 13, based upon the following assumptions:

(1) The existing labour cost and implied existing equipment operating costs given in the Gochenour evaluation are valid.

(2) The estimated future labour and equipment operating costs given in the Gochenour evaluation are valid for the first year following completion of new facilities (1976) and should be escalated at two percent to year 1990.

(3) The estimated future volumes of cargo given in the Gochenour evaluation are valid.

TABLE 13

Year	Projected Annual Throughput (long tons)	Projected Port Operating Cost (CI$)	Projected Port Operating Cost per Ton of Throughput (CI$)	Port Operating Costs Saving per ton throughput (CI$)	Port Operating Cost-Saving (CI$)
	(1)	(2)	(3)	(4)	(5)
1972	34,000	138,928	4.09		
1976	68,356	236,328	3.46	0.63	43,064
7	75,364	241,054	3.20	0.89	67,074
8	83,090	245,876	2.96	1.13	93,892
9	91,608	250,793	2.74	1.35	123,671
1980	101,000	255,809	2.53	1.56	157,560
1	108,122	260,925	2.41	1.68	181,645
2	115,747	266,144	2.30	1.75	202,557
3	123,908	271,467	2.19	1.90	235,425
4	132,646	276,896	2.09	2.00	265,392
1985	142,000	282,434	1.99	2.10	298,200
6	148,299	288,083	1.94	2.15	318,843
7	154,731	293,844	1.90	2.19	338,861
8	161,519	299,721	1.86	2.23	360,187
9	168,604	305,715	1.81	2.28	384,417
1990	176,000	311,830	1.77	2.32	408,320
					3,479,108

SECTION IV

The future costs are identified and are compared with identified future benefits that are attributable to the proposed new port facilities. All costs and benefits are discounted to present worth and conclusions are presented concerning viability of the project.

BENEFIT-COST COMPARISON
PROPOSED NEW PORT AT GEORGE TOWN, CAYMAN ISLANDS

Costs

The new construction, new equipment, and port operating costs are summarized in Table 14. This summary differs from the Gochenour evaluation in two principal respects:

(1) the entire estimated cost of labour and equipment to operate the port is included and escalated to reflect increasing cost with increasing volumes of cargo, whereas the Gochenour evaluation included only part of the operating cost, a constant annual amount representing estimated labour cost in addition to port pre-improvement; and

(2) the stream of costs is extended to cover a term of thirty years beginning with the year following completion of new port facilities. The total cost at year 1990 reaches about CI$4.4 million versus about CI$2.9 million in the Gochenour evaluation. [See Gochenour Table 25, Column (6)].

Benefits

Benefits or cost-savings attributable to the new port facilities are summarized in Table 15. Included are the cost-savings due to: (1) reduced ship time at port; (2) improved Customs administration; (3) reduced theft and breakage; and (4) more efficient handling of cargo. Items (3) and (4) were not included in the Gochenour evaluation. One category of cost-savings in the Gochenour evaluation, the avoidance of future air freight, has been excluded. Another difference in the two evaluations is the extension of the stream of benefits to cover a term of thirty years beginning with the year following completion of new port facilities. The total of benefits accruing to the new port at year 1990 is about CI$14.7

million versus about CI$19.4 million in the Gochenour evaluation. /See Gochenour Table 25, Column (3)_7.

Omitting the "avoidance of future air freight" benefit is suggested as it is susceptible to controversy because there would be various other alternative ways that the traffic in excess of present port capacity might be less costly than air freight. A less controversial manner of evaluating the benefit of the excess capacity of the new port versus the old port may be accomplished in fact by comparing the respective cargo handling costs (port operating costs) which has been done and is shown in Column (5) of Table 13. Similarly, a part of the benefit of a port having adequate capacity versus one having inadequate facilities is found in the reduction of ships time at port. This has been done only to the extent of reduced ships time in port up to the capacity of the old port and is shown in Column (1) of Table 12. Instead of the constant amount of ships waiting time from year 1975 onward, it would be legitimate to show the increasing amounts of ship waiting time that would be involved if the existing port were considered capable of putting through the progressively larger quantities of cargo, but at the existing levels of port performance (i.e. existing ships turnaround time). This portion of the ships-time-in-port saving has been omitted because it too is susceptible to controversy. However, if it should be deemed necessary or advisable to demonstrate additional benefits than are reflected in Table 15 it is suggested that the ships time saving concept is more tenable than the air freight concept.

Benefits-Costs Comparison

The benefits and the costs are compared in Table 16 where the annual differences in the streams of benefits and costs are shown and are discounted to the beginning of the first year after new facilities are completed, at various discount rates, 10%, 20%, 30% and 40%, over terms of 15 years and 30 years.

It is apparent, that even with some possibly justifiable benefits omitted, the project shows an internal rate of return of about 32% at 15 years or of 34% at 30 years. The amount of net benefit discounted at the indicated rates over either 15 years or 30 years are tabulated in CI$1,000 at 1972 prices:

Discount Rate	0%	10%	20%	30%	40%
15-yr. term	8,885	3,242	1,184	173	-369
30-yr. term	23,591	5,027	1,482	236	-353

and the approximate discounted benefit-cost ratios are as follows:

Discount Rate	0%	10%	20%	30%	40%
15-yr. term	2.54	1.90	1.37	1.05	0.87
30-yr. term	3.17	2.00	1.41	1.10	0.87

TABLE 14

SUMMARY OF PORT COSTS AFTER NEW PORT IS COMPLETED
(In CI$1,000 at 1972 Prices).

Year	Cost of New Port Infrastructure		Cost of Port Equipment	Annual Port Operating Cost	Total, Capital Costs and Operating Costs
	Capital Cost	Maintenance Cost			
	(1)	(2)	(3)	(4)	(5)
1974	639			139	778
1975	319		52	139	510
6		9.6		236	245.6
7		9.6		241	250.6
8		9.6		246	255.6
9		9.6		251	260.6
1980		19.6		256	275.6
1		19.6	52	261	332.6
2		19.6		266	285.6
3		19.6		271	290.6
4		19.6		277	296.6
1985		28.6		282	310.6
6		28.6		288	316.6
7		28.6	52	294	374.6
8		28.6		300	328.6
9		28.6		306	334.6
1990		28.6		312	340.6
Sub-total	958	308	156	4365	5787
1991-2005	0	15 @ 28.6 = 429	0	15 @ 312 = 4680	15 @ 340.6 = 5109
TOTAL	958	737	156	9045	10896

Notes to Table 14

Source:

(1) From Gochenour evaluation, Table 24.

(2) From Gochenour evaluation, Table 24.

(3) From Gochenour evaluation, Table 24.

(4) From Plumlee analysis, Table 13.

TABLE 15

SUMMARY OF BENEFITS ACCRUING TO THE NEW PORT
(In CI$1,000 at 1972 Prices).

Year	Cost-Saving Due to Reduced Ships Time in Port	Cost-Saving Due to Improved Customs Administration	Cost-Saving Due to Reduced Theft and Breakage	Cost-Savings Due to more Efficient Port Operations	Total Direct Benefits Attributable to Investment in New Port Facilities
	(1)	(2)	(3)	(4)	(5)
1974	0	0	0	0	
1975	0	82	0	0	82
6	312	177	68	43	600
7	317	191	75	67	650
8	320	207	83	94	704
9	324	223	92	124	763
1980	310	241	101	158	810
1	331	254	108	182	875
2	334	268	116	203	921
3	338	283	124	235	980
4	342	299	133	265	1039
1985	345	315	142	298	1100
6	349	326	148	319	1142
7	352	338	155	339	1184
8	355	350	162	360	1227
9	359	362	169	384	1274
1990	363	374	176	408	1321
Sub-total	5051	4290	1852	3479	14672
1991-2005	15 @ 363 = 5445	15 @ 374 = 5610	15 @ 176 = 2640	15 @ 408 = 6120	15 @ 1321 = 19815
TOTAL	10496	9900	4492	9599	34487

Notes to Table 15

Source:

(1) From Plumlee analysis Table 12 Column (5), extended from year 1990 to year 2005 at level rate.

(2) From Gochenour evaluation, Table 23, Column (2), extended from year 1990 to year 2005 at level rate.

(3) From Plumlee analysis, a judgement figure representing one CI$ per ton of cargo, see Table 13, Column (1).

(4) From Plumlee analysis, Table 13, Column (5).

TABLE 16

BENEFIT-COST COMPARISON
PROPOSED NEW PORT AT GEORGE TOWN, CAYMAN ISLANDS
(In CI$1,000 at 1972 Prices)

Year	Annual Benefits	Annual Costs	Net Benefits Discounted to January 1976				
			0%	10%	20%	30%	40%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1974	0	778	-778	-856	-934	-1011	-1089
1975	82	510	-428	-428	-428	-428	-428
6	600	245.6	354.4	322	295	273	253
7	650	250.6	399.4	330	277	236	204
8	704	255.6	448.4	337	259	204	163
9	763	260.6	502.4	343	242	176	131
1980	810	275.6	534.4	332	215	144	99
1	875	332.6	542.4	306	182	112	72
2	921	285.6	635.4	326	222	101	60
3	980	290.6	689.4	322	160	85	47
4	1039	296.6	742.4	315	144	70	36
1985	1100	310.6	789.4	304	127	57	27
6	1142	316.6	825.4	289	111	46	20
7	1184	374.6	809.4	258	91	35	14
8	1227	328.6	898.4	260	84	30	10
9	1274	334.6	939.4	247	73	24	7
1990	1321	340.6	980.4	235	64	19	5
Sub-total	14672	5787	8885	+3242	+1184	+173	-369
1991 - 2005	15 yrs @ 1321 = 19815	15 yrs @ 340.6 = 5109	15 yrs @ 980.4 = 14706	1785	298	63	16
TOTAL	34,487	10,896	23,591	+5027	+1482	+236	-353

Notes to Table 16

Source:

(1) Plumlee analysis, Table 15, Column 5.

(2) Plumlee analysis, Table 14, Column 5.

(3) Column (1) minus Column (2).

APPENDIX "A"

Carl H. Plumlee's notes with reference to Joel G. Gochenour's economic evaluation of the proposed new port at George Town, Grand Cayman, as contained in Enclosure "A" of his progress report for the quarter ending 25 August 1973. (The notes were intended for reference during oral discussion with Mr. Gochenour, or for preparing correspondence with respect to the economic evaluation if a meeting were not to be possible).

CARL H. PLUMLEE'S COMMENTS ON ENCLOSURE A
TO JOEL G. GOCHENOUR'S PROGRESS REPORT
FOR THE QUARTER ENDING 25 AUGUST 1973

These are notes intended for reference purposes when preparing possible future communications to Mr. Gochenour or the Government of the Cayman Islands.

The papers bound as Enclosure A, "Economic Evaluation of the Proposed New Port at George Town on Grand Cayman", comprise four separate sections, each having its pages numbered serially. In these notes a roman numeral prefix is added to page numbers according to the following schedule:

ECONOMIC BACKGROUND	(I)	pages 1 - 4
THE PRESENT PORT AND THE PROPOSED NEW PORT	(II)	pages 1 - 4
ECONOMIC EVALUATION	(III)	pages 1 - 10
FINANCES	(IV)	pages 1 - 2

Enclosure A includes two charts, No.1 and No.2, and 31 tables.

Tables 1 - 11 inclusive suport Sections I & II.

Tables 12 - 25 inclusive support Section III.

Tables 26-31 support Section IV.

Table 1 - Projected Growth of the Economy

The estimated growth in population by five-year increments (six years in first step) as shown in the fourth columr from the right margin represents the following annual growth rates:

1969 - 1975	5.8%
1975 - 1980	2.4%
1980 - 1985	2.1%
1985 - 1990	1.00%

It seems to me that the projected increases in total population may be questionable. I would expect a higher correlation between population growth rate and the per capita GDP growth rate.

Page (I) 4. Projected Future Imports

1972	34,000 tons	
1980	101,000 tons	14.6% annual growth
1990	176,000 tons	5.7% annual growth

Seems reasonable.

Table 12 - Time Loss Due to Lack of Ship Berths

The analysis of ships time at port is done in a manner that is difficult to follow due to an obscure definition of "normal ship working hours". I feel the conclusion reached regarding the percentage of "normal ship working hours" (17%) lost due to lack of berth space may be open to question. I analyzed the ship and cargo traffic personally in great detail, working from a complete photo-copy of the port register showing the name of each ship, date and hour of arrival, of berthing, of completing cargo handling, and of departure, the type of cargo, and tonnages of cargo for the period 14 December 1971 through 31 December 1972. The result of analysis was conveyed to Grand Cayman by our letter TEC 323/1(152-1-73-19) on 19 January 1973. Deleting the 17 days of December 1971, the net 1972 traffic in my analysis agrees essentially with that shown in Table 12 with respect to the number of ship visits, total ship time at port, and the amount of cargo handled. Actual comparison is as follows:

	Plumlee Analysis	Gochenour Analysis
Number of Ships	173	172
Total ship-hours in port	16,353 hrs.	16,994 hrs.
Tons cargo handled	34,038 long tons (38,120 short tons)	34,100 long tons
Ships delay awaiting berth	2,818 hrs.	not shown
Ship departure delays after completing cargo	1,166 hrs	
Total Ship delays	3,984 hrs.	
Ship delays % total ship time	24.4%	
Ship delays % "normal work time"	not shown	17%

Page (I) 4. Projected Future Imports

The projected future volume of import tonnage:

		annual rate of increase
Actual 1972	34,000 long tons	
1975	62,000 " "	22.2%
1980	101,000 " "	10.3%
1985	142,000 " "	7.1%
1990	176,000 " "	4.3%

is a drastic increase from the last previous study, the one I reviewed in December 1972. At that time I expressed the opinion that the projected 41,000 long tons of traffic by 1985 was probably too low and that a volume of 150,000 long tons by 1985 would not be surprising. I made the specific recommendation that the probable future volume of cargo should be carefully assessed by competent economists (which apparently has been done). I also made the specific recommendation that the economic viability of the proposed port development at Prospect Point should be re-examined by competent engineers and economists taking into account the best judgement about the future volume of cargo and the estimates of construction cost. (There is no evidence here that such has been done).

The analyst seems to assume there will be no outbound cargo movements at all. This is not realistic in my opinion. How much cargo will move between Grand Cayman and the other Cayman Islands? How will empty containers leave Grand Cayman? whether they contain cargo or not, they comprise outbound shipping, and require port facilities.

Page (I) 2. "The Present Port and the Proposed New Port at George Town".

The statement that the roll-on/roll-off containers off-loaded at the "very primitive berth" are "stacked two high in the open space surrounding the berth" is surprising. It was my impression last December, that the containers handled at this berth were on their own wheels, i.e. container trailers, but of course I may be mistaken.

Page (III) 3. Estimated Capacity of Present Port

Table 15 includes estimates of present port capacity and of future new port capacity. New port capacity is shown to be 25,000 tons per ship berth per year for general cargo and 50,000 tons per year per ship berth for roll-on/roll-off container cargo. The source of new port capacity is given as Wallace Evans, Consulting Engineers. The indicated capacity for a roll-on/roll-off container berth is entirely too low in my opinion.

Economic Evaluation

Page (III) 2. Choices

Alternative solutions are identified in four classes. The simple statement is made that each class of solution except number one, has been considered and rejected as being economically impractical. Yet none of the evidence is presented. If such analyses were made it would be pertinent to show the comparative results.

Page (III) 3. Assumptions

The assumption that only import cargo movements should be considered is highly questionable. Even though import cargo will comprise the most important facet of the shipping, recognition should be given and appropriate estimates should be made of:

(1) inter-island traffic between Grand Cayman and other Cayman Islands; and

(2) outbound movement of the incoming containers whether containing cargo or not.

The projected volumes of cargo to be handled through the port of George Town is segregated into All Imports and Cement and Lumber. The inference is that the petroleum fuel would be handled through the new port facilities. The amount of liquid petroleum fuel should be shown separately as it can be handled without a ship's berth in the new harbour. If the total cargo estimates do in fact include estimates of liquid petroleum susceptible of pumping through submarine pipeline,

then the planned capacity of new berthing facilities is in excess of the requirements. How much? I would expect $\frac{1}{4}$ to 1/3 of total cargo would be liquid petroleum fuel.

Page (III) 3. "Compulsory Use of New Government Port"

Here it is revealed that petroleum is not expected to move through the new port facility - however, it does not reveal whether the total estimate of traffic includes or excludes the estimated petroleum cargo.

Page (III) 3. Loan Limitation

It is inferred that either (a) previous feasibility study has found the maximum justifiable investment in new port facilities is one million US dollars, or (b) that this limit has been set arbitrarily.

Page (III) 4. Economic Life of the New Port

The logic stated for selecting 17-year economic life is not entirely valid. However, any term can be used if proper salvage values are assigned. In this case the capital facilities will have many years life remaining at the end of 17 years.

Page (III) 4. Cost Saving and Benefits

An important cost-saving is omitted. The reduced cost of handling cargo through the port. The present cost per ton should have been ascertained or estimated and compared with the cost per ton that will result from the new facilities. There will be a significant reduction in cost per ton, which applied to the increasing volumes of cargo, year by year, will "generate" important operating cost savings attributable to the new investment. (If this were not found to be the case - the viability of the project would immediately be suspect).

A further saving would result from decreasing the extent that theft and breakage is a present loss. This benefit is akin to the savings in import duty revenue presently lost. Both categories, import duty saved and reductions of pilferage should be evaluated and credited as benefits to the new investment.

Page (III) 6. Loss of Ship Waiting Time Due to Lack of Berth Space

The presentation of ships' time lost due to waiting for a berth seems to imply that there would be none lost for that reason after

new facilities are provided. However, this is not a valid basis for estimating the value of benefits accruing to new facilities. Regardless of the new facilities, ships will continue to arrive at random and thus there will be occasions when the number of ships at port exceeds the berthing and cargo-handling capacity. (This is a proper economic situation. The port should not have berthing capacity to serve the peaks of ship congestion).

(The amount of ships time lost waiting for a berth during 1972, as shown here, seems to be substantially less than I recall from my own alalysis. I must check my source documents on this point).

Nothing is mentioned about the amount of time lost due to adverse waves and swells and one might suspect that time lost for this cause may be included under the category labelled "waiting time due to lack of a berth". If such should be the case, the amount of time lost due to adverse seas and swells should be treated separately in comparing the existing conditions with the proposed future conditions. (The new port facilities will be exposed to the ocean seas and swells as is the present port).

Page (III) 8. Cost of Additional Labour to Operate New Port

Use of the word "additional" is misleading, as it may imply that the new port is to be less efficient than the old port in the use of labour. Actually, the reverse must be true, as discussed above, and what should have been demonstrated is the comparison of operating cost per ton of cargo under existing conditions versus the cost per ton of cargo under future new port conditions. The differences in cost per ton, year by year, times the respective volumes of cargo will indicate the value of more efficient port facilities in terms of operating cost.

Similarly estimates should have been made of the loss per ton presently incurred due to theft and breakage, and compared to the loss per ton that may reasonably be expected after new port facilities are provided. This difference in cost per ton, year by year, times the respective volumes of cargo will indicate the savings attributable to the new port facilities.

Table 24 - Summary of New Port Costs

The estimated annual overall maintenance and operating costs year by year to 1990 amount to 28,600 + 3,400 + 94,000 = CI$126,000 which amounts to about 11.3% of the capital invested (CI$1,114,000) which is reasonable.

However, it is not reasonable that the cost of fuel and maintenance of port equipment be estimated to be constant at $3,400 per year, nor is it reasonable that the labour cost of operating the port be estimated at a constant rate of CI$94,000 per year. Both of these costs will depend upon the amount of cargo handled. Thus, the cost of operating the port will rise as the annual throughput of cargo rises, although at a rate somewhat less than by direct proportion. The net result would be a substantial reduction in the present worth of future port operating costs, and thus tending to enhance the attraction of the investment.

Page (III) 7-8. Construction and Operating Costs

The cost of maintaining the new port structures, escalating from initially 1% of capital investment up to 3% is not unreasonable.

The estimated cost of additional equipment is not unreasonable, and the 6-year estimated life is acceptable, although actually should probably be more like ten years.

However, the inventory of present equipment must also be included in estimating future capital costs and future maintenance and operating costs. There should be a schedule of equipment investment that is related to estimated future volumes of cargo. Thus perhaps CI$52,000 may be more than required in 1975 (unless this is partially to replace existing equipment that will reach the end of useful life in 1975), and may be inadequate for the requirement in 1981 and 1987.

The present labour cost is stated to be CI$135,000. At 35,000 tons annual throughput in 1972 this amounts to about CI$3.86 per ton for labour only. The future labour cost in 1990 is estimated to be

CI$229,000 amounting to CI$2.07 per ton on 176,000 tons annual throughput. A significant labour-cost-per-ton reduction should be realized immediately upon completion of new port facilities. Therefore important operating cost savings should be credited as a benefit to the investment in new facilities, as mentioned above.