Table 9-8-2 Cost Breakdown of the Ordinary Construction Works Existing Container Terminal Upgrading

Unit: US$

Work Categories	Unit Rate	Total		Short Term		Long Term		Remarks
		Quantity	Cost	Quantity	Cost	Quantity	Cost	
A.General Works			1,387,500		693,750		693,750	
B.Marine Works								
Seawall Improvement	310$/m	3734m	1,575,540	-	-	3,734m	1,157,540	
Ro-Ro System	575,000$/m	1set	575,000	-	-	1set	575,000	Provisional
			1,732,540		0		1,732,540	
C.On-land Works								
Pavement Repairing	100$/m	1,848m²	-	-	-	-	-	Routine maintenance
Normal Pavement (1)	105.3$/m²	17,600m²	1,853,280	17,600m²	1,853,280	-	-	Area A (10,000m²) Area B (7,600m²)
Normal Pavement (2)	105.3$/m²	32,200m²	3,390,660	-	-	32,200m	3,391,660	Area C (33,200m²)-1,000m²
Storm Water Drainage (1)	53,000$/ha	5.19ha	275,070	11.87ha	99,110	3,32ha	175,960	Area A, Area Band Area C
Pavement Making and Sign	20.2$/m²	4,300m²	86,860	4,300m²	86,860	-	-	11,900 - 7,600 = 4,300
			5,605,70		2,039,250		3,566,620	
D.Building								
Misc. Buildings	570$/m²	500m²	285,000	-	-	500m²	285,000	
Fence	123$/m	200m	24,600	100m	12,300	100m	12,300	
Landscaping	19$/m²	2,300m²	43,700	2,300m²	43,700	-	-	
Park	35$/m²	2,000m²	70,000	1,000m²	35,000	1,000m²	35,000	
			423,300		91,000		332,300	
E.Utilities								
Power Supply (Distribution)	1,020,000$/B	2.1B	2,142,000	0.1B	102,000	2.0B	2,040,000	including pier and mole
Lighting (Yard)	240,000$/B	2.7B	648,000	0.7B	168,000	2.0B	480,000	
Lighting (Road)	24,000$/ha	1.28ha	30,720	0.51ha	12,240	0.77ha	18,480	
Misc. Utilities	-	LS	150,000	-	60,000	-	90,000	
			2,970,720		342,240		2,628,480	
F.Supplemental Works								
Outer Access (Improve) I	34.8$/m²	2,500m²	87,000	2,500m²	87,000	-	-	250m x 20m x 50%
Outer Access (improve) II	34.8$/m²	10,000m²	348,000	-	-	10,000m²	348,000	1000m x 20m x 50%
Demolishing (On-land Civil)	3.0$/m²	32,000m²	96,000	12,000m²	36,000	20,000m²	60,000	
Demolishing (Building)	100$/m²	2,00m²	200,000	200m²	20,000	1,800m²	180,000	
			731,000		143,000		588,000	
Total			12,850,930 (100%)		3,309,240 (32.0%)		9,541,690 (68.0%)	

Note: Outer Access (Improve) I is the required work seawards the existing railway.
Outer Access (Improve) II is the required work between the railway and Colon Free Zone.

ii) Additional cost for the Area "B"

Area "B" = 8,700 m2
It is assumed that 900 m2 of this area will be used for landscaping etc, thus the net area to be paved is 7,600 m2. It is also assumed this area should completely re-paved.

7,600 m2 x 105.3 $/m2 = 800,280 US$

iii) Required cost for the road sign and bay marking paint

The required marking area reducing the other area,

11,900 m2 - 7,600m2 = 4,300m2

Assuming the required unit cost is 20.2 $/m2, the required marking cost will be, 4,300 m2 x 20.2 $/m2 = 86,860 US$

iv) Stormwater drainage

Area 18,700 m2
Assuming the required cost is 75% of those for new one.

The required cost is,

18,700 m2 x 5.3 $/m2 = 99,110 US$

v) Total cost during the Short Term Development

- Additional cost, Area "A"	1,053,000	US$
- Additional cost, Area "B"	800,280	
- Marking cost	86,860	
- Stormwater drainage	99,110	
Total	2,039,250	US$

Addition to these items, routine maintenance work of the existing concrete pavement should be conducted. Required maintenance cost for the pavement is estimated as follows. (Note; This cost will be covered by the operation and maintenance cost.)

Repair cost of the existing concrete pavement

Total area 83,600 m2
Nos. of pavement bays
83,600 / (3.5 x 8.0) = 2,725 bays
Affected bays according to the visual inspection
About 40 bays
Rate of damage
40 / 2,725 = 1.5%

Net damaged bays

Since about 40% of the pavement areas were covered by the container,

40 bays / 0.6 = 66 bays

Assuming the required repair unit cost is 100$/m2, the repair cost will be,

66 bays x (3.5m x 8.0m) x 100$/m2 = 184,800 US$

(2) Long Term Development

i) Pavement cost

Total area 33,200 m2

The required pavement area reducing the coastal area and other area not to be paved,

33,200 - 1,000 = 32,200 m2

This area is partly paved, however it is assumed that completely new pavement should be provided, adjusting the formation and pavement strength. Thus, the required cost will be,

32,000 m2 x 105.3 $/m2 = 3,390,660 US$

Note: 105.3 $/m2 is the required cost for concrete pavement (t=25cm) including the concrete curb and road marking cost.

ii) Stormwater drainage

Total area 33,200 m2

The required cost is,

33,200 m2 x 5.3 $/m2 = 175,960 US$

iii) Total Cost

3,390,660 + 175,960 = 3,566,620 US$

9.8.3 Related Instrument Work for Modernization

Details of related instrument works for modernization of container terminal operation are shown in Table 9-8-3. The required costs for this category amounts to 8.5 million US$ which shares 25.2% of the total initial cost. As shown in the table, costs for computer introduction amounts to 4.5 million US$ which shares about 53.0% of the required cost. Investment will be conducted separately in both stages, Short Term and Long Term.

Related Instrument Works	Total	Short Term 1999	Master Plan 2009
a. Maintenance Instrument	$ 84,000	$ 84,000	0
b. Computer	4,514,000	514,000	4,000,000
c. Container Repair Instrmt	1,131,800	0	1,131,800
d. Electric Power Supply	788,360	0	788,360
e. Others	1,978,206	0	1,978,206
Total	$8,496,366	$598,000	$7,898,366

Note: Basic investment for existing facilities is the Short Term in 1994/1955 and Long Term in 2001/2002, however this instrument work has an independent schedule.

Due to the characteristics of works, periodical renewal should be considered. It is estimated that this renewal will be conducted every five years. Thus, initial cost and periodical cost of works are shown as below.

Table 9-8-3a Summary of Instrument Replacement Cost: Existing Terminal

Unit : 1,000 US$

	Short Term 1999	Long Term 2009	Total Master Plan
Initial Purchase	598.00	7,898.37	8,496.37
Periodical Purchase	598.00	31,592.00	32,190.00
Total	1,196.00	39,490.37	40,686.37
	(2.9%)	(97.1%)	

Table 9-8-3b Cost Breakdown of Related Instrument Works for Modernization of Existing Container Terminal

Unit: US$

	Work Categy	Works	Unit Rate Unit		Works Unit		Cost	Short Term 1999	Long Term 2009
A.	Maintenance Instrument								
	Repar Instrument		LS	48,000	LS	1	48,000	48,000	-
	Movable Repair Shop truck		"	36,000	"	1	36,000	36,000	-
	Sub-Total						84,000	84,000	-
B.	Computer								
	Personal Computer		LS	34,000	LS	1	34,000	34,000	-
	Small Scale Computer System		"	480,000	"	1	480,000	480,000	-
	Total Computer System		"	4,000,000	"	1	4,000,000	-	4,000,000
	Sub-Total						4,514,000	514,000	4,000,000
C.	Container Repair Instrument								
	Work Shop		$/m2	1,042	m2	600	625,200	-	625,200
	Roof Crane (3ton)		$/ea	224,000	ea	2	448,000	-	448,000
	Instrument		LS	3,600	LS	1	3,600	-	3,600
	Others		"	55,000	"	1	55,000	-	55,000
	Sub-Total						1,131,800	-	1,131,800
D.	Electric Power Supply								
	Power House		$/m2	602	m2	180	108,360	-	108,360
	Generator (1,000KVA)		$/ea	320,000	ea	2	640,000	-	640,000
	Others		LS	40,000	LS	1	40,000	-	40,000
	Sub-Total						788,360	-	788,360
E.	Others								
	Terminal Office		$/m2	1,170	m2	1,600	1,872,000	-	1,872,000
	Main Gate		"	567	"	18	10,206	-	10,206
	Truck Scale		$/ea	48,000	ea	2	96,000	-	96,000
	Sub-Total						1,978,206	-	1,978,206
	Total						8,496,366 (100%)	598,000 (7.0%)	7,898,366 (93.0%)

9.8.4 Renewal and Replacement of Cargo Handling Equipment

The required costs for cargo handling equipment renewal and replacement amount to 77.4 million by 2029. Between 1995/2029, 238 sets of various machines should be purchased as shown below.

Wharf crane (Gantry crane)	5	sets	x	8,800,000$/set =	44,000,000 US$
Yard crane (Transfer crane)	6	"	x	1,344,000$/set =	8,064,000 US$
" (") Rep,	11	"	x	1,334,000$/set =	14,784,000 US$
Top-loader	5	"	x	480,000$/set =	2,400,000 US$
Forklift truck (average 4ton)	26	"	x	44,800$/set =	1,164,800 US$
Tractor	70	"	x	62,710$/set =	4,389,700 US$
Chassis	38	"	x	22,400$/set =	851,200 US$
" Rep,	77		x	22,400$/set =	1,724,800 US$
Total	238	sets			77,378,500 US$

Table 9-8-4b shows the annual renewal and replacement cost of equipment for the existing container terminal.
Table 9-8-5 shows the cost breakdown.

Table 9-8-4a Summary of Equipment Renewal and Replacement Cost: Existing Terminal

Unit: 1000 US$

Type of Cost	Short Term 1994-1999	Long Term 2000/2029	Master plan Total
Initial Purchase	(12) 1,590.40	(4) 5,376.00	(16) 6,966.40
Renewal	(41) 15,487.18	(109) 45,382.52	(150) 60,869.70
Replacement	(0) 0	(72) 9,542.40	(72) 9,542.40
Total	(53) 17,077.58	(185) 60,300.92	(238) 77,378.50
	(22.1%)	(77.9%)	(100%)

Notes: 1. Both renewal and replacement costs indicate the required cost by 2029.
2. Figures in parenthesis show the total number of machine units.

Table 9-8-4b Annual Equipment Cost for Existing Container Terminal

Unit: 1,000 US$

Year	Per Year	Breakdown		Breakdown (2) Initial			Breakdown (3) Periodical		
	Tab9-8-5	Renewal	Replace	Renewal	Replace	Sub-total	Renewal	Replace	Sub-total
1992	-	-	-	-	-	-	-	-	-
1993	-	-	-	-	-	-	-	-	-
1994	0	0	0	0	0	0	0	0	0
1995	6,192.52	4,602.12	1,590.40	0	1,590.40	1,590.40	4,602.12	0	4,602.12
1996	480.00	480.00	0	-	-	-	480.00	0	480.00
1997	645.06	645.06	0	-	-	-	645.06	0	645.06
1998	0	0	0	0	0	0	0	0	0
1999	9,760.00	9,760.00	0	0	0	0	9,760.00	0	9,760.00
2000	448.00	201.60	246.40	-	-	-	201.60	246.40	448.00
2001	8,800.00	8,800.00	0	0	0	0	8,800.00	0	8,800.00
2002	0	0	0	0	0	0	0	0	0
2003	5,814,97	438.97	5,376.00	0	5,376.00	5,376.00	438.97	0	438.97
2004	0	0	0	0	0	0	0	0	0
2005	936.26	689.86	246.40	-	-	-	689.86	246.40	936.26
2006	0	0	0	-	-	-	0	0	0
2007	0	0	0	-	-	-	0	0	0
2008	0	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0	0
2010	4,368.00	2,777.60	1,590.40	-	-	-	2,777.60	1,590.40	4,368.00
2011	438.97	438.97	0				438.97	0	438.97
2012	0	0	0				0	0	0
2013	600.26	600.26	0				600.26	0	600.26
2014	8,800.00	8,800.00	0				8,800.00	0	8,800.00
2015	336.00	89.60	246.40				89.60	246.40	336.00
2016	8,800.00	8,800.00	0				8,800.00	0	8,800.00
2017	0	0	0				0	0	0
2018	5,376.00	0	5,376.00				0	5,376.00	5,376.00
2019	438.97	438.97	0				438.97	0	438.97
2020	336.00	89.60	246.40				89.60	246.40	336.00
2021	600.26	600.26	0				600.26	0	600.26
2022	0	0	0				0	0	0
2023	0	0	0				0	0	0
2024	0	0	0				0	0	0
2025	4,368.00	2,777.60	1,590.40				2,777.60	1,590.40	4,368.00
2026	0	0	0				0	0	0
2027	438.97	438.97	0				438.97	0	438.97
2028	0	0	0				0	0	0
2029	9,400.26	9,400.26	0				9,400.26	0	9,400.26
Total	77,378.50 (100%)	60,869.70 (78,7%)	16,508.80 (21.3%)	0	6,966.40	6,966.40	60,869.70	9,542.40	70,412.10

Table 9-8-5 Cost Breakdown of Cargo Handling Equipment Renewal and Replacement for Existing Container Terminal

Unit: 1,000 US$

Clndr. Year	Renewal							Replacement			Total
	Gantry Crane 8,800	Transfer Crane 1,344	Top-Loader 480	Forklift Truck 44.8	Tractor 62.71	Chassis 22.4	Sub-Total	Transfer Crane 1,344	Chassis 22.4	Sub-Total	
93											
94											
1995		(2)2688	(2)960		(12)752.52	(9)201.6	(25)4602.12	*(1)1,344	*(11)246.40	*(12)1,590.40	(37)6,192.52
96			(1)480				(1)480.00			0	(1)480.00
97				(6)268.8	(6)376.26		(12)645.06			0	(12)645.06
98							(0)0			0	0
99	(1)8800		(2)960				(3)9760.00			0	(3)9,760.00
2000						(9)201.6	(9)201.60		(11)246.40	(11)246.40	(20)448.00
01	(1)8800						(1)8800.00			0	(1)8,800.00
02							(0)0			0	0
03					(7)438.97		(7)438.97	*(4)5376		*(4)5376.00	(11)5,814.97
04							(0)0			0	0
2005				(5)224.0	(6)376.26	(4)89.6	(15)689.86		(11)246.40	(11)246.40	(26)936.26
06							(0)0			0	0
07							(0)0			0	0
08							(0)0			0	0
09							(0)0			0	0
2010		(2)2688				(4)89.6	(6)2777.60	(1)1,344	(11)246.40	(12)1,590.40	(18)4,368.00
11					(7)438.97		(7)438.97			0	(7)438.97
12							(0)0			0	0
13				(5)224.0	(6)376.26		(11)600.26			0	(11)600.26
14	(1)8800						(1)8800.00			0	(1)8,800.00
2015						(4)89.6	(4)89.60		(11)246.40	(11)246.40	(15)336.00
16	(1)8800						(1)8800.00			0	(1)8,800.00
17							(0)0			0	0
18							(0)0	(4)5376		(4)5376.00	(4)5,376.00
19					(7)438.97		(7)438.97			0	(7)438.97
2020						(4)89.6	(4)89.60		(11)246.40	(11)246.40	(15)336.00
21				(5)224.0	(6)376.26		(11)600.26			0	(11)600.26
22							(0)0			0	0
23							(0)0			0	0
24							(0)0			0	0
25		(2)2688				(4)89.6	(6)2777.60	(1)1,344	(11)246.40	(12)1,590.40	(18)4,368.00
26							(0)0			0	0
27					(7)438.97		(7)438.97			0	(7)438.97
28							(0)0			0	0
29	(1)8800			(5)224.0	(6)376.26		(12)9400.26			0	(12)9,400.26
Renw	(5)44000	(6)8064	(5)2400	(26)1164.8	(70)4389.7	(38)851.2	(150)60869.70	(11)14784	(77)1,724.8	(88)16,508.80	(238)77,378.50

Notes: 1. Figures in parenthesis indicate numbers of required machine.
2. Figures with asterisk indicates the initial investment.

9.8.5 Disbursement Schedule for Existing Container Terminal

Based on the development phasing as shown in Section 9.4 the estimated annual expenditure plan of these costs is shown in Table 9-8-6.

Table 9-8-6 Cost Disbursement Schedule for Existing Container Terminal

Unit: 1,000 US$

Year	Phase	Ordinary Construction Works	Instrument Initial	Instrument Replace	Equipment Replace	Equipment Initial	Equipment Renewal	Total
1992	-	-	-	-	-	-	-	-
1993	-	-	-	-	-	-	-	-
1994	1	1,655	-	-	-	-	0	1,655
1995	"	1,655	-	-	-	1,590	4,602	7,847
1996	"	-	-	-	-	-	480	480
1997	"	-	-	-	-	-	645	645
1998	"	-	-	-	-	-	0	0
1999	"	-	598	-	-	-	9,760	10,358
2000	2	-	-	-	246	-	202	448
2001	"	4,771	-	-	-	-	8,800	13,571
2002	"	4,771	-	-	-	-	0	4,771
2003	3	-	-	-	-	5,376	439	5,815
2004	"	-	-	598	-		0	598
2005	"	-	-	-	246		690	936
2006	"	-	-	-	-		0	0
2007	"	-	-	-	-		0	0
2008	"	-	-	-	-		0	0
2009	"	-	7,898	-	-		0	7,898
2010	4	-	-	-	1,590		2,778	4,368
2011	"	-	-	-	-		439	439
2012	"	-	-	-	-		0	0
2013	"	-	-	-	-		600	600
2014	"	-	-	7,898	-		8,800	16,698
2015	"	-	-	-	246		90	306
2016	"	-	-	-	-		8,800	8,800
2017	"	-	-	-	-		0	0
2018	"	-	-	-	5,376		0	5,376
2019	"	-	-	7,898	-		439	8,337
2020	"	-	-	-	246		90	336
2021	"	-	-	-	-		600	600
2022	"	-	-	-	-		0	0
2023	"	-	-	-	-		0	0
2024	"	-	-	7,898	-		0	7,898
2025	"	-	-	-	1,590		2,778	4,368
2026	"	-	-	-	-		0	0
2027	"	-	-	-	-		439	439
2028	"	-	-	-	-		0	0
2029	"	-	-	7,898	-		9,400	17,298
Total		12,852	8,496	32,190	9,540	6,966	60,871	130.915

9.9 Required Cost for Upgrading of Existing Finger Pier and Mole

This section deals with the cost estimation with respect to the upgrading of the existing finger piers No.6, No.7 and No.8 and mole.

9.9.1 Summary of Required Cost

The required total costs including equipment renewal by 2029 amounts to 15.6 million US$ which consists of the initial construction together with equipment purchase costs and equipment renewal by 2029 of 5.6 million US$ and 10.0 million US$ respectively. Among the initial costs, construction cost amounts to 4.8 million US$ which shares 85.0% of the required initial ones. During the Short Term Development, 2.4 million US$ will be spent and another 3.2 million US$ will be spent for the Long Term Plan. Refer to Table 9-9-1 below.

Table 9-9-1 Summary of Required Cost for Existing Piers and Mole

Unit: Million $

Category	Total	Short Term 1994/1999	Long Term 2000/2029
A. Initial Cost			
a) Construction	4.8(85.0%)	1.6	3.2
b) Cargo Handling E.	0.8(15.0%)	0.8	0
Sub-Total	5.6(100%)	2.4	3.2
	(100%)	(42.9%)	(57.1%)
B. Periodical Cost			
a) Cargo Handling E. Renewal by 2029*	6.8	1.3	5.5
b) Replacement	3.2	0	3.2
Sub-Total	10.0	1.3	8.7
Grand Total	15.6	3.7	11.9

Notes: Figures shown above do not include contingency and engineering cost.
Refer to Table 9-9-3 for Cargo Handling Equipment Renewal and Replacement by 2029.

9.9.2 Construction Works

The required cost for ordinary construction works amount to 4.8 million US$. All the required costs are categorized into the Short Term Development stage 1994/1995 and the Long Term stage 2001/2002 as indicated in Table 9-9-2.

As shown in the table, the required works on the pier deck amount to 2.5 million US$ sharing about 67.4% of this category. The other is mainly for enlarging of the yard and access pavement at the mole.

Table 9-9-2 Cost Breakdown of Construction Works for Upgrading of Existing Finger Piers and Mole

Works Categories	Short Term 1994/1995	Long Term 2001/2002	Total	Finger Piers	Mole
a.Demolishing of Shed of Pier No.7	80.0$/m²x7,900m²=632,000	-	632,000		
b.Pavement of Deck Face after Demolishing of Shed of Pier No.7	66.0$/m²x7,900m²=521,400	-	521,400		
c.Passenger Terminal at Pier No.8	-	450.0$/m²x3,000m²=1,350,000	1,350,000	(2,503,400)	
d.Open Storage pavement at Mole	69.6$/m²x4,860m²=338,250	69.6$/m²x24,000m²=1,670,400	2,008,650		
e.Upgrading of Road on Mole	100.0$/m²x600m²=60,000	-	60,000		
f.Road pavement on Mole		105.3$/m²x1,800m²=189,540	189,540		(2,258,190)
	(32.6%)1,551,650	(67.4%)3,209,940	(100%)4,761,590		

9.9.3 Renewal and Replacement of Cargo Handling Equipment

The required costs for cargo handling equipment renewal and replacement amount to 10.8 million US$ by 2029. Between 1995/2029, 168 sets of various machines should be purchased as shown below.

Mobile crane	5	sets x	800,000$/set =	4,000,000	US$
Forklift truck	112	" x	44,800$/set =	5,017,600	US$
Tractor	16	" x	62,710$/set =	1,003,360	US$
Chassis	35	" x	22,400$/set =	784,000	US$
Total	168	sets		10,804,960	US$

Table 9-9-3 shows the annual renewal and replacement cost of equipment for the existing finger piers.

Among these machines, the following will be purchased in 1995 as a part of the initial requirement.

Mobile crane (Gantry crane)	1	sets x	800,000$/set =	800,000	US$

Table 9-9-3 Cost Breakdown of Cargo Handling Equipment Renewal and Replacement for Existing Finger Piers

Unit: 1,000 US$

Cldr. Year	Renewal				Replacement	Total
	1 Forklift Truck 44.8	2 Tractor 62.71	3 Chassis 22.4	Sub-Total	4 Mobile Crane 800	
93						
94						
1995			(5)112	(5)112	(1)800	(6)912.00
96				0	0	0
97	(11)492.8	(4)250.84		(15)743.64	0	(15)743.64
98	(9)403.2			(9)403.2	0	(9)403.20
99				0	0	0
2000			(5)112	(5)112	0	(5)112.00
01				0	0	0
02				0	0	0
03	(8)358.4			(8)358.4	(1)800	(9)1,158.4
04				0	0	0
2005	(11)492.8	(4)250.84	(5)112	(20)855.64	0	(20)855.64
06	(9)403.2			(9)403.2	0	(9)403.2
07				0	0	0
08				0	0	0
09				0	0	0
2010			(5)112	(5)112	0	(5)112.00
11	(8)358.4			(8)358.4	(1)800	(9)1,158.4
12				0	0	0
13	(11)492.8	(4)250.84		(15)743.64	0	(15)743.64
14	(9)403.2			(9)403.2	0	(9)403.20
2015			(5)112	(5)112	0	(5)112.00
16				0	0	0
17				0	0	0
18				0	0	0
19	(8)358.4			(8)358.4	(1)800	(9)1,158.4
2020			(5)112	(5)112	0	(5)112.00
21	(11)492.8	(4)250.84		(15)743.64	0	(15)743.64
22	(9)403.2			(9)403.2	0	(9)403.20
23				0	0	0
24				0	0	0
2025			(5)112	(5)112	0	(5)112.00
26				0	0	0
27	(8)358.4			(8)358.4	(1)800	(9)1,158.4
28				0	0	0
29				0	0	0
Total	(112)5017.6	(16)1003.36	(35)784	(163)6804.96	(5)4000	(168)10804.96

Note : Figures in parenthesis indicate numbers of required machine.

9.10 Required Cost for Access Roads

This section deals with the cost estimation of the related inland road networks.

There are three sections, namely Section I, Section II and Section III. The Section-I is the road construction and existing road improvement in the Short Term Development and the Section II is the works in the Long Term Development. The Section III is however the works for further improvement in the Long Term Development and is excluded from the project cost.

Section I (Short Term)

(1)	For the Existing Container Terminal : B1	
	a. Improvement between the terminal and existing free zone	2,500m^2
(2)	For the New Container Terminal: B2	
	a. Improvement between the new terminal and Bolivar Road	7,200m^2(2 lanes)
	b. New access between the new terminal and Bolivar Road	20,000m^2(2 lanes)
	Subtotal	29,700m^2

Section II (Long Term)

(1)	For the Existing Container Terminal : B1	
	a. Improvement between the terminal to the Expanded Free Zone Area	10,000m^2(4 lanes)
(2)	For the New Container Terminal : B2	
	a. Improvement between the new terminal and Bolivar Road	27,000m^2(4 lanes)
	b. New bridge construction	1 unit
	Subtotal	37,000m^2

Section III (Long Term, but for reference only)

a. Improvement between Bolivar Road to France Field	82,000m^2(4 lanes)
b. New bridge construction	4 units
Subtotal	82,000m^2
Total Area	148,700m^2

The required initial cost amounts to 6.3 million US$ as shown in Table 9-10-1. Among this, the cost for the Short Term Development and Long Term Development are 2.4 million US$ and 3.9 million US$ respectively.

Table 9-10-1 Cost Breakdown for Upgrading of Inland Road Networks

Unit: US$

Work Categories	Short Term	Long Term	Master Plan Total
A.Existing C. Terminal (B1)			
Section I, road	34.85$/m² x 2,500m² = 87,000		87,000
Section II, road		34.85$/m² x 10,000m² =348,000	348,000
B.New Container Terminal (B2)(B3/4)			
Section I, road	34.85$/m² x 7,200m² = 250,560		250,560
road	105.35$/m² x 20,000m² = 2,106,000		2,106,000
Section II, road		105.35$/m² x 27,000m² = 2,843,100	2,843,100
bridge		700,000$ x 1unit = 700,000	700,000
Subtotal (A+B)	2,443,560	3,891,100	6,334,660
C.New Container Terminal (B3/4)			
Section III, road		105.35$/m² x 82,000 = 8,634,600	8,634,600
bridges		700,000$ x 4units = 2,800,000	2,800,000
Subtotal (C)		11,434,600	11,434,600

Note: The required costs for items A and B are included in cost estimation of Section 9.7 and Section 9.8.

9.11 Operation and Maintenance Cost

This section deals with the scale of required routine maintenance cost. The maintenance cost, for the existing facilities is estimated based on the scale of fixed facilities and number of cargo handling equipment. Those for new container terminal is also calculated based on the final data indicated in subsection 9.7.

In order to evaluate the scale of these maintenance costs, operation and maintenance cost is roughly estimated based on the last similar project.

Operation and Maintenance Cost: O/M Cost

The operation and maintenance costs are tentatively estimated by the following formula. More detailed information for the short term development will be given in Chapter 9 and Chapter 10 of Part III.

$$C = U \times V$$

where, C : O/M cost per year ($)
U : Unit O/M cost per unit cargo = 40 $/TEU
V : Cargo volume per year (TEUs/year)
Cargo volume for the existing finger piers, Prospective 1/2
V1 = 40,000 TEUs
Cargo volume for the existing container terminal, Prospective 1/2
V2 = 150,000 TEUs
Cargo volume for the first container wharf at Telfers Island, Prospective 3 (Short Term Development: STD)
V3s = 150,000 TEUs

Cargo volume for the next two container wharves at Telfers Island, Prospective 3 (Long Term Development: LTD)

V3m = 300,000 TEUs

Thus, the required operation and maintenance cost for each phase is;

Prospective 1/2	:	C =	2,000,000 $/year
Prospective 1/2	:	C =	6,000,000 $/year
Prospective 3 (STD)	:	C =	6,000,000 $/year
Prospective 3 (LTD)	:	C =	12,000,000 $/year

Maintenance Costs

According to the past experience, the required maintenance cost relates to the initial investment cost.

Average annual maintenance cost ratio adopted are shown below:

Table 9-11-1 Annual Maintenance Cost

Type of Facility	% of Initial Cost
Fixed Facilities	
a. Aged and Flexible Structure	1.25
b. New and Rigid Structure	1.75
Cargo Handling Euipment	5.00

The required maintenance costs for fixed facilities and cargo handling equipment are estimated as follows. Note; Fixed facilities mean the civil works, building works and Utilities.

a) Existing facility routine maintenance for piers and mole

Total deck area of the existing piers and mole;

Pier No.6	14,000	m2
Pier No.7	14,400	m2
Pier No.8	13,700	m2
Pier No.16	20,000	m2
Mole	7,475	m2
Total	69,575	m2

Estimated initial cost assuming an unit cost of 1,000 $/m2;
69,575 m2 x 1,000 $/m2 = 69,575,000 $

Thus, an annual routine maintenance cost will be;
69,575,000 x 1.25% = 869,000 $ year

Estimated annual routine maintenance cost in Section 9.13 for piers and mole is;

Pier No.6	46,000	$/year
Pier No.7	11,700	"
Pier No.8	13,500	"
Pier No.16	364,000	"
Mole etc.	215,400	"
Total	650,600	"

This cost is for the structural maintenance works. The required total repair cost including other items will amount to 150,000$/year which is lower than 869,000$/year. This may attribute to the existing healthy structures considering the actual age.

The required maintenance cost for the existing cargo handling equipment is roughly estimated.

Forklift	11 sets	x	44,800	= 492,800	$
Tractor	4 sets	x	62,710	= 250,840	
Chassis	5 sets	x	22,400	= 112,000	
Sub-Total				855,640	$

Thus, an annual routine maintenance cost for the existing equipment will be;

856,000 x 5.00% = 42,800 $/year

It is estimated that the estimated O/M cost of 2 million US$ can cover these required costs for routine maintenance works.

b) Existing facility routine maintenance for the existing container terminal

It is expected that the existing terminal area will be enlarged to 13.6 ha from the present 8.4 ha in near future. The initial cost is estimated using the cost data for the new terminal at SITE-T.

- Piers No.9/10	:	10,465 m2	x	1000 $/m2	=	10,465,000 $
- Onland works	:	7,800,000	x 0.7 x	13.6/8.4	=	8,810,000 $
- Building	:	6,500,000	x	0.5	=	3,250,000 $
- Utilities	:	5,300,000	x	0.5	=	2,650,000 $
Sub-Total						24,710,000 $

Thus, an annual routine maintenance cost for the fixed facilities will be;

24,710,000 x 1.25% = 309,000 $/year

The required maintenance cost for the existing cargo handling equipment is roughly.

Wharf Crane (Gantry C.)	2 sets x	8,800,000	=	17,600,000	US$
Yard Crane (Transfer C.)	2 sets x	1,344,000	=	2,688,000	
Top-Loader	2 sets x	480,000	=	960,000	
Forklift	6 sets x	44,800	=	268,800	
Tractor	18 sets x	62,710	=	1,128,780	
Chassis	20 sets x	22,400	=	448,000	
Sub-total				23,093,580	US$

Thus, an annual routine maintenance cost for the existing equipment will be:

23,100,000 x 5.00% = 1,150,000 US$/year

Total annual maintenance cost amounts to 1,459,000 US$.

Estimated routine maintenance cost of existing concrete pavement is 184,800 US$. Since the estimated annual routine maintenance cost of Piers No.9 and No.10 is 59,100 $/year, the maintenance cost for pavement and piers will be 243,900 $/year.
It is assumed that the estimated O/M cost of 6 million US$ can cover this required cost.

c) Routine maintenance works for an unit container wharf to be constructed during the Short Term Development

According to the cost estimation for the new container terminal at SITE-T, the required initial construction cost is 72.2 million US$. The required cost for mechanical works is 30.0 million US$.

- Initial construction cost	72,209,000 $	(57,767,000x1.25)
- Equipment cost	29,554,000 $	
Total	101,763,000 $	

Note: Initial construction cost includes contingency and engineering cost.

Thus, an annual routine maintenance cost will be;

72,209,000	x	0.75%	= 542,000	$/year
29,554,000	x	5.00%	= 1,478,000	$/year
Total			2,020,000	$/year

It is assumed that the estimated O/M cost of 6 million US$ can cover this maintenance cost.

d) Routine maintenance works for two unit container wharves to be constructed during the Long Term Development

The required initial construction cost and the equipment cost are 131.8 million US$ and 59.1 million US$ respectively.

- Initial construction cost	131,777,000 $	(105,421,000x1.25)
- Equipment cost	59,108,000 $	
Total	190,885,000 $	

Note: Initial construction cost includes contingency and engineering cost.

Thus, an annual routine maintenance cost will be;

131,777,000	x 0.75%	= 988,000	$/year
59,108,000	x 5.00%	= 3,003,000	$/year
Total		3,991,000	$/year

It is estimated that the estimated M/O cost of 12 million US$ can cover this maintenance cost.

9.12 Preliminary Construction Program

This section deals with the basic construction program of the new container terminal including alternative studies on the work quantity and construction method of marine works. It is concluded that the new container terminal will be constructed along the existing north-west coast of Telfers Island. It is also concluded that the terminal will be constructed berth by berth. Thus the preliminary construction program to be discussed in this section is for the first berth construction on the island.

9.12.1 Quantity of Major Works

Based on the study results of wharf structural type, two most possible cases are selected.

OSV : Open Structure by Vertical Pile
CC : Concrete Caisson

Table 9-12-1 shows the major works required for these two cases.

According to this table, dredging and reclamation volume is about 1.5 million m3. Among this, 0.6 million m3 of sandy soil should be borrowed from the specified site by APN at 25 km hauling distance. About 0.9 million m3 of marine soft clay should be

dredged and dumped for disposal at the specified site by APN at 8 km hauling distance.

The required earthworks can be summarized as follows.

Dredging works		
- Dredging and reclamation		180,000 m3
- Dredging and disposal		722,500 m3
- Borrowing and reclamation		607,000 m3
Rock and selected fill	OSV:	102,170 m3
	CC:	162,660 m3

As seen in the table, the required work quantities for OSV and CC are almost the same except the wharf construction.
OSV supports the earth pressure and vertical loads by steel piles driven into the Gatun formation. Thus, major wharf materials are steel and armor rock for slope rip-rapping. While CC consists of concrete structure to be placed on the Gatun formation. Due to this reason the required concrete volume for the CC wharf structure is 18,630 m3.

The on-land works, building and utilities, are just common works in Panama, thus there is nothing to discuss.

Table 9-12-1 Quantities of Major Works : "OSV" AND "CC"

Major Work Item		Wharf Structure	
		OSV	CC
Marine works			
Dredging and reclamation	m3	1,510,000	1,510,000
Seawall, Armor rock and fill	m3	15,470	15,470
Wharf	m	300	300
- Preboring d=1,300	m	2,202	-
- Pile driving d=1,100	t	4,110	-
driving length	m	7,218	-
- Armor rock and fill	m3	86,700	45,090
- Concrete	m3	7,740	18,630
caisson box	ea	-	20
On-land Works			
Pavement	m2	93,600	93,600
Storm water drainage	m2	105,000	105,000
Building and office			
Building	m2	7,000	7,000
Weigh bridge	set	3	3
Park and landscaping	m2	4,200	4,200
Utilities	cs	1	1

Note: Further details of work quantity are attached in Appendix II-A.

9.12.2 Preliminary Construction Schedule

The required construction period is estimated to be about three years including one year for prequalification and contract. The required period of preparation work before this will depend upon engineering preparation and financial arrangements. Figure 9-12-1 shows a typical schedule to meet the phasing of project implementation as shown in Section 9.4. It is assumed that the required minimum time is one year for a series of financial arrangement, detailed design and contract.

Items	Year				
	1995	1996	1997 ①	1998 ②	1999 ③
Financial Arrangement					
Detailed Design					
Contract					
Construction					
Operation					

Figure 9-12-1 Tentative Master Construction Schedule for Short Term Development: One Terminal Unit

Figure 9-12-2 shows a draft schedule when actual construction effort commences at the beginning of 1998.

After executing the construction contract, a contractor will dispatch their first team to the site within one month. Mobilization will be completed within two months.

The critical works will be wharf construction and yard pavement. Building and utilities will be constructed at the last year. It is expected that the first container berth at Telfers Island will commence its service at the beginning of year 2000.

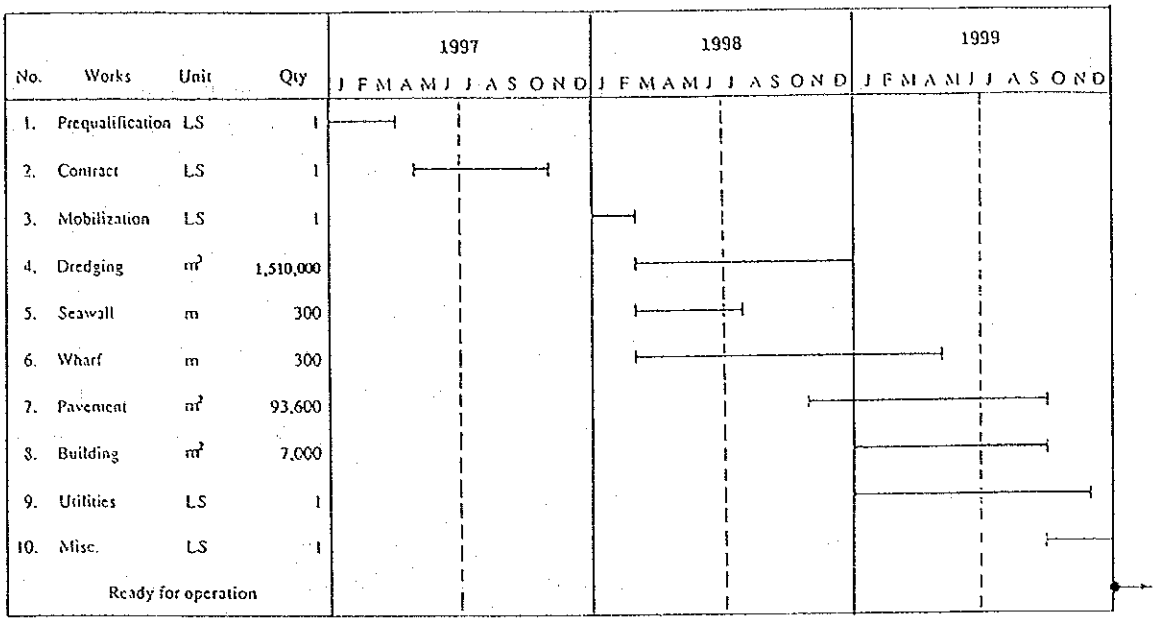


Figure 9-12-2 Preliminary Construction Schedule
One Terminal Unit (300 m x 350 m)

9.12.3 Particular Construction Aspects

For the construction of a new terminal, an appropriate temporary construction site should be provided. The required area for this purpose is about 2.5 ha.

Site office and closed storage	0.1 ha
Material storage	0.4 ha
Machine pool	0.2 ha
Parking area	0.1 ha
Pile preparation yard or caisson preparation yard	1.0 ha
Preparation yard	0.5 ha
Other use	0.2 ha
Total Temporary Site Area	2.5 ha

It is proposed that APN provided a contractor with such an area near the existing Pier No.16. This site has various advantages including,

- Good access to inland area
- Good access to the sea
- Wide open space for construction activities

One of the important aspects is the loading and unloading point between land and sea. There are two methods on this matter, Scheme A and Scheme B.

Scheme A: Partial use of Pier No.16

It may be proposed that APN provides a contractor with use of eastern half of Pier 16. In case of caisson structure wharf, a floating dock of 6,000 ton capacity will be anchored here and will cast three concrete caisson boxes every 45 days.

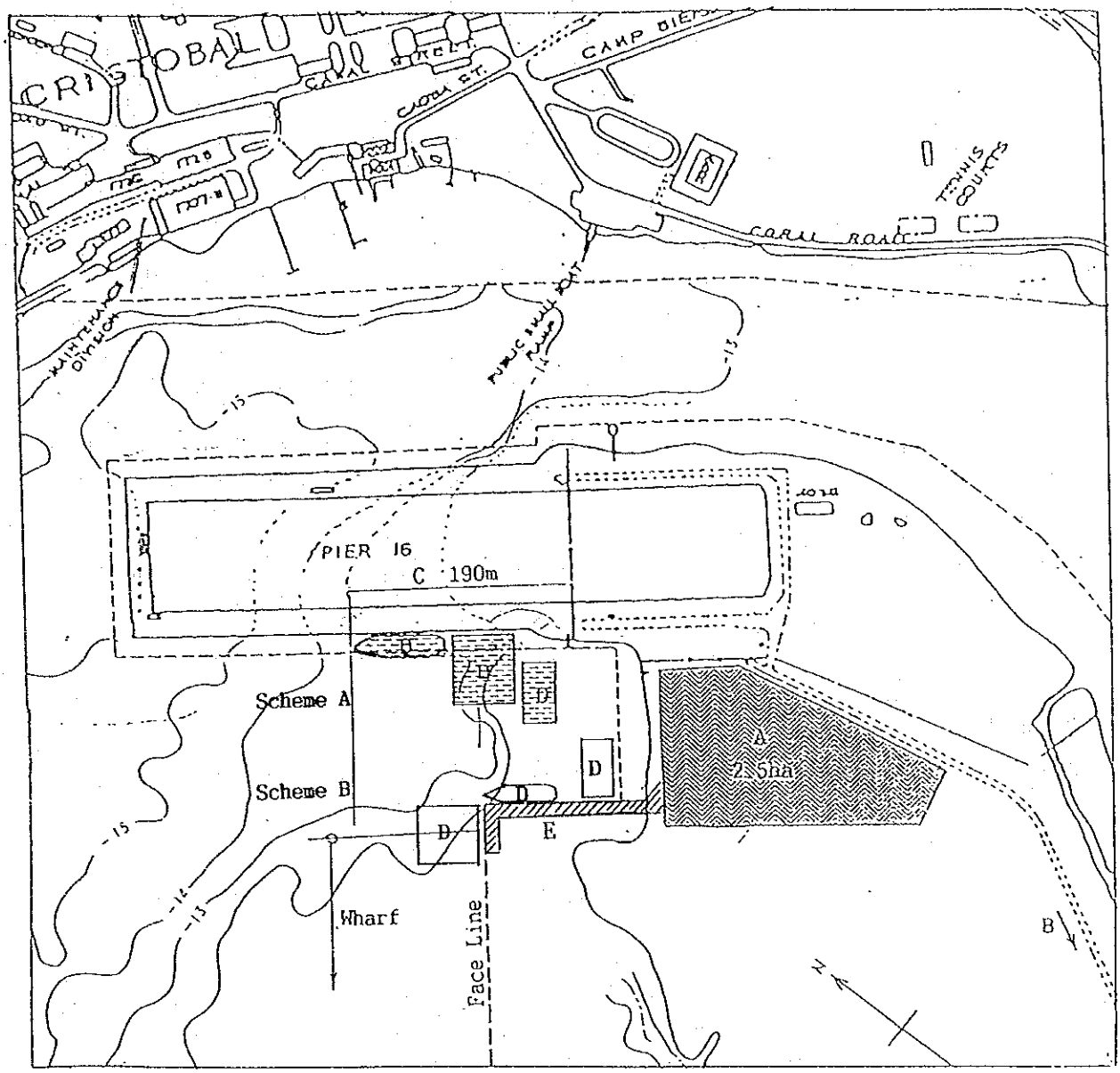
Scheme B: Construction of temporary jetty near Pier No.16

This scheme is an alternative plan against Scheme A.
It is known that Pier No.16 is being used under the concession contract between APN and a private company. Thus, this scheme recommends to construct a temporary jetty near Pier No.16 by a contractor. This means that the contract amount may increase.

Note: Possible solutions of this matter would be as follows:

a. For the cost estimation purpose, it is assumed that a contractor should build a new temporary jetty near Pier No.16 for the construction works.
b. At the tender stage, APN would finally decide the use of Pier No.16 by a contractor with conditions of its use and total economy of APN account.

Figure 9-12-3 shows the construction temporary yard at Telfers Island.



Legend

A : Main Construction Yard
B : Access to Colon City
C : Pier No.16
D : Floating Plant
E : Temporary Jetty for Construction Purpose

Figure 9-12-3 Construction Temporary Yard at Telfers Island

9.13 Routine Maintenance Work for Existing Piers and Mole

This section deals with the repair work for the existing piers. Refer to Chapter 7 of Part I. The scope of works are the required routine maintenance for six piers, including the finger piers No.6, No.7 and No.8 and marginal wharves of pier No.9 and No.10 and an independent pier No.16. The Cristobal mole is included also.

The quantities of work for the finger piers and Pier No.16 are based on the result of the visual investigation by the Study Team. However the work to be made for other piers and mole are estimated by the Study Team based on the information collected.

This section does not discuss any work for structural upgrading and improvement.

> (Note: Upgrading means to give further modifications to allow for new functions and future loading conditions. For example, to add a wharf crane load on pier No.7.)

Another purpose of this section is to provide necessary data to estimate the required maintenance cost of the existing facilities.

9.13.1 Basic Cost Estimation Procedure

The required repair works depend on the damage scope of each structure.

Pier Structure

The required repair cost for deck structures will be estimated by the following formula.

$$C = \text{Sum } (Ci \times Ai)$$

where, C : Required repair cost for a same member group ($/pier)

Ci : Unit repair cost by Damage Grade (DG)
= ai x C(III)

C(III) : Unit cost per Damage Grade III = 100 $/m2

ai : Constant figure by Damage Grade

Grade 0	ai	= 0
Grade I	ai	= 0
Grade II	ai	= 0.5
Grade III	ai	= 1.0
Grade IV	ai	= 2.0
Grade V	ai	= 4.0

Ai : Area to be repaired by Damage Grade (m2)
= bi x ni x Ao

Ao : Unit area of member (m2/ea)

bi : Constant figure by Damage Grade

Grade 0 bi = 0
Grade I bi = 0
Grade II bi = 20%
Grade III bi = 40%
Grade IV bi = 60%
Grade V bi = 100%

ni : Number of damaged member by Damage Grade (ea/pier)

Refer to Chapter 7 of Part I and Chapter 6 of Part III.

Thus, C = Sum (Ci x Ai)
= Sum (ai x C(III)) x (bi x ni x Ao)
= C(III) x Ao x Sum (ai x bi x ni)
= 100$/m2 x Ao x (0.1*n2 + 0.4*n3 + 1.2*n4 + 4.0*n5)

Similar to deck structure, the pile foundation repair work will be estimated by using C(III) = 400 $/m2.

Thus, C = 400 x Ao x (0.1*n2 + 0.4*n3 + 1.2*n4 + 4.0*n5)

Dike Structure

The existing mole consists of earth dike covered by pavement and protective rock riprapping armor. The required repair cost for mole will be estimated by the following formula.

C = Sum (Ci x Ai)

Where, C : Required repair cost
Ci : Unit repair cost
Cp = 100 $/m2for pavement
Cr =47 $/m2for rock riprapping
Ai : Area to be repaired
Ap for pavement
Ar for rock riprapping

9.13.2 Required Repair Cost for Finger Piers

(1) Pier No.6

Deck structure : Concrete beams

Ao = 1/2 (8.1m + 13.8m) x 4.5m = 49.3 m2/beam

From the Table 7-2-8 in Part I

n2 = 5, n3 = 4

Thus, Cb = 100 x 49.3 x (0.1*5 + 0.4*4)
= 4,930 x 2.1 = 10,353 $/pier

Deck structure : Concrete Slabs

Ao = 8.1 x 13.8 = 112 m2/slab

n2 = 32, n3 = 2

Thus, Cs = 100 x 112 x (0.1*32 + 0.4*2)

= 11,200 x 4 = 44,800 $/pier

Pile foundation : Concrete piles

Ao = 3.14 x D x 1.5D(D : Pile diameter)

= 3.14 x 1.5 x 1.80^2 = 15.3 m2/pile

n2 = 6 piles

Thus, Cp = 400 x 15.3 x 6 = 36,700 $/pier

Total costs is;

Sum (C) = 10,353 + 44,800 + 36,720 = 91,873 $/pier

It is assumed that this repair works will be conducted every two years. Thus, an annual repair cost for pier No.6 is;

91,873 x 1/2 = 46,000 $/pier.year

(2) Pier No.7

Deck structure : Concrete beams

Ao = 1/2 x (8.1m + 13.8m) x 4.5m = 49.3 m2/beam

n2 = 2

Thus, Cb = 100 x 49.3 x (0.1*2) = 986 $/pier

Deck structure : Concrete Slabs

Ao = 8.1 x 13.8 = 112 m2/slab

n2 = 9

Thus, Cs = 100 x 112 (0.1*9)

= 11,200 x 0.9 = 10,080 $/pier

Pile foundation : Concrete piles

Ao = 15.3 m2/pile

n2 = 2 piles

Thus, Cp = 400 x 15.3 x 2 = 12,240 $/pier

Total costs is;

Sum (C) = 986 + 10,080 + 12,240 = 23,306 $/pier

Similar to pier No.6, an annual repair cost for pier No.7 is;

23,306 x 1/2 = 11,700 $/pier.year

(3) Pier No.8

Deck structure : Concrete beams

Ao = 1/2 x (8.2m + 9.3m) x 4.5m = 39.4 m2/beam

n2 = 16

Thus, C = 100 x 39.4 x (0.1*16) = 6,304 $/pier

Deck structure : Concrete Slabs

Ao = 8.2 x 9.3 = 76.3 m2/slab

n2 = 7, n3 = 1

Thus, Cs = 100 x 76.3 x (0.1*7 + 0.4*1)

= 7,630 x 1.1 = 8,393 $/pier

Pile foundation : Concrete piles

Ao = 15.3 m2/pile

n2 = 2 piles

Thus, Cp = 400 x 15.3 x 2 = 12,240 $/pier

Total costs is;

Sum (C) = 6,304 + 8,393 + 12,240 = 26,937 $/pier

Similar to pier No.6, an annual repair cost for pier No.7 is;

26,937 x 1/2 = 13,500 $/pier.year

(4) Total Repair Costs for Finger Piers

Required annual repair cost will be;

Cf = C6 + C7 + C8

= 46,000 + 11,700 + 13,500 = 71,200 $/year

Total area of finger piers is;

A = 21,455 m2 + 20,672 m2 + 20,623 m2 = 62,750 m2

Unit annual repair cost is;

Cf / A

= 71,200 / 62,750 = 1.13 $/m2.year

9.13.3 Required Repair Cost for Marginal Wharf : Pier No.9 and No.10

The marginal wharf was not visually inspected by the Study Team. According to the partial observation, the general damage grade is same as the finger piers or less. It is assumed that the unit repair cost per entire wharf area will be more than double of what the finger piers requires due to the intensive heavy traffic by container box transport.

The required routine repair cost for the marginal wharf is estimated as follows:

Cm = C' x Am

where, Cm : Required routine repair cost per every three years ($/pier)

C' : Unit repair cost for the entire area
C' = 5 x 1.13 $/m2 = 5.65 $/m2

Am : Total marginal wharf area
Pier No.9 + No.10
= 7,475 + 2,990 = 10,465 m2

Thus, Cm = 5.65 x 10,465 = 59,100 $/pier.year

This cost is not an initial cost but a part of the maintenance cost of the marginal wharves.

9.13.4Required Repair Cost for Pier No.16

The required repair cost for deck structures will also be estimated by the same procedure. The damage grade is based on the result of visual investigation.Refer to Chapter 7 of Part I and Chapter 6 of Part III.

Deck Structure : Concrete beams

Ao = 7m x 4.5m = 31.5 m2/beam

n2 = 180, n3 = 50, n4 = 74

Thus,

Cb = 100 x 31.5(0.1x180 + 0.4x150 + 1.2x78)
= 3,150 x 166.8 = 525,420 $/pier

Deck Structure : Concrete slabs

Ao = 7m x 7m = 49 m2/beam

n2 = 85, n3 = 40

Thus,

Cb = 100 x 49.0(0.1x85 + 0.4x40)
= 4,900 x 24.5 = 120,050 $/pier

Deck Structure : Concrete piles

Ao = 3.14 x D x 1.5D
= 1.5 x 3.14 x 1.8^2 = 15.3 m2/pile

n2 = 35, n3 = 25

Thus,

Cp = 400 x 15.3 x (0.1x 5 + 0.4x25) = 82,620 $/pier

Therefore, the total cost will be,

C = Cb + Cs + Cp
= 525,420 + 120,050 + 82,620 = 728,100 $/pier

Similar to the finger piers, an annual repair cost for Pier No.16 is;

728,100 x 1/2 = 364,000 $/year

9.13.5 Required Repair Cost for Mole

The mole is 1,030 m length.Width varies from 60 m to 120 m.Refer to Section 7.3.2 of Part I.

Pavement:

Total area, Ap = 1,030 x 90 x 60% x 3% = 1,670 m2
Unit repair cost, Cp = 100 $/m2

Thus required repair cost for pavement is,
C1 = Cp x Ap
= 100 x 1,670 = 167,000 $/mole

Rock Riprapping Protection:

Total area, Ar = 2 x 1,030 x 10 x 5% = 1,030 m2
Unit repair cost, Cr = 47 $/m2

Thus, required repair cost for dike protection is,
Cr = Cr x Ar
= 47 x 1,030 = 48,400 $/mole

Total cost are
Sum C = Cp + Cr
= 167,000 + 48,400 = 215,400 $/mole

It is assumed that these repair works will be conducted every year.

CHAPTER 10 MANAGEMENT AND OPERATION

10.1 Basic Policy for Management and Operation

10.1.1 Key Factors

Key factors that will have a great impact on the future of port development are as follows.

(1) Progress of Containerization

The ports of Cristobal have excellent potential as a container port.

1) Location of the ports and presence of the Canal attract major container service lines.

2) Presence of Free Zone close to the ports.

3) The ports are situated in a calm and deep bay area.

The container terminals of the ports of Cristobal are already very busy. It is expected that container turn-over at the Ports will increase further in conjunction with the progress of containerization. The Ports must cope with this trend.

(2) Competition among the Neighboring Ports

The neighboring Caribbean and Central/South American container ports can potentially extend their roles because of the economic growth of these countries and progress of containerization. Competition among these ports will become keen. The ports of Cristobal function as a container distribution center of Caribbean and Central/South American countries. The ports of Cristobal have to maintain this situation.

(3) Commercialization Policy

Actual application of the Government's commercialization policy will have a great impact on the future of port development.

10.1.2 Required Function for the Port of Cristobal

To cope with progress of containerization and competition among the neighboring ports, the ports of Cristobal should be "an attractive and profitable port for users". It is thought that (1) highly efficient, (2) cost saving, (3) safe and reliable services are priority requirements in becoming an attractive port for users.

The most important function of a port is as a terminal where sea and land

transportation meet. Efficiency and safety in the transfer of cargo and passenger are therefore vital. For container cargo handling, quickness, reliability and cost effectiveness are strongly required in particular.

10.1.3 Major Issues of Present Port Management and Operation

The ports of Cristobal and Balboa originally functioned as supporting facilities for the Panama Canal and logistic centers for the United States Army. After being transferred to Panama, they began to be used as commercial ports. These ports are now involved in the progress of containerization. Due to rather short experience in managing large scale international ports, Panama is seeking the most suitable port management system to become a viable international port, mainly as a container terminal.
Under the situation, following problem areas in port management and operation are observed.

(1) Administration of Port Area

1) Under absence of basic policy and plan for development and conservation of Panamanian ports, the ports are not properly controlled with unified coordination.

2) Due to the limited legal port water area (only around piers), it is very difficult for Port Authority (APN) to manage their ports appropriately.

(2) Operation of Container Terminal

1) Container marshaling is managed in an outdated manner. (Card system is still used at the port of Cristobal)

2) Public sector (APN) directly performs container handling operation exclusively. There is no competition in this field.

(3) Organization, Personnel

1) APN has excess number of personnel in general.

2) The present personnel evaluation system is inadequate and does not contribute to the improvement of port efficiency.

3) There is no personnel transfer between APN Central Office and Port Administration offices.

4) Concerning training system, there is no special training program to make office work more efficient.

(4) Finance

1) Procurement system and other executing procedures of APN budget are inefficient.

2) While financial status of APN has been improving gradually in recent years, it seems still not in sound condition.

(5) Port Statistics and Promotion

1) Actual port statistics are not useful in analyzing the present condition in conducting a study on future strategy.

2) Port promotion activities are not effective enough to attract port users.

10.1.4 Basic Policy for Port Management and Operation

Taking into consideration the following issues, smooth and efficient operation and management systems should be introduced to Panamanian ports including the port of Cristobal in particular.

(1) Port activity has a great influence on the national economy. Safeguarding the national interest should be the first priority issue concerning port management and operation.

(2) The basic role of ports is normally considered to function as a public facility. Port infrastructure and facilities should be basically operated in open use to the public.

(3) APN should establish a basic policy and plan for proper development and conservation of port area which should be controlled under the policy to realize proper port activity.

(4) Safe and efficient transfer of cargo and passenger is vital. Container cargo handling efficiency is strongly required in particular.

(5) Organization of APN should be improved to realize high efficiency.

10.2 Management and Operation of Terminals of Port of Cristobal

In this section we will focus on the management and operation of terminals at the port of Cristobal (Coco Solo Norte and Bahia Las Minas are excluded). Because the port of Cristobal can only accept large size vessels, the container terminals of this port will be improved and expanded to be a center of cargo handling in this area.

10.2.1 Management and Operation of Container Terminal of Port of Cristobal

(1) General

There is no single optimum system for the institution and organization of container terminal management which port related people all over the world agree on. Each country which manages and operates container terminals has its own management and operation system shown as follows.

1) In Hong-Kong, container terminals are constructed by private companies that manage and operate the terminals. The port authority only leases the water area to the companies.

2) In Japan, major container terminals are normally possessed by public corporations which were established to construct and manage such terminals. They lease the terminals to shipping companies which manage and operate them.

3) In Holland, at the port of Rotterdam, container terminals are possessed by the port authority which leases the terminal to private companies by long-term base contract. This system is common to the port of New York in the United States as well as in many ports in Europe and the United States.

4) In Singapore, the port authority owns, manages and operates the container terminals. This system is also used in the port of London, England.

5) At the German port of Bremerhafen, the port authority owns container terminals. The port authority leases them mainly to a semi-government corporation of which a 50% share is possessed by the state government.

In Panama, public institution (APN) owns the container terminal and provides cargo handling service (It is partly provided by private companies).

(2) Alternative Systems for Port Operation and Management

Alternative systems for port operation and management are developed considering three different aspects as shown below.

1) Type of Operation and Management

a) Whether owner of the terminal will be public sector or not.
b) Whether the terminal will be open use terminal or not.
c) Whether cargo handling operation will be done by private entity or not.

2) Container Terminals

a) Pier No. 9

b) New container terminals constructed by the year 2000
c) New container terminals constructed during the year 2000-2010 (except b)

3) Period

a) Urgent
b) Short Term (up to the year 2000)
c) Long Term (up to the year 2010)
d) Post Master Plan

While many alternatives can be considered logically, seven representative alternatives are selected and arranged as shown in the table 10-2-1.

Table 10-2-1 Alternatives of Cristobal Container Terminal Operation

		Urgent	Short Term(~2000)		LONG TERM (~2010)			Post M.P.
		Pier 9	Pier 9	Pier X	Pier 9	Pier X	Pier Y....	
Alternative (A)	Owned by	Public	Public	Public	Public	Public	Public	Same as
	Provide service for	Open	Open	Open	Open	Open	Open	Long Term
	Cargo Handled by	Public	Public	Public	Public	Public	Private	Stage
Alternative (B)	Owned by	Public	Public	Public	Public	Public	Public	Same as
	Provide service for	Open	Open	Open	Open	Open	Open	Long Term
	Cargo Handled by	Public	Public	Private	Public	Private	Private	Stage
Alternative (C)	Owned by	Public	Public	Public	Public	Public	Public	Same as
	Provide service for	Open	Open	Open	Open	Open	Exclusive	Long Term
	Cargo Handled by	Public	Public	Private	Private	Private	Private	Stage
Alternative (D)	Owned by	Public	Public	Public	Public	Public	Public	Same as
	Provide service for	Open	Open	Open	Open	Open	Exclusive	Long Term
	Cargo Handled by	Public	Private	Private	Private	Private	Private	Stage
Alternative (E)	Owned by	Public	Public	Public	Public	Public	Private	Same as
	Provide service for	Open	Open	Exclusive	Open	Exclusive	Exclusive	Long Term
	Cargo Handled by	Public	Private	Private	Private	Private	Private	Stage
Alternative (F)	Owned by	Public	Public	Private	Public	Private	Private	Same as
	Provide service for	Open	Open	Exclusive	Exclusive	Exclusive	Exclusive	Long Term
	Cargo Handled by	Private	Private	Private	Private	Private	Private	Stage
Alternative (G)	Owned by	Public	Public	Private	Private	Private	Private	Same as
	Provide service for	Open	Exclusive	Exclusive	Exclusive	Exclusive	Exclusive	Long Term
	Cargo Handled by	Private	Private	Private	Private	Private	Private	Stage

Pier X : A new container berth available in 2000
Pier Y.. : Additional container berths available in 2010
Exclusive : The type of operation which allows only a limited number of companies to use berth(s).

(3) Basic Policy for Management and Operation

1) Major Issues

Major issues to be taken into consideration in examining management and operation system are listed below.

a) Safe and punctual operation is the most vital requirement for container transportation. In this sense, container terminals are required to provide quick, reliable and economical service to users.

b) The container terminal of port of Cristobal can be a very profitable

one if operated appropriately. Benefits derived from operation of such a beneficial port should be returned directly to the Panamanian economy.

c) The basic role of ports is normally considered to function as a public facility. This concept means that public port should be managed and operated not for limited or specified users but for open public use.

d) One of the most important national policies in this country is commercialization which will have a great impact on future port development.

e) Efficient service can often be expected by establishing a competitive market among private entities.

f) The port of Cristobal will be able to collect more cargoes because of its excellent location. If the port of Cristobal continues to provide inefficient cargo handling service, present port users shall move elsewhere. The neighboring Caribbean and Central South American container ports such as Kingston are aiming at becoming hub container ports of this area. APN should recognize that it faces an emergency; APN's action to improve its operation is therefore urgent.

2) Policy for Container Terminal Management and Operation

Taking into consideration the above mentioned issues, main policies for management and operation of the container terminals are formulated as follows.

a) Ports are vital to the Panamanian economy. Revenue from ports is important income for Panama. Consumption goods for Panamanian people must be provided steadily through the ports. The container terminals should be owned by port of the public sector or entities under proper control of the government.

b) At least one new container terminal which will be constructed by 2000 should be an open use terminal for the public. Under such operation, the terminal will accept all ships of different companies.

c) In addition to a public container terminal mentioned above, an exclusive use container terminal can be constructed as second berth for the year 2010. At that time, some shipping companies will be able to collect adequate volume of cargo to manage one exclusive use terminal.

d) To improve cargo handling efficiency, cargo handling service should be transferred to the private sector. At the same time, a competitive climate should be fostered.

3) Conclusion

According to above mentioned policies, Alternative (C) and Alternative (D) in Table 10-2-1 are considered the best selections for APN.

Under alternative (D), early introduction of commercialization in cargo handling operation is recommended. As is commonly understood, public sector is normally not flexible in providing personnel or investment in response to the actual fluctuation of demand. In this sense, full involvement of port authority in cargo handling services is not always suitable for improvement of efficiency of such services under a competitive market, and increased situation of cargo flow in particular.

Therefore, it is sound for the port of Cristobal to commercialize cargo handling function as soon as possible and improve their efficiency through competition among private companies. This will be a better solution to realize efficient cargo handling system in the future.

4) Management Entity of New Container Terminals Constructed in Long Term (up to the year 2010)

In the Long Term Plan, there is a possibility that new container terminals will be managed and operated exclusively by private companies such as shipping companies. In this case, it is very important to determine how to select the best entities for appropriate operation of the terminal. Examples of criteria for selection of such companies are shown as follows.

a) Companies which are able to perform efficient container cargo handling to fit customer demand.

b) Companies which can collect adequate quantity of container cargo while keeping sound financial position.

c) Companies which can provide reliable services throughout its leasing term

(4) Semi-government Corporation

1) Owner of Container Terminal

The owner of a container terminal should be a public sector or entity under proper control of the government in the light of securing public benefit.

While there are some alternative types of public entities suitable for ownership of the container terminal, APN is recommended as the most appropriate owner organization of such infrastructure, considering that the container terminal to be

constructed by the year 2000 (Short Term Plan) is the first full-scale and very important terminal for public use in Panama.

On the other hand, concerning the container terminals which will be constructed by the year 2010 (Long Term Plan), there is a possibility that a semi-government corporation will own these terminals.
However, in this case, the owner should be limited to an entity which port authority can control properly because port area is an important zone for public interest.

2) Cargo Handling Entities

Concerning cargo handling service, it is fair to say that the nature of this activity does not require direct service from a government entity.
However, there is a possibility that the public sector will have to establish a semi-governmental corporation if the private sector does not have enough capital to establish a new company or for other reasons.

(5) Introduction of competitive condition

Present operation of monopolistic cargo handling service by APN should be modernized by the year 2000. APN should encourage private sector to enter into the field of cargo handling service providing an attractive environment for competition. One of the methods is suggested as follows.

APN will deliberately commercialize the cargo handling sections; APN should give more business opportunities to private companies gradually by concession or other means by the year 2000.
At the same time, APN should introduce a system to encourage fair competition. A system in which a certain company is always appointed to a specified berth or pier is not preferable. Instead, a port user should be able to evaluate the ability of a company and make his selection accordingly.

(6) Introduction of Information System to Container Terminal Operation

1) Necessity of Information System

Container terminal operation can sometimes be conducted without a computer system. In fact, at some terminals, container operations are effectively conducted using the magnet board or cards. But, when the number of container increases and exceeds a certain level of handling activity, delay and mistakes in handling works usually increase. Generally, it is said that 60 thousand TEUs per year is the limit of manual processing of yard operation control.
Considering that Pier 9 at the port of Cristobal currently handles more than 100 thousand TEUs with irregular and narrow shaped container yard through complicated operation, an information system for container operation must be introduced.

2) Merit of Information System

The merits of introducing an information system are considered as follows:

a) An optimum yard operation plan can be developed. Yard operation can be conducted more quickly and more accurately.

b) Utilization of container yard can be rationalized

c) Various kinds of information including container location for safety of container storage can be obtained more easily.

These merits greatly contribute to upgrading quality of service to the terminal users.

3) Outline of Information System to be Introduced

a) At Pier 9, a rather simple system should be introduced as soon as possible to improve container inventory management system. Examination should be started from this point of view.
This system consists of minimum data file of container and its location (container number, B/L number, name of a ship to be loaded, name of agency company, its location number (address)). In addition, a basic communication system to connect yard site and the control room is necessary.

b) At the terminal which will be constructed in the Short Term Plan (by the year 2000), a system which can control container operation in the yard should be introduced. The system should have detailed files for container inventory, location and history, on-line communication systems which connect the control room and terminal gates, container ban pool, billing system.
This system should be designed taking into consideration that this terminal will be used by plural private companies.

c) At the terminal which will be constructed in the Long Term Plan (by the year 2010), a more efficient system should be introduced by private companies. In addition to container operation system mentioned in b), stowage plan system which can automatically make a stowage plan to a container ship, data transmission system which can transmit the work instructions to the yard handling machines, i.e. transtainers by the displays on the machines should be introduced.

It should be recognized that detailed examination by system engineers and other proper staff is necessary to design above mentioned systems.

10.2.2 Management and Operation for General Cargo Terminal

At the port of Cristobal terminals other than the container terminal are mainly for general cargo handling. When examining the management and operation of these terminals, the same method as described in 12.2.1 should be adapted. Basic policies recommended for management and operation of these terminals are as follows.

(1) General cargo terminals are normally used by various users and handle a smaller amount of cargo compared with container terminals. Naturally, these terminals should be open to public use.

(2) To improve cargo handling efficiency, cargo handling service should be commercialized as soon as possible. At the same time, well arranged environment for fair and active competition should be prepared for private entities.

(3) In the case of passenger terminal, APN will own and manage the berth, and passenger ship will be given priority to use it. One alternative may be a public berth with passenger terminal buildings for exclusive use by particular companies. Furthermore, where a private company is willing to invest, it can be the owner and exclusive user of that passenger terminal building.

10.3 Control of Port Area, Infrastructure and Facilities

10.3.1 General

Port should be properly controlled to provide efficient and reliable operation. To this end, APN should formulate basic policy for national ports and prepare plan concerning development and conservation of port area. In this policy and plan, basic roles and functions of ports, policy for usage of port area, location and scale of port infrastructure and facilities should be defined. (Hereafter this policy and plan will be referred to as "the port policy and plan".)

Construction work for port development, permission for usage of port infrastructure, facility and area should conform to the port policy and plan.
The port policy and plan should be coordinated among authorities concerned and other related entities. This system should be introduced as soon as possible.

10.3.2 Items to be included in the Port Policy and Plan

The port policy and plan are categorized into two levels, i.e., national level and individual port level.

(1) National Level

For the national level port policy and plan, following items are mainly defined.

1) Basic role of Panamanian ports
2) Capacity of Panamanian ports at target year
3) Functional allotment of each Panamanian port

(2) Individual Port Level

For the individual port level policy and plan, the following items are normally defined within the frame-work of the national level policy and plan.

1) Capacity of individual port at target year
2) Basic policy for utilization of water area in the port
3) Location and scale of port infrastructure and facilities

Important ports for the national economy, such as the ports of Cristobal and Balboa, should have an individual port policy and plan.
Considering tight financial conditions of APN, investment should be allocated preferentially to projects which are included in the policy and plan.

10.3.3 Effect of the Port Policy and Plan

To execute proper port development, port operation and management should be based on the port policy and plan. It is thought expedient to include certain control mechanisms of port development, port operation and management in the port policy and plan.

(1) Control of Water Area

Water area of port is one of the most important assets for port authorities because ports are the transit point of water and land transportation. If a port authority cannot control port area properly, it will be impossible even to accept ships in its port. Therefore, proper and strict control of water area by port authority is a necessity.
Any kind of exclusive use or activities at the water area should be regulated with permission of port authority. The permission should not be based on arbitrary decisions, but on the port policy and plan.

(2) Control of Land Area

Land areas used for port activities are currently owned by APN under its exclusive control. But, it seems that there is no concrete policy for land use or management of the area which is currently conducted according to case-by-case decision. Any activities in APN areas need permission based on the port policy and plans.

There is a possibility in future that APN will control private area beyond the present APN area for the purpose of proper and smooth port management and operation. In this case it will be better that APN controls this area to a certain extent including the prohibition of activities which seriously impede the utilization or preservation of the ports.

(3) Construction of Port Infrastructure and Facilities

Infrastructure and facilities for new construction or large scale improvement described in the port policy and plan should be given priority with special allocation of National budget.

10.3.4 Regulations for The Port Policy and Plan

(1) Procedure for Formulation of The Port Policy and Plan

Ports are important infrastructure for national interest. The port policy and plan indicates future condition of ports. Furthermore, the port policy and plan controls various kinds of activities in port areas. Therefore, it should be coordinated among authorities concerned. The port policy and plan should be formulated in a proper and fair manner under formal regulation.

(2) Restriction of Activities in Port Areas

In Panama, it is now regulated by law that all entities have to make concession contracts when carrying out certain activities such as exclusive use of port area. The criteria for restriction and kinds of activities should also be regulated formally.

10.3.5 Estimation of Future Demand and Improvement of Statistic System

In the port policy and plan, capacity of ports of target year is an important issue. To estimate the capacity, present cargo turnover needs to be analyzed.

But, present port statistics are not sufficient to analyze actual condition to formulate the port policy and plan. While total cargo volume of each port is calculated commodity wise, cargo volume is not arranged by destination and origin. These information which is necessary to estimate future demand exists on the original data sheets, but it is not input into the computer.
It is necessary to improve statistic system for future demand estimation and port policy formulation. This can be realized simply by improving office work system without introducing any new computer system.

10.3.6 Port Area

In the future, APN should designate and control all land and water areas which are necessary for proper port activities. This will include not only the APN area but also private areas.
Concerning water area, it should include sufficient turning basin and access water way.

10.4 Organization and Personnel

Efficient and safe cargo handling operation is the most important target for APN. Whole organization of APN must cooperate to realize this target.

10.4.1 Organization and Personnel Affairs

(1) APN Central Office

Concerning APN Central Office,

1) APN is independent from other national ministries. Because;

   a) APN has independent budget,
   b) APN can decide the port tariff and
   c) APN can execute construction work of port infrastructure and facilities.

2) APN Central Office has following divisions common to most port authorities.

   a) Planning Division, Engineering Division: responsible for port development plan, conducts construction work and maintenance of port infrastructure and facilities.
   b) Port Service Division: supervises cargo handling service and other port services.
   c) Administrative Division, Financial Division: deals with personnel, financial matters.
   d) Marketing Department: conducts port promotion activities.

As far as the organization structure concerned, no serious problems are observed.

However, if cargo handling service is commercialized, following administrative functions will be transferred to a private entity.

1) Calculation, billing, collection of cargo handling charge
2) Grievance procedure about cargo handling service
3) Management of cargo handling personnel

At the same time, each Division should tackle rather unexperienced field of works shown as follows.

1) Port Service Division;
   a) Supervise new container terminals operation
   b) Proper management of port area based on the port policy and plan

2) Administration Division:
   a) Creation of new personnel system towards commercialization of cargo handling service

3) Planning Division:
   a) Formulation of the port policy and plan described in 12.3
   b) Creation of new tariff system towards commercialization of cargo handling service
   c) Development of port statistic system

4) Financial Division:
   a) Preparation of financial strategy towards commercialization of cargo handling service.

APN Central Office has about 650 personnel, which seems to be too much. (In the case of one Japanese major port, Port and Harbor Bureau carries 25 million tons of cargo yearly, with only 200 personnel)

This is partly because APN conducts cargo handling service directly by their personnel. APN Central Office has personnel who are in charge of administration of cargo handling service. If cargo handling service is commercialized, these personnel will be transferred to private sector.
One of the other reasons is that APN Central Office has 200 security guards for port activities and public facilities. While this kind of activity is not easy to commercialize, some security works may be shifted to the private entities.

(2) Port Administration Office

If cargo handling service is privatized, the sections for cargo verification, cargo handling, warehouse will be separated from APN. Eventually the organization for mooring, water supply, repair work of cargo handling equipment, should also be separated.

However, the organization which conducts management of port infrastructure and facilities should be left under APN administration. The following management activities will be done by APN in such case.

1) Permission of usage of port infrastructure and facilities, berth allotment
2) Calculation, billing and collection of usage fee of port infrastructure and facilities
3) Maintenance of port infrastructure

(3) New Container Terminal

At container terminals, uniform operation is normally preferable. Concerning the new container terminal which will be constructed by the year 2000, however, it will be open to plural companies. Therefore, there is a possibility that an organization which centrally controls container operation will be necessary at this terminal.
It may be one solution that a joint corporation is established for this purpose by shipping companies and/or cargo handling companies. This company will grasp container yard condition, make container operation plan, give directions to cargo handling entities to coordinate in-yard container operation.

10.4.2 Personnel Evaluation System and Personal Movement

(1) Personnel Evaluation System, Promotion

It is thought necessary to raise morale of port authorities' staff and to promote their ability to discharge duties for proper port management. Personnel management system to realize this will be important.

One solution will be the introduction of a modern personnel evaluation system by which APN staffs can be objectively evaluated. Proper promotion and transfer of APN personnel based on ability of each staff will be possible by the system.
Introducing a staff evaluation report system is one effective means. This system should be introduced as soon as possible. When introducing and designing this report, following items should be taken into consideration for objective evaluation.

1) Evaluation items should be objective as much as possible.
2) Various staff evaluation reports should be carefully designed corresponding with the type of job and rank.
3) Certain fixed evaluation period should be adopted.

Contribution to improvement of port management should be counted in evaluating staff performance. Whether a person made any proposal to develop the management system, working efficiency should be included in the evaluation items.
Based on the evaluation, proper measures should be taken such as sending a person to proper training courses, or having his superior give him the necessary guidance. A well designed promotion system will stimulate the personnel incentives and will greatly contribute to developing overall quality of APN organization.

(2) Personnel Change

It will become more important to post the right person to the right place for APN to cope with new structural changes such as commercialization of cargo handling service. The above mentioned staff evaluation report system will be very useful in this respect.

In addition to this, personnel transfer system between APN Central Office and Port Administration Offices should be introduced.
To realize development of port management and operation, APN Central Office and Port Administration Offices should cope with this theme in cooperation with each other.
On the other hand, ports are unique spots where sea transport and land transport meet. Expert knowledge is needed to control port management and operation. All APN staff should be well versed in actual condition of the ports. They should all be highly qualified and have experience in port operation and management. Port Service Division needs such staffs in particular because it must play the role of leader in developing port efficiency. Therefore, persons who have experience of port operation site should be sent to APN Central Office.

10.4.3 Training System

(1) Training System for Office Worker

Concerning training system, some Ministries conduct training courses which are supervised and coordinated by MIPPE (Ministry of Planning and Economic Policy). The themes of the training courses are, however, specialized such as tax system, accounting system, legal knowledge, mainly for national public service officials. Since APN does not have such a training course for office workers, APN should have its personnel join above mentioned training courses.

In future, APN needs to develop its own training course. The purpose of the course will be to change mentality of APN office workers to cope with promoting efficiency of port management and operation. This type of training has not yet been introduced. The themes of the training should be as follows.

1) To change APN office workers mentality from "strict supervisors of public port" to "aggressive businessmen and salesmen providing good service to port users".

2) To make APN office worker recognize that all APN staffs must contribute to improve efficiency of port activities to survive competition with rival ports.

3) To make APN office worker recognize cost-consciousness.

(2) Training system for Operational Employees

Cargo handling service will be commercialized, at the same time, the operational employees of APN will be transferred to private sector. It will be important to further improve their technical ability to cope with modernized container handling operation. APN should examine the training system for operational employees to develop their ability to cope with more quick and reliable cargo handling.

10.5 Procurement System and Financial System

10.5.1 Procurement System

(1) Necessity of Modernization of Procurement System

According to our observation, APN seems to take much time in concluding procurement procedure which is strictly regulated by law. Since it is very important in operating modern container terminal to minimize idling time of cargo handling equipment, more effective procurement activities for spare parts of maintenance works are required in order to avoid possible delay of cargo handling for highly time conscious container vessels.

(2) Modernization of Procurement System

It is desirable that APN is able to purchase spare parts for cargo handling equipment through a more simplified procedure, if it is urgently necessary to avoid long time stoppage of cargo handling operation.
APN should appeal to ministries concerned to modernize the procurement system and realize it as soon as possible. In this case, APN should point out that if cargo handling stops for long time, it will result in serious damage not only to this terminal but also to Panamanian national economy.

10.5.2 Financial System

(1) Financial System

APN uses normal financial statements and is financially independent from other Ministries. There is not a serious defect observed in the financial system.
However, if operational personnel is transferred to private sector, personnel expense will be reduced accordingly, but cargo handling revenue will also be decreased. Cargo handling revenue is currently the major source for APN, so the financial condition will be drastically changed. The concession revenue will partially cover such cargo handling revenue.
Before commercialization of cargo handling service, APN should make a strategy concerning financial matters to realize sound financial condition.
APN should rationalize its management, through simplification of its organization. On the other hand APN should aggressively invest in construction work of container terminals which will be the most vital source of revenue.

(2) Contribution to the Government

Financial status of APN has improved gradually in recent years. APN has to pay an annual contribution to the Government. APN pays back its income to the Government in this way. It is thought inevitable that the Government collects this kind of

contribution from profitable institutions and uses it un-profitable divisions.

However, the amount of the contribution has considerably increased compared with the original budget according to the financial condition of the nation. This system makes financial position of APN unstable.
Ports are vital for the national economy and its security. Panamanian ports, the port of Cristobal in particular, can make a profit in the short term thanks to their excellent location and infrastructure including facilities transferred from the United States. But, new container terminal is necessary to secure stable income in the future.
APN should appeal to the ministries concerned to define criterion as soon as possible for deciding the amount of the contribution and to reserve financial resources for important projects such as new container terminals.

10.6 Provision of Services for Ships

10.6.1 Water Supply and Bunkering

To become a more attractive port for ships, the port of Cristobal should continue necessary water supply or bunkering service in addition to cargo handling service.

At new container terminals, water supply facilities for ships should be installed. It is desirable that APN will own such water supply facilities, but provision of service should be performed by suitable private companies.
The port of Cristobal is now the bunkering center for the ships which pass through the Panama Canal and which use the ports of Cristobal. The number of ships which call at the port of Cristobal is expected to increase. Ships which need bunkering service will also increase. The port of Cristobal should continue bunkering service.

10.6.2 Rapier Service for Ships

PCC (Panama Canal Commission) has a small size rapier shop at the mouth of the French Canal. This shop provides rapier service mainly to small ships such as tug boats, gates of locks of Panama Canal. These services are necessary for Panama Canal operation. This rapier shop will continue its service in this area.
On the other hand, larger size ships will be provided with repair service mainly at the ship yard of the port of Balboa.

10.7 Port Promotion

10.7.1 Necessity of Port Promotion

The Marketing Department in the Planning Division is in charge of port promotion, however, it does not seem to be pursued aggressively. APN marketing staff seldom call

at shipping companies, shipping agents or shippers for sales.

Since the current container handling capacity of the ports is not sufficient, APN position for sales activities is considered not realistic. But it is recommendable that port promotion should be aggressively performed for new container facilities. They should recognize that even if the capacity is small, there will be a chance to attract shipping companies by appealing to the total merit of the port. The staffs of the Marketing Department should become aggressive, and approach all companies which might possibly bring cargo to Panamanian ports in the future.

10.7.2 Port Promotion Strategy

For performing port promotion activities, it will be effective to take aim at main targets and to make strategies to attack the targets. This strategy should be established as soon as possible.

APN should take aim at container cargo including transhipment cargo for the Caribbean and Central/South American countries in particular, and call for sales at the shipping companies and shippers which carry the transhipment cargo. In this case, sales point should be focused on not only on the port facilities but on the merit of using Panamanian ports for the companies.

To make an attractive brochure for this purpose will be necessary. In this brochure, merits of Panamanian ports should be described plainly. It should be well designed so that everyone wants to take a look.

Holding seminars to introduce Panamanian ports to shippers of various countries is thought also effective.

10.7.3 Improvement of Port Statistic System

To formulate port promotion strategy, analysis of cargo turnover is necessary. But, present port statistics are not sufficient to analyze actual condition. Cargo statistics are not arranged by destination and origin by each commodity as mentioned 12.3.5.

It also necessary to provide easy access to port information with port users. This service will make the ports more attractive. Proper information service is mandatory to survive competition with rival ports.

It is necessary to improve statistic system to support formulation of the strategy. To establish quick and proper information service system is also desirable. Panamanian ports will be able to lead rival ports by implementing these systems.

APPENDIX

Appendix II-A-1 Cost Comparison of Alternative Sites

This Appendix shows the summary of construction cost. Refer to Chapter 8 of Part II.

** Legend **

Case : SITE-P14 B1

P : Existing Pier and Existing Container Terminal
C : West Colon
T : Telfers
F : French Canal
CS : Coco Solo

14 : Depth of water and Wharf design depth
12 : -ditto-

B1 : Berth at the existing Pier No. 9
B2 : New berth for the Short-term Development
B3/4 : New berths for the Master Plan stage
Note : Cost in case of depth change is also shown in the last page of each case.

The refined cost estimation is shown in Appendix III-A-1 of Part III.

TABLE P14 B1 CRISTOBAL PORT COST ESTIMATION : Summary

Case: SITE - P14 B1

Work Category		Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
A.	General Works						1,387,500
B.	Marine Works						1,732,540
C.	On-land Works						5,790,670
D.	Building						423,300
E.	Utilities						540,720
F.	Supplemental Works						383,000
G.	Others						0
H.		Subtotal					10,221,730
I.	Contingency	Physical (15 % of H)					1,533,260
J.	Engineering	(10 % of H)					1,022,170
K.		Total (H + I + J)					12,777,160
	Land Use						
	Total Area			13.30+0.25	ha	100.0%	
	Back apron			1.50	ha	11.1	
	Inner access			2.13	ha	15.7	
	Yard pavement	(1) Gravel pavement		0	ha	0	
	Yard pavement	(2) Light pavement		0	ha	0	
	Yard pavement	(3) Normal pavement		6.61	ha	48.8	
	Yard pavement	(4) Heavy pavement C2		0	ha	0	
	Yard pavement	(5) Heavy pavement C3		0	ha	0	
	Building			0.78	ha	5.8	
	Parks			0.20	ha	1.5	
	Reserves			1.14	ha	8.4	
	Multi-Purpose Area			1.19	ha	8.7	
A.	General Works						
		Mobilization/Demobilization					200,000
		Mobilization/Demobilization					0
		Site Common Works					1,187,500
		Subtotal					1,387,500
B.	Marine Works						
		Seabed Clearance	$/B	101,000	B	0	0
		Dredging and reclamation	$/m³	1.80	m³	0	0
		Dredging and reclamation	$/m³	5.40	m³	0	0
		Dredging and reclamation	$/m³	54.0	m³	0	0
		Dredging and disposal	$/m³	2.76	m³	0	0
		Dredging and disposal	$/m³	9.96	m³	0	0
		Borrowing and reclamation	$/m³	4.80	m³	0	0
		Seawall (1) +3.6 m~±0.0m	$/m	1,280	m	310	396,800
		(2) ±0.0 ~ -5.0	$/m	2,454	m	310	760,740
		(3) -5.0 ~ -10.0	$/m	7,987	m	0	0
		(4) -10.0 ~ -15.0	$/m	15,375	m	0	0
		Wharf (1) -10.0 m	$/m		m	0	0
		(2) -12.0 m	$/m		m	0	0

Case: SITE - P14 B1

Work Category		Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
		(3) -14.0 m	$/m	0	m	0	0
		Ro-Ro System	LS	575,000	set	1	575,000
		Subtotal					1,732,540
C.	On-land Works						
		Soil Improvement	$/ha	700,000	ha	0	0
		Inner access	$/m²	69.6	m²	0	0
		Back apron	$/m²	131.5	m²	(15,000)	0
		Pavement Repairing	$/m²	100.0	m²	1,848	184,800
		Pavement (1) Gravel pave.	$/m²	39.0	m²	0	0
		(2) Light pave.	$/m²	69.6	m²	0	0
		(3) Normal pave.	$/m²	105.3	m²	49,800	5,243,940
		(4) Heavy pave. C2	$/m²	150.0	m²	0	0
		(5) Heave pave. C3	$/m²	411.6	m²	0	0
		Storm water Drainage	$/ha	53,000	ha	5.19	275,070
		Pavement Marking	$/m²	20.0	m²	4,300	86,860
		Subtotal					5,790,670
D.	Building					(7,850 m²)	
		Main Gate	$/m²	567	m²	(450)	0
		Control House	$/m²	1,170	m²	(800)	0
		Maintenance Shops	$/m²	1,042	m²	(1,000)	0
		CFS	$/m²	846	m²	(4,400)	0
		Substation/Power station	$/m²	602	m²	(700)	0
		Passenger Terminal	$/m²	450	m²	0	0
		Misc., buildings	$/m²	570	m²	500	285,000
		Weigh bridge	$/set	76,300	set	0	0
		Over-head passenger bridge	$/m	3,000	m	0	0
		Fence	$/m	123	m	200	24,600
		Park	$/m²	35	m²	2,000	70,000
		Landscaping	$/m²	19	m²	2,300	43,700
		Subtotal					423,300
E.	Utilities						
		Water Supply (Main)	$/B	175,000	B	0	0
		Water Supply (Dis.)	$/ha	20,000	ha	0	0
		Fire fighting	$/ha	2,000	ha	0	0
		Sewerage	$/ha	9,300	ha	0	0
		Power Supply (Distr.)	$/B	1,020,000	B	0.2	204,000
		Power Supply (P. Plant)	$/B	530,000	B	0	0
		Power Supply (W. Crane)	$/B	455,000	B	0	0
		Lighting (Yard)	$/B	240,000	B	0.2	120,000
		Lighting (Road)	$/ha	24,000	ha	1.28	30,720
		Telecommunication	$/B	42,000	B	0	0
		Reefer System	$/B	100,000	B	0	0
		Bunker System	$/m	1,000	m	0	0
		Misc., utilities			LS	1	150,000
		Subtotal					540,720
F.	Supplemental Works						
		Navigational aid	$/B	500,000	B	0	0
		Outer access (new)	$/m²	105.3	m²	0	0
		Outer access (improve)	$/m²	34.8	m²	2,500	87,000
		Demolishing					
		Demolishing (Pier No. 16)	$/m³	40	m³	0	0

Case: SITE - P14 B1

Work Category		Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
		Demolishing (Small pier)	$/pier	10,000	pier	0	0
		Demolishing (Onland civil)	$/m²	3	m²	32,000	96,000
		Demolishing (Building)	$/m²	100	m²	2,000	200,000
		Environmental protection			LS	0	0
		Misc. works			LS	0	0
		Subtotal					383,000
G.	Others						
		Flyover	$/m²	2,500	m²	0	0
		Bunker pier reinstallation	$/set	11,000,000	set	0	0
		Loading arms	$/set	440,000	set	0	0
		Bunker lines	$/m	2,000	m	0	0
		Breakwater Improvement	$/m	4,000	m	0	0
		Subtotal					0
	Cost by Wharf Depth						
	Cost P-14/12	B1					10,221,730
	Cost P-12	B1					10,221,730

TABLE C14 B2 CRISTOBAL PORT COST ESTIMATION : Summary

Case: SITE - C14 B2

Work Category		Works		Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
A.	General Works							4,500,000
B.	Marine Works							20,787,600
C.	On-land Works							14,434,540
D.	Building							6,241,530
E.	Utilities							3,232,500
F.	Supplemental Works							2,884,090
G.	Others							0
H.		Subtotal						52,080,260
I.	Contingency	Physical	(15 % of H)					7,812,040
J.	Engineering		(10 % of H)					5,208,020
K.		Total	(H + I + J)					65,100,320
	Land Use							
	Total Area				10.50	ha	100.0 %	
	Back apron				0.50	ha	4.8	
	Inner access				2.63	ha	25.0	
	Yard pavement	(1) Gravel pavement			0.22	ha	2.2	
	Yard pavement	(2) Light pavement			1.05	ha	10.0	
	Yard pavement	(3) Normal pavement			3.78	ha	36.0	
	Yard pavement	(4) Heavy pavement C2			0.47	ha	4.4	
	Yard pavement	(5) Heavy pavement C3			0.47	ha	4.4	
	Building				0.70	ha	6.7	
	Parks				0.21	ha	2.0	
	Reserves				0.47	ha	4.5	
A.	General Works							
		Mobilization/Demobilization						500,000
		Mobilization/Demobilization						1,625,000
		Site Common Works						2,375,000
		Subtotal						4,500,000
B.	Marine Works							
		Seabed Clearance		$/B	101,000	B	1	101,000
		Dredging and reclamation		$/m³	1.80	m³	0	0
		Dredging and reclamation		$/m³	5.40	m³	0	0
		Dredging and reclamation		$/m³	54.0	m³	0	0
		Dredging and disposal		$/m³	2.76	m³	819,000	2,260,440
		Dredging and disposal		$/m³	9.96	m³	0	0
		Borrowing and reclamation		$/m³	4.80	m³	1,785,000	8,568,000
		Seawall	(1) +3.6 m~±0.0m	$/m	3,466	m	50	173,300
			(2) ±0.0 ~-5.0	$/m	5,814	m	100	581,400
			(3) -5.0 ~ -10.0	$/m	8,894	m	440	3,913,360
			(4) -10.0 ~ -15.0	$/m	16,282	m	150	2,442,300
		Wharf	(1) -10.0 m	$/m		m	0	0
			(2) -12.0 m	$/m	61,700	m	0	0

Case: SITE - C14 B2

Work Category		Works		Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
			(3) -14.0 m	$/m	67,900	m	32	2,172,800
		Ro-Ro System		LS	575,000	set	1	575,000
		Subtotal						20,787,600
C.	On-land Works							
		Soil Improvement		$/ha	700,000	ha	5.25	3,675,000
		Inner access		$/m²	69.6	m²	26,300	1,830,480
		Back apron		$/m²	131.5	m²	(5,100)	0
		Side apron		$/m²	131.5	m²	7,000	920,500
		Pavement	(1) Gravel pave.	$/m²	39.0	m²	2,600	101,400
			(2) Light pave.	$/m²	69.6	m²	10,500	730,800
			(3) Normal pave.	$/m²	105.3	m²	37,800	3,980,340
			(4) Heavy pave. C2	$/m²	150.0	m²	4,700	705,000
			(5) Heavy pave. C3	$/m²	411.6	m²	4,700	1,934,520
		Stom water Drainage		$/ha	53,000	ha	10.5	556,500
		Subtotal						14,434,540
D.	Building						(7,000 m²)	
		Main Gate		$/m²	567	m²	650	368,550
		Control House		$/m²	1,170	m²	1,000	1,170,000
		Maintenance Shops		$/m²	1,042	m²	1,000	1,042,000
		CFS		$/m²	846	m²	2,500	2,115,000
		Substation/Power station		$/m²	602	m²	1,050	632,100
		Passenger Terminal		$/m²	450	m²	0	0
		Misc., buildings		$/m²	570	m²	800	456,000
		Weigh bridge		$/set	76,300	set	2	152,600
		Over-head passenger bridge		$/m	3,000	m	0	0
		Fence		$/m	123	m	1,560	191,880
		Park		$/m²	35	m²	2,100	73,500
		Landscaping		$/m²	19	m²	2,100	39,900
		Subtotal						6,241,530
E.	Utilities							
		Water Supply (Main)		$/B	175,000	B	1	175,500
		Water Supply (Dis.)		$/ha	20,000	ha	10.50	210,000
		Fire fighting		$/ha	2,000	ha	10.50	21,000
		Sewerage		$/ha	9,300	ha	10.50	97,650
		Power Supply (Distr.)		$/B	1,020,000	B	1	1,020,000
		Power Supply (P. Plant)		$/B	530,000	B	1	530,000
		Power Supply (W. Crane)		$/B	455,000	B	1	455,000
		Lighting (Yard)		$/B	240,000	B	1	240,000
		Lighting (Road)		$/ha	24,000	ha	3.68	88,320
		Telecommunication		$/B	42,000	B	1	42,000
		Reefer System		$/B	100,000	B	1	100,000
		Bunker System		$/m	1,000	m	0	0
		Misc., utilities				LS	1	253,530
		Subtotal						3,232,500
F.	Supplemental Works							
		Navigational aid		$/B	500,000	B	0	0
		Outer access (new)		$/m²	105.3	m²	2,500	263,250
		Outer access (improve)		$/m²	34.8	m²	7,500	261,000
		Demolishing						

Case: SITE - C14 B2

Work Category		Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
		Demolishing (Pier No. 7 shed)	$/m²	80	m²	7,900	632,000
		Demolishing (Pier No. 16)	$/m³	40	m³	0	0
		Demolishing (Small pier)	$/pier	10,000	pier	0	0
		Demolishing (Onland civil)	$/m²	3	m²	10,000	30,000
		Demolishing (Building)	$/m²	100	m²	1,000	100,000
		Environmental protection			LS	1	324,850
		Misc. works			LS	1	353,340
		Pavement after P7 shed	$/m²	66.0	m²	7,900	521,400
		Mole yard pavement	$/m²	69.6	m²	4,860	338,250
		Mole road repair	$/m²	100.0	m²	600	60,000
		Subtotal					2,884,090
G.	Others						
		Flyover	$/m²	2,500	m²	0	0
		Bunker pier reinstallation	$/set	11,000,000	set	0	0
		Loading arms	$/set	440,000	set	0	0
		Bunker lines	$/m	2,000	m	0	0
		Breakwater Improvement	$/m	4,000	m	0	0
		Subtotal					0
	Cost by Wharf Depth						
	Cost C-14/12	B2					52,080,260
	Cost C-14	B2					52,080,260

TABLE C14 B3/4 CRISTOBAL PORT COST ESTIMATION : Summary

Case: SITE - C14 B3/4

Work Category		Works		Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
A.	General Works							7,312,500
B.	Marine Works							79,607,520
C.	On-land Works							30,486,280
D.	Building							16,567,060
E.	Utilities							7,215,000
F.	Supplemental Works							4,737,950
G.	Others							0
H.		Subtotal						145,926,310
I.	Contingency	Physical	(15 % of H)					21,888,950
J.	Engineering		(10 % of H)					14,592,630
K.		Total	(H + I + J)					182,407,890
	Land Use							
	Total Area				21.00	ha	100 %	
	Back apron				1.00	ha	4.8	
	Inner access				5.26	ha	25.0	
	Yard pavement	(1) Gravel pavement			0.44	ha	2.1	
	Yard pavement	(2) Light pavement			2.10	ha	10.0	
	Yard pavement	(3) Normal pavement			7.56	ha	36.0	
	Yard pavement	(4) Heavy pavement C2			0.94	ha	4.5	
	Yard pavement	(5) Heavy pavement C3			0.94	ha	4.5	
	Building				2.00	ha	9.5	
	Parks				0.42	ha	2.0	
	Reserves				0.34	ha	1.6	
A.	General Works							
		Mobilization/Demobilization						500,000
		Mobilization/Demobilization						3,250,000
		Site Common Works						3,562,500
		Subtotal						7,312,500
B.	Marine Works							
		Seabed Clearance		$/B	101,000	B	2	202,000
		Dredging and reclamation		$/m³	1.80	m³	0	0
		Dredging and reclamation		$/m³	5.40	m³	0	0
		Dredging and reclamation		$/m³	54.0	m³	0	0
		Dredging and disposal		$/m³	2.76	m³	4,824,000	13,314,240
		Dredging and disposal		$/m³	9.96	m³	0	0
		Borrowing and reclamation		$/m³	4.80	m³	3,990,000	19,152,000
		Seawall	(1) +3.6 m~±0.0m	$/m	2,559	m	50	127,950
			(2) ±0.0 ~ - 5.0	$/m	4,907	m	100	490,700
			(3) -5.0 ~ -10.0	$/m	7,987	m	240	1,916,880
			(4) -10.0 ~ -15.0	$/m	15,375	m	90	1,383,750
		Wharf	(1) -10.0 m	$/m		m	0	0
			(2) -12.0 m	$/m	61,700	m	0	0

Case: SITE - C14 B3/4

Work Category		Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
		(3) -14.0 m	$/m	67,900	m	600	40,740,000
		Ro-Ro System	LS	2,280,000	set	1	2,280,000
		Subtotal					79,607,520
C.	On-land Works						
		Soil Improvement	$/ha	700,000	ha	14.70	10,290,000
		Inner access	$/m²	69.6	m²	52,600	3,660,960
		Back apron	$/m²	131.5	m²	(10,200)	0
		Side apron	$/m²	131.5	m²	4,000	526,000
		Pavement (1) Gravel pave.	$/m²	39.0	m²	5,000	195,000
		(2) Light pave.	$/m²	69.6	m²	21,000	1,461,600
		(3) Normal pave.	$/m²	105.3	m²	75,600	7,960,680
		(4) Heavy pave. C2	$/m²	150.0	m²	9,400	1,410,000
		(5) Heave pave. C3	$/m²	411.6	m²	9,400	3,869,040
		Storm water Drainage	$/ha	53,000	ha	21.0	1,113,000
		Subtotal					30,486,280
D.	Building					(20,000 m²)	
		Main Gate	$/m²	567	m²	1,300	737,100
		Control House	$/m²	1,170	m²	2,000	2,340,000
		Maintenance Shops	$/m²	1,042	m²	3,000	3,126,000
		CFS	$/m²	846	m²	7,000	5,922,000
		Substation/Power station	$/m²	602	m²	2,100	1,264,200
		Passenger Terminal	$/m²	450	m²	3,000	1,350,000
		Misc., buildings	$/m²	570	m²	1,600	912,000
		Weigh bridge	$/set	76,300	set	4	305,200
		Over-head passenger bridge	$/m	3,000	m	0	0
		Fence	$/m	123	m	3,120	383,760
		Park	$/m²	35	m²	4,200	147,000
		Landscaping	$/m²	19	m²	4,200	79,800
		Subtotal					16,567,060
E.	Utilities						
		Water Supply (Main)	$/B	175,000	B	2	350,000
		Water Supply (Dis.)	$/ha	20,000	ha	21.00	420,000
		Fire fighting	$/ha	2,000	ha	21.00	42,000
		Sewerage	$/ha	9,300	ha	21.00	195,300
		Power Supply (Distr.)	$/B	1,020,000	B	2	2,040,000
		Power Supply (P. Plant)	$/B	530,000	B	2	1,060,000
		Power Supply (W. Crane)	$/B	455,000	B	2	910,000
		Lighting (Yard)	$/B	240,000	B	2	480,000
		Lighting (Road)	$/ha	24,000	ha	7.36	176,640
		Telecommunication	$/B	42,000	B	2	84,000
		Reefer System	$/B	100,000	B	2	200,000
		Bunker System	$/m	1,000	m	750	750,000
		Misc., utilities			LS	2	507,060
		Subtotal					7,215,000
F.	Supplemental Works						
		Navigational aid	$/B	500,000	B	2	1,000,000
		Outer access (new)	$/m²	105.3	m²	0	0
		Outer access (improve)	$/m²	34.8	m²	0	0
		Demolishing					
		Demolishing (Pier No. 16)	$/m³	40	m³	0	0

Case: SITE - C14 B3/4

Work Category		Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
		Demolishing (Small pier)	$/pier	10,000	pier	0	0
		Demolishing (Onland civil)	$/m²	3	m²	0	0
		Demolishing (Building)	$/m²	100	m²	1,500	150,000
		Environmental protection			LS	1	973,990
		Misc. works			LS	1	754,020
		Mole yard pavement	$/m²	69.6	m²	24,000	1,670,400
		Mole road pavement	$/m²	105.3	m²	1,800	189,540
		Subtotal					4,737,950
G.	Others						
		Flyover	$/m²	2,500	m²	0	0
		Bunker pier reinstallation	$/set	11,000,000	set	0	0
		Loading arms	$/set	440,000	set	0	0
		Bunker lines	$/m	2,000	m	0	0
		Breakwater Improvement	$/m	4,000	m	0	0
		Subtotal					0
	Cost by Wharf Depth						
	Cost C14	B 3/4					145,926,310
	Marine Works	Dredging reduction	$/m³	2.76	m³	1,625,000	-4,485,000
		Supplement reduction			LS	0	0
		Total reduction					-4,485,000
	Cost C14/12	B 3/4					141,441,310
	Cost C14						145,926,310
	Marine Works	Reduction 14/12					-4,485,000
		Wharf cost reduction	$/m	6,200	m	600	-3,720,000
		Supplemental reduction			LS	0	0
		Total reduction					-8,205,000
	Cost C12	B 3/4					137,721,310

TABLE T14 B2 CRISTOBAL PORT COST ESTIMATION : Summary

Case: SITE - T14 B2

Work Category		Works		Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
A.	General Works							5,250,000
B.	Marine Works							29,403,020
C.	On-land Works							9,913,140
D.	Building							6,172,650
E.	Utilities							3,732,500
F.	Supplemental Works							4,847,790
G.	Others							0
H.		Subtotal						59,319,100
I.	Contingency	Physical	(15 % of H)					8,897,860
J.	Engineering		(10 % of H)					5,931,910
K.		Total	(H + I + J)					74,148,870
	Land Use							
	Total Area				10.50	ha	100.0 %	
	Back apron				0.50	ha	4.8	
	Inner access				2.63	ha	25.0	
	Yard pavement	(1) Gravel pavement			0.22	ha	2.2	
	Yard pavement	(2) Light pavement			1.05	ha	10.0	
	Yard pavement	(3) Normal pavement			3.78	ha	36.0	
	Yard pavement	(4) Heavy pavement C2			0.47	ha	4.4	
	Yard pavement	(5) Heavy pavement C3			0.47	ha	4.4	
	Building				0.70	ha	6.7	
	Parks				0.21	ha	2.0	
	Reserves				0.47	ha	4.5	
A.	General Works	Mobilization/Demobilization						500,000
		Mobilization/Demobilization						1,625,000
		Site Common Works						3,125,000
		Subtotal						5,250,000
B.	Marine Works							
		Seabed Clearance		$/B	101,000	B	1	101,000
		Dredging and reclamation		$/m³	1.80	m³	90,000	162,000
		Dredging and reclamation		$/m³	5.40	m³	90,000	486,000
		Dredging and reclamation		$/m³	54.0	m³	0	0
		Dredging and disposal		$/m³	2.76	m³	722,500	1,994,100
		Dredging and disposal		$/m³	9.96	m³	0	0
		Borrowing and reclamation		$/m³	4.80	m³	607,000	2,913,600
		Seawall	(1) +3.6 m~±0.0m	$/m	2,559	m	0	0
			(2) ±0.0 ~ -5.0	$/m	4,907	m	300	1,472,100
			(3) -5.0 ~ -10.0	$/m	7,987	m	60	479,220
			(4) -10.0 ~ -15.0	$/m	15,375	m	40	615,000
		Wharf	(1) -10.0 m	$/m		m	0	0
			(2) -12.0 m	$/m	58,700	m	0	0
			(3) -14.0 m	$/m	63,000	m	300	18,900,000
		Ro-Ro System		LS	2,280,000	set	1	2,280,000
		Subtotal						29,403,020
C.	On-land Works							
		Soil Improvement		$/ha	700,000	ha	0	0
		Inner access		$/m²	69.6	m²	26,300	1,830,480
		Back apron		$/m²	131.5	m²	(5,100)	0
		Side apron		$/m²	131.5	m²	0	0
		Pavement	(1) Gravel pave.	$/m²	39.0	m²	4,500	175,500
			(2) Light pave.	$/m²	69.6	m²	10,500	730,800
			(3) Nomal pave.	$/m²	105.3	m²	37,800	3,980,340
			(4) Heavy pave. C2	$/m²	150.0	m²	4,700	705,000
			(5) Heavy pave. C3	$/m²	411.6	m²	4,700	1,934,520
		Stom water Drainage		$/ha	53,000	ha	10.5	556,500
		Subtotal						9,913,140
D.	Building						(7,000 m²)	
		Main Gate		$/m²	567	m²	650	368,550
		Control House		$/m²	1,170	m²	1,000	1,170,000
		Maintenance Shops		$/m²	1,042	m²	1,000	1,042,000
		CFS		$/m²	846	m²	2,500	2,115,000
		Substation/Power station		$/m²	602	m²	1,050	632,100
		Passenger Terminal		$/m²	450	m²	0	0
		Misc., buildings		$/m²	570	m²	800	456,000
		Weigh bridge		$/set	76,300	set	2	152,600
		Over-head passenger bridge		$/m	3,000	m	0	0
		Fence		$/m	123	m	1,000	123,000
		Park		$/m²	35	m²	2,100	73,500
		Landscaping		$/m²	19	m²	2,100	39,900
		Subtotal						6,172,650
E.	Utilities							
		Water Supply (Main)		$/B	175,000	B	1	175,000
		Water Supply (Dis.)		$/ha	20,000	ha	10.50	210,000
		Fire fighting		$/ha	2,000	ha	10.50	21,000
		Sewerage		$/ha	9,300	ha	10.50	97,650
		Power Supply (Distr.)		$/B	1,020,000	B	1	1,020,000
		Power Supply (P. Plant)		$/B	530,000	B	1	530,000
		Power Supply (W. Crane)		$/B	455,000	B	1	455,000
		Lighting (Yard)		$/B	240,000	B	1	240,000
		Lighting (Road)		$/ha	24,000	ha	3.68	88,320
		Telecommunication		$/B	42,000	B	1	42,000
		Reefer System		$/B	100,000	B	1	100,000
		Bunker System		$/m	1,000	m	500	500,000
		Misc., utilities				LS	1	253,530
		Subtotal						3,732,500
F.	Supplemental Works							
		Navigational aid		$/B	500,000	B	1	500,000
		Outer access (new)		$/m²	105.3	m²	20,000	2,106,000
		Outer access (improve)		$/m²	34.8	m²	7,200	250,560
		Demolishing						

Case: SITE - T14 B2

Work Category		Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
		Demolishing (Pier No. 7 shed)	$/m²	80	m²	7,900	632,000
		Demolishing (Pier No. 16)	$/m³	40	m³	0	0
		Demolishing (Small pier)	$/pier	10,000	pier	0	0
		Demolishing (Onland civil)	$/m²	3	m²	0	0
		Demolishing (Building)	$/m²	100	m²	0	0
		Environmental protection			LS	1	166,670
		Misc. works			LS	1	272,910
		Pavement after P7 shed	$/m²	66.0	m²	7,900	521,400
		Mole yard pavement	$/m²	69.6	m²	4,860	338,250
		Mole road repair	$/m²	100.0	m²	600	60,000
		Subtotal					4,847,790
G.	Others						
		Flyover	$/m²	2,500	m²	0	0
		Bunker pier reinstallation	$/set	11,000,000	set	0	0
		Loading arms	$/set	440,000	set	0	0
		Bunker lines	$/m	2,000	m	0	0
		Breakwater Improvement	$/m	4,000	m	0	0
		Subtotal					0
	Cost by Wharf Depth						
	Cost T-14	B2					59,319,100
	Marine Works	Dredging reduction	$/m³	2.76	m³	800,000	-2,208,000
		Supplemental reduction			LS	0	0
		Total reduction					-2,208,000
	Cost T-14/12	B2					57,111,100
	Cost T-14						59,319,100
	Marine Works	Reduction 14/12					-2,208,000
		Wharf cost reduction	$/m	4,300	m	300	-1,290,000
		Supplemental reduction			LS	0	0
		Total reduction					-3,498,000
	Cost T-12	B2					55,821,100

TABLE T14 B3/4 CRISTOBAL PORT COST ESTIMATION : Summary

Case: SITE - T14 B3/4

Work Category		Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
A.	General Works						6,437,500
B.	Marine Works						52,021,120
C.	On-land Works						19,826,280
D.	Building						16,429,300
E.	Utilities						7,065,000
F.	Supplemental Works						6,851,940
G.	Others						0
H.		Subtotal					108,631,140
I.	Contingency	Physical (15 % of H)					16,294,670
J.	Engineering	(10 % of H)					10,863,110
K.		Total (H + I + J)					135,788,920
	Land Use						
	Total Area			21.00	ha	100.0 %	
	Back apron			1.00	ha	4.8	
	Inner access			5.26	ha	25.0	
	Yard pavement	(1) Gravel pavement		0.44	ha	2.1	
	Yard pavement	(2) Light pavement		2.10	ha	10.0	
	Yard pavement	(3) Normal pavement		7.56	ha	36.0	
	Yard pavement	(4) Heavy pavement C2		0.94	ha	4.5	
	Yard pavement	(5) Heavy pavement C3		0.94	ha	4.5	
	Building			2.00	ha	9.5	
	Parks			0.42	ha	2.0	
	Reserves			0.34	ha	1.6	
A.	General Works	Mobilization/Demobilization					500,000
		Mobilization/Demobilization					1,625,000
		Site Common Works					4,312,500
		Subtotal					6,437,500
B.	Marine Works						
		Seabed Clearance	$/B	101,000	B	2	202,000
		Dredging and reclamation	$/m³	1.80	m³	40,500	72,900
		Dredging and reclamation	$/m³	5.40	m³	40,500	218,700
		Dredging and reclamation	$/m³	54.0	m³	0	0
		Dredging and disposal	$/m³	2.76	m³	324,000	894,240
		Dredging and disposal	$/m³	9.96	m³	0	0
		Borrowing and reclamation	$/m³	4.80	m³	1,566,000	7,516,800
		Seawall (1) +3.6 m~±0.0m	$/m	2,559	m	200	511,800
		(2) ±0.0 ~ -5.0	$/m	4,907	m	300	1,472,100
		(3) -5.0 ~ -10.0	$/m	7,987	m	90	718,830
		(4) -10.0 ~ -15.0	$/m	15,375	m	170	2,613,750
		Wharf (1) -10.0 m	$/m		m	0	0
		(2) -12.0 m	$/m	58,700	m	0	0

Case: SITE - T14 B3/4

Work Category		Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
		(3) -14.0 m	$/m	63,000	m	600	37,800,000
		Ro-Ro System	LS	2,280,000	set	0	0
		Subtotal					52,021,120
C.	On-land Works						
		Soil Improvement	$/ha	700,000	ha	0	0
		Inner access	$/m²	69.6	m²	52,600	3,660,960
		Back apron	$/m²	131.5	m²	(10,200)	0
		Side apron	$/m²	131.5	m²	0	0
		Pavement (1) Gravel pave.	$/m²	39.0	m²	9,000	351,000
		(2) Light pave.	$/m²	69.6	m²	21,000	1,461,600
		(3) Normal pave.	$/m²	105.3	m²	75,600	7,960,680
		(4) Heavy pave. C2	$/m²	150.0	m²	9,400	1,410,000
		(5) Heavy pave. C3	$/m²	411.6	m²	9,400	3,869,040
		Storm water Drinage	$/ha	53,000	ha	21.0	1,113,000
		Subtotal					19,826,280
D.	Building					(20,000 m²)	
		Main Gate	$/m²	567	m²	1,300	737,100
		Control House	$/m²	1,170	m²	2,000	2,340,000
		Maintenance Shops	$/m²	1,042	m²	3,000	3,126,000
		CFS	$/m²	846	m²	7,000	5,922,000
		Substation/Power station	$/m²	602	m²	2,100	1,264,200
		Passenger Terminal	$/m²	450	m²	3,000	1,350,000
		Misc., buildings	$/m²	570	m²	1,600	912,000
		Weigh bridge	$/set	76,300	set	4	305,200
		Over-head passenger bridge	$/m	3,000	m	0	0
		Fence	$/m	123	m	2,000	246,000
		Park	$/m²	35	m²	4,200	147,000
		Landscaping	$/m²	19	m²	4,200	79,800
		Subtotal					16,429,300
E.	Utilities						
		Water Supply (Main)	$/B	175,000	B	2	350,000
		Water Supply (Dis.)	$/ha	20,000	ha	21.00	420,000
		Fire fighting	$/ha	2,000	ha	21.00	42,000
		Sewerage	$/ha	9,300	ha	21.00	195,300
		Power Supply (Distr.)	$/B	1,020,000	B	2	2,040,000
		Power Supply (P. Plant)	$/B	530,000	B	2	1,060,000
		Power Supply (W. Crane)	$/B	455,000	B	2	910,000
		Lighting (Yard)	$/B	240,000	B	2	480,000
		Lighting (Road)	$/ha	24,000	ha	7.36	176,640
		Telecommunication	$/B	42,000	B	2	84,000
		Reefer System	$/B	100,000	B	2	200,000
		Bunker System	$/m	1,000	m	600	600,000
		Misc., utilities			LS	2	507,060
		Subtotal					7,065,000
F.	Supplemental Works						
		Navigational aid	$/B	500,000	B	1	500,000
		Outer access (to Bolivar)	$/m²	105.3	m²	27,000	2,843,100
		Outer access (bridge)	ea	700,000	ea	1	700,000
		Demolishing					

Case: SITE - T14 B3/4

Work Category		Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
		Demolishing (Pier No. 16)	$/m³	40	m³	0	0
		Demolishing (Small pier)	$/pier	10,000	pier	0	0
		Demolishing (Onland civil)	$/m²	3	m²	0	0
		Demolishing (Building)	$/m²	100	m²	1,500	150,000
		Environmental protection			LS	1	261,080
		Misc. works			LS	1	537,820
		Mole yard pavement	$/m²	69.6	m²	24,000	1,670,400
		Mole raod pavement	$/m²	105.3	m²	1,800	189,540
		Subtotal					6,851,940
G.	Others						
		Flyover	$/m²	2,500	m²	0	0
		Bunker pier reinstallation	$/set	11,000,000	set	0	0
		Loading arms	$/set	440,000	set	0	0
		Bunker lines	$/m	2,000	m	0	0
		Breakwater Improvement	$/m	4,000	m	0	0
		Subtotal					0
	Cost by Wharf Depth						
	Cost T-14	B3/4					108,631,140
	Marine Works	Dredging Reduction	$/m³	2.76	m³	170,000	-469,200
	Supplemental	Reduction			LS	0	0
		Total reduction					-469,200
	Cost T-14/12						108,161,940
	Cost T-14	B3/4					108,631,140
	Marine Works	Reduction 14/12					-469,200
		Wharf cost reduction	$/m	4,300	m	600	-2,580,000
		Supplemental reduction			LS	0	0
							-3,049,200
	Cost T-12	B3/4					105,581,940

TABLE T14 B6 CRISTOBAL PORT COST ESTIMATION : Summary

Case: SITE - T14 B6

	Work Category	Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
A.	General Works						5,250,000
B.	Marine Works						25,744,040
C.	On-land Works						9,913,140
D.	Building						6,129,600
E.	Utilities						3,532,500
F.	Supplemental Works						3,997,810
G.	Others						0
H.		Subtotal					54,567,090
I.	Contingency	Physical (15 % of H)					8,185,060
J.	Engineering	(10 % of H)					5,456,710
K.		Total (H + I + J)					68,208,860
	Land Use						
	Total Area			10.50	ha	100.0 %	
	Back apron			0.50	ha	4.8	
	Inner access			2.63	ha	25.0	
	Yard pavement	(1) gravel pavement		0.22	ha	2.2	
	Yard pavement	(2) Light pavement		1.05	ha	10.0	
	Yard pavement	(3) Normal pavement		3.78	ha	36.0	
	Yard pavement	(4) Heavy pavement C2		0.47	ha	4.4	
	Yard pavement	(5) Heavy pavement C3		0.47	ha	4.4	
	Building			0.70	ha	6.7	
	Parks			0.21	ha	2.0	
	Reserves			0.47	ha	4.5	
A.	General Works						
		Mobilization/Demobilization					500,000
		Mobilization/Demobilization					1,625,000
		Site Common Works					3,125,000
		Subtotal					5,250,000
B.	Marine Works						
		Seabed Clearance	S/B	101,000	B	1	101,000
		Dredging and reclamation	$/m³	1.80	m³	20,000	36,000
		Dredging and reclamation	$/m³	5.40	m³	20,000	108,000
		Dredging and reclamation	$/m³	54.0	m³	0	0
		Dredging and disposal	$/m³	2.76	m³	162,000	447,120
		Dredging and disposal	$/m³	9.96	m³	0	0
		Borrowing and reclamation	$/m³	4.80	m³	747,000	3,585,600
		Seawall (1) +3.6 m~±0.0m	$/m	2,559	m	0	0
		(2) ±0.0 ~ -5.0	$/m	4,907	m	300	1,472,100
		(3) -5.0 ~ -10.0	$/m	7,987	m	60	479,220
		(4) -10.0 ~ -15.0	$/m	15,375	m	40	615,000
		Wharf (1) -10.0 m	$/m		m	0	0
		(2) -12.0 m	$/m	58,700	m	0	0
		(3) -14.0 m	$/m	63,000	m	300	18,900,000
		Ro-Ro System	LS	2,280,000	set	0	0
		Subtotal					25,744,040
C.	On-land Works						
		Soil Improvement	$/ha	700,000	ha	0	0
		Inner access	$/m²	69.6	m²	26,300	1,830,480
		Back apron	$/m²	131.5	m²	(5,100)	0
		Side apron	$/m²	131.5	m²	0	0
		Pavement (1) Gravel pave.	$/m²	39.0	m²	4,500	175,500
		(2) Light pave.	$/m²	69.6	m²	10,500	730,800
		(3) Normal pave.	$/m²	105.3	m²	37,800	3,980,340
		(4) Heavy pave. C2	$/m²	150.0	m²	4,700	705,000
		(5) Heavy pave. C3	$/m²	411.6	m²	4,700	1,934,520
		Storm water Drainage	$/ha	53,000	ha	10.5	556,500
		Subtotal					9,913,140
D.	Building					(7,000 m²)	
		Main Gate	$/m²	567	m²	650	368,550
		Control House	$/m²	1,170	m²	1,000	1,170,000
		Maintenance Shops	$/m²	1,042	m²	1,000	1,042,000
		CFS	$/m²	846	m²	2,500	2,115,000
		Substation/Power station	$/m²	602	m²	1,050	632,100
		Passenger Terminal	$/m²	450	m²	0	0
		Misc., buildings	$/m²	570	m²	800	456,000
		Weigh bridge	$/set	76,300	set	2	152,600
		Over-head passenger bridge	$/m	3,000	m	0	0
		Fence	$/m	123	m	650	79,950
		Park	$/m²	35	m²	2,100	73,500
		Landscaping	$/m²	19	m²	2,100	39,900
		Subtotal					6,129,600
E.	Utilities						
		Water Supply (Main)	$/B	175,000	B	1	175,000
		Water Supply (Dis.)	$/ha	20,000	ha	10.50	210,000
		Fire fighting	$/ha	2,000	ha	10.50	21,000
		Sewerage	$/ha	9,300	ha	10.50	97,650
		Power Supply (Distr.)	$/B	1,020,000	B	1	1,020,000
		Power Supply (P. Plant)	$/B	530,000	B	1	530,000
		Power Supply (W. Crane)	$/B	455,000	B	1	455,000
		Lighting (Yard)	$/B	240,000	B	1	240,000
		Lighting (Road)	$/ha	24,000	ha	3.68	88,320
		Telecommunication	$/B	42,000	B	1	42,000
		Reefer System	$/B	100,000	B	1	100,000
		Bunker System	$/m	1,000	m	300	300,000
		Misc., utilities			LS	1	253,530
		Subtotal					3,532,500
F.	Supplemental Works						
		Navigational aid	$/B	500,000	B	0	0
		Outer access (new)	$/m²	105.3	m²	12,000	1,263,600
		Outer access (hinterland)	$/m²	39.0	m²	60,000	2,340,000
		Demolishing					

Case: SITE - T14 B6

Work Category		Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
		Demolishing (Pier No. 16)	$/m³	40	m³	0	0
		Demolishing (Small pier)	$/pier	10,000	pier	0	0
		Demolishing (Onland civil)	$/m²	3	m²	0	0
		Demolishing (Building)	$/m²	100	m²	0	0
		Environmental protection			LS	1	125,300
		Misc. works			LS	1	268,910
		Subtotal					3,997,810
G.	Others						
		Flyover	$/m²	2,500	m²	0	0
		Bunker pier reinstallation	$/set	11,000,000	set	0	0
		Loading arms	$/set	440,000	set	0	0
		Bunker lines	$/m	2,000	m	0	0
		Breakwater Improvement	$/m	4,000	m	0	0
		Subtotal					0
	Cost by Wharf Depth						
	Cost T-14	B6					54,567,090
	Marine Works	Dredging reduction	$/m³	2.76	m³	50,000	-138,000
		Supplemental reduction			LS	0	0
		Total reduction					-138,000
	Cost T-14/12	B6					54,429,090
	Cost T-14						54,567,090
	Marine Works	Reduction 14/12					-138,000
		Wharf cost reduction	$/m	4,300	m	300	-1,290,000
		Supplemental reduction			LS	0	0
		Total reduction					-1,428,000
	Cost T-12	B6					53,139,090

TABLE F14 (I) B5/6 CRISTOBAL PORT COST ESTIMATION : Summary

Case: SITE - F14 (a) B5/6

Work Category		Works		Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
A.	General Works							6,437,500
B.	Marine Works							62,499,460
C.	On-land Works							22,766,280
D.	Building							14,998,120
E.	Utilities							7,265,000
F.	Supplemental Works							4,086,300
G.	Others							16,040,000
H.		Subtotal						134,092,660
I.	Contingency	Physical	(15 % of H)				-	20,113,900
J.	Engineering		(10 % of H)					13,409,270
K.		Total	(H + I + J)					167,615,830
	Land Use				B5/6			
	Total Area				21.00	ha	100.0 %	
	Back apron				1.00	ha	4.8	
	Inner access				5.26	ha	25.0	
	Yard pavement	(1) Gravel pavement			0.44	ha	2.1	
	Yard pavement	(2) Light pavement			2.10	ha	10.0	
	Yard pavement	(3) Normal pavement			7.56	ha	36.0	
	Yard pavement	(4) Heavy pavement C2			0.94	ha	4.5	
	Yard pavement	(5) Heavy pavement C3			0.94	ha	4.5	
	Building				1.70	ha	8.1	
	Parks				0.42	ha	2.0	
	Reserves				0.64	ha	3.0	
A.	General Works							
		Mobilization/Demobilization						500,000
		Mobilization/Demobilization						1,625,000
		Site Common Works						4,312,500
		Subtotal						6,437,500
B.	Marine Works							
		Seabed Clearance		$/B	101,000	B	2	202,000
		Dredging and reclamation		$/m³	1.80	m³	0	0
		Dredging and reclamation		$/m³	5.40	m³	0	0
		Dredging and reclamation		$/m³	54.0	m³	0	0
		Dredging and disposal		$/m³	2.76	m³	735,000	2,028,600
		Dredging and disposal		$/m³	9.96	m³	0	0
		Borrowing and reclamation		$/m³	4.80	m³	3,780,000	18,144,000
		Seawall	(1) +3.6 m~±0.0m	$/m	2,559	m	0	0
			(2) ±0.0 ~ -5.0	$/m	4,907	m	260	1,275,820
			(3) -5.0 ~ -10.0	$/m	7,987	m	170	1,357,790
			(4) -10.0 ~ -15.0	$/m	15,375	m	110	1,691,250
		Wharf	(1) -10.0 m	$/m		m	0	0
			(2) -12.0 m	$/m	58,700	m	0	0

Case: SITE - F14 (a) B5/6

Work Category	Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
	(3) -14.0 m	$/m	63,000	m	600	37,800,000
	Ro-Ro System	LS	2,280,000	set	0	0
	Subtotal					62,499,460
C. On-land Works						
	Soil Improvement	$/ha	700,000	ha	4.20	2,940,000
	Inner access	$/m²	69.6	m²	52,600	3,660,960
	Back apron	$/m²	131.5	m²	(10,200)	0
	Side apron	$/m²	131.5	m²	0	0
	Pavement (1) Gravel pave.	$/m²	39.0	m²	9,000	351,000
	(2) Light pave.	$/m²	69.6	m²	21,000	1,461,600
	(3) Normal pave.	$/m²	105.3	m²	75,600	7,960,680
	(4) Heavy pave. C2	$/m²	150.0	m²	9,400	1,410,000
	(5) Heavy pave. C3	$/m²	411.6	m²	9,400	3,869,040
	Storm water Drinage	$/ha	53,000	ha	21.0	1,113,000
	Subtotal					22,766,280
D. Building					(17,000 m²)	
	Main Gate	$/m²	567	m²	1,300	737,100
	Control House	$/m²	1,170	m²	2,000	2,340,000
	Maintenance Shops	$/m²	1,042	m²	3,000	3,126,000
	CFS	$/m²	846	m²	7,000	5,922,000
	Substation/Power station	$/m²	602	m²	2,100	1,264,200
	Passenger Terminal	$/m²	450	m²	0	0
	Misc., buildings	$/m²	570	m²	1,600	912,000
	Weigh bridge	$/set	76,300	set	4	305,200
	Over-head passenger bridge	$/m	3,000	m	0	0
	Fence	$/m	123	m	1,340	164,820
	Park	$/m²	35	m²	4,200	147,000
	Landscaping	$/m²	19	m²	4,200	79,800
	Subtotal					14,998,120
E. Utilities						
	Water Supply (Main)	$/B	175,000	B	2	350,000
	Water Supply (Dis.)	$/ha	20,000	ha	21.00	420,000
	Fire fighting	$/ha	2,000	ha	21.00	42,000
	Sewerage	$/ha	9,300	ha	21.00	195,300
	Power Supply (Distr.)	$/B	1,020,000	B	2	2,040,000
	Power Supply (P. Plant)	$/B	530,000	B	2	1,060,000
	Power Supply (W. Crane)	$/B	455,000	B	2	910,000
	Lighting (Yard)	$/B	240,000	B	2	480,000
	Lighting (Road)	$/ha	24,000	ha	7.36	176,640
	Telecommunication	$/B	42,000	B	2	84,000
	Reefer System	$/B	100,000	B	2	200,000
	Bunker System	$/m	1,000	m	800	800,000
	Misc., utilities			LS	2	507,060
	Subtotal					7,265,000
F. Supplemental Works						
	Navigational aid	$/B	500,000	B	1	500,000
	Outer access (new)	$/m²	105.3	m²	15,000	1,579,500
	Outer access (improve)	$/m²	34.8	m²	0	0
	Demolishing					

Case: SITE - F14 (a) B5/6

Work Category	Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
	Demolishing (Pier No. 16)	$/m³	40	m³	17,500	700,000
	Demolishing (Small pier)	$/pier	10,000	pier	5	50,000
	Demolishing (Onland civil)	$/m²	3	m²	7,000	21,000
	Demolishing (Building)	$/m²	100	m²	300	30,000
	Environmental protection					605,180
	Misc. works			LS	1	600,620
	Subtotal					4,086,300
G. Others						
	Flyover	$/m²	2,500	m²	0	0
	Bunker pier reinstallation	$/set	11,000,000	set	1	11,000,000
	Loading arms	$/set	440,000	set	6	2,640,000
	Bunker lines	$/m	2,000	m	1,200	2,400,000
	Breakwater Improvement	$/m	4,000	m	0	0
	Subtotal					16,040,000
	Cost by Wharf Depth					
	Cost F-14 (I)	B5/6				134,092,660
	Marine Works	Dredging reduction	$/m³	2.76	m³	0
		Supplemental reduction				0
		Total reduction				0
	Cost F-14 (I)/12					134,092,660
	Cost F-14 (I)	B5/6				134,092,660
	Marine Works	Reduction 14/12				0
		Wharf cost reduction	$/m	4,300	m	600
		Supplemental reduction			LS	0
		Total reduction				-2,580,000
	Cost F-12 (I)	B5/6				131,512,660

TABLE F14 (II) B5/6 CRISTOBAL PORT COST ESTIMATION : Summary

Case: SITE - F14 (b) B5/6

Work Category		Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
A.	General Works						6,437,500
B.	Marine Works						85,664,410
C.	On-land Works						22,766,280
D.	Building						14,998,120
E.	Utilities						8,475,000
F.	Supplemental Works						4,595,440
G.	Others						14,440,000
H.		Subtotal					157,376,750
I.	Contingency	Physical (15 % of H)					23,606,510
J.	Engineering	(10 % of H)					15,737,670
K.		Total (H + I + J)					196,720,930
	Land Use			B5/6			
	Total Area			21.00	ha	100.0 %	
	Back apron			1.00	ha	4.8	
	Inner access			5.26	ha	25.0	
	Yard pavement	(1) Gravel pavement		0.44	ha	2.1	
	Yard pavement	(2) Light pavement		2.10	ha	10.0	
	Yard pavement	(3) Normal pavement		7.56	ha	36.0	
	Yard pavement	(4) Heavy pavement C2		0.94	ha	4.5	
	Yard pavement	(5) Heavy pavement C3		0.94	ha	4.5	
	Building			1.70	ha	8.1	
	Parks			0.42	ha	2.0	
	Reserves			0.64	ha	3.0	
A.	General Works						
		Mobilization/Demobilization					500,000
		Mobilization/Demobilization					1,625,000
		Site Common Works					4,312,500
		Subtotal					6,437,500
B.	Marine Works						
		Seabed Clearance	$/B	101,000	B	2	202,000
		Dredging and reclamation	$/m³	1.80	m³	893,000	1,607,400
		Dredging and reclamation	$/m³	5.40	m³	0	0
		Dredging and reclamation	$/m³	54.0	m³	383,000	20,682,000
		Dredging and disposal	$/m³	2.76	m³	735,000	2,028,600
		Dredging and disposal	$/m³	9.96	m³	0	0
		Borrowing and reclamation	$/m³	4.80	m³	2,504,000	12,019,200
		Seawall (1) +3.6 m~±0.0m	$/m	2,559	m	0	0
		(2) ±0.0 ~ -5.0	$/m	4,907	m	710	3,483,970
		(3) -5.0 ~ -10.0	$/m	7,987	m	770	6,149,990
		(4) -10.0 ~ -15.0	$/m	15,375	m	110	1,691,250
		Wharf (1) -10.0 m	$/m		m	0	0
		(2) -12.0 m	$/m	58,700	m	0	0

Case: SITE - F14 (b) B5/6

Work Category		Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
		(3) -14.0 m	$/m	63,000	m	600	37,800,000
		Ro-Ro System	LS	2,280,000	set	0	0
		Subtotal					85,664,410
C.	On-land Works						
		Soil Improvement	$/ha	700,000	ha	4.20	2,940,000
		Inner access	$/m²	69.6	m²	52,600	3,660,960
		Back apron	$/m²	131.5	m²	(10,200)	0
		Side apron	$/m²	131.5	m²	0	0
		Pavement (1) Gravel pave.	$/m²	39.0	m²	9,000	351,000
		(2) Light pave.	$/m²	69.6	m²	21,000	1,461,600
		(3) Normal pave.	$/m²	105.3	m²	75,600	7,960,680
		(4) Heavy pave. C2	$/m²	150.0	m²	9,400	1,410,000
		(5) Heavy pave. C3	$/m²	411.6	m²	9,400	3,869,040
		Storm water Drinage	$/ha	53,000	ha	21.0	1,113,000
		Subtotal					22,766,280
D.	Building					(17,000 m²)	
		Main Gate	$/m²	567	m²	1,300	737,100
		Control House	$/m²	1,170	m²	2,000	2,340,000
		Maintenance Shops	$/m²	1,042	m²	3,000	3,126,000
		CFS	$/m²	846	m²	7,000	5,922,000
		Substation/Power station	$/m²	602	m²	2,100	1,264,200
		Passenger Terminal	$/m²	450	m²	0	0
		Misc., buildings	$/m²	570	m²	1,600	912,000
		Weigh bridge	$/set	76,300	set	4	305,200
		Over-head passenger bridge	$/m	3,000	m	0	0
		Fence	$/m	123	m	1,340	164,820
		Park	$/m²	35	m²	4,200	147,000
		Landscaping	$/m²	19	m²	4,200	79,800
		Subtotal					14,998,120
E.	Utilities						
		Water Supply (Main)	$/B	175,000	B	2	350,000
		Water Supply (Dis.)	$/ha	20,000	ha	21.00	420,000
		Fire fighting	$/ha	2,000	ha	21.00	42,000
		Sewerage	$/ha	9,300	ha	21.00	195,300
		Power Supply (Distr.)	$/B	1,020,000	B	2	2,040,000
		Power Supply (P. Plant)	$/B	530,000	B	2	1,060,000
		Power Supply (W. Crane)	$/B	455,000	B	2	910,000
		Lighting (Yard)	$/B	240,000	B	2	480,000
		Lighting (Road)	$/ha	24,000	ha	7.36	176,640
		Telecommunication	$/B	42,000	B	2	84,000
		Reefer System	$/B	100,000	B	2	200,000
		Bunker System	$/m	1,000	m	2,010	2,010,000
		Misc., utilities			LS	2	507,060
		Subtotal					8,475,000
F.	Supplemental Works						
		Navigational aid	$/B	500,000	B	1	500,000
		Outer access (new)	$/m²	105.3	m²	15,000	1,579,500
		Outer access (improve)	$/m²	34.8	m²	0	0
		Demolishing					

Case: SITE - F14 (b) B5/6

Work Category		Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
		Demolishing (Pier No. 16)	$/m³	40	m³	17,500	700,000
		Demolishing (Small pier)	$/pier	10,000	pier	5	50,000
		Demolishing (Onland civil)	$/m²	3	m²	7,000	21,000
		Demolishing (Building)	$/m²	100	m²	300	30,000
		Environmental protection			LS	1	1,090,120
		Misc. works			LS	1	624,820
		Subtotal					4,595,440
G.	Others						
		Flyover	$/m²	2,500	m²	0	0
		Bunker pier reinstallation	$/set	11,000,000	set	1	11,000,000
		Loading arms	$/set	440,000	set	6	2,640,000
		Bunker lines	$/m	2,000	m	400	800,000
		Breakwater Improvement	$/m	4,000	m	0	0
		Subtotal					14,440,000
	Cost by Wharf Depth						
	Cost F-14 (II)	B5/6					157,376,750
	Marine Works	Dredging reduction	$/m³	2.76	m³	900,000	-2,484,000
		Reduction	$/m³	54.00	m³	231,000	-12,474,000
		Supplemental reduction			LS	0	0
		Total reduction					-14,958,000
	Cost F-14 (II)/12						142,418,750
	Cost F-14 (II)	B5/6					157,376,750
	Marine Works	Reduction 14/12					-14,958,000
		Wharf cost reduction	$/m	4,300	m	600	-2,580,000
		Supplemental reduction			LS	0	0
		Total reduction					-17,538,000
	Cost F-12 (II)	B5/6					139,838,750

TABLE F14 (III) B3/4 CRISTOBAL PORT COST ESTIMATION : Summary

Case: SITE - F14 (c) B3/4

	Work Category	Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
A.	General Works						6,437,500
B.	Marine Works						87,788,010
C.	On-land Works						23,501,280
D.	Building						16,319,830
E.	Utilities						9,415,000
F.	Supplemental Works						6,028,630
G.	Others						14,440,000
H.		Subtotal					163,930,250
I.	Contingency	Physical (15 % of H)					24,589,540
J.	Engineering	(10 % of H)					16,393,020
K.		Total (H + I + J)					204,912,810
	Land Use						
	Total Area			21.00	ha	100.0 %	
	Back apron			1.00	ha	4.8	
	Inner access			5.26	ha	25.0	
	Yard pavement	(1) Gravel pavement		0.44	ha	2.1	
	Yard pavement	(2) Light pavement		2.10	ha	10.0	
	Yard pavement	(3) Normal pavement		7.56	ha	36.0	
	Yard pavement	(4) Heavy pavement C2		0.94	ha	4.5	
	Yard pavement	(5) Heavy pavement C3		0.94	ha	4.5	
	Building			2.00	ha	9.5	
	Parks			0.42	ha	2.0	
	Reserves			0.34	ha	1.6	
A.	General Works						
		Mobilization/Demobilization					500,000
		Mobilization/Demobilization					1,625,000
		Site Common Works					4,312,500
		Subtotal					6,437,500
B.	Marine Works						
		Seabed Clearance	$/B	101,000	B	2	202,000
		Dredging and reclamation	$/m³	1.80	m³	3,172,000	5,709,600
		Dredging and reclamation	$/m³	5.40	m³	0	0
		Dredging and reclamation	$/m³	54.0	m³	620,000	33,480,000
		Dredging and disposal	$/m³	2.76	m³	913,800	2,522,090
		Dredging and disposal	$/m³	9.96	m³	0	0
		Borrowing and reclamation	$/m³	4.80	m³	0	0
		Seawall (1) +3.6 m~±0.0m	$/m	2,559	m	0	0
		(2) ±0.0 ~ -5.0	$/m	4,907	m	30	147,210
		(3) -5.0 ~ -10.0	$/m	7,987	m	30	239,610
		(4) -10.0 ~ -15.0	$/m	15,375	m	500	7,687,500
		Wharf (1) -10.0 m	$/m		m	0	0
		(2) -12.0 m	$/m	58,700	m	0	0

Case: SITE - F14 (c) B3/4

Work Category		Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
		(3) -14.0 m	$/m	63,000	m	600	37,800,000
		Ro-Ro System	LS	2,280,000	set	0	0
		Subtotal					87,789,010
C.	On-land Works						
		Soil Improvement	$/ha	700,000	ha	5.25	3,675,000
		Inner access	$/m²	69.6	m²	52,600	3,660,960
		Back apron	$/m²	131.5	m²	(10,200)	0
		Side apron	$/m²	131.5	m²	0	0
		Pavement (1) Gravel pave.	$/m²	39.0	m²	9,000	351,000
		(2) Light pave.	$/m²	69.6	m²	21,000	1,461,600
		(3) Normal pave.	$/m²	105.3	m²	75,600	7,960,680
		(4) Heavy pave. C2	$/m²	150.0	m²	9,400	1,410,000
		(5) Heavy pave. C3	$/m²	411.6	m²	9,400	3,869,040
		Storm water Drinage	$/ha	53,000	ha	21.0	1,113,000
		Subtotal					23,501,280
D.	Building					(20,000 m²)	
		Main Gate	$/m²	567	m²	1,300	737,100
		Control House	$/m²	1,170	m²	2,000	2,340,000
		Maintenance Shops	$/m²	1,042	m²	3,000	3,126,000
		CFS	$/m²	846	m²	7,000	5,922,000
		Substation/Power station	$/m²	602	m²	2,100	1,264,200
		Passenger Terminal	$/m²	450	m²	3,000	1,350,000
		Misc., buildings	$/m²	570	m²	1,600	912,000
		Weigh bridge	$/set	76,300	set	4	305,200
		Over-head passenger bridge	$/m	3,000	m	0	0
		Fence	$/m	123	m	1,110	136,530
		Park	$/m²	35	m²	4,200	147,000
		Landscaping	$/m²	19	m²	4,200	79,800
		Subtotal					16,319,830
E.	Utilities						
		Water Supply (Main)	$/B	175,000	B	2	350,000
		Water Supply (Dis.)	$/ha	20,000	ha	21.00	420,000
		Fire fighting	$/ha	2,000	ha	21.00	42,000
		Sewerage	$/ha	9,300	ha	21.00	195,300
		Power Supply (Distr.)	$/B	1,020,000	B	2	2,040,000
		Power Supply (P. Plant)	$/B	530,000	B	2	1,060,000
		Power Supply (W. Crane)	$/B	455,000	B	2	910,000
		Lighting (Yard)	$/B	240,000	B	2	480,000
		Lighting (Road)	$/ha	24,000	ha	7.36	176,640
		Telecommunication	$/B	42,000	B	2	84,000
		Reefer System	$/B	100,000	B	2	200,000
		Bunker System	$/m	1,000	m	2,950	2,950,000
		Misc., utilities			LS	2	507,060
		Subtotal					9,415,000
F.	Supplemental Works						
		Navigational aid	$/B	500,000	B	1	500,000
		Outer access (new)	$/m²	105.3	m²	3,400	358,020
		Outer access (improve)	$/m²	34.8	m²	0	0
		Demolishing					

Case: SITE - F14 (c) B3/4

Work Category		Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
		Demolishing (Pier No. 16)	$/m³	40	m³	17,500	700,000
		Demolishing (Small pier)	$/pier	10,000	pier	5	50,000
		Demolishing (Onland civil)	$/m²	3	m²	7,000	21,000
		Demolishing (Building)	$/m²	100	m²	6,300	630,000
		Environmental protection				1	1,251,350
		Misc. works			LS	1	658,320
		Mole yard pavement	$/m²	69.6	m²	24,000	1,670,400
		Mole road pavement	$/m²	105.3	m²	1,800	189,540
		Subtotal					6,028,630
G.	Others						
		Flyover	$/m²	2,500	m²	0	0
		Bunker pier reinstallation	$/set	11,000,000	set	1	11,000,000
		Loading arms	$/set	440,000	set	6	2,640,000
		Bunker lines	$/m	2,000	m	400	800,000
		Breakwater improvement	$/m	4,000	m	0	0
		Subtotal					14,440,000
	Cost by Wharf Depth						
	Cost F-14 (III)	B3/4					163,930,250
	Marine Works	Dredging reduction	$/m³	2.76	m³	900,000	-2,484,000
		Reduction	$/m³	54.00	m³	264,000	-14,256,000
		Supplemental reduction			LS	0	0
		Total reduction					-16,740,000
	Cost F-14 (III)/12						147,190,250
	Cost F-14 (III)	B3/4					163,930,250
	Marine Works	Reduction 14/12					-16,740,000
		Wharf cost reduction	$/m	4,300	m	600	-2,580,000
		Supplemental reduction			LS	0	0
		Total reduction					-19,320,000
	Cost F-12 (III)	B3/4					144,610,250

TABLE F14 (III) B5 CRISTOBAL PORT COST ESTIMATION : Summary

Case: SITE - F14 (c) B5

Work Category		Works		Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
A.	General Works							3,625,000
B.	Marine Works							18,900,000
C.	On-land Works							9,913,140
D.	Building							6,130,210
E.	Utilities							3,532,500
F.	Supplemental Works							1,545,410
G.	Others							0
H.		Subtotal						43,646,260
I.	Contingency	Physical	(15 % of H)					6,546,940
J.	Engineering		(10 % of H)					4,364,630
K.		Total	(H + I + J)					54,557,830
	Land Use							
	Total Area				10.50	ha	100.0 %	
	Back apron				0.50	ha	4.8	
	Inner access				2.63	ha	25.0	
	Yard pavement	(1) gravel pavement			0.22	ha	2.2	
	Yard pavement	(2) Light pavement			1.05	ha	10.0	
	Yard pavement	(3) Normal pavement			3.78	ha	36.0	
	Yard pavement	(4) Heavy pavement C2			0.47	ha	4.4	
	Yard pavement	(5) Heavy pavement C3			0.47	ha	4.4	
	Building				0.70	ha	6.7	
	Parks				0.21	ha	2.0	
	Reserves				0.47	ha	4.5	
A.	General Works							
		Mobilization/Demobilization						500,000
		Mobilization/Demobilization						0
		Site Common Works						3,125,000
		Subtotal						3,625,000
B.	Marine Works							
		Seabed Clearance		$/B	101,000	B	0	0
		Dredging and reclamation		$/m³	1.80	m³	0	0
		Dredging and reclamation		$/m³	5.40	m³	0	0
		Dredging and reclamation		$/m³	54.0	m³	0	0
		Dredging and disposal		$/m³	2.76	m³	0	0
		Dredging and disposal		$/m³	9.96	m³	0	0
		Borrowing and reclamation		$/m³	4.80	m³	0	0
		Seawall	(1) +3.6 m~±0.0m	$/m	2,559	m	0	0
			(2) ±0.0 ~- 5.0	$/m	4,907	m	0	0
			(3) -5.0 ~ -10.0	$/m	7,987	m	0	0
			(4) -10.0 ~ -15.0	$/m	15,375	m	0	0
		Wharf	(1) -10.0 m	$/m		m	0	0
			(2) -12.0 m	$/m	58,700	m	0	0

Case: SITE - F14 (c) B5

Work Category		Works		Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
		(3) -14.0 m		$/m	63,000	m	300	18,900,000
		Ro-Ro System		LS	2,280,000	set	0	0
		Subtotal						18,900,000
C.	On-land Works							
		Soil Improvement		$/ha	700,000	ha	0	0
		Inner access		$/m²	69.6	m²	26,300	1,830,480
		Back apron		$/m²	131.5	m²	(5,100)	0
		Side apron		$/m²	131.5	m²	0	0
		Pavement	(1) Gravel pave.	$/m²	39.0	m²	4,500	175,500
			(2) Light pave.	$/m²	69.6	m²	10,500	730,800
			(3) Nomal pave.	$/m²	105.3	m²	37,800	3,980,340
			(4) Heavy pave. C2	$/m²	150.0	m²	4,700	705,000
			(5) Heavy pave. C3	$/m²	411.6	m²	4,700	1,934,520
		Storm water Drainage		$/ha	53,000	ha	10.5	556,500
		Subtotal						9,913,140
D.	Building						(7,000 m²)	
		Main Gate		$/m²	567	m²	650	368,550
		Control House		$/m²	1,170	m²	1,000	1,170,000
		Maintenance Shops		$/m²	1,042	m²	1,000	1,042,000
		CFS		$/m²	846	m²	2,500	2,115,000
		Substation/Power station		$/m²	602	m²	1,050	632,100
		Passenger Terminal		$/m²	450	m²	0	0
		Misc., buildings		$/m²	570	m²	800	456,000
		Weigh bridge		$/set	76,300	set	2	152,600
		Over-head passenger bridge		$/m	3,000	m	0	0
		Fence		$/m	123	m	655	80,560
		Park		$/m²	35	m²	2,100	73,500
		Landscaping		$/m²	19	m²	2,100	39,900
		Subtotal						6,130,210
E.	Utilities							
		Water Supply (Main)		$/B	175,000	B	1	175,000
		Water Supply (Dis.)		$/ha	20,000	ha	10.50	210,000
		Fire fighting		$/ha	2,000	ha	10.50	21,000
		Sewerage		$/ha	9,300	ha	10.50	97,650
		Power Supply (Distr.)		$/B	1,020,000	B	1	1,020,000
		Power Supply (P. Plant)		$/B	530,000	B	1	530,000
		Power Supply (W. Crane)		$/B	455,000	B	1	455,000
		Lighting (Yard)		$/B	240,000	B	1	240,000
		Lighting (Road)		$/ha	24,000	ha	3.68	88,320
		Telecommunication		$/B	42,000	B	1	42,000
		Reefer System		$/B	100,000	B	1	100,000
		Bunker System		$/m	1,000	m	300	300,000
		Misc., utilities				LS	1	253,530
		Subtotal						3,532,500
F.	Supplemental Works							
		Navigational aid		$/B	500,000	B	1	500,000
		Outer access (new)		$/m²	105.3	m²	5,000	526,500
		Outer access (improve)		$/m²	34.8	m²	0	0
		Demolishing						

Case: SITE - F14 (c) B5

Work Category		Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
		Demolishing (Pier No. 16)	$/m³	40	m³	0	0
		Demolishing (Small pier)	$/pier	10,000	pier	0	0
		Demolishing (Onland civil)	$/m²	3	m²	50,000	150,000
		Demolishing (Building)	$/m²	100	m²	1,000	100,000
		Environmental protection			LS	0	0
		Misc. works			LS	1	268,910
		Subtotal					1,545,410
G.	Others						
		Flyover	$/m²	2,500	m²	0	0
		Bunker pier reinstallation	$/set	11,000,000	set	0	0
		Loading arms	$/set	440,000	set	0	0
		Bunker lines	$/m	2,000	m	0	0
		Breakwater Improvement	$/m	4,000	m	0	0
		Subtotal					0
	Cost by Wharf Depth						
	Cost F-14 (III)	B5					43,646,260
	Marine Works	Dredging reduction	$/m³	2.76	m³	0	0
		Supplemental reduction					0
		Total reduction					0
	Cost F-14 (III)/12	B5					43,646,260
	Cost F-14 (III)						43,646,260
	Marine Works	Reduction 14/12					0
		Wharf cost reduction	$/m	4,300	m	300	-1,290,000
		Supplemental reduction					0
		Total reduction					-1,290,000
	Cost F-12 (III)	B5					42,356,260

TABLE F14 (IV) B5 CRISTOBAL PORT COST ESTIMATION : Summary

Case: SITE - F14 (d) B5

Work Category		Works		Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
A.	General Works							5,250,000
B.	Marine Works							28,929,050
C.	On-land Works							11,383,140
D.	Building							6,180,030
E.	Utilities							4,382,500
F.	Supplemental Works							1,827,850
G.	Others							11,290,000
H.		Subtotal						69,242,570
I.	Contingency	Physical	(15 % of H)					10,386,380
J.	Engineering		(10 % of H)					6,924,260
K.		Total	(H + I + J)					86,553,210
	Land Use							
		Total Area			10.50	ha	100.0 %	
		Back apron			0.50	ha	4.8	
		Inner access			2.63	ha	25.0	
		Yard pavement	(1) gravel pavement		0.22	ha	2.2	
		Yard pavement	(2) Light pavement		1.05	ha	10.0	
		Yard pavement	(3) Normal pavement		3.78	ha	36.0	
		Yard pavement	(4) Heavy pavement C2		0.47	ha	4.4	
		Yard pavement	(5) Heavy pavement C3		0.47	ha	4.4	
		Building			0.70	ha	6.7	
		Parks			0.21	ha	2.0	
		Reserves			0.47	ha	4.5	
A.	General Works							
		Mobilization/Demobilization						500,000
		Mobilization/Demobilization						1,625,000
		Site Common Works						3,125,000
		Subtotal						5,250,000
B.	Marine Works							
		Seabed Clearance		$/B	101,000	B	1	101,000
		Dredging and reclamation		$/m³	1.80	m³	800,000	1,440,000
		Dredging and reclamation		$/m³	5.40	m³	0	0
		Dredging and reclamation		$/m³	54.0	m³	0	0
		Dredging and disposal		$/m³	2.76	m³	335,000	924,600
		Dredging and disposal		$/m³	9.96	m³	0	0
		Borrowing and reclamation		$/m³	4.80	m³	0	0
		Seawall	(1) +3.6 m~±0.0m	$/m	2,559	m	0	0
			(2) ±0.0 ~ -5.0	$/m	4,907	m	50	245,350
			(3) -5.0 ~ -10.0	$/m	7,987	m	50	399,350
			(4) -10.0 ~ -15.0	$/m	15,375	m	450	6,918,750
		Wharf	(1) -10.0 m	$/m		m	0	0
			(2) -12.0 m	$/m	58,700	m	0	0

Case: SITE - F14 (d) B5

Work Category	Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
	(3) -14.0 m	$/m	63,000	m	300	18,900,000
	Ro-Ro System	LS	2,280,000	set	0	0
	Subtotal					28,929,050
C. On-land Works						
	Soil Improvement	$/ha	700,000	ha	2.10	1,470,000
	Inner access	$/m²	69.6	m²	26,300	1,830,480
	Back apron	$/m²	131.5	m²	(5,100)	0
	Side apron	$/m²	131.5	m²	0	0
	Pavement (1) Gravel pave.	$/m²	39.0	m²	4,500	175,500
	(2) Light pave.	$/m²	69.6	m²	10,500	730,800
	(3) Nomal pave.	$/m²	105.3	m²	37,800	3,980,340
	(4) Heavy pave. C2	$/m²	150.0	m²	4,700	705,000
	(5) Heavy pave. C3	$/m²	411.6	m²	4,700	1,934,520
	Stom water Drainage	$/ha	53,000	ha	10.5	556,500
	Subtotal					11,383,140
D. Building					(7,000 m²)	
	Main Gate	$/m²	567	m²	650	368,550
	Control House	$/m²	1,170	m²	1,000	1,170,000
	Maintenance Shops	$/m²	1,042	m²	1,000	1,042,000
	CFS	$/m²	846	m²	2,500	2,115,000
	Substation/Power station	$/m²	602	m²	1,050	632,100
	Passenger Terminal	$/m²	450	m²	0	0
	Misc., buildings	$/m²	570	m²	800	456,000
	Weigh bridge	$/set	76,300	set	2	152,600
	Over-head passenger bridge	$/m	3,000	m	0	0
	Fence	$/m	123	m	1,060	130,380
	Park	$/m²	35	m²	2,100	73,500
	Landscaping	$/m²	19	m²	2,100	39,900
	Subtotal					6,180,030
E. Utilities						
	Water Supply (Main)	$/B	175,000	B	1	175,000
	Water Supply (Dis.)	$/ha	20,000	ha	10.50	210,000
	Fire fighting	$/ha	2,000	ha	10.50	21,000
	Sewerage	$/ha	9,300	ha	10.50	97,650
	Power Supply (Distr.)	$/B	1,020,000	B	1	1,020,000
	Power Supply (P. Plant)	$/B	530,000	B	1	530,000
	Power Supply (W. Crane)	$/B	455,000	B	1	455,000
	Lighting (Yard)	$/B	240,000	B	1	240,000
	Lighting (Road)	$/ha	24,000	ha	3.68	88,320
	Telecommunication	$/B	42,000	B	1	42,000
	Reefer System	$/B	100,000	B	1	100,000
	Bunker System	$/m	1,000	m	1,150	1,150,000
	Misc., utilities			LS	1	253,530
	Subtotal					4,382,500
F. Supplemental Works						
	Navigational aid	$/B	500,000	B	0	500,000
	Outer access (new)	$/m²	105.3	m²	2,000	210,600
	Outer access (improve)	$/m²	34.8	m²	0	0
	Demolishing					

Case: SITE - F14 (d) B5

Work Category	Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
	Demolishing (Pier No. 16)	$/m³	40	m³	15,750	630,000
	Demolishing (Small pier)	$/pier	10,000	pier	5	50,000
	Demolishing (Onland civil)	$/m²	3	m²	7,000	21,000
	Demolishing (Building)	$/m²	100	m²	300	30,000
	Environmental protection			LS	1	70,940
	Misc. works			LS	1	315,310
	Subtotal					1,827,850
G. Others						
	Flyover	$/m²	2,500	m²	0	0
	Bunker pier reinstallation	$/set	11,000,000	set	0.75	8,250,000
	Loading arms	$/set	440,000	set	6	2,640,000
	Bunker lines	$/m	2,000	m	200	400,000
	Breakwater Improvement	$/m	4,000	m	0	0
	Subtotal					11,290,000
Cost by Wharf Depth						
Cost F-14 (IV)	B5					69,242,570
Marine Works	Dredging reduction	$/m³	2.76	m³	0	0
	Supplemental reduction			LS	0	0
	Total reduction					0
Cost F-14 (IV)/12	B5					69,242,570
Cost F-14 (IV)						69,242,570
Marine Works	Reduction 14/12					0
	Wharf cost reduction	$/m	4,300	m	300	-1,290,000
	Supplemental reduction			LS	0	0
	Total reduction					-1,290,000
Cost F-12 (IV)	B5					67,952,570

TABLE CS14 B2 CRISTOBAL PORT COST ESTIMATION : Summary

Case: SITE - CS14 B2

	Work Category	Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
A.	General Works						6,875,000
B.	Marine Works						49,642,800
C.	On-land Works						9,913,140
D.	Building						6,172,650
E.	Utilities						9,232,500
F.	Supplemental Works						5,664,540
G.	Others						0
H.		Subtotal					87,500,630
I.	Contingency	Physical (15 % of H)					13,125,090
J.	Engineering	(10 % of H)					8,750,060
K.		Total (H + I + J)					109,375,780
	Land Use						
	Total Area			10.50	ha	100.0 %	
	Back apron			0.50	ha	4.8	
	Inner access			2.63	ha	25.0	
	Yard pavement	(1) Gravel pavement		0.22	ha	2.2	
	Yard pavement	(2) Light pavement		1.05	ha	10.0	
	Yard pavement	(3) Normal pavement		3.78	ha	36.0	
	Yard pavement	(4) Heavy pavement C2		0.47	ha	4.4	
	Yard pavement	(5) Heavy pavement C3		0.47	ha	4.4	
	Building			0.70	ha	6.7	
	Parks			0.21	ha	2.0	
	Reserves			0.47	ha	4.5	
A.	General Works						
		Mobilization/Demobilization					500,000
		Mobilization/Demobilization					3,250,000
		Site Common Works					3,125,000
		Subtotal					6,875,000
B.	Marine Works						
		Seabed Clearance	S/B	101,000	B	3	303,000
		Dredging and reclamation	$/m³	1.80	m³	0	0
		Dredging and reclamation	$/m³	5.40	m³	122,500	661,500
		Dredging and reclamation	$/m³	54.0	m³	0	0
		Dredging and disposal	$/m³	2.76	m³	7,047,000	19,449,720
		Dredging and disposal	$/m³	9.96	m³	660,500	6,578,580
		Borrowing and reclamation	$/m³	4.80	m³	0	0
		Seawall (1) +3.6 m~±0.0m	$/m	2,559	m	0	0
		(2) ±0.0 ~ -5.0	$/m	4,907	m	0	0
		(3) -5.0 ~ -10.0	$/m	7,987	m	0	0
		(4) -10.0 ~ -15.0	$/m	15,375	m	0	0
		Wharf (1) -10.0 m	$/m		m	0	0
		(2) -12.0 m	$/m	61,700	m	0	0

Case: SITE - CS14 B2

	Work Category	Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
		(3) -14.0 m	$/m	67,900	m	300	20,370,000
		Ro-Ro System	LS	228,000	set	1	2,280,000
		Subtotal					49,642,800
C.	On-land Works						
		Soil Improvement	$/ha	700,000	ha	0	0
		Inner access	$/m²	69.6	m²	26,300	1,830,480
		Back apron	$/m²	131.5	m²	(5,100)	0
		Side apron	$/m²	131.5	m²	0	0
		Pavement (1) Gravel pave.	$/m²	39.0	m²	4,500	175,500
		(2) Light pave.	$/m²	69.6	m²	10,500	730,800
		(3) Nomal pave.	$/m²	105.3	m²	37,800	3,980,340
		(4) Heavy pave. C2	$/m²	150.0	m²	4,700	705,000
		(5) Heavy pave. C3	$/m²	411.6	m²	4,700	1,934,520
		Storm water Drainage	$/ha	53,000	ha	10.5	556,500
		Subtotal					9,913,140
D.	Building					(7,000 m²)	
		Main Gate	$/m²	567	m²	650	368,550
		Control House	$/m²	1,170	m²	1,000	1,170,000
		Maintenance Shops	$/m²	1,042	m²	1,000	1,042,000
		CFS	$/m²	846	m²	2,500	2,115,000
		Substation/Power station	$/m²	602	m²	1,050	632,100
		Passenger Terminal	$/m²	450	m²	0	0
		Misc., buildings	$/m²	570	m²	800	456,000
		Weigh bridge	$/set	76,300	set	2	152,600
		Over-head passenger bridge	$/m	3,000	m	0	0
		Fence	$/m	123	m	1,000	123,000
		Park	$/m²	35	m²	2,100	73,500
		Landscaping	$/m²	19	m²	2,100	39,900
		Subtotal					6,172,650
E.	Utilities						
		Water Supply (Main)	S/B	175,000	B	1	175,000
		Water Supply (Dis.)	$/ha	20,000	ha	10.50	210,000
		Fire fighting	$/ha	2,000	ha	10.50	21,000
		Sewerage	$/ha	9,300	ha	10.50	97,650
		Power Supply (Distr.)	S/B	1,020,000	B	1	1,020,000
		Power Supply (P. Plant)	S/B	530,000	B	1	530,000
		Power Supply (W. Crane)	S/B	455,000	B	1	455,000
		Lighting (Yard)	S/B	240,000	B	1	240,000
		Lighting (Road)	$/ha	24,000	ha	3.68	88,320
		Telecommunication	S/B	42,000	B	1	42,000
		Reefer System	S/B	100,000	B	1	100,000
		Bunker System	$/m	1,000	m	6,000	6,000,000
		Misc., utilities	S/B	253,530	LS	1	253,530
		Subtotal					9,232,500
F.	Supplemental Works						
		Navigational aid	S/B	500,000	B	4	2,000,000
		Outer access (new)	$/m²	105.3	m²	0	0
		Outer access (improve)	$/m²	34.8	m²	9,000	313,200
		Demolishing	$/m³	40	m³	11,000	440,000

Case: SITE - CS14 B2

Work Category		Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
		Demolishing (Pier No. 7 shed)	$/m²	80	m²	7,900	632,000
		Demolishing (Pier No. 16)	$/m³	40	m³	0	0
		Demolishing (Small pier)	$/pier	10,000	pier	0	0
		Demolishing (Onland civil)	$/m²	3	m²	42,000	126,000
		Demolishing (Building)	$/m²	100	m²	500	50,000
		Environmental protection			LS	1	800,690
		Misc. works			LS	1	382,910
		Pavement after P7 shed	$/m²	66.0	m²	7,900	521,400
		Mole yard pavement	$/m²	69.6	m²	4,860	338,250
		Mole road repair	$/m²	100.0	m²	600	60,000
		Subtotal					5,664,540
G.	Others						
		Flyover	$/m²	2,500	m²	0	0
		Bunker pier reinstallation	$/set	11,000,000	set	0	0
		Loading arms	$/set	440,000	set	0	0
		Bunker lines	$/m	2,000	m	0	0
		Breakwater Improvement	$/m	4,000	m	0	0
		Subtotal					0
	Cost by Wharf Depth						
	Cost CS-14	B2					87,500,630
	Marine Works	Dredging Reduction	$/m³	2.76	m³	2,519,000	-6,952,440
		Supplemental reduction			LS	0	0
		Total reduction					-6,952,440
	Cost CS-14/12	B2					80,548,190
	Cost CS-14						87,500,630
	Marine Works	Reduction 14/12					-6,952,440
		Wharf cost reduction	$/m	6,200	m	300	-1,860,000
		Supplemental reduction			LS	0	0
		Total reduction					-8,812,440
	Cost CS-12	B2					78,698,190

TABLE CS14 B3/4 CRISTOBAL PORT COST ESTIMATION : Summary

Case: SITE - CS14 B3/4

Work Category		Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
A.	General Works						8,062,500
B.	Marine Works						61,733,710
C.	On-land Works						19,826,280
D.	Building						16,429,300
E.	Utilities						7,065,000
F.	Supplemental Works						3,139,590
G.	Others						0
H.		Subtotal					116,256,380
I.	Contingency	Physical (15 % of H)					17,438,460
J.	Engineering	(10 % of H)					11,625,640
K.		Total (H + I + J)					145,320,480
	Land Use						
	Total Area			21.00	ha	100 %	
	Back apron			1.00	ha	4.8	
	Inner access			5.26	ha	25.0	
	Yard pavement	(1) Gravel pavement		0.44	ha	2.1	
	Yard pavement	(2) Light pavement		2.10	ha	10.0	
	Yard pavement	(3) Normal pavement		7.56	ha	36.0	
	Yard pavement	(4) Heavy pavement C2		0.94	ha	4.5	
	Yard pavement	(5) Heavy pavement C3		0.94	ha	4.5	
	Building			2.00	ha	9.5	
	Parks			0.42	ha	2.0	
	Reserves			0.34	ha	1.6	
A.	General Works						
		Mobilization/Demobilization					500,000
		Mobilization/Demobilization					3,250,000
		Site Common Works					4,312,500
		Subtotal					8,062,500
B.	Marine Works						
		Seabed Clearance	$/B	101,000	B	2	202,000
		Dredging and reclamation	$/m³	1.80	m³	157,500	283,500
		Dredging and reclamation	$/m³	5.40	m³	0	0
		Dredging and reclamation	$/m³	54.0	m³	0	0
		Dredging and disposal	$/m³	2.76	m³	472,500	1,304,100
		Dredging and disposal	$/m³	9.96	m³	0	0
		Borrowing and reclamation	$/m³	4.80	m³	2,362,500	11,340,000
		Seawall (1) +3.6 m~±0.0m	$/m	2,559	m	0	0
		(2) ±0.0 ~ -5.0	$/m	4,907	m	80	392,560
		(3) -5.0 ~ -10.0	$/m	7,987	m	650	5,191,550
		(4) -10.0 ~ -15.0	$/m	15,375	m	0	0
		Wharf (1) -10.0 m	$/m		m	0	0
		(2) -12.0 m	$/m	61,700	m	0	0

Case: SITE - CS14 B3/4

Work Category	Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
	(3) -14.0 m	$/m	67,900	m	600	40,740,000
	Ro-Ro System	LS	2,280,000	set	1	2,280,000
	Subtotal					61,733,710
C. On-land Works						
	Soil Improvement	$/ha	700,000	ha	0	0
	Inner access	$/m²	69.6	m²	52,600	3,660,960
	Back apron	$/m²	131.5	m²	(10,200)	0
	Side apron	$/m²	131.5	m²	0	0
	Pavement (1) Gravel pave.	$/m²	39.0	m²	9,000	351,000
	(2) Light pave.	$/m²	69.6	m²	21,000	1,461,600
	(3) Normal pave.	$/m²	105.3	m²	75,600	7,960,680
	(4) Heavy pave. C2	$/m²	150.0	m²	9,400	1,410,000
	(5) Heave pave. C3	$/m²	411.6	m²	9,400	3,869,040
	Storm water Drainage	$/ha	53,000	ha	21.0	1,113,000
	Subtotal					19,826,280
D. Building					(20,000 m²)	
	Main Gate	$/m²	567	m²	1,300	737,100
	Control House	$/m²	1,170	m²	2,000	2,340,000
	Maintenance Shops	$/m²	1,042	m²	3,000	3,126,000
	CFS	$/m²	846	m²	7,000	5,922,000
	Substation/Power station	$/m²	602	m²	2,100	1,264,200
	Passenger Terminal	$/m²	450	m²	3,000	1,350,000
	Misc., buildings	$/m²	570	m²	1,600	912,000
	Weigh bridge	$/set	76,300	set	4	305,200
	Over-head passenger bridge	$/m	3,000	m	0	0
	Fence	$/m	123	m	2,000	246,000
	Park	$/m²	35	m²	4,200	147,000
	Landscaping	$/m²	19	m²	4,200	79,800
	Subtotal					16,429,300
E. Utilities						
	Water Supply (Main)	$/B	175,000	B	2	350,000
	Water Supply (Dis.)	$/ha	20,000	ha	21.00	420,000
	Fire fighting	$/ha	2,000	ha	21.00	42,000
	Sewerage	$/ha	9,300	ha	21.00	195,300
	Power Supply (Distr.)	$/B	1,020,000	B	2	2,040,000
	Power Supply (P. Plant)	$/B	530,000	B	2	1,060,000
	Power Supply (W. Crane)	$/B	455,000	B	2	910,000
	Lighting (Yard)	$/B	240,000	B	2	480,000
	Lighting (Road)	$/ha	24,000	ha	7.36	176,640
	Telecommunication	$/B	42,000	B	2	84,000
	Reefer System	$/B	100,000	B	2	200,000
	Bunker System	$/m	1,000	m	600	600,000
	Misc., utilities			LS	2	507,060
	Subtotal					7,065,000
F. Supplemental Works						
	Navigational aid	$/B	500,000	B	0	0
	Outer access (new)	$/m²	105.3	m²	0	0
	Outer access (improve)	$/m²	34.8	m²	0	0
	Demolishing					
	Demolishing (Pier No. 16)	$/m³	40	m³	700	28,000

Case: SITE - CS14 B3/4

Work Category	Works	Unit Rate Unit	Unit Rate	Works Unit	Works	Cost
	Demolishing (Small pier)	$/pier	10,000	pier	0	0
	Demolishing (Onland civil)	$/m²	3	m²	42,000	126,000
	Demolishing (Building)	$/m²	100	m²	2,000	200,000
	Environmental protection			LS	1	387,830
	Misc. works			LS	1	537,820
	Mole yard pavement	$/m²	69.6	m²	24,000	1,670,400
	Mole road pavement	$/m²	105.3	m²	1,800	189,540
	Subtotal					3,139,590
G. Others						
	Flyover	$/m²	2,500	m²	0	0
	Bunker pier reinstallation	$/set	11,000,000	set	0	0
	Loading arms	$/set	440,000	set	0	0
	Bunker lines	$/m	2,000	m	0	0
	Breakwater Improvement	$/m	4,000	m	0	0
	Subtotal					0
	Cost by Wharf Depth					
	Cost CS14	B 3/4				116,320,480
	Marine Works	Reduction				0
	Cost CS14/12	B 3/4				116,320,480
	Cost CS14					116,320,480
	Marine Works	Reduction 14/12				0
		Wharf cost reduction	$/m	6,200	m	600	-3,720,000
		Supplemental reduction			LS	0	0
		Total reduction					-3,720,000
	Cost CS12	B 3/4				112,600,480

Appendix II-A-2 Wharf Cost by Structural Type

TABLE UNIT COST STUDY SHEET

WHARF -12.0 m SITE - C

Works	Specifications	Quantity		Unit Rate		Unit Cost	
		Unit		Unit		Unit	
Open Structure Type	Batter Pile Type						
Dredging and Replacing		m³/m	192.0	$/m³	7.56	$/m	1,451.5
Pile, Line-1, Ø900	Preboring,	m/m	0	$/m	1,084.0	$/m	0
	Material, Ø900 t=1.6 L=32.6	t/m	2.31	$/t	1,282.0	$/m	2,961.4
	Driving Vertical	m/m	6.52	$/m	162.0	$/m	1,056.2
Pile, Line-2, 3, 4, 5 Ø600	Preboring,	m/m	0	$/m	1,084.0	$/m	0
	Material, Ø600 t=1.3 L=32.6	t/m	5.00	$/t	1,282.0	$/m	6,410.0
	Driving Vertical	m/m	26.08	$/m	108.0	$/m	2,816.6
Pile, Line-1, 2, Ø600	Material, Ø600 t=1.3 L=33.8	t/m	7.78	$/t	1,282.0	$/m	9,974.0
	Driving Batter	m/m	40.6	$/m	108.0	$/m	4,384.8
Crane foundation pile	Material, Ø900 t=1.6 L=32.1	t/m	1.52	$/t	1,282.0	$/m	1,948.6
	Driving	m/m	4.28	$/m	54.0	$/m	231.1
Cathodic protection		m²/m	36.4	$/m²	65.0	$/m	2,366.0
Selected fill		m³/m	237.1	$/m³	25.0	$/m	5,927.5
Rubble back-fill		m³/m	11.4	$/m³	56.4	$/m	643.0
Armor rock		m³/m	49.3	$/m³	70.5	$/m	3,475.7
Concrete deck		m³/m	20.8	$/m³	440.0	$/m	9,152.0
L-shaped wall		m³/m	2.2	$/m³	440.0	$/m	968.0
Crane beam		m³/m	2.8	$/m³	440.0	$/m	1,232.0
Apron pavement		m²/m	19.3	$/m²	131.5	$/m	2,538.0
Pile protection	FRP covering ~ -1.0 m	m²/m	14.88	$/m²	100.0	$/m	1,488.0
Sheet	t = 5 mm	m²/m	71.0	$/m²	20.0	$/m	1,420.0
Fender		ea/m	0.1	$/ea	20,000.0	$/m	2,000.0
Bollard		ea/m	0.02	$/ea	2,000.0	$/m	40.0
Fittings, etc.	Misc. fittings, Utilities, Crane Rail		1	LS	1,600.0	$/m	1,600.0
	Subtotal					$/m	64,084.4
Construction Equipment	Boring fleet mobilization		0	LS	810.0	$/m	0
	Pile driving fleet mobilization		1	LS	1,304.0	$/m	1,304.0
	Pile Yard		1	LS	400.0	$/m	400.0
	Subtotal					$/m	1,704.0
	Grand Total					$/m	65,788.4

TABLE UNIT COST STUDY SHEET

WHARF -12.0 m SITE - C

Works	Specifications	Quantity		Unit Rate		Unit Cost	
		Unit		Unit		Unit	
Open Structure Type	Vertical Pile Type						
Dredging and Replacing		m³/m	192.0	$/m³	7.56	$/m	1,451.5
Pile, Line-1, 2, 3, 4, 5	Preboring,	m/m	0	$/m	1,084.0	$/m	0
Ø1,100	Material, Ø1,100 t=1.6 L=32.6	t/m	14.11	$/t	1,282.0	$/m	18,089.0
	Driving	m/m	32.60	$/m	198.0	$/m	6,454.8
		m/m		$/m		$/m	
		t/m		$/t		$/m	
		m/m		$/m		$/m	
		t/m		$/t		$/m	
		m/m		$/m		$/m	
Crane foundation pile	Material, Ø900 t=1.6 L=32.1	t/m	1.52	$/t	1,282.0	$/m	1,948.6
	Driving	m/m	4.28	$/m	54.0	$/m	231.1
Cathodic protection		m²/m	27.3	$/m²	65.0	$/m	1,774.5
Selected fill		m³/m	237.1	$/m³	25.0	$/m	5,927.5
Rubble back-fill		m³/m	11.4	$/m³	56.4	$/m	643.0
Armor rock		m³/m	49.3	$/m³	70.5	$/m	3,475.7
Concrete deck		m³/m	20.8	$/m³	440.0	$/m	9,152.0
L-shaped wall		m³/m	2.2	$/m³	440.0	$/m	968.0
Crane beam		m³/m	2.8	$/m³	440.0	$/m	1,232.0
Apron pavement		m²/m	19.3	$/m²	131.5	$/m	2,538.0
Pile protection	FRP covering ~ -1.0 m	m²/m	11.74	$/m²	100.0	$/m	1,174.0
Sheet	t = 5 mm	m²/m	71.0	$/m²	20.0	$/m	1,420.0
Fender		ea/m	0.1	$/ea	20,000.0	$/m	2,000.0
Bollard		ea/m	0.02	$/ea	2,000.0	$/m	40.0
Fittings, etc.	Misc. fittings, Utilities, Crane Rail		1	LS	1,600.0	$/m	1,600.0
	Subtotal					$/m	60,119.7
Construction Equipment	Boring fleet mobilization		0	LS	810.0	$/m	0
	Pile driving fleet mobilization		1	LS	1,304.0	$/m	1,304.0
	Pile Yard		1	LS	280.0	$/m	280.0
	Subtotal					$/m	1,584.0
	Grand Total					$/m	61,703.7

TABLE UNIT COST STUDY SHEET

WHARF -12.0 m SITE - T

Works	Specifications	Quantity		Unit Rate		Unit Cost	
		Unit		Unit		Unit	
Open Structure Type	Vertical Piles						
Dredging		m³/m	0	$/m³	5.4	$/m	0
Pile, Line - 1/2, ø1,100	Preboring, ø1,300	m/m	1.23	$/m	1,300.0	$/m	1,599.0
	Material, ø1,100 t=1.6 L=25.1	t/m	4.35	$/t	1,282.0	$/m	5,576.7
	Driving	m/m	10.04	$/m	198.0	$/m	1,987.9
Pile, Line - 3/5, ø1,100	Preboring	m/m	1.85	$/m	1,300.0	$/m	2,405
	Material, ø1,100 t=1.6 L=22.6	t/m	5.87	$/t	1,282.0	$/m	7,525.3
	Driving	m/m	13.56	$/m	198.0	$/m	2,684.9
		t/m		$/t		$/m	
		m/m		$/m		$/m	
Crane foundation pile	Material, ø900 t=1.6 L=22.1	t/m	1.04	$/t	1,282.0	$/m	1,333.3
	Driving	m/m	2.95	$/m	54.0	$/m	159.3
Cathodic protection		m²/m	16.7	$/m²	65.0	$/m	1,085.5
Selected fill		m³/m	237.1	$/m³	25.0	$/m	5,927.5
Rubble back-fill		m³/m	11.4	$/m³	56.4	$/m	643.0
Armor rock		m³/m	49.3	$/m³	70.5	$/m	3,475.7
Concrete deck		m³/m	20.8	$/m³	440.0	$/m	9,152.0
L-shaped wall		m³/m	2.2	$/m³	440.0	$/m	968.0
Crane beam		m³/m	2.8	$/m³	440.0	$/m	1,232.0
Apron pavement		m²/m	19.3	$/m²	131.5	$/m	2,538.0
Pile protection	FRP covering ~ -1.0 m	m²/m	11.74	$/m²	100.0	$/m	1,174.0
Sheet	t = 5 mm	m²/m	71.0	$/m²	20.0	$/m	1,420.0
Fender		ea/m	0.1	$/ea	20,000.0	$/m	2,000.0
Bollard		ea/m	0.02	$/ea	2,000.0	$/m	40.0
Fittings, etc.	Misc. fittings, Utilities, Crane Rail		1	LS	1,600.0	$/m	1,600.0
	Subtotal					$/m	54,527.1
Construction Equipment	Boring fleet mobilization		1	LS	1,265.0	$/m	1,265.0
	Pile driving fleet mobilization		1	LS	1,304.0	$/m	1,304.0
	Pile Yard		1	LS	280.0	$/m	280.0
	Subtotal					$/m	2,849.0
	Grand Total					$/m	57,376.1

TABLE UNIT COST STUDY SHEET

WHARF -14.0 m SITE - C

Works	Specifications	Quantity		Unit Rate		Unit Cost	
		Unit		Unit		Unit	
Open Structure Type	Batter Pile Type						
Dredging and Replacing		m³/m	216.0	$/m³	7.56	$/m	1,633.0
Pile, Line-1, ø900	Preboring,	m/m	0	$/m	1,084.0	$/m	0
	Material, ø900 t=1.6 L=32.6	t/m	2.31	$/t	1,282.0	$/m	2,961.4
	Driving Vertical	m/m	6.52	$/m	162.0	$/m	1,056.2
Pile, Line-2, 3, 4, 5 ø600	Preboring,	m/m	0	$/m	1,084.0	$/m	0
	Material, ø600 t=1.3 L=32.6	t/m	5.00	$/t	1,282.0	$/m	6,410.0
	Driving Vertical	m/m	26.1	$/m	108.0	$/m	2,818.8
Pile, Line-1, 2, ø600	Material, ø600 t=1.3 L=33.8	t/m	7.78	$/t	1,282.0	$/m	9,974.0
	Driving Batter	m/m	40.6	$/m	108.0	$/m	4,384.8
Crane foundation pile	Material, ø900 t=1.6 L=32.1	t/m	1.52	$/t	1,282.0	$/m	1,948.6
	Driving	m/m	4.28	$/m	54.0	$/m	231.1
Cathodic protection		m²/m	36.4	$/m²	65.0	$/m	2,366.0
Selected fill		m³/m	254.7	$/m³	25.0	$/m	6,367.5
Rubble back-fill		m³/m	11.4	$/m³	56.4	$/m	643.0
Armor rock		m³/m	46.7	$/m³	70.5	$/m	3,292.4
Concrete deck		m³/m	20.8	$/m³	440.0	$/m	9,152.0
L-shaped wall		m³/m	2.2	$/m³	440.0	$/m	968.0
Crane beam		m³/m	2.8	$/m³	440.0	$/m	1,232.0
Apron pavement		m²/m	19.3	$/m²	131.5	$/m	2,538.0
Pile protection	FRP covering ~ -1.0 m	m²/m	14.88	$/m²	100.0	$/m	1,488.0
Sheet	t = 5 mm	m²/m	76.0	$/m²	20.0	$/m	1,520.0
Fender		ea/m	0.1	$/ea	20,000.0	$/m	2,000.0
Bollard		ea/m	0.02	$/ea	2,000.0	$/m	40.0
Fittings, etc.	Misc. fittings, Utilities, Crane Rail		1	LS	1,600.0	$/m	1,600.0
	Subtotal					$/m	64,624.8
Construction Equipment	Boring fleet mobilization		0	LS	810	$/m	0
	Pile driving fleet mobilization		1	LS	1,304.0	$/m	1,304.0
	Pile Yard		1	LS	400.0	$/m	400.0
	Subtotal					$/m	1,704.0
	Grand Total					$/m	66,328.8

TABLE UNIT COST STUDY SHEET

WHARF -14.0 m SITE - C

Works	Specifications	Quantity		Unit Rate		Unit Cost	
		Unit		Unit		Unit	
Open Structure Type	Vertical Pile Type						
Dredging and Replacing		m³/m	216.0	$/m³	7.56	$/m	1,633.0
Pile, Line-1, 2, 3, 4, 5	Preboring, Ø1,300	m/m	0	$/m	1,084.0	$/m	0
Ø1,100	Material, Ø1,100 t=2.1 L=32.6	t/m	18.53	$/t	1,282.0	$/m	23,755.5
	Driving	m/m	32.6	$/m	198.0	$/m	6,454.8
		m/m		$/m		$/m	
		t/m		$/t		$/m	
		m/m		$/m		$/m	
		t/m		$/t		$/m	
		m/m		$/m		$/m	
Crane foundation pile	Material, Ø900 t=1.6 L=32.1	t/m	1.52	$/t	1,282.0	$/m	1,948.6
	Driving	m/m	4.28	$/m	54.0	$/m	231.1
Cathodic protection		m²/m	27.4	$/m²	65.0	$/m	1,781.0
Selected fill		m³/m	253.9	$/m³	25.0	$/m	6,347.5
Rubble back-fill		m³/m	11.4	$/m³	56.4	$/m	643.0
Armor rock		m³/m	46.7	$/m³	70.5	$/m	3,292.4
Concrete deck		m³/m	20.8	$/m³	440.0	$/m	9,152.0
L-shaped wall		m³/m	2.2	$/m³	440.0	$/m	968.0
Crane beam		m³/m	2.8	$/m³	440.0	$/m	1,232.0
Apron pavement		m²/m	19.3	$/m²	131.5	$/m	2,538.0
Pile protection	FRP covering ~ -1.0 m	m²/m	11.74	$/m²	100.0	$/m	1,174.0
Sheet	t = 5 mm	m²/m	76.0	$/m²	20.0	$/m	1,520.0
Fender		ea/m	0.1	$/ea	20,000.0	$/m	2,000.0
Bollard		ea/m	0.02	$/ea	2,000.0	$/m	40.0
Fittings, etc.	Misc. fittings, Utilities, Crane Rail		1	LS	1,600.0	$/m	1,600.0
	Subtotal					$/m	66,310.9
Construction Equipment	Boring fleet mobilization		0	LS	810.0	$/m	0
	Pile driving fleet mobilization		1	LS	1,304.0	$/m	1,304.0
	Pile Yard		1	LS	280.0	$/m	280.0
	Subtotal					$/m	1,584.0
	Grand Total					$/m	67,894.9

TABLE UNIT COST STUDY SHEET

WHARF -14.0 m SITE - T

Works	Specifications	Quantity		Unit Rate		Unit Cost	
		Unit		Unit		Unit	
Open Structure Type	Vertical Pile Type						
Dredging and Replacing		m³/m	0	$/m³	5.4	$/m	0
Pile, Line - 1/3, Ø1,100	Preboring, Ø1,300	m/m	2.20	$/m	1,300.0	$/m	2,860.0
	Material, Ø1,100 t=2.1 L=25.1	t/m	8.56	$/t	1,282.0	$/m	10,973.9
	Driving	m/m	15.06	$/m	198.0	$/m	2,981.9
Pile, Line - 3/4, Ø1,100	Preboring	m/m	3.30	$/m	1,300.0	$/m	4,290
	Material, Ø1,100 t=2.1 L=22.6	t/m	5.14	$/t	1,282.0	$/m	6,589.5
	Driving	m/m	9.00	$/m	198.0	$/m	1,782.0
		t/m		$/t		$/m	
		m/m		$/m		$/m	
Crane foundation pile	Material, Ø900 t=1.6 L=22.1	t/m	1.04	$/t	1,282.0	$/m	1,333.3
	Driving	m/m	2.95	$/m	54.0	$/m	159.3
Cathodic protection		m²/m	25.77	$/m²	65.0	$/m	1,675.1
Selected fill		m³/m	230.9	$/m³	25.0	$/m	5,772.5
Rubble back-fill		m³/m	11.4	$/m³	56.4	$/m	643.0
Armor rock		m³/m	46.7	$/m³	70.5	$/m	3,292.4
Concrete deck		m³/m	20.8	$/m³	440.0	$/m	9,152.0
L-shaped wall		m³/m	2.2	$/m³	440.0	$/m	968.0
Crane beam		m³/m	2.8	$/m³	440.0	$/m	1,232.0
Apron pavement		m²/m	19.3	$/m²	131.5	$/m	2,538.0
Pile protection	FRP covering ~ -1.0 m	m²/m	11.74	$/m²	100.0	$/m	1,174.0
Sheet	t = 5 mm	m²/m	76.0	$/m²	20.0	$/m	1,520.0
Fender		ea/m	0.1	$/ea	20,000.0	$/m	2,000.0
Bollard		ea/m	0.02	$/ea	2,000.0	$/m	40.0
Fittings, etc.	Misc. fittings, Utilities, Crane Rail		1	LS	1,600.0	$/m	1,600.0
	Subtotal					$/m	65,576.9
Construction Equipment	Boring fleet mobilization		1	LS	1,265.0	$/m	1,265.0
	Pile driving fleet mobilization		1	LS	1,304.0	$/m	1,304.0
	Pile Yard		1	LS	280.0	$/m	280.0
	Subtotal					$/m	2,849.0
	Grand Total					$/m	65,425.9

TABLE UNIT COST STUDY SHEET

WHARF -12.0 m SITE - C

Works	Specifications	Quantity		Unit Rate		Unit Cost	
		Unit		Unit		Unit	
Caisson Type							
Dredging and Replacing		m^3/m	192.0	$/m³	7.56	$/m	1,451.5
Base rock mound		m^3/m	35.0	$/m³	70.5	$/m	2,467.5
Caisson	Prefabrication	m^3/m	40.6	$/m³	440.0	$/m	17,864.0
Caisson	Towing and setting	ea/m	0.05	$/ea	50,400.0	$/m	2,520.0
Sand fill		m^3/m	86.4	$/m³	9.6	$/m	829.4
Concrete capping		m^3/m	3.4	$/m³	300.0	$/m	1,020.0
Head beam		m^3/m	7.4	$/m³	330.0	$/m	2,442.0
Rubble back fill	+ 1.0 ~ -14.0	m^3/m	117.2	$/m³	56.4	$/m	6,610.1
Rubble back fill	+ 3.3 ~ +1.0	m^3/m	5.6	$/m³	47.0	$/m	263.2
Sheet	t = 5 mm	m^2/m	48.1	$/m²	20.0	$/m	962.0
Crane beam		m^3/m	2.8	$/m³	440.0	$/m	1,232.0
Piles, material	Steel, ⌀900 t=1.6 L=32.1 etc 7.5	t/m	1.52	$/t	1,282.0	$/m	1,948.6
Pile driving		m/m	4.28	$/m	54.0	$/m	231.1
Apron pavement		m^2/m	41.0	$/m²	131.5	$/m	5,391.5
Fender		ea/m	0.1	$/ea	20,000.0	$/m	2,000.0
Bollard		ea/m	0.02	$/ea	2,000.0	$/m	40.0
Fittings, etc.	Misc. fittings, Utilities, Crane Rail		1	LS	1,600.0	$/m	1,600.0
	Subtotal					$/m	48,872.9
Construction Equipment	Floating dock mobilization		1	LS	3,023.0	$/m	3,023.0
	Floating dock operation		1	LS	8,389.5	$/m	8,389.5
	Subtotal					$/m	11,412.5
	Grand total					$/m	60,285.4

TABLE UNIT COST STUDY SHEET

WHARF -12.0 m SITE - T

Works	Specifications	Quantity		Unit Rate		Unit Cost	
		Unit		Unit		Unit	
Caisson Type							
Dredging and Replacing	Hard/weathered rock	m^3/m	0	$/m³	5.4	$/m	0
Base rock mound		m^3/m	40.6	$/m³	70.5	$/m	2,862.3
Caisson	Prefabrication	m^3/m	40.6	$/m³	440.0	$/m	17,864.0
Caisson	Towing and setting	ea/m	0.05	$/ea	50,400.0	$/m	2,520.0
Sand fill		m^3/m	86.4	$/m³	9.6	$/m	829.4
Concrete capping		m^3/m	3.4	$/m³	300.0	$/m	1,020.0
Head beam		m^3/m	7.4	$/m³	330.0	$/m	2,442.0
Rubble back fill	+ 1.0 ~ -14.0	m^3/m	117.2	$/m³	56.4	$/m	6,610.1
Rubble back fill	+ 3.3 ~ +1.0	m^3/m	5.6	$/m³	47.0	$/m	263.2
Sheet	t = 5 mm	m^2/m	48.1	$/m²	20.0	$/m	962.0
Crane beam		m^3/m	2.8	$/m³	440.0	$/m	1,232.0
Piles, material	Steel, ⌀900 t=1.6 L=22.1 etc 7.5	t/m	1.04	$/t	1,282.0	$/m	1,333.3
Pile driving		m/m	6.14	$/m	54.0	$/m	331.6
Apron pavement		m^2/m	41.0	$/m²	131.5	$/m	5,391.5
Fender		ea/m	0.1	$/ea	20,000.0	$/m	2,000.0
Bollard		ea/m	0.02	$/ea	2,000.0	$/m	40.0
Fittings, etc.	Misc. fittings, Utilities, Crane Rail		1	LS	1,600.0	$/m	1,600.0
	Subtotal					$/m	47,301.4
Construction Equipment	Floating dock mobilization		1	LS	3,023.0	$/m	3,023.0
	Floating dock operation		1	LS	8,389.5	$/m	8,389.5
	Subtotal					$/m	11,412.5
	Grand total					$/m	58,713.9

TABLE UNIT COST STUDY SHEET

WHARF -14.0 m SITE - C

Works	Specifications	Quantity		Unit Rate		Unit Cost	
		Unit		Unit		Unit	
Caisson Type							
Dredging and Replacing		m³/m	216.0	$/m³	7.56	$/m	1,633.0
Base rock mound		m³/m	49.4	$/m³	70.5	$/m	3,482.7
Caisson	Prefabrication	m²/m	48.2	$/m²	440.0	$/m	21,208.0
Caisson	Towing and setting	ea/m	0.05	$/ea	50,400.0	$/m	2,520.0
Sand fill		m³/m	119.8	$/m³	9.6	$/m	1,150.1
Concrete capping		m³/m	3.7	$/m³	300.0	$/m	1,110.0
Head beam		m³/m	7.4	$/m³	330.0	$/m	2,442.0
Rubble back fill	+ 1.0 ~ -14.0	m³/m	127.2	$/m³	56.4	$/m	7,174.1
Rubble back fill	+ 3.3 ~ +1.0	m³/m	5.6	$/m³	47.0	$/m	263.2
Sheet	t = 5 mm	m²/m	60.1	$/m²	20.0	$/m	1,202.0
Crane beam		m³/m	2.8	$/m³	440.0	$/m	1,232.0
Piles, material	Steel, Ø900 t=1.6 L=32.1 ctc 7.5	t/m	1.52	$/t	1,282.0	$/m	1,948.6
Pile driving		m/m	4.28	$/m	54.0	$/m	231.1
Apron pavement		m²/m	41.0	$/m²	131.5	$/m	5,391.5
Fender		ea/m	0.1	$/ea	20,000.0	$/m	2,000.0
Bollard		ea/m	0.02	$/ea	2,000.0	$/m	40.0
Fittings, etc.	Misc. fittings, Utilities, Crane Rail		1	LS	1,600.0	$/m	1,600.0
	Subtotal					$/m	54,628.3
Construction Equipment	Floating dock mobilization		1	LS	3,023.0	$/m	3,023.0
	Floating dock operation		1	LS	9,870.0	$/m	9,870.0
	Subtotal					$/m	12,893.0
	Grand total					$/m	67,521.3

TABLE UNIT COST STUDY SHEET

WHARF -14.0 m SITE - T

Works	Specifications	Quantity		Unit Rate		Unit Cost	
		Unit		Unit		Unit	
Caisson Type							
Dredging	Hard/weathered rock	m³/m	0	$/m³	5.4	$/m	0
Base rock mound		m³/m	17.5	$/m³	70.5	$/m	1,233.8
Caisson	Prefabrication	m²/m	48.2	$/m³	440.0	$/m	21,208.0
Caisson	Towing and setting	ea/m	0.05	$/ea	50,400.0	$/m	2,520.0
Sand fill		m³/m	119.8	$/m³	9.6	$/m	1,150.1
Concrete capping		m³/m	3.7	$/m³	300.0	$/m	1,110.0
Head beam		m³/m	7.4	$/m³	330.0	$/m	2,442.0
Rubble back fill	+ 1.0 ~ -14.0	m³/m	127.2	$/m³	56.4	$/m	7,174.1
Rubble back fill	+ 3.3 ~ +1.0	m³/m	5.6	$/m³	47.0	$/m	263.2
Sheet	t = 5 mm	m²/m	60.1	$/m²	20.0	$/m	1,202.0
Crane beam		m³/m	2.8	$/m³	440.0	$/m	1,232.0
Piles, material	Steel, Ø900 t=1.6 L=22.1 ctc 7.5	t/m	1.04	$/t	1,282.0	$/m	1,333.3
Pile driving		m/m	2.95	$/m	54.0	$/m	159.3
Apron pavement		m²/m	41.0	$/m²	131.5	$/m	5,391.5
Fender		ea/m	0.1	$/ea	20,000.0	$/m	2,000.0
Bollard		ea/m	0.02	$/ea	2,000.0	$/m	40.0
Fittings, etc.	Misc. fittings, Utilities, Crane Rail		1	LS	1,600.0	$/m	1,600.0
	Subtotal					$/m	50,059.3
Construction Equipment	Floating dock mobilization		1	LS	3,023.0	$/m	3,023.0
	Floating dock operation		1	LS	9,870.0	$/m	9,870..0
	Subtotal					$/m	12,893.0
	Grand total					$/m	62,952.3

TABLE UNIT COST STUDY SHEET

WHARF -12.0 m SITE - C

Works	Specifications	Quantity		Unit Rate		Unit Cost	
		Unit		Unit		Unit	
Sheet Pile Wall Type							
Dredging and Replacing		m³/m	192.0	$/m³	7.56	$/m	1,451.5
Sheet Pile	Preboring, ø1,200	m/m	0	$/m	1,084.0	$/m	0
Sheet Pile main body	Material, ø1,000 t=1.3 L=29.0	t/m	7.73	$/t	1,282.0	$/m	9,909.9
Sheet Pile joint	Material	m/m	13.3	$/m	114.4	$/m	1,521.5
	Driving	m/m	24.2	$/m	216.0	$/m	5,227.2
Anchor pile	Steel pile, ø900 t=1.6 L=25.2	t/m	1.49	$/t	1,282.0	$/m	1,910.2
Anchor pile	Driving	m/m	4.2	$/m	198.0	$/m	831.6
Wale		t/m	0.26	$/t	798.0	$/m	207.5
Tie-rope	86 ton, (2,117 mm²)	ea/m	0.42	$/ea	6,178.0	$/m	2,594.8
Selected fill	Coral and sand	m³/m	237.5	$/m³	25.0	$/m	5,937.5
Rubble back-fill	+ 1.0 ~ -14.0	m³/m	118.2	$/m³	56.4	$/m	6,666.5
Anchor capping		m³/m	4.8	$/m³	440.0	$/m	2,112.0
Concrete capping	Front wall	m³/m	7.2	$/m³	440.0	$/m	3,168.0
Crane beam		m³/m	5.6	$/m³	440.0	$/m	2,464.0
Pile, material	Steel ø900 t=1.6 L=32.1 ctc=7.5	t/m	3.03	$/t	1,282.0	$/m	3,884.5
Pile driving		m/m	8.56	$/m	54.0	$/m	462.2
Cathodic protection		m²/m	21.2	$/m²	65.0	$/m	1,378.0
Apron pavement		m²/m	42.0	$/m²	131.5	$/m	5,523.0
Fender		ea/m	0.1	$/ea	20,000.0	$/m	2,000.0
Bollard		ea/m	0.02	$/ea	2,000.0	$/m	40.0
Fittings, etc.	Misc. fittings, Utilities, Crane Rail		1	LS	1,600.0	$/m	1,600.0
	Subtotal					$/m	58,889.9
Construction Equipment	Boring fleet mobilization		0	LS	810.0	$/m	0
	Pile driving fleet mobilization		1	LS	1,304.0	$/m	1,304.0
	Pile Yard		1	LS	440.0	$/m	440.0
	Subtotal					$/m	1,744.0
	Grand Total					$/m	60,633.9

TABLE UNIT COST STUDY SHEET

WHARF -12.0 m SITE - T

Works	Specifications	Quantity		Unit Rate		Unit Cost	
		Unit		Unit		Unit	
Sheet Pile Wall Type							
Dredging		m³/m	0	$/m³	5.4	$/m	0
Sheet Pile	Preboring, ø1,200	m/m	3.06	$/m	1,300.0	$/m	3,978
Sheet Pile main body	Material, ø1,000 t=1.3 L=21.5	t/m	5.73	$/t	1,282.0	$/m	7,345.9
Sheet Pile joint	Material	m/m	13.3	$/m	114.4	$/m	1,521.5
	Driving	m/m	17.9	$/m	216.0	$/m	3,866.4
Anchor pile	Steel pile, ø900 t=1.3 L=17.4	t/m	1.03	$/t	1,282.0	$/m	1,320.5
Anchor pile	Driving	m/m	1.2	$/m	198.0	$/m	237.6
Wale		t/m	0.26	$/t	798.0	$/m	207.5
Tie-rope	86 ton, (2,117 mm²)	ea/m	0.42	$/ea	6,178.0	$/m	2,594.8
Foot protection	Rock	m³/m	11.4	$/m³	70.5	$/m	803.7
Selected fill	Coral and sand	m²/m	192.4	$/m³	25.0	$/m	4,810.0
Rubble back fill	+ 1.0 ~ -14.0	m³/m	118.2	$/m³	56.4	$/m	6,666.5
Anchor capping		m³/m	4.8	$/m³	440.0	$/m	2,112.0
Concrete capping	Front wall	m³/m	7.2	$/m³	440.0	$/m	3,168.0
Crane beam		m³/m	5.6	$/m³	440.0	$/m	2,464.0
Pile, material	Steel ø900 t=1.6 L=17.4 ctc=6.0	t/m	2.05	$/t	1,282.0	$/m	2,628.1
Pile driving		m/m	5.80	$/m	54.0	$/m	313.2
Cathodic protection		m²/m	21.2	$/m²	65.0	$/m	1,378.0
Apron pavement		m²/m	42.0	$/m²	131.5	$/m	5,523.0
Fender		ea/m	0.1	$/ea	20,000.0	$/m	2,000.0
Bollard		ea/m	0.02	$/ea	2,000.0	$/m	40.0
Fittings, etc.	Misc. fittings, Utilities, Crane Rail		1	LS	1,600.0	$/m	1,600.0
	Subtotal					$/m	54,578.7
Construction Equipment	Boring fleet mobilization		1	LS	1,265.0	$/m	1,265.0
	Pile driving fleet mobilization		1	LS	1,304.0	$/m	1,304.0
	Pile Yard		1	LS	440.0	$/m	440.0
	Subtotal					$/m	3,009.0
	Grand Total					$/m	57,587.7

TABLE UNIT COST STUDY SHEET

WHARF -14.0 m SITE - C

Works	Specifications	Quantity		Unit Rate		Unit Cost	
		Unit		Unit		Unit	
Sheet Pile Wall Type							
Dredging and Replacing		m³/m	216.0	$/m³	7.56	$/m	1,633.0
Sheet Pile	Preboring, Ø1,200	m/m	0	$/m	1,084.0	$/m	0
Sheet Pile main body	Material, Ø1,000 t=1.7 L=30.5	t/m	10.63	$/t	1,282.0	$/m	13,627.7
Sheet Pile joint	Material	m/m	15.0	$/m	114.4	$/m	1,716.0
	Driving	m/m	25.4	$/m	216.0	$/m	5,486.4
Anchor pile	Steel pile, Ø900 t=1.6 L=25.4	t/m	2.50	$/t	1,282.0	$/m	3,205.0
Anchor pile	Driving	m/m	7.1	$/m	198.0	$/m	1,405.8
Wale		t/m	0.26	$/t	798.0	$/m	207.5
Tie-rope	86 ton, (2,117 mm²)	ea/m	0.50	$/ea	6,178.0	$/m	3,089.0
Selected fill	Coral and sand	m³/m	302.4	$/m³	25.0	$/m	7,560.0
Rubble back fill	+ 1.0 ~ -14.0	m³/m	118.2	$/m³	56.4	$/m	6,666.5
Anchor capping		m³/m	2.8	$/m³	440.0	$/m	1,232.0
Concrete capping	Front wall	m³/m	7.2	$/m³	440.0	$/m	3,168.0
Crane beam		m³/m	5.6	$/m³	440.0	$/m	2,464.0
Pile, material	Steel Ø900 t=1.6 L=32.1 ctc=7.5	t/m	3.03	$/t	1,282.0	$/m	3,884.5
Pile driving		m/m	8.6	$/m	54.0	$/m	464.4
Cathodic protection		m²/m	21.2	$/m²	65.0	$/m	1,378.0
Apron pavement		m²/m	42.0	$/m²	131.5	$/m	5,523.0
Fender		ea/m	0.1	$/ea	20,000.0	$/m	2,000.0
Bollard		ea/m	0.02	$/ea	2,000.0	$/m	40.0
Fittings, etc.	Misc. fittings, Utilities, Crane Rail		1	LS	1,600.0	$/m	1,600.0
	Subtotal					$/m	66,350.8
Construction Equipment	Boring fleet mobilization		0	LS	810	$/m	0
	Pile driving fleet mobilization		1	LS	1,304.0	$/m	1,304.0
	Pile Yard		1	LS	440.0	$/m	440.0
	Subtotal					$/m	1,744.0
	Grand Total					$/m	68,094.8

TABLE UNIT COST STUDY SHEET

WHARF -14.0 m SITE - T

Works	Specifications	Quantity		Unit Rate		Unit Cost	
		Unit		Unit		Unit	
Sheet Pile Wall Type							
Dredging		m³/m	0	$/m³	5.4	$/m	0
Sheet Pile	Preboring, Ø1,200	m/m	5.67	$/m	1,300.0	$/m	7,371.0
Sheet Pile main body	Material, Ø1,000 t=1.7 L=24.0	t/m	8.36	$/t	1,282.0	$/m	10,717.5
Sheet Pile joint	Material	m/m	15.0	$/m	114.4	$/m	1,716.0
	Driving	m/m	20.0	$/m	216.0	$/m	4,320.0
Anchor pile	Steel pile, Ø900 t=1.3 L=17.4	t/m	1.39	$/t	1,282.0	$/m	1,782.0
Anchor pile	Driving	m/m	4.83	$/m	198.0	$/m	956.3
Wale		t/m	0.26	$/t	798.0	$/m	207.5
Tie-rope	86 ton, (2,117 mm²)	ea/m	0.50	$/ea	6,178.0	$/m	3,089.0
Selected fill	Coral and sand	m³/m	235.7	$/m³	25.0	$/m	5,892.5
Rubble back fill	+ 1.0 ~ -14.0	m³/m	118.2	$/m³	56.4	$/m	6,666.5
Anchor capping		m³/m	4.8	$/m³	440.0	$/m	2,112.0
Concrete capping	Front wall	m³/m	6.3	$/m³	440.0	$/m	2,772.0
Crane beam		m³/m	5.6	$/m³	440.0	$/m	2,464.0
Pile, material	Steel Ø900 t=1.6 L=22.1 ctc=7.5	t/m	2.09	$/t	1,282.0	$/m	2,679.4
Pile driving		m/m	5.89	$/m	54.0	$/m	318.1
Cathodic protection		m²/m	21.2	$/m²	65.0	$/m	1,378.0
Apron pavement		m²/m	42.0	$/m²	131.5	$/m	5,523.0
Fender		ea/m	0.1	$/ea	20,000.0	$/m	2,000.0
Bollard		ea/m	0.02	$/ea	2,000.0	$/m	40.0
Fittings, etc.	Misc. fittings, Utilities, Crane Rail		1	LS	1,600.0	$/m	1,600.0
	Subtotal					$/m	63,604.8
Construction Equipment	Boring fleet mobilization		1	LS	1,265.0	$/m	1,265.0
	Pile driving fleet mobilization		1	LS	1,304.0	$/m	1,304.0
	Pile Yard		1	LS	440.0	$/m	440.0
	Subtotal					$/m	3,009.0
	Grand Total					$/m	66,613.8

TABLE UNIT COST STUDY SHEET

WHARF -12.0 m SITE - C

Works	Specifications	Quantity		Unit Rate		Unit Cost	
		Unit		Unit		Unit	
Concrete Block Type							
Dredging and replacing		m^3/m	282.0	$/$m^3$	7.56	$/m	2,131.9
Base rock mound		m^3/m	39.5	$/$m^3$	70.5	$/m	2,784.8
Concrete blocks	Prefabrication and storage	m^3/m	104.0	$/$m^3$	350.0	$/m	36,400.0
Concrete blocks	Transp. Tem. Storage and setting	ea/m	2.33	$/ea	2,357.5	$/m	5,493.0
Head beam		m^3/m	7.4	$/$m^3$	330.0	$/m	2,442.0
Rubble back fill	+ 1.0 ~ -14.0	m^3/m	133.6	$/$m^3$	56.4	$/m	7,535.0
Rubble back fill	+ 3.3 ~ +1.0	m^3/m	5.6	$/$m^3$	47.0	$/m	263.2
Sheet	t = 5 mm	m^2/m	88.0	$/$m^2$	20.0	$/m	1,760.0
Crane beam		m^3/m	2.8	$/$m^3$	440.0	$/m	1,232.0
Piles, material	Steel, Ø900 t=1.6 t=32.1 ctc=7.5	t/m	1.52	$/t	1,282.0	$/m	1,948.6
Pile, driving		m/m	4.28	$/m	54.0	$/m	231.1
Apron pavement		m^2/m	41.0	$/$m^2$	131.5	$/m	5,391.5
Fender		ea/m	0.1	$/ea	20,000.0	$/m	2,000.0
Bollard		ea/m	0.02	$/ea	2,000.0	$/m	40.0
Fittings, etc.	Misc. fittings, Utilities, Crane Rail		1	LS	1,600.0	$/m	1,600.0
	Subtotal					$/m	71,253.1
Construction Equipment	Block yard installation		1	LS	2,805.0	$/m	2,805.0
	Block yard operation		1	LS	1,360.0	$/m	1,360.0
	Floating crane mobilization		1	LS	1,109.0	$/m	1,109.0
	Subtotal					$/m	5,274.0
	Grand Total					$/m	76,527.1

TABLE UNIT COST STUDY SHEET

WHARF -12.0 m SITE - T

Works	Specifications	Quantity		Unit Rate		Unit Cost	
		Unit		Unit		Unit	
Concrete Block Type							
Dredging		m^3/m	0	$/$m^3$	5.4	$/m	0
Base rock mound		m^3/m	49.4	$/$m^3$	70.5	$/m	3,482.7
Concrete blocks	Prefabrication and storage	m^3/m	104.0	$/$m^3$	350.0	$/m	36,400.0
Concrete blocks	Transp. Tem. Storage and setting	ea/m	2.33	$/ea	2,357.5	$/m	5,493.0
Head beam		m^3/m	7.4	$/$m^3$	330.0	$/m	2,442.0
Rubble back fill	+ 1.0 ~ -14.0	m^3/m	133.6	$/$m^2$	56.4	$/m	7,535.0
Rubble back fill	+ 3.3 ~ +1.0	m^3/m	5.6	$/$m^3$	47.0	$/m	263.2
Sheet	t = 5 mm	m^2/m	88.0	$/$m^2$	20.0	$/m	1,760.0
Crane beam		m^3/m	2.8	$/$m^3$	440.0	$/m	1,232.0
Piles, material	Steel, Ø900 t=1.6 L=22.1 ctc=7.5	t/m	1.04	$/t	1,282.0	$/m	1,333.3
Pile, driving		m/m	2.95	$/m	54.0	$/m	159.3
Apron pavement		m^2/m	41.0	$/$m^2$	131.5	$/m	5,391.5
Fender		ea/m	0.1	$/ea	20,000.0	$/m	2,000.0
Bollard		ea/m	0.02	$/ea	2,000.0	$/m	40.0
Fittings, etc.	Misc. fittings, Utilities, Crane Rail		1	LS	1,600.0	$/m	1,600.0
	Subtotal					$/m	69,132.0
Construction Equipment	Block yard installation		1	LS	2,805.0	$/m	2,805.0
	Block yard operation		1	LS	1,360.0	$/m	1,360.0
	Floating crane mobilization		1	LS	1,109.0	$/m	1,109.0
	Subtotal					$/m	5,274.0
	Grand Total					$/m	74,406.0

TABLE UNIT COST STUDY SHEET

WHARF -14.0 m SITE - C

Works	Specifications	Quantity		Unit Rate		Unit Cost	
		Unit		Unit		Unit	
Concrete Block Type							
Dredging and replacing		m³/m	246.0	$/m³	7.56	$/m	1,859.8
Base rock mound		m³/m	70.5	$/m³	70.5	$/m	4,970.3
Concrete blocks	Prefabrication and storage	m³/m	129.6	$/m³	350.0	$/m	45,360.0
Concrete blocks	Transp. Tem. Storage and setting	ea/m	2.67	$/ea	2,357.5	$/m	6,294.5
Head beam		m³/m	7.4	$/m³	330.0	$/m	2,442.0
Rubble back fill	+ 1.0 ~ -14.0	m³/m	162.7	$/m³	56.4	$/m	9,176.3
Rubble back fill	+ 3.3 ~ +1.0	m³/m	5.6	$/m³	47.0	$/m	263.2
Sheet	t = 5 mm	m²/m	86.5	$/m²	20.0	$/m	1,730.0
Crane beam		m³/m	2.8	$/m³	440.0	$/m	1,232.0
Piles, material	Steel, ø900 t=1.6 L=32.1 ctc=7.5	t/m	1.52	$/t	1,282.0	$/m	1,948.6
Pile, driving		m/m	4.28	$/m	54.0	$/m	231.1
Apron pavement		m²/m	41.0	$/m²	131.5	$/m	5,391.5
Fender		ea/m	0.1	$/ea	20,000.0	$/m	2,000.0
Bollard		ea/m	0.02	$/ea	2,000.0	$/m	40.0
Fittings, etc.	Misc. fittings, Utilities, Crane Rail		1	LS	1,600.0	$/m	1,600.0
	Subtotal					$/m	84,539.0
Construction Equipment	Block yard installation		1	LS	3,300.0	$/m	3,300.0
	Block yard operation		1	LS	1,600.0	$/m	1,600.0
	Floating crane mobilization		1	LS	1,109.0	$/m	1,109.0
	Subtotal					$/m	6,009.0
	Grand Total					$/m	90,548.3

TABLE UNIT COST STUDY SHEET

WHARF -14.0 m SITE - T

Works	Specifications	Quantity		Unit Rate		Unit Cost	
		Unit		Unit		Unit	
Concrete Block Type							
Dredging and replacing		m³/m	0	$/m³	5.4	$/m	0
Base rock mound		m³/m	20.5	$/m³	70.5	$/m	1,445.3
Concrete blocks	Prefabrication and storage	m³/m	129.6	$/m³	350.0	$/m	45,360.0
Concrete blocks	Transp. Tem. Storage and setting	ea/m	2.67	$/ea	2,357.5	$/m	6,294.5
Head beam		m³/m	7.4	$/m³	330.0	$/m	2,442.0
Rubble back fill	+ 1.0 ~ -14.0	m³/m	162.7	$/m³	56.4	$/m	9,176.3
Rubble back fill	+ 3.3 ~ +1.0	m³/m	5.6	$/m³	47.0	$/m	263.2
Sheet	t = 5 mm	m²/m	86.5	$/m²	20.0	$/m	1,730.0
Crane beam		m²/m	2.8	$/m³	440.0	$/m	1,232.0
Piles, material	Steel, ø900 t=1.6 L=22.1 ctc=7.5	t/m	2.09	$/t	1,282.0	$/m	2,679.4
Pile, driving		m/m	2.95	$/m	54.0	$/m	159.3
Apron pavement		m²/m	41.0	$/m²	131.5	$/m	5,391.5
Fender		ea/m	0.1	$/ea	20,000.0	$/m	2,000.0
Bollard		ea/m	0.02	$/ea	2,000.0	$/m	40.0
Fittings, etc.	Misc. fittings, Utilities, Crane Rail		1	LS	1,600.0	$/m	1,600.0
	Subtotal					$/m	79,813.5
Construction Equipment	Block yard installation		1	LS	3,300.0	$/m	3,300.0
	Block yard operation		1	LS	1,600.0	$/m	1,600.0
	Floating crane mobilization		1	LS	1,109.0	$/m	1,109.0
	Subtotal					$/m	6,009.0
	Grand Total					$/m	85,822.5

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