

## **Appendix-5**

### **Economic and Financial Analysis**

---



Appendix-5.8.10 Economic Analysis (Alternative 1)

Year	Capital Cost				Replace & Maintenance			Operation		in 1,000 USD					Benefit - Cost		
	New Container Terminal (Pack 2)	Passenger & General C. Terminal (Pack 3)	Replace-ment of facilities (Pack 2,3)	Mainte-nance (Pack 2,3)	Fuel and Personnel Cost (Pack 2,3)	Total Cost	Tmasporta-tion Savings by Larger Ships	Tmasporta-tion Cost/Time Savings *	Savings of Congestion Surcharge**	Savings of breakbulk transpor-tation cost	Passenger Ship Increases	Total Benefit	Benefit - Cost	Cost +10% Benefit/0%	Cost 0% Benefit -10%	Cost +10% Benefit -10%	
2017	S7	S7	S7	S7-85	S6-43												
2018	3,430					3,430							-3,430	-3,773	-3,430	-3,773	
2019	0					0							0	0	0	0	
2020	56,715					56,715							-56,715	-62,386	-56,715	-62,386	
2021	78,596					78,596							-78,596	-86,455	-78,596	-86,455	
2022	78,596	915				79,511							-79,511	-87,462	-79,511	-87,462	
2023	0			4,125	513	4,637	2,720	0	36,597	2,142	41,459	36,822	36,358	32,676	32,212		
2024	2,139	19,921		4,125	1,632	27,817	3,006	1,470	36,597	2,289	43,362	15,545	12,763	11,209	8,427		
2025	0	19,921		4,125	3,367	27,412	3,325	3,123	36,597	2,436	45,481	18,069	15,328	13,521	10,780		
2026	31,582			4,785	5,854	42,221	3,682	4,984	36,597	2,583	48,161	1,718	1,124	1,124			
2027	53,463			4,785	8,623	66,871	4,082	7,081	36,597	2,731	50,843	-16,028	-22,715	-21,113	-27,800		
2028	53,463			4,785	11,707	69,955	4,529	9,444	36,597	2,878	53,840	-16,115	-23,111	-21,499	-28,495		
2029				7,701	15,322	23,023	5,030	12,110	42,086	3,025	392	39,222	37,319	33,357	31,055		
2030				7,701	19,441	27,142	5,593	15,120	42,086	3,172	392	39,222	36,508	32,586	29,872		
2031			21,429	7,701	23,846	52,976	6,225	18,519	42,086	3,172	392	39,222	12,122	10,380	5,082		
2032				8,344	27,732	36,075	6,712	21,152	42,086	3,172	392	37,440	33,832	30,088	26,481		
2033				8,344	27,732	36,075	6,712	21,152	42,086	3,172	392	37,440	33,832	30,088	26,481		
2034				8,344	27,732	36,075	6,712	21,152	42,086	3,172	392	37,440	33,832	30,088	26,481		
2035				8,344	27,732	36,075	6,712	21,152	42,086	3,172	392	37,440	33,832	30,088	26,481		
2036				8,344	27,732	36,075	6,712	21,152	42,086	3,172	392	37,440	33,832	30,088	26,481		
2037			24,567	8,344	27,732	60,642	6,712	21,152	42,086	3,172	392	12,873	6,809	5,521	-543		
2038				8,344	27,732	36,075	6,712	21,152	42,086	3,172	392	37,440	33,832	30,088	26,481		
2039				8,344	27,732	36,075	6,712	21,152	42,086	3,172	392	37,440	33,832	30,088	26,481		
2040				8,344	27,732	36,075	6,712	21,152	42,086	3,172	392	37,440	33,832	30,088	26,481		
2041				8,344	27,732	36,075	6,712	21,152	42,086	3,172	392	37,440	33,832	30,088	26,481		
2042				8,344	27,732	36,075	6,712	21,152	42,086	3,172	392	37,440	33,832	30,088	26,481		
2043			24,567	8,344	27,732	60,642	6,712	21,152	42,086	3,172	392	12,873	6,809	5,521	-543		
2044				8,344	27,732	36,075	6,712	21,152	42,086	3,172	392	37,440	33,832	30,088	26,481		
2045				8,344	27,732	36,075	6,712	21,152	42,086	3,172	392	37,440	33,832	30,088	26,481		
2046				8,344	27,732	36,075	6,712	21,152	42,086	3,172	392	37,440	33,832	30,088	26,481		
2047			21,429	8,344	27,732	57,504	6,712	21,152	42,086	3,172	392	16,011	10,260	8,659	2,909		
2048				8,344	27,732	36,075	6,712	21,152	42,086	3,172	392	37,440	33,832	30,088	26,481		
2049				8,344	27,732	36,075	6,712	21,152	42,086	3,172	392	37,440	33,832	30,088	26,481		
2050				8,344	27,732	36,075	6,712	21,152	42,086	3,172	392	37,440	33,832	30,088	26,481		
2051				8,344	27,732	36,075	6,712	21,152	42,086	3,172	392	37,440	33,832	30,088	26,481		
2052			24,567	8,344	27,732	60,642	6,712	21,152	42,086	3,172	392	12,873	6,809	5,521	-543		
2053			21,429	8,344	27,732	57,504	6,712	21,152	42,086	3,172	392	16,011	10,260	8,659	2,909		
2054				8,344	27,732	36,075	6,712	21,152	42,086	3,172	392	37,440	33,832	30,088	26,481		
													EIRR=	EIRR=	EIRR=	EIRR=	
													7.07%	6.84%	4.61%	9.19%	

\* Container cargoes over 500,000 TEUs  
 \*\* Container cargoes up to 500,000 TEUs

**Economic Analysis (Alternative 2)**

Year	Capital Cost		Replace & Maintenance			Operation		in 1,000 USD							Benefit - Cost		
	New Container Terminal (Pack 2)	Passenger & General C. Terminal (Pack 3)	Replace-ment of facilities (Pack 2.3)	Mainte-nance (Pack 2.3)	Fuel and Personnel Cost (Pack 2.3)	Total Cost	Tmasporta-tion Savings by Larger Ships	Tmasporta-tion Cost/Time Savings *	Savings of Congestion Surcharge**	Savings of breakbulk transportation cost	Passenger Ship Increases	Total Benefit	Benefit - Cost	Cost +10% Benefit/0%	Cost 0% Benefit -10%	Cost +10% Benefit -10%	
2017	S7	S7	S7	S7-85	S6-43												
2018	4,089					4,089							-4,089	-4,498	0	-4,089	-4,498
2019	0					0							0	0	0	0	0
2020	69,555					69,555							-69,555	-76,511	-69,555	-76,511	-76,511
2021	91,435					91,435							-91,435	-100,579	-91,435	-100,579	-100,579
2022	91,435	924				92,359							-92,360	-101,595	-92,360	-101,595	-101,595
2023	0					513	2,720	0	36,597	2,142	41,459	36,035	35,493	31,889	31,889	31,347	
2024	2,202	19,921				1,632	3,006	1,470	36,597	2,289	43,362	14,695	11,829	10,359	7,492	7,492	
2025	0	19,921				3,367	3,325	3,123	36,597	2,436	45,481	17,282	14,463	12,734	9,914	9,914	
2026	32,819					5,572	4,824	4,984	36,597	2,583	48,161	3,916	35,489	31,660	28,853	28,853	
2027	54,699					8,627	4,529	7,081	36,597	2,731	50,843	-18,051	35,489	31,660	28,853	28,853	
2028	54,699					11,707	4,529	9,444	36,597	2,878	53,840	-18,138	35,489	31,660	28,853	28,853	
2029						15,322	5,030	12,110	42,086	3,025	62,645	38,696	36,301	32,431	30,036	30,036	
2030						19,441	5,593	15,120	42,086	3,172	66,364	38,296	35,489	31,660	28,853	28,853	
2031						23,846	6,225	18,519	42,086	3,172	70,395	15,349	32,814	29,162	25,462	25,462	
2032						27,732	6,712	21,152	42,086	3,172	73,515	36,514	32,814	29,162	25,462	25,462	
2033						37,001	6,712	21,152	42,086	3,172	73,515	36,514	32,814	29,162	25,462	25,462	
2034						37,001	6,712	21,152	42,086	3,172	73,515	36,514	32,814	29,162	25,462	25,462	
2035						37,001	6,712	21,152	42,086	3,172	73,515	36,514	32,814	29,162	25,462	25,462	
2036						37,001	6,712	21,152	42,086	3,172	73,515	36,514	32,814	29,162	25,462	25,462	
2037			26,447			63,448	6,712	21,152	42,086	3,172	73,515	10,067	3,722	2,715	-3,629	-3,629	
2038						37,001	6,712	21,152	42,086	3,172	73,515	36,514	32,814	29,162	25,462	25,462	
2039						37,001	6,712	21,152	42,086	3,172	73,515	36,514	32,814	29,162	25,462	25,462	
2040						37,001	6,712	21,152	42,086	3,172	73,515	36,514	32,814	29,162	25,462	25,462	
2041						37,001	6,712	21,152	42,086	3,172	73,515	36,514	32,814	29,162	25,462	25,462	
2042						37,001	6,712	21,152	42,086	3,172	73,515	36,514	32,814	29,162	25,462	25,462	
2043						62,293	6,712	21,152	42,086	3,172	73,515	11,222	4,993	3,870	-2,359	-2,359	
2044			25,292			37,001	6,712	21,152	42,086	3,172	73,515	36,514	32,814	29,162	25,462	25,462	
2045						37,001	6,712	21,152	42,086	3,172	73,515	36,514	32,814	29,162	25,462	25,462	
2046						37,001	6,712	21,152	42,086	3,172	73,515	36,514	32,814	29,162	25,462	25,462	
2047						37,001	6,712	21,152	42,086	3,172	73,515	36,514	32,814	29,162	25,462	25,462	
2048			22,573			59,574	6,712	21,152	42,086	3,172	73,515	13,941	7,984	6,589	632	632	
2049						37,001	6,712	21,152	42,086	3,172	73,515	36,514	32,814	29,162	25,462	25,462	
2050						37,001	6,712	21,152	42,086	3,172	73,515	36,514	32,814	29,162	25,462	25,462	
2051						37,001	6,712	21,152	42,086	3,172	73,515	36,514	32,814	29,162	25,462	25,462	
2052			25,292			37,001	6,712	21,152	42,086	3,172	73,515	36,514	32,814	29,162	25,462	25,462	
2053			22,573			59,574	6,712	21,152	42,086	3,172	73,515	11,222	4,993	3,870	-2,359	-2,359	
2054						37,001	6,712	21,152	42,086	3,172	73,515	36,514	32,814	29,162	25,462	25,462	
													EIRR=	EIRR=	EIRR=		
													5.42%	5.20%	3.04%		
													EIRR= 7.43%				
													** Container cargoes up to 500,000 TEUs				
													* Container cargoes over 500,000 TEUs				

Financial Analysis (Alternative 1)

Year	Capital Cost			Former Investment			Replace & Maintenance			Operation		Revenue			FIRR			
	Present Container Terminal (Pack 1)	New Container Terminal (Pack 2)	Passenger & General C. Terminal (Pack 3)	Depreciation (P3, P4, P10)	Former Investment Interest	Replacement (Incl. tug boats)	Maintenance (P3, P4, P10)	Maintenance (Package 1,2,3)	Operation Cost	Total Cost	Total Revenue	Balance	Cost +10% Rev. -10%	Cost 0% Rev. -10%	Cost +10% Rev. -10%	FIRR=	FIRR=	FIRR=
2012	S7	S7	S7	S7-45	S5-21	S7-36	S7-69	S7-84	S6-32	24,913	30,086	5,173	5.173	5.173	5.173	2.93%	1.53%	0.25%
2013				2,530	2,948		1,727		17,708	24,913	30,086	5,173	5.173	5.173	5.173			
2014	208			2,530	2,901		1,727		18,136	25,503	31,827	6,303	6.303	6.303	6.303			
2015	8,674			2,530	2,942		1,727		18,610	25,809	33,953	8,144	8.144	8.144	8.144			
2016	8,327			2,530	3,551		1,727		19,130	35,612	36,173	560	-307	-307	-307			
2017	208			4,034	4,275		1,727		19,701	36,560	37,724	331	1.164	1.164	331			
2018	0	3,605		4,034	4,318	3,738	2,855	516	20,325	35,995	41,079	5,085	5.085	5.085	4,690			
2019	8,674	0		4,034	4,015	0	2,855	628	21,092	36,382	43,059	6,677	6.677	6.677	6,119			
2020	8,327	59,610		4,034	3,832	0	2,855	628	21,920	42,127	45,943	3,816	2.949	3.330	2,462			
2021		82,608		4,034	3,617	0	2,855	1,145	20,653	114,912	41,397	-52,506	-59,300	-53,377	-60,171			
2022		82,608	989	4,034	3,402	7,477	2,855	1,145	22,014	124,523	44,305	-75,515	-81,776	-73,547	-81,808			
2023		0	0	4,034	3,186	0	2,855	5,494	23,559	39,129	46,884	7,755	7.755	7.755	7,175			
2024		2,248	21,533	4,034	2,971	16,197	2,855	5,494	25,004	80,335	50,463	-33,870	-30,810	-30,810	-34,808			
2025		0	21,533	4,034	2,756	0	2,855	5,979	27,324	64,482	55,167	-11,468	-10,724	-10,724	-12,877			
2026		33,194		4,034	2,540	0	2,855	6,640	30,738	80,002	61,497	-18,505	-18,505	-18,505	-21,825			
2027		56,192		4,034	2,325	0	2,855	6,640	34,690	106,736	68,425	-38,311	-43,930	-41,045	-46,665			
2028		56,192		4,034	2,110	0	2,855	9,556	39,183	111,015	76,297	-34,718	-40,337	-38,240	-43,859			
2029				4,034	1,895	0	2,855	9,556	44,619	62,958	84,976	22,018	22,018	17,628	17,628			
2030				4,034	1,675	0	2,855	9,556	50,840	68,961	94,782	25,822	25,822	20,452	20,452			
2031				4,034	1,538	28,509	2,855	9,556	57,495	103,987	104,760	774	-2,077	-5,594	-8,445			
2032				4,034	1,400	0	2,855	10,199	63,414	81,901	111,881	29,980	29,980	22,900	22,900			
2033				4,034	1,262	0	2,855	10,199	63,414	81,763	112,871	31,108	31,108	23,929	23,929			
2034				4,034	1,124	19,148	2,855	10,199	63,414	100,774	113,361	12,587	10,672	10,672	5,359	3,444		
2035				4,034	986	7,080	2,855	10,773	63,414	89,142	113,361	24,219	23,511	16,991	16,283			
2036				4,034	916	0	2,855	10,773	63,414	81,992	113,361	31,369	31,369	24,141	24,141			
2037				3,357	846	28,305	2,855	10,773	63,414	109,551	113,361	3,810	980	-3,418	-6,249			
2038				3,357	777	0	2,855	10,773	63,414	81,176	113,361	32,185	32,185	24,957	24,957			
2039				3,357	707	16,197	2,855	10,773	63,414	97,303	113,361	16,058	14,438	8,830	7,210			
2040				3,357	641	0	2,855	10,773	63,414	81,041	113,361	32,320	32,320	25,092	25,092			
2041				3,357	577	9,574	2,855	10,773	63,414	90,551	113,361	22,810	21,853	15,582	14,625			
2042				3,357	513	0	2,855	10,773	63,414	80,912	113,361	32,449	32,449	25,220	25,220			
2043				3,357	449	24,567	2,855	10,773	63,414	105,415	113,361	7,946	5,489	718	-1,739			
2044				3,357	385	0	2,855	10,773	63,414	80,784	113,361	32,577	32,577	25,349	25,349			
2045				3,357	321	9,574	2,855	10,773	63,414	90,294	113,361	23,067	22,109	15,839	14,881			
2046				3,357	256	7,080	2,855	10,773	63,414	87,736	113,361	25,625	24,917	18,397	17,689			
2047				3,357	192	21,429	2,855	10,773	63,414	102,021	113,361	11,340	9,197	4,112	1,969			
2048				3,357	128	0	2,855	10,773	63,414	80,528	113,361	32,833	32,833	25,605	25,605			
2049				3,357	64	0	2,855	10,773	63,414	80,464	113,361	32,897	32,897	25,669	25,669			
2050				3,357	0	7,080	2,855	10,773	63,414	87,479	113,361	25,881	25,173	18,653	17,945			
2051				3,357	0	0	2,855	10,773	63,414	80,399	113,361	32,961	32,961	25,733	25,733			
2052				3,357	0	28,305	2,855	10,773	63,414	108,704	113,361	4,656	1,826	-2,572	-5,402			
2053				3,357	0	21,429	2,855	10,773	63,414	101,828	113,361	11,532	9,390	4,304	2,161			
2054				3,357	0	16,197	2,855	10,773	63,414	96,596	113,361	16,765	15,145	9,537	7,917			
												<b>FIRR=</b>	<b>FIRR=</b>	<b>FIRR=</b>	<b>FIRR=</b>	<b>FIRR=</b>	<b>FIRR=</b>	<b>FIRR=</b>
												4.27%	2.93%	1.53%	0.25%			

**Financial Analysis (Alternative 2)**

Year	Capital Cost			Former Investment			Replace & Maintenance			Operation			Revenue			FIRR		
	Present Container Terminal (Pack 1)	New Container Terminal (Pack 2)	Passenger & General C. Terminal (Pack 3)	Depreciation (P3, P4, P10)	Former Investment Interest	Replacement (incl. tug boats)	Maintenance (P3, P4, P10)	Maintenance (Package 1,2,3)	Operation Cost	Total Cost	Total Revenue	Balance	Cost +10% Rev. -10%	Cost 0% Rev. -10%	Cost +10% Rev. -10%	FIRR=	FIRR=	FIRR=
2012	\$7	\$7	\$7	\$742	\$521	\$736	\$766	\$784	\$632	24,913	30,086	5,173	5,173	5,173	5,173	1.79%	FIRR=	-0.81%
2013	208			2,530	2,948		1,727	1,727	17,708	24,913	30,086	5,173	5,173	5,173	1.79%	FIRR=	-0.81%	
2014	0			2,530	2,901		1,727	1,727	18,136	25,503	31,827	6,303	6,303	6,303	1.79%	FIRR=	-0.81%	
2015	8,674			2,530	2,942		1,727	1,727	18,610	25,809	33,953	8,144	8,144	8,144	1.79%	FIRR=	-0.81%	
2016	8,327			2,530	3,551		1,727	1,727	19,130	35,612	36,173	560	-307	560	1.79%	FIRR=	-0.81%	
2017	208			4,034	4,275		1,727	1,727	19,701	36,560	37,724	1,164	331	1,164	1.79%	FIRR=	-0.81%	
2018	0	4,298		4,034	4,318	3,738	2,855	516	20,325	35,995	41,079	5,085	4,690	5,085	1.79%	FIRR=	-0.81%	
2019	8,674	0		4,034	4,015	0	2,855	628	21,092	37,075	43,059	5,984	5,555	5,984	1.79%	FIRR=	-0.81%	
2020	8,327	0		4,034	3,832	0	2,855	628	21,920	42,127	45,943	3,816	2,949	3,330	1.79%	FIRR=	-0.81%	
2021	0	73,106		4,034	3,617	0	2,855	1,145	20,653	128,407	41,397	-87,010	-87,042	-66,873	1.79%	FIRR=	-0.81%	
2022	0	96,103	989	4,034	3,402	7,477	2,855	1,145	22,014	138,018	44,305	-93,714	-104,170	-94,036	1.79%	FIRR=	-0.81%	
2023	0	0	0	4,034	3,186	0	2,855	6,280	23,004	115,786	49,784	6,969	6,969	6,388	1.79%	FIRR=	-0.81%	
2024	0	2,314	21,533	4,034	2,971	14,050	2,855	6,280	25,004	79,042	50,463	-28,578	-29,517	-32,368	1.79%	FIRR=	-0.81%	
2025	0	0	21,533	4,034	2,756	0	2,855	6,702	27,324	65,204	55,167	-10,037	-12,191	-11,446	1.79%	FIRR=	-0.81%	
2026	0	34,494	0	4,034	2,540	0	2,855	7,363	30,738	82,024	61,497	-20,528	-23,977	-22,569	1.79%	FIRR=	-0.81%	
2027	57,491	0	0	4,034	2,325	0	2,855	7,363	34,690	108,758	68,425	-40,332	-46,081	-43,067	1.79%	FIRR=	-0.81%	
2028	57,491	0	0	4,034	2,110	0	2,855	10,417	39,183	113,036	76,297	-36,740	-42,489	-40,261	1.79%	FIRR=	-0.81%	
2029	0	0	0	4,034	1,895	0	2,855	10,417	44,619	63,820	84,976	21,156	16,767	16,767	1.79%	FIRR=	-0.81%	
2030	0	0	0	4,034	1,675	0	2,855	10,417	50,840	69,822	94,782	24,960	19,590	19,590	1.79%	FIRR=	-0.81%	
2031	0	0	0	4,034	1,538	28,509	2,855	10,417	57,495	104,848	104,760	-88	-9,359	-9,307	1.79%	FIRR=	-0.81%	
2032	0	0	0	4,034	1,400	0	2,855	11,060	63,414	82,763	111,881	29,118	22,038	22,038	1.79%	FIRR=	-0.81%	
2033	0	0	0	4,034	1,262	0	2,855	11,060	63,414	82,625	112,871	30,246	23,067	23,067	1.79%	FIRR=	-0.81%	
2034	0	0	0	4,034	1,124	19,148	2,855	11,060	63,414	101,635	113,361	9,811	4,498	4,498	1.79%	FIRR=	-0.81%	
2035	0	0	0	4,034	986	7,080	2,855	11,635	63,414	90,003	113,361	22,650	16,129	16,129	1.79%	FIRR=	-0.81%	
2036	0	0	0	4,034	916	0	2,855	11,635	63,414	82,854	113,361	30,507	23,279	23,279	1.79%	FIRR=	-0.81%	
2037	0	0	0	3,357	846	28,305	2,855	11,635	63,414	110,412	113,361	118	-4,280	-7,110	1.79%	FIRR=	-0.81%	
2038	0	0	0	3,357	777	0	2,855	11,635	63,414	82,038	113,361	31,323	24,095	24,095	1.79%	FIRR=	-0.81%	
2039	0	0	0	3,357	707	14,050	2,855	11,635	63,414	96,018	113,361	17,343	10,114	10,114	1.79%	FIRR=	-0.81%	
2040	0	0	0	3,357	641	0	2,855	11,635	63,414	81,902	113,361	31,459	24,231	24,231	1.79%	FIRR=	-0.81%	
2041	0	0	0	3,357	577	9,574	2,855	11,635	63,414	91,412	113,361	21,949	14,721	14,721	1.79%	FIRR=	-0.81%	
2042	0	0	0	3,357	513	0	2,855	11,635	63,414	81,774	113,361	31,587	24,359	24,359	1.79%	FIRR=	-0.81%	
2043	0	0	0	3,357	449	24,567	2,855	11,635	63,414	106,277	113,361	7,084	4,627	-144	1.79%	FIRR=	-0.81%	
2044	0	0	0	3,357	385	0	2,855	11,635	63,414	88,597	113,361	31,715	24,487	24,487	1.79%	FIRR=	-0.81%	
2045	0	0	0	3,357	321	9,574	2,855	11,635	63,414	91,156	113,361	22,205	14,977	14,977	1.79%	FIRR=	-0.81%	
2046	0	0	0	3,357	256	7,080	2,855	11,635	63,414	88,597	113,361	24,763	17,535	17,535	1.79%	FIRR=	-0.81%	
2047	0	0	0	3,357	192	21,429	2,855	11,635	63,414	102,882	113,361	10,479	8,336	8,336	1.79%	FIRR=	-0.81%	
2048	0	0	0	3,357	128	0	2,855	11,635	63,414	81,389	113,361	31,972	24,744	24,744	1.79%	FIRR=	-0.81%	
2049	0	0	0	3,357	64	0	2,855	11,635	63,414	81,325	113,361	32,036	24,808	24,808	1.79%	FIRR=	-0.81%	
2050	0	0	0	3,357	0	7,080	2,855	11,635	63,414	88,341	113,361	25,020	17,992	17,992	1.79%	FIRR=	-0.81%	
2051	0	0	0	3,357	0	0	2,855	11,635	63,414	81,261	113,361	32,100	24,872	24,872	1.79%	FIRR=	-0.81%	
2052	0	0	0	3,357	0	28,305	2,855	11,635	63,414	109,566	113,361	3,795	964	-3,433	1.79%	FIRR=	-0.81%	
2053	0	0	0	3,357	0	21,429	2,855	11,635	63,414	102,690	113,361	10,671	8,528	3,443	1.79%	FIRR=	-0.81%	
2054	0	0	0	3,357	0	14,050	2,855	11,635	63,414	95,311	113,361	18,050	16,644	10,821	1.79%	FIRR=	-0.81%	

**Financial Analysis (Alternative 1': Private Superstructure and Operation)**

FIRR (Alternative 1': Private Superstructure & Operation)							in 1,000 USD		Revenue			FIRR						
Year	Capital Cost			Former Investment				Replace & Maintenance			Operation			Cost +10% Rev. -10%	Cost 0% Rev. -10%	Cost +10% Rev. -10%		
	Present Container Terminal (Pack 1)	New Container Terminal (Pack 2)	Passenger & General C. Terminal (Pack 3)	Depreciation (P3, P4, P10)	Former Investment Interest	Replacement (Incl. tug boats)	Maintenance (P3, P4, P10)	Maintenance (Package 1,2,3)	Operation Cost	Total Cost	Total Revenue	Balance	FIRR					
2012	\$7	\$7	\$7	\$7.45	\$5.22	\$7.36	\$7.69	\$7.84	\$6.35		\$9-N	5.173	5.173	5.173	5.173	5.173	5.173	
2013	208			2,530	2,948		1,727		17,708	24,913	30,086	5.173	6.301	6.301	6.301	6.301	6.301	
2014	0			2,530	2,901		1,727		18,136	25,503	31,825	8.125	8.125	8.125	8.125	8.125	8.125	
2015	8,674			2,530	2,942		1,727		18,610	25,809	33,934	-357	-357	-357	-357	-357	-357	
2016	8,327			2,530	4,275		1,727		19,130	35,612	36,122	1,065	2,322	2,322	2,322	2,322	2,322	
2017	208			4,034	4,318	3,738	2,855	516	20,325	35,995	41,079	5,085	4,690	4,690	4,690	4,690	4,690	
2018	0	2,281		4,034	4,167	0	2,855	628	21,092	35,058	42,986	7,928	7,700	7,700	7,700	7,700	7,700	
2019	8,674	0		4,034	4,015	0	2,855	628	21,920	42,127	45,775	3,648	2,781	2,781	2,781	2,781	2,781	
2020	8,327	44,408		4,034	3,832	0	2,855	628	23,004	87,088	49,324	-37,764	-43,889	-43,889	-43,889	-43,889	-43,889	
2021		44,408		4,034	3,617	0	2,855	1,145	20,653	76,712	41,397	-35,315	-39,788	-39,788	-39,788	-39,788	-39,788	
2022		44,408	989	4,034	3,402	7,477	2,855	1,145	21,880	86,190	44,012	-42,178	-47,465	-47,465	-47,465	-47,465	-47,465	
2023		0		4,034	3,186	0	2,855	3,402	17,436	30,913	36,134	5,221	5,221	5,221	5,221	5,221	5,221	
2024		924		4,034	2,971	16,197	2,855	3,402	15,832	67,748	33,734	-34,014	-38,879	-38,879	-38,879	-38,879	-38,879	
2025		0		4,034	2,756	0	2,855	3,887	15,062	50,127	33,572	-16,556	-18,709	-18,709	-18,709	-18,709	-18,709	
2026		17,992		4,034	2,540	0	2,855	4,548	15,385	47,355	34,875	-12,480	-13,778	-13,778	-13,778	-13,778	-13,778	
2027		17,992		4,034	2,325	0	2,855	4,548	19,194	50,949	42,205	-8,744	-10,543	-10,543	-10,543	-10,543	-10,543	
2028		17,992		4,034	2,110	0	2,855	5,372	23,545	55,085	50,569	-6,315	-7,034	-7,034	-7,034	-7,034	-7,034	
2029		17,992		4,034	1,895	0	2,855	5,372	25,768	39,924	55,307	15,383	12,116	12,116	12,116	12,116	12,116	
2030				4,034	1,675	0	2,855	5,946	28,435	42,371	60,301	17,929	13,966	13,966	13,966	13,966	13,966	
2031				4,034	1,538	7,080	2,855	5,372	28,898	49,777	60,876	11,100	10,392	10,392	10,392	10,392	10,392	
2032				4,034	1,400	0	2,855	5,372	30,966	44,627	63,379	18,753	14,183	14,183	14,183	14,183	14,183	
2033				4,034	1,262	0	2,855	5,372	30,966	44,889	64,369	19,881	15,113	15,113	15,113	15,113	15,113	
2034				4,034	1,124	19,148	2,855	5,372	30,966	63,499	64,859	-554	-554	-554	-554	-554	-554	
2035				4,034	986	7,080	2,855	5,946	30,966	51,867	64,859	12,992	12,284	12,284	12,284	12,284	12,284	
2036				4,034	916	0	2,855	5,946	30,966	44,717	64,859	20,142	20,142	20,142	20,142	20,142	20,142	
2037				3,357	846	3,738	2,855	5,946	30,966	47,709	64,859	17,150	16,776	16,776	16,776	16,776	16,776	
2038				3,357	777	0	2,855	5,946	30,966	43,901	64,859	20,958	20,958	20,958	20,958	20,958	20,958	
2039				3,357	707	16,197	2,855	5,946	30,966	60,029	64,859	4,831	3,211	3,211	3,211	3,211	3,211	
2040				3,357	641	9,574	2,855	5,946	30,966	43,766	64,859	21,093	16,228	16,228	16,228	16,228	16,228	
2041				3,357	577	0	2,855	5,946	30,966	53,276	64,859	11,583	10,626	10,626	10,626	10,626	10,626	
2042				3,357	513	0	2,855	5,946	30,966	43,638	64,859	21,222	21,222	21,222	21,222	21,222	21,222	
2043				3,357	449	0	2,855	5,946	30,966	43,574	64,859	21,286	21,286	21,286	21,286	21,286	21,286	
2044				3,357	385	0	2,855	5,946	30,966	43,509	64,859	21,350	21,350	21,350	21,350	21,350	21,350	
2045				3,357	321	9,574	2,855	5,946	30,966	53,020	64,859	11,840	10,882	10,882	10,882	10,882	10,882	
2046				3,357	256	7,080	2,855	5,946	30,966	50,461	64,859	14,398	13,690	13,690	13,690	13,690	13,690	
2047				3,357	192	0	2,855	5,946	30,966	43,317	64,859	21,542	21,542	21,542	21,542	21,542	21,542	
2048				3,357	128	0	2,855	5,946	30,966	43,253	64,859	21,606	16,741	16,741	16,741	16,741	16,741	
2049				3,357	64	0	2,855	5,946	30,966	43,189	64,859	21,670	16,805	16,805	16,805	16,805	16,805	
2050				3,357	0	7,080	2,855	5,946	30,966	50,205	64,859	14,654	13,946	13,946	13,946	13,946	13,946	
2051				3,357	0	0	2,855	5,946	30,966	43,125	64,859	21,734	17,996	17,996	17,996	17,996	17,996	
2052				3,357	0	3,738	2,855	5,946	30,966	46,863	64,859	17,623	16,623	16,623	16,623	16,623	16,623	
2053				3,357	0	0	2,855	5,946	30,966	43,125	64,859	21,734	16,869	16,869	16,869	16,869	16,869	
2054				3,357	0	16,197	2,855	5,946	30,966	59,322	64,859	3,918	672	672	672	672	672	
											<b>FIRR=</b>	<b>7.42%</b>	<b>FIRR=</b>	<b>5.47%</b>	<b>FIRR=</b>	<b>4.26%</b>	<b>FIRR=</b>	<b>2.75%</b>

**Cash Flow, Profit Loss Statement, Balance Sheet**

<b>PROFIT AND LOSS STATEMENT</b>									
	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	
<b>Operating Revenue (excl. VAT)</b>									
Operating Revenue	28,025	30,086	31,827	33,953	36,173	37,724	41,079	43,059	
<b>Operating Expenses</b>	23,560	24,291	24,334	24,422	24,558	24,743	29,008	29,689	
Fuel and motor oil for operation	3,125	3,423	3,628	3,845	4,076	4,321	4,581	4,858	
Supplies for Workshop & Spare-parts	2,526	2,768	2,933	3,109	3,296	3,494	3,704	3,928	
Salaries and Bonus	5,615	5,683	5,393	5,103	4,813	4,522	4,232	4,028	
Depreciation	5,241	4,856	4,471	4,085	3,700	3,315	5,311	5,112	
Repair and maintenance	1,727	1,727	1,727	1,727	1,727	1,727	3,372	3,484	
Fuel for administration & maintenance	1,440	1,577	1,672	1,772	1,878	1,991	2,111	2,239	
Miscellaneous administrative others	3,885	4,256	4,511	4,781	5,068	5,373	5,697	6,040	
<b>Net Operating Income</b>	4,465	5,795	7,493	9,531	11,615	12,980	12,072	13,370	
<b>Non-operating revenues</b>									
Interest gains, Exchange gains	0	0	0	0	0	0	0	0	
<b>Non-operating Expenses</b>									
Interest on long-term-loans (MEF Int.)	3,029	2,948	2,901	2,942	3,551	4,275	4,318	4,167	
Interest on loans for Package #1,#2,#3							688	654	
Interest on short-term loans	0	0	0	0	0	0	0	0	
<b>Net Income Before Tax</b>	1,437	2,847	4,591	6,588	8,064	8,705	7,066	8,550	
Income tax	287	569	918	1,318	1,613	1,741	1,413	1,710	
<b>Net income after tax</b>	1,149	2,277	3,673	5,271	6,451	6,964	5,652	6,840	
<b>Dividend payments</b>									
<b>Retained Earnings</b>	6,609	8,887	12,560	17,830	24,282	31,246	36,898	43,738	
<b>CASH FLOW STATEMENT</b>									
	<b>2011</b>	<b>2,012</b>	<b>2013</b>	<b>2,014</b>	<b>2015</b>	<b>2,016</b>	<b>2017</b>	<b>2,018</b>	
Cash at Beginning	5,459	10,205	15,694	22,194	28,016	34,633	41,378	44,209	
<b>Cash Inflow</b>	9,707	12,038	16,943	41,536	57,646	32,085	17,591	22,087	
Net operating income	4,465	5,795	7,493	9,531	11,615	12,980	12,072	13,370	
Depreciation cost (All)	5,241	4,856	4,471	4,085	3,700	3,315	5,311	5,112	
Long-term loans (Package #1,#2,#3)			208	0	8,674	8,327	208	3,604	
<i>Accumulated Principal of Longterm Loans</i>				208	208	8,882	17,209	16,557	
Long-term loans (Package P3,P4,P10)		1,387	4,771	27,920	33,657	7,463			
<i>Accumulated Principal of Longterm Loans</i>	71,798	70,153	69,896	73,024	97,410	127,532	131,461	127,927	
Interest on deposits	0	0	0	0	0	0	0	0	
<b>Cash Outflow (excluding G. Funds)</b>	4,960	6,549	10,443	35,714	51,028	25,340	14,760	14,529	
Investment (Package #1,#2,#3)			208	0	8,674	8,327	208	3,604	
Investment (CP-P10)		1,387	4,771	27,920	33,657	7,463			
Replacement of existing assets							3,738	0	
Repayment new long-term loans principal							860	860	
Repayment P3,P4,P10 loan principal	1,644	1,644	1,644	3,534	3,534	3,534	3,534	3,534	
Interest on long-term loans (New)				0	0	0	688	654	
Interest on former MEF long-term loans	3,029	2,948	2,901	2,942	3,551	4,275	4,318	4,167	
Income tax+ Transfer	287	569	918	1,318	1,613	1,741	1,413	1,710	
Interest on short-term loans	0	0	0	0	0	0	0	0	
Cash Inflow - Cash Outflow	4,746	5,489	6,500	5,822	6,617	6,745	2,831	7,558	
<b>Cash at End</b>	10,205	15,694	22,194	28,016	34,633	41,378	44,209	51,767	



**Cash Flow, Profit Loss Statement, Balance Sheet (2)**

<b>PROFIT AND LOSS STATEMENT</b>								
	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>	<b>2023</b>	<b>2024</b>	<b>2025</b>	<b>2026</b>
<b>Operating Revenue (excl. VAT)</b>								
Operating Revenue	45,943	49,784	41,397	44,305	46,884	50,463	55,167	61,497
<b>Operating Expenses</b>	30,131	30,829	29,872	31,233	43,656	45,100	48,986	53,942
Fuel and motor oil for operation	5,152	5,518	5,911	6,332	6,783	7,266	8,034	9,177
Supplies for Workshop & Spare-parts	4,165	4,462	4,780	5,120	5,484	5,875	6,496	7,420
Salaries and Bonus	3,823	3,619	3,414	3,548	3,779	3,815	3,894	3,974
Depreciation	4,727	4,342	5,219	5,219	11,747	11,747	12,827	13,708
Repair and maintenance	3,484	3,484	4,000	4,000	8,349	8,349	8,835	9,496
Fuel for administration & maintenance	2,374	2,543	1,771	1,897	2,032	2,176	2,406	2,749
Miscellaneous administrative others	6,406	6,862	4,778	5,118	5,482	5,872	6,493	7,418
<b>Net Operating Income</b>	15,812	18,955	11,525	13,072	3,228	5,363	6,180	7,555
Non-operating revenues								
Interest gains, Exchange gains	0	0	0	0	0	0	0	0
Non-operating Expenses								
Interest on long-term-loans (MEF Int.)	4,015	3,832	3,617	3,402	3,186	2,971	2,756	2,540
Interest on loans for Package #1,#2,#3	620	585	1,239	1,170	5,670	5,601	5,532	6,345
Interest on short-term loans	0	0	0	0	0	0	0	0
<b>Net Income Before Tax</b>	11,177	14,537	6,669	8,500	-5,628	-3,209	-2,108	-1,330
Income tax	2,235	2,907	1,334	1,700	0	0	0	0
<b>Net income after tax</b>	8,942	11,630	5,335	6,800	-5,628	-3,209	-2,108	-1,330
<b>Dividend payments</b>								
<b>Retained Earnings</b>	52,680	64,310	69,645	76,445	70,816	67,607	65,499	64,169
<b>CASH FLOW STATEMENT</b>								
	<b>2019</b>	<b>2,020</b>	<b>2021</b>	<b>2,022</b>	<b>2023</b>	<b>2,024</b>	<b>2025</b>	<b>2,026</b>
Cash at Beginning	51,767	58,535	67,605	70,398	67,178	65,536	50,116	53,073
<b>Cash Inflow</b>	29,213	91,234	99,352	101,888	14,976	40,891	40,541	54,457
Net operating income	15,812	18,955	11,525	13,072	3,228	5,363	6,180	7,555
Depreciation cost (All)	4,727	4,342	5,219	5,219	11,747	11,747	12,827	13,708
Long-term loans (Package #1,#2,#3)	8,674	67,937	82,608	83,597	0	23,780	21,533	33,194
Accumulated Principal of Longterm Loans	19,300	27,114	94,190	175,077	256,953	255,232	277,291	297,103
Long-term loans (Package P3,P4,P10)								
Accumulated Principal of Longterm Loans	124,393	118,352	112,312	106,271	100,230	94,190	88,149	82,108
Interest on deposits	0	0	0	0	0	0	0	0
<b>Cash Outflow (excluding G. Funds)</b>	22,445	82,163	96,559	105,107	16,618	56,311	37,583	49,841
Investment (Package #1,#2,#3)	8,674	67,937	82,608	83,597		23,780	21,533	33,194
Investment (CP-P10)								
Replacement of existing assets	0	0	0	7,477	0	16,197	0	0
Repayment new long-term loans principal	860	860	1,721	1,721	1,721	1,721	1,721	1,721
Repayment P3,P4,P10 loan principal	6,041	6,041	6,041	6,041	6,041	6,041	6,041	6,041
Interest on long-term loans (New)	620	585	1,239	1,170	5,670	5,601	5,532	6,345
Interest on former MEF long-term loans	4,015	3,832	3,617	3,402	3,186	2,971	2,756	2,540
Income tax+ Transfer	2,235	2,907	1,334	1,700	0	0	0	0
Interest on short-term loans	0	0	0	0	0	0	0	0
Cash Inflow - Cash Outflow	6,768	9,071	2,792	-3,220	-1,642	-15,420	2,958	4,616
<b>Cash at End</b>	58,535	67,605	70,398	67,178	65,536	50,116	53,073	57,690

**Cash Flow, Profit Loss Statement, Balance Sheet (3)**

<b>PROFIT AND LOSS STATEMENT</b>									
	<b>2027</b>	<b>2028</b>	<b>2029</b>	<b>2030</b>	<b>2031</b>	<b>2032</b>	<b>2033</b>	<b>2034</b>	
<b>Operating Revenue (excl. VAT)</b>									
Operating Revenue	68,425	76,297	84,976	94,782	104,760	111,881	112,871	113,361	
<b>Operating Expenses</b>									
Fuel and motor oil for operation	10,484	11,976	13,680	15,627	17,851	19,593	19,593	19,593	
Supplies for Workshop & Spare-parts	8,477	9,683	11,061	12,635	14,434	15,842	15,842	15,842	
Salaries and Bonus	4,116	4,259	4,723	5,266	5,435	6,274	6,274	6,274	
Depreciation	13,708	13,708	18,251	18,251	18,251	19,108	19,108	19,108	
Repair and maintenance	9,496	9,496	12,411	12,411	12,411	13,054	13,054	13,054	
Fuel for administration & maintenance	3,140	3,587	4,098	4,681	5,347	5,869	5,869	5,869	
Miscellaneous administrative others	8,473	9,679	11,057	12,630	14,428	15,836	15,836	15,836	
<b>Net Operating Income</b>	<b>10,532</b>	<b>13,909</b>	<b>9,696</b>	<b>13,281</b>	<b>16,603</b>	<b>16,305</b>	<b>17,295</b>	<b>17,785</b>	
Non-operating revenues									
Interest gains, Exchange gains	0	0	0	0	0	0	0	0	0
Non-operating Expenses									
Interest on long-term-loans (MEF Int.)	2,325	2,110	1,895	1,675	1,538	1,400	1,262	1,124	
Interest on loans for Package #1,#2,#3	6,276	6,207	9,095	8,797	8,500	8,203	7,906	7,564	
Interest on short-term loans	0	0	0	0	0	0	0	0	0
<b>Net Income Before Tax</b>	<b>1,931</b>	<b>5,592</b>	<b>-1,294</b>	<b>2,808</b>	<b>6,566</b>	<b>6,703</b>	<b>8,128</b>	<b>9,097</b>	
Income tax	386	1,118	0	562	1,313	1,341	1,626	1,819	
<b>Net income after tax</b>	<b>1,545</b>	<b>4,474</b>	<b>-1,294</b>	<b>2,246</b>	<b>5,253</b>	<b>5,362</b>	<b>6,502</b>	<b>7,278</b>	
<b>Dividend payments</b>									
<b>Retained Earnings</b>	<b>65,714</b>	<b>70,188</b>	<b>68,894</b>	<b>71,140</b>	<b>76,393</b>	<b>81,755</b>	<b>88,258</b>	<b>95,536</b>	
<b>CASH FLOW STATEMENT</b>									
	<b>2027</b>	<b>2,028</b>	<b>2029</b>	<b>2,030</b>	<b>2031</b>	<b>2,032</b>	<b>2033</b>	<b>2,034</b>	
Cash at Beginning	57,690	65,181	75,602	73,376	76,222	53,566	60,385	66,143	
<b>Cash Inflow</b>									
Net operating income	10,532	13,909	9,696	13,281	16,603	16,305	17,295	17,785	
Depreciation cost (All)	13,708	13,708	18,251	18,251	18,251	19,108	19,108	19,108	
Long-term loans (Package #1,#2,#3)	56,192	56,192	0	0	0	0	0	0	
<i>Accumulated Principal of Longterm Loans</i>	<i>328,576</i>	<i>383,047</i>	<i>437,519</i>	<i>424,376</i>	<i>411,234</i>	<i>398,091</i>	<i>384,949</i>	<i>369,603</i>	
Long-term loans (Package P3,P4,P10)									
<i>Accumulated Principal of Longterm Loans</i>	<i>76,068</i>	<i>70,027</i>	<i>63,986</i>	<i>57,946</i>	<i>53,438</i>	<i>48,930</i>	<i>44,421</i>	<i>39,913</i>	
Interest on deposits	0	0	0	0	0	0	0	0	0
<b>Cash Outflow (excluding G. Funds)</b>	<b>72,941</b>	<b>73,389</b>	<b>30,172</b>	<b>28,685</b>	<b>57,510</b>	<b>28,594</b>	<b>30,646</b>	<b>49,509</b>	
Investment (Package #1,#2,#3)	<b>56,192</b>	<b>56,192</b>							
Investment (CP-P10)									
Replacement of existing assets	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>28,509</b>	<b>0</b>	<b>0</b>	<b>19,148</b>	
Repayment new long-term loans principal	1,721	1,721	13,142	13,142	13,142	13,142	15,345	15,345	
Repayment P3,P4,P10 loan principal	6,041	6,041	6,041	4,508	4,508	4,508	4,508	4,508	
Interest on long-term loans (New)	6,276	6,207	9,095	8,797	8,500	8,203	7,906	7,564	
Interest on former MEF long-term loans	2,325	2,110	1,895	1,675	1,538	1,400	1,262	1,124	
Income tax+ Transfer	386	1,118	0	562	1,313	1,341	1,626	1,819	
Interest on short-term loans	0	0	0	0	0	0	0	0	0
Cash Inflow - Cash Outflow	7,491	10,421	-2,226	2,846	-22,656	6,820	5,757	-12,616	
<b>Cash at End</b>	<b>65,181</b>	<b>75,602</b>	<b>73,376</b>	<b>76,222</b>	<b>53,566</b>	<b>60,385</b>	<b>66,143</b>	<b>53,527</b>	

**Cash Flow, Profit Loss Statement, Balance Sheet (4)**

<b>PROFIT AND LOSS STATEMENT</b>									
	<b>2035</b>	<b>2036</b>	<b>2037</b>	<b>2038</b>	<b>2039</b>	<b>2040</b>	<b>2041</b>	<b>2042</b>	
<b>Operating Revenue (excl. VAT)</b>									
Operating Revenue	113,361	113,361	113,361	113,361	113,361	113,361	113,361	113,361	113,361
<b>Operating Expenses</b>									
Fuel and motor oil for operation	19,593	19,593	19,593	19,593	19,593	19,593	19,593	19,593	19,593
Supplies for Workshop & Spare-parts	15,842	15,842	15,842	15,842	15,842	15,842	15,842	15,842	15,842
Salaries and Bonus	6,274	6,274	6,274	6,274	6,274	6,274	6,274	6,274	6,274
Depreciation	19,197	19,197	19,197	19,197	19,197	19,197	19,197	19,197	19,197
Repair and maintenance	13,628	13,628	13,628	13,628	13,628	13,628	13,628	13,628	13,628
Fuel for administration & maintenance	5,869	5,869	5,869	5,869	5,869	5,869	5,869	5,869	5,869
Miscellaneous administrative others	15,836	15,836	15,836	15,836	15,836	15,836	15,836	15,836	15,836
<b>Net Operating Income</b>	<b>17,121</b>	<b>17,121</b>	<b>17,121</b>	<b>17,121</b>	<b>17,121</b>	<b>17,121</b>	<b>17,121</b>	<b>17,121</b>	<b>17,121</b>
<b>Non-operating revenues</b>									
Interest gains, Exchange gains	0	0	0	0	0	0	0	0	0
<b>Non-operating Expenses</b>									
Interest on long-term-loans (MEF Int.)	986	916	846	777	707	641	577	513	
Interest on loans for Package #1,#2,#3	7,223	6,734	6,245	5,790	5,335	4,880	4,426	4,005	
Interest on short-term loans	0	0	0	0	0	0	0	0	0
<b>Net Income Before Tax</b>	<b>8,913</b>	<b>9,472</b>	<b>10,031</b>	<b>10,555</b>	<b>11,079</b>	<b>11,600</b>	<b>12,119</b>	<b>12,603</b>	
Income tax	1,783	1,894	2,006	2,111	2,216	2,320	2,424	2,521	
<b>Net income after tax</b>	<b>7,130</b>	<b>7,577</b>	<b>8,024</b>	<b>8,444</b>	<b>8,864</b>	<b>9,280</b>	<b>9,695</b>	<b>10,083</b>	
<b>Dividend payments</b>									
<b>Retained Earnings</b>	<b>102,666</b>	<b>110,243</b>	<b>118,267</b>	<b>126,711</b>	<b>135,575</b>	<b>144,855</b>	<b>154,550</b>	<b>164,633</b>	
<b>CASH FLOW STATEMENT</b>									
	<b>2035</b>	<b>2,036</b>	<b>2037</b>	<b>2,038</b>	<b>2039</b>	<b>2,040</b>	<b>2041</b>	<b>2,042</b>	
Cash at Beginning	53,527	47,419	48,839	23,261	26,408	13,778	17,873	13,669	
<b>Cash Inflow</b>									
Net operating income	17,121	17,121	17,121	17,121	17,121	17,121	17,121	17,121	
Depreciation cost (All)	19,197	19,197	19,197	19,197	19,197	19,197	19,197	19,197	
Long-term loans (Package #1,#2,#3)	0	0	0	0	0	0	0	0	
<i>Accumulated Principal of Longterm Loans</i>	<i>354,258</i>	<i>331,521</i>	<i>308,785</i>	<i>286,909</i>	<i>265,033</i>	<i>243,157</i>	<i>221,281</i>	<i>200,265</i>	
Long-term loans (Package P3,P4,P10)									
<i>Accumulated Principal of Longterm Loans</i>	<i>35,405</i>	<i>32,787</i>	<i>30,169</i>	<i>27,550</i>	<i>24,932</i>	<i>22,314</i>	<i>19,807</i>	<i>17,301</i>	
Interest on deposits	0	0	0	0	0	0	0	0	
<b>Cash Outflow (excluding G. Funds)</b>	<b>42,426</b>	<b>34,899</b>	<b>61,896</b>	<b>33,172</b>	<b>48,949</b>	<b>32,224</b>	<b>40,523</b>	<b>30,561</b>	
Investment (Package #1,#2,#3)									
Investment (CP-P10)									
Replacement of existing assets	<b>7,080</b>	<b>0</b>	<b>28,305</b>	<b>0</b>	<b>16,197</b>	<b>0</b>	<b>9,574</b>	<b>0</b>	
Repayment new long-term loans principal	22,737	22,737	21,876	21,876	21,876	21,876	21,016	21,016	
Repayment P3,P4,P10 loan principal	2,618	2,618	2,618	2,618	2,618	2,507	2,507	2,507	
Interest on long-term loans (New)	7,223	6,734	6,245	5,790	5,335	4,880	4,426	4,005	
Interest on former MEF long-term loans	986	916	846	777	707	641	577	513	
Income tax+ Transfer	1,783	1,894	2,006	2,111	2,216	2,320	2,424	2,521	
Interest on short-term loans	0	0	0	0	0	0	0	0	
<b>Cash Inflow - Cash Outflow</b>	<b>-6,107</b>	<b>1,420</b>	<b>-25,578</b>	<b>3,147</b>	<b>-12,630</b>	<b>4,095</b>	<b>-4,204</b>	<b>5,758</b>	
<b>Cash at End</b>	<b>47,419</b>	<b>48,839</b>	<b>23,261</b>	<b>26,408</b>	<b>13,778</b>	<b>17,873</b>	<b>13,669</b>	<b>19,426</b>	

**Cash Flow, Profit Loss Statement, Balance Sheet (5)**

<b>PROFIT AND LOSS STATEMENT</b>									
	<b>2043</b>	<b>2044</b>	<b>2045</b>	<b>2046</b>	<b>2047</b>	<b>2048</b>	<b>2049</b>	<b>2050</b>	
<b>Operating Revenue (excl. VAT)</b>									
Operating Revenue	113,361	113,361	113,361	113,361	113,361	113,361	113,361	113,361	113,361
<b>Operating Expenses</b>									
Fuel and motor oil for operation	19,593	19,593	19,593	19,593	19,593	19,593	19,593	19,593	19,593
Supplies for Workshop & Spare-parts	15,842	15,842	15,842	15,842	15,842	15,842	15,842	15,842	15,842
Salaries and Bonus	6,274	6,274	6,274	6,274	6,274	6,274	6,274	6,274	6,274
Depreciation	19,197	19,197	19,197	19,197	19,197	19,197	19,197	19,197	19,197
Repair and maintenance	13,628	13,628	13,628	13,628	13,628	13,628	13,628	13,628	13,628
Fuel for administration & maintenance	5,869	5,869	5,869	5,869	5,869	5,869	5,869	5,869	5,869
Miscellaneous administrative others	15,836	15,836	15,836	15,836	15,836	15,836	15,836	15,836	15,836
<b>Net Operating Income</b>	<b>17,121</b>	<b>17,121</b>	<b>17,121</b>	<b>17,121</b>	<b>17,121</b>	<b>17,121</b>	<b>17,121</b>	<b>17,121</b>	<b>17,121</b>
<b>Non-operating revenues</b>									
Interest gains, Exchange gains	0	0	0	0	0	0	0	0	0
<b>Non-operating Expenses</b>									
Interest on long-term-loans (MEF Int.)	449	385	321	256	192	128	64	0	0
Interest on loans for Package #1,#2,#3	3,585	3,165	2,744	2,324	1,904	1,483	1,063	871	0
Interest on short-term loans	0	0	0	0	0	0	0	0	0
<b>Net Income Before Tax</b>	<b>13,088</b>	<b>13,572</b>	<b>14,057</b>	<b>14,541</b>	<b>15,025</b>	<b>15,510</b>	<b>15,994</b>	<b>16,250</b>	
Income tax	2,618	2,714	2,811	2,908	3,005	3,102	3,199	3,250	
<b>Net income after tax</b>	<b>10,470</b>	<b>10,858</b>	<b>11,245</b>	<b>11,633</b>	<b>12,020</b>	<b>12,408</b>	<b>12,795</b>	<b>13,000</b>	
<b>Dividend payments</b>									
<b>Retained Earnings</b>	<b>175,103</b>	<b>185,961</b>	<b>197,206</b>	<b>208,839</b>	<b>220,859</b>	<b>233,267</b>	<b>246,062</b>	<b>259,062</b>	
<b>CASH FLOW STATEMENT</b>									
	<b>2043</b>	<b>2,044</b>	<b>2045</b>	<b>2,046</b>	<b>2047</b>	<b>2,048</b>	<b>2049</b>	<b>2,050</b>	
Cash at Beginning	19,426	1,004	7,537	4,883	5,111	-8,622	-1,833	17,784	
<b>Cash Inflow</b>									
Net operating income	17,121	17,121	17,121	17,121	17,121	17,121	17,121	17,121	17,121
Depreciation cost (All)	19,197	19,197	19,197	19,197	19,197	19,197	19,197	19,197	19,197
Long-term loans (Package #1,#2,#3)	0	0	0	0	0	0	0	0	0
Accumulated Principal of Longterm Loans	179,249	158,234	137,218	116,203	95,187	74,171	53,156	43,562	
Long-term loans (Package P3,P4,P10)	0	0	0	0	0	0	0	0	0
Accumulated Principal of Longterm Loans	14,794	12,288	9,781	7,274	4,768	2,261	0	0	
Interest on deposits	0	0	0	0	0	0	0	0	0
<b>Cash Outflow (excluding G. Funds)</b>	<b>54,741</b>	<b>29,786</b>	<b>38,973</b>	<b>36,091</b>	<b>50,052</b>	<b>29,529</b>	<b>16,702</b>	<b>20,795</b>	
Investment (Package #1,#2,#3)	0	0	0	0	0	0	0	0	0
Investment (CP-P10)	0	0	0	0	0	0	0	0	0
Replacement of existing assets	24,567	0	9,574	7,080	21,429	0	0	7,080	
Repayment new long-term loans principal	21,016	21,016	21,016	21,016	21,016	21,016	9,594	9,594	
Repayment P3,P4,P10 loan principal	2,507	2,507	2,507	2,507	2,507	2,507	2,507	0	
Interest on long-term loans (New)	3,585	3,165	2,744	2,324	1,904	1,483	1,063	871	
Interest on former MEF long-term loans	449	385	321	256	192	128	64	0	
Income tax+ Transfer	2,618	2,714	2,811	2,908	3,005	3,102	3,199	3,250	
Interest on short-term loans	0	0	0	0	0	1,293	275	0	
Cash Inflow - Cash Outflow	-18,422	6,533	-2,654	228	-13,734	6,789	19,617	15,523	
<b>Cash at End</b>	<b>1,004</b>	<b>7,537</b>	<b>4,883</b>	<b>5,111</b>	<b>-8,622</b>	<b>-1,833</b>	<b>17,784</b>	<b>33,307</b>	

**Cash Flow, Profit Loss Statement, Balance Sheet (6)**

<b>PROFIT AND LOSS STATEMENT</b>					
	<b>2051</b>	<b>2052</b>	<b>2053</b>	<b>2054</b>	
<b>Operating Revenue (excl. VAT)</b>					
Operating Revenue	113,361	113,361	113,361	113,361	
<b>Operating Expenses</b>					
Fuel and motor oil for operation	19,593	19,593	19,593	19,593	
Supplies for Workshop & Spare-parts	15,842	15,842	15,842	15,842	
Salaries and Bonus	6,274	6,274	6,274	6,274	
Depreciation	19,197	19,197	19,197	19,197	
Repair and maintenance	13,628	13,628	13,628	13,628	
Fuel for administration & maintenance	5,869	5,869	5,869	5,869	
Miscellaneous administrative others	15,836	15,836	15,836	15,836	
<b>Net Operating Income</b>	<b>17,121</b>	<b>17,121</b>	<b>17,121</b>	<b>17,121</b>	
<b>Non-operating revenues</b>					
Interest gains, Exchange gains	0	0	0	0	
<b>Non-operating Expenses</b>					
Interest on long-term-loans (MEF Int.)	0	0	0	0	
Interest on loans for Package #1,#2,#3	679	488	296	148	
Interest on short-term loans					
<b>Net Income Before Tax</b>	<b>16,442</b>	<b>16,634</b>	<b>16,826</b>	<b>16,974</b>	
Income tax	3,288	3,327	3,365	3,395	
<b>Net income after tax</b>	<b>13,154</b>	<b>13,307</b>	<b>13,461</b>	<b>13,579</b>	
<b>Dividend payments</b>					
<b>Retained Earnings</b>	<b>272,216</b>	<b>285,523</b>	<b>298,984</b>	<b>312,562</b>	
<b>CASH FLOW STATEMENT</b>					
	<b>2051</b>	<b>2,052</b>	<b>2053</b>	<b>2,054</b>	
Cash at Beginning	33,307	56,064	50,670	54,507	
<b>Cash Inflow</b>					
Net operating income	17,121	17,121	17,121	17,121	
Depreciation cost (All)	19,197	19,197	19,197	19,197	
Long-term loans (Package #1,#2,#3)					
<i>Accumulated Principal of Longterm Loans</i>	<i>33,968</i>	<i>24,374</i>	<i>14,780</i>	<i>7,388</i>	
Long-term loans (Package P3,P4,P10)					
<i>Accumulated Principal of Longterm Loans</i>					
Interest on deposits					
<b>Cash Outflow (excluding G. Funds)</b>	<b>13,562</b>	<b>41,713</b>	<b>32,481</b>	<b>27,131</b>	
Investment (Package #1,#2,#3)					
Investment (CP-P10)					
Replacement of existing assets	<b>0</b>	<b>28,305</b>	<b>21,429</b>	<b>16,197</b>	
Repayment new long-term loans principal	9,594	9,594	7,391	7,391	
Repayment P3,P4,P10 loan principal					
Interest on long-term loans (New)	679	488	296	148	
Interest on former MEF long-term loans	0	0	0	0	
Income tax+ Transfer	3,288	3,327	3,365	3,395	
Interest on short-term loans	0	0	0	0	
Cash Inflow - Cash Outflow	22,757	-5,395	3,838	9,188	
<b>Cash at End</b>	<b>56,064</b>	<b>50,670</b>	<b>54,507</b>	<b>63,695</b>	

**Cash Flow, Profit Loss Statement, Balance Sheet (7)**

<b>BALANCE SHEET</b>								
	<b>2011</b>	<b>2,012</b>	<b>2013</b>	<b>2,014</b>	<b>2015</b>	<b>2,016</b>	<b>2017</b>	<b>2,018</b>
<b>(Assets)</b>								
Current Assets	10,205	15,694	22,194	28,016	34,633	41,378	44,209	51,767
Cash & Deposit	10,205	15,694	22,194	28,016	34,633	41,378	44,209	51,767
Fixed Assets (Package #1,#2,#3 & P3,P4,P10)	66,627	66,240	69,445	95,591	136,148	150,164	149,955	149,217
Construction costs (Package #1,#2,#3)	0	0	208	0	8,674	8,327	3,946	3,604
Fixed assets (Package #1,#2,#3)	0	0	0	208	208	8,882	17,209	21,155
Depreciation (Package #1,#2,#3) S6	0	0	0	0	0	0	877	1,064
Net fixed assets (Package #1,#2,#3)	0	0	208	208	8,882	17,209	20,278	22,818
Construction (CP-P3, P4, P10)		1,387	4,771	27,920	33,657	7,463		
Fixed assets (CP-P3, P4, P10)	71,798	71,798	73,185	77,956	105,876	139,533	146,996	146,996
Depreciation (CP-P3, P4, P10)	1,774	1,774	1,774	1,774	1,774	1,774	3,278	3,278
Net fixed assets (CP-P3, P4, P10)	66,627	66,240	69,237	95,383	127,266	132,955	129,677	126,399
<b>Total Assets (Package 1,2,3 &amp; P3,P4,P10)</b>	<b>76,832</b>	<b>81,934</b>	<b>91,639</b>	<b>123,607</b>	<b>170,781</b>	<b>191,542</b>	<b>194,164</b>	<b>200,984</b>
<b>(Liabilities and Capital)</b>								
Liabilities	71,798	70,153	69,896	73,232	97,618	136,414	148,670	144,483
Short-term loans	0	0	0	0	0	0	0	0
Long-term loans (Package #1,#2,#3)	0	0	0	208	208	8,882	17,209	16,557
Long-term loans (Package P3,P4,P10)	71,798	70,153	69,896	73,024	97,410	127,532	131,461	127,927
Capital (Package #1,#2,#3 & P3,P4,P10))	5,034	11,781	21,743	50,376	73,164	55,128	45,494	56,501
<b>Total Liabilities and Capital</b>	<b>76,832</b>	<b>81,934</b>	<b>91,639</b>	<b>123,607</b>	<b>170,781</b>	<b>191,542</b>	<b>194,164</b>	<b>200,984</b>
<b>FINANCIAL INDICATORS</b>								
	<b>2011</b>	<b>2,012</b>	<b>2013</b>	<b>2,014</b>	<b>2015</b>	<b>2,016</b>	<b>2017</b>	<b>2,018</b>
Working Ratio	65%	65%	62%	60%	58%	57%	58%	57%
Operating Ratio	84%	81%	76%	72%	68%	66%	71%	69%
Rate of Return on Net Fixed Assets			6.6%	6.9%	5.9%	5.8%	4.7%	5.7%
Debt Service Coverage ratio	2.08	2.32	2.63	2.10	2.16	2.09	1.85	2.01

**Cash Flow, Profit Loss Statement, Balance Sheet (8)**

<b>BALANCE SHEET</b>								
	<b>2019</b>	<b>2,020</b>	<b>2021</b>	<b>2,022</b>	<b>2023</b>	<b>2,024</b>	<b>2025</b>	<b>2,026</b>
<b>(Assets)</b>								
Current Assets	58,535	67,605	70,398	67,178	65,536	50,116	53,073	57,690
Cash & Deposit	58,535	67,605	70,398	67,178	65,536	50,116	53,073	57,690
Fixed Assets (Package #1,#2,#3 & P3,P4,P10)	153,549	217,144	294,533	380,388	368,641	396,870	405,576	425,061
Construction costs (Package #1,#2,#3)	8,674	67,937	82,608	91,074	0	39,977	21,533	33,194
Fixed assets (Package #1,#2,#3)	24,759	33,433	101,370	183,978	275,052	275,052	315,029	336,562
Depreciation (Package #1,#2,#3) S6	1,064	1,064	1,941	1,941	8,470	8,470	9,549	10,430
Net fixed assets (Package #1,#2,#3)	30,428	97,301	177,967	267,100	258,631	290,138	302,122	324,885
Construction (CP-P3, P4, P10)								
Fixed assets (CP-P3, P4, P10)	146,996	146,996	146,996	146,996	146,996	146,996	146,996	146,996
Depreciation (CP-P3, P4, P10)	3,278	3,278	3,278	3,278	3,278	3,278	3,278	3,278
Net fixed assets (CP-P3, P4, P10)	123,121	119,844	116,566	113,288	110,010	106,732	103,454	100,176
<b>Total Assets (Package 1,2,3 &amp; P3,P4,P10)</b>	<b>212,084</b>	<b>284,749</b>	<b>364,931</b>	<b>447,566</b>	<b>434,176</b>	<b>446,985</b>	<b>458,649</b>	<b>482,751</b>
<b>(Liabilities and Capital)</b>								
Liabilities	143,693	145,466	206,502	281,348	357,183	349,422	365,440	379,212
Short-term loans	0	0	0	0	0	0	0	0
Long-term loans (Package #1,#2,#3)	19,300	27,114	94,190	175,077	256,953	255,232	277,291	297,103
Long-term loans (Package P3,P4,P10)	124,393	118,352	112,312	106,271	100,230	94,190	88,149	82,108
Capital (Package #1,#2,#3 & P3,P4,P10))	68,391	139,284	158,429	166,218	76,993	97,564	93,209	103,539
<b>Total Liabilities and Capital</b>	<b>212,084</b>	<b>284,749</b>	<b>364,931</b>	<b>447,566</b>	<b>434,176</b>	<b>446,985</b>	<b>458,649</b>	<b>482,751</b>
<b>FINANCIAL INDICATORS</b>								
	<b>2019</b>	<b>2,020</b>	<b>2021</b>	<b>2,022</b>	<b>2023</b>	<b>2,024</b>	<b>2025</b>	<b>2,026</b>
Working Ratio	55%	53%	60%	59%	68%	66%	66%	65%
Operating Ratio	66%	62%	72%	70%	93%	89%	89%	88%
Rate of Return on Net Fixed Assets	7.3%	6.7%	2.3%	2.2%	-1.5%	-0.8%	-0.5%	-0.3%
Debt Service Coverage ratio	1.78	2.06	1.33	1.48	0.90	1.05	1.18	1.28

**Cash Flow, Profit Loss Statement, Balance Sheet (9)**

<b>BALANCE SHEET</b>									
	<b>2027</b>	<b>2,028</b>	<b>2029</b>	<b>2,030</b>	<b>2031</b>	<b>2,032</b>	<b>2033</b>	<b>2,034</b>	
<b>(Assets)</b>									
Current Assets	65,181	75,602	73,376	76,222	53,566	60,385	66,143	53,527	
Cash & Deposit	65,181	75,602	73,376	76,222	53,566	60,385	66,143	53,527	
Fixed Assets (Package #1,#2,#3 & P3,P4,P10)	467,545	510,029	491,778	473,527	483,785	464,678	445,570	445,610	
Construction costs (Package #1,#2,#3)	56,192	56,192	0	0	28,509	0	0	19,148	
Fixed assets (Package #1,#2,#3)	369,756	425,948	482,140	482,140	482,140	510,649	510,649	510,649	
Depreciation (Package #1,#2,#3) S6	10,430	10,430	14,973	14,973	14,973	15,830	15,830	15,830	
Net fixed assets (Package #1,#2,#3)	370,647	416,408	401,435	386,463	399,999	384,169	368,339	371,657	
Construction (CP-P3, P4, P10)									
Fixed assets (CP-P3, P4, P10)	146,996	146,996	146,996	146,996	146,996	146,996	146,996	146,996	
Depreciation (CP-P3, P4, P10)	3,278	3,278	3,278	3,278	3,278	3,278	3,278	3,278	
Net fixed assets (CP-P3, P4, P10)	96,898	93,620	90,342	87,065	83,787	80,509	77,231	73,953	
<b>Total Assets (Package 1,2,3 &amp; P3,P4,P10)</b>	<b>532,726</b>	<b>585,631</b>	<b>565,154</b>	<b>549,749</b>	<b>537,351</b>	<b>525,063</b>	<b>511,712</b>	<b>499,137</b>	
<b>(Liabilities and Capital)</b>									
Liabilities	404,644	453,074	501,505	482,322	464,671	447,021	429,370	409,517	
Short-term loans	0	0	0	0	0	0	0	0	
Long-term loans (Package #1,#2,#3)	328,576	383,047	437,519	424,376	411,234	398,091	384,949	369,603	
Long-term loans (Package P3,P4,P10)	76,068	70,027	63,986	57,946	53,438	48,930	44,421	39,913	
Capital (Package #1,#2,#3 & P3,P4,P10))	128,082	132,556	63,649	67,428	72,680	78,042	82,342	89,620	
<b>Total Liabilities and Capital</b>	<b>532,726</b>	<b>585,631</b>	<b>565,154</b>	<b>549,749</b>	<b>537,351</b>	<b>525,063</b>	<b>511,712</b>	<b>499,137</b>	
<b>FINANCIAL INDICATORS</b>									
	<b>2027</b>	<b>2,028</b>	<b>2029</b>	<b>2,030</b>	<b>2031</b>	<b>2,032</b>	<b>2033</b>	<b>2,034</b>	
Working Ratio	65%	64%	67%	67%	67%	68%	68%	67%	
Operating Ratio	85%	82%	89%	86%	84%	85%	85%	84%	
Rate of Return on Net Fixed Assets	0.4%	1.1%	-0.3%	0.6%	1.4%	1.4%	1.8%	2.0%	
Debt Service Coverage ratio	1.48	1.72	0.93	1.12	1.26	1.30	1.25	1.29	



**Cash Flow, Profit Loss Statement, Balance Sheet (10)**

<b>BALANCE SHEET</b>								
	<b>2035</b>	<b>2,036</b>	<b>2037</b>	<b>2,038</b>	<b>2039</b>	<b>2,040</b>	<b>2041</b>	<b>2,042</b>
<b>(Assets)</b>								
Current Assets	47,419	48,839	23,261	26,408	13,778	17,873	13,669	19,426
Cash & Deposit	47,419	48,839	23,261	26,408	13,778	17,873	13,669	19,426
Fixed Assets (Package #1,#2,#3 & P3,P4,P10)	433,493	414,296	423,403	404,206	401,206	382,008	372,385	353,188
Construction costs (Package #1,#2,#3)	7,080	0	28,305	0	16,197	0	9,574	0
Fixed assets (Package #1,#2,#3)	529,797	536,877	536,877	565,182	565,182	581,379	581,379	590,953
Depreciation (Package #1,#2,#3) S6	16,596	16,596	16,596	16,596	16,596	16,596	16,596	16,596
Net fixed assets (Package #1,#2,#3)	362,141	345,545	357,254	340,658	340,259	323,663	316,642	300,046
Construction (CP-P3, P4, P10)								
Fixed assets (CP-P3, P4, P10)	146,996	146,996	146,996	146,996	146,996	146,996	146,996	146,996
Depreciation (CP-P3, P4, P10)	2,601	2,601	2,601	2,601	2,601	2,601	2,601	2,601
Net fixed assets (CP-P3, P4, P10)	71,352	68,750	66,149	63,548	60,946	58,345	55,744	53,142
<b>Total Assets (Package 1,2,3 &amp; P3,P4,P10)</b>	<b>480,912</b>	<b>463,135</b>	<b>446,665</b>	<b>430,614</b>	<b>414,984</b>	<b>399,881</b>	<b>386,054</b>	<b>372,614</b>
<b>(Liabilities and Capital)</b>								
Liabilities	389,663	364,308	338,954	314,459	289,965	265,471	241,088	217,566
Short-term loans	0	0	0	0	0	0	0	0
Long-term loans (Package #1,#2,#3)	354,258	331,521	308,785	286,909	265,033	243,157	221,281	200,265
Long-term loans (Package P3,P4,P10)	35,405	32,787	30,169	27,550	24,932	22,314	19,807	17,301
Capital (Package #1,#2,#3 & P3,P4,P10))	91,249	98,826	107,711	116,155	125,019	134,410	144,966	155,048
<b>Total Liabilities and Capital</b>	<b>480,912</b>	<b>463,135</b>	<b>446,665</b>	<b>430,614</b>	<b>414,984</b>	<b>399,881</b>	<b>386,054</b>	<b>372,614</b>
<b>FINANCIAL INDICATORS</b>								
	<b>2035</b>	<b>2,036</b>	<b>2037</b>	<b>2,038</b>	<b>2039</b>	<b>2,040</b>	<b>2041</b>	<b>2,042</b>
Working Ratio	68%	68%	68%	68%	68%	68%	68%	68%
Operating Ratio	85%	85%	85%	85%	85%	85%	85%	85%
Rate of Return on Net Fixed Assets	2.1%	2.3%	2.4%	2.6%	2.8%	3.0%	3.3%	3.6%
Debt Service Coverage ratio	1.08	1.10	1.15	1.17	1.19	1.21	1.27	1.30

**Cash Flow, Profit Loss Statement, Balance Sheet (11)**

<b>BALANCE SHEET</b>									
	<b>2043</b>	<b>2,044</b>	<b>2045</b>	<b>2,046</b>	<b>2047</b>	<b>2,048</b>	<b>2049</b>	<b>2,050</b>	
<b>(Assets)</b>									
Current Assets	1,004	7,537	4,883	5,111	-8,622	-1,833	17,784	33,307	
Cash & Deposit	1,004	7,537	4,883	5,111	-8,622	-1,833	17,784	33,307	
Fixed Assets (Package #1,#2,#3 & P3,P4,P10)	358,558	339,360	329,737	317,620	319,852	300,655	281,457	269,340	
Construction costs (Package #1,#2,#3)	24,567	0	9,574	7,080	21,429	0	0	7,080	
Fixed assets (Package #1,#2,#3)	590,953	615,520	615,520	625,094	632,174	653,603	653,603	653,603	
Depreciation (Package #1,#2,#3) S6	16,596	16,596	16,596	16,596	16,596	16,596	16,596	16,596	
Net fixed assets (Package #1,#2,#3)	308,017	291,421	284,399	274,883	279,716	263,120	246,524	237,009	
Construction (CP-P3, P4, P10)									
Fixed assets (CP-P3, P4, P10)	146,996	146,996	146,996	146,996	146,996	146,996	146,996	146,996	
Depreciation (CP-P3, P4, P10)	2,601	2,601	2,601	2,601	2,601	2,601	2,601	2,601	
Net fixed assets (CP-P3, P4, P10)	50,541	47,940	45,338	42,737	40,135	37,534	34,933	32,331	
<b>Total Assets (Package 1,2,3 &amp; P3,P4,P10)</b>	<b>359,562</b>	<b>346,898</b>	<b>334,621</b>	<b>322,731</b>	<b>311,229</b>	<b>298,822</b>	<b>299,241</b>	<b>302,647</b>	
<b>(Liabilities and Capital)</b>									
Liabilities	194,044	170,521	146,999	123,477	99,955	76,433	53,156	43,562	
Short-term loans	0	0	0	0	0	0	0	0	
Long-term loans (Package #1,#2,#3)	179,249	158,234	137,218	116,203	95,187	74,171	53,156	43,562	
Long-term loans (Package P3,P4,P10)	14,794	12,288	9,781	7,274	4,768	2,261	0	0	
Capital (Package #1,#2,#3 & P3,P4,P10))	165,519	176,376	187,621	199,254	211,275	222,389	246,085	259,086	
<b>Total Liabilities and Capital</b>	<b>359,562</b>	<b>346,898</b>	<b>334,621</b>	<b>322,731</b>	<b>311,229</b>	<b>298,822</b>	<b>299,241</b>	<b>302,647</b>	
<b>FINANCIAL INDICATORS</b>									
	<b>2043</b>	<b>2,044</b>	<b>2045</b>	<b>2,046</b>	<b>2047</b>	<b>2,048</b>	<b>2049</b>	<b>2,050</b>	
Working Ratio	68%	68%	68%	68%	68%	68%	68%	68%	
Operating Ratio	85%	85%	85%	85%	85%	85%	85%	85%	
Rate of Return on Net Fixed Assets	3.7%	4.0%	4.3%	4.6%	4.7%	5.2%	5.7%	6.0%	
Debt Service Coverage ratio	1.32	1.34	1.37	1.39	1.42	1.45	2.75	3.47	

**Cash Flow, Profit Loss Statement, Balance Sheet (12)**

<b>BALANCE SHEET</b>				
	<b>2051</b>	<b>2,052</b>	<b>2053</b>	<b>2,054</b>
<b>(Assets)</b>				
Current Assets	56,064	50,670	54,507	63,695
Cash & Deposit	56,064	50,670	54,507	63,695
Fixed Assets (Package #1,#2,#3 & P3,P4,P10)	250,143	259,251	261,482	258,482
Construction costs (Package #1,#2,#3)	0	28,305	21,429	16,197
Fixed assets (Package #1,#2,#3)	660,683	660,683	688,988	710,417
Depreciation (Package #1,#2,#3) S6	16,596	16,596	16,596	16,596
Net fixed assets (Package #1,#2,#3)	220,413	232,122	236,955	236,556
Construction (CP-P3, P4, P10)				
Fixed assets (CP-P3, P4, P10)	146,996	146,996	146,996	146,996
Depreciation (CP-P3, P4, P10)	2,601	2,601	2,601	2,601
Net fixed assets (CP-P3, P4, P10)	29,730	27,129	24,527	21,926
<b>Total Assets (Package 1,2,3 &amp; P3,P4,P10)</b>	<b>306,207</b>	<b>309,920</b>	<b>315,989</b>	<b>322,177</b>
<b>(Liabilities and Capital)</b>				
Liabilities	33,968	24,374	14,780	7,388
Short-term loans	0	0	0	0
Long-term loans (Package #1,#2,#3)	33,968	24,374	14,780	7,388
Long-term loans (Package P3,P4,P10)	0	0	0	0
Capital (Package #1,#2,#3 & P3,P4,P10))	272,239	285,546	301,210	314,789
<b>Total Liabilities and Capital</b>	<b>306,207</b>	<b>309,920</b>	<b>315,989</b>	<b>322,177</b>
<b>FINANCIAL INDICATORS</b>				
	<b>2051</b>	<b>2,052</b>	<b>2053</b>	<b>2,054</b>
Working Ratio	68%	68%	68%	68%
Operating Ratio	85%	85%	85%	85%
Rate of Return on Net Fixed Assets	6.6%	6.4%	6.4%	6.6%
Debt Service Coverage ratio	3.54	3.60	4.72	4.82



## **Appendix-6**

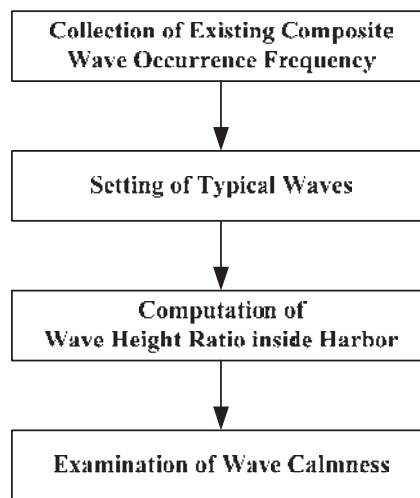
### **Wave Calmness Analysis Inside Harbor**



## 1. General

In 1996-1997, a JICA M/S and F/S Study carried out a wave calmness analysis for future port layout. In 2011, detailed engineering services of the Multi-purpose Terminal Development Project undertook a wave calmness analysis to determine the structural type of the quay. Although these studies had different purposes, some information can be utilized in this Project. In particular, the detailed engineering services collected wind observation data for 10 years from 2000 to 2010 in Sihanoukville metrological office and summarized the data for wave hind-cast by applying the SMB method. The data was finally combined with previous wave hind-cast data for the entrance of Sihanoukville Port.

This Project applied the combined wave occurrence frequencies for two periods from 1983 to 1996 and 2000 to 2010, which were summarized in the detailed engineering services. Figure 1-1 shows the flowchart of this analysis.



Source: Project Team

**Figure 1-1 Flowchart of Wave Calmness Analysis**

## 2. Methodology of Wave Calmness Analysis

### (1) Computation of Wave Diffraction and Reflection

#### 1) General

It is widely recognized that a series of reflection waves can be estimated by applying a numerical simulation. While there are various numerical models proposed for regular or irregular waves, the numerical model by Takayama (1981) can be adopted for the analysis. The conditions of the model are limited for constant depth but the model can be applied for the wave irregularity that is most important for the wave reflection and diffraction.

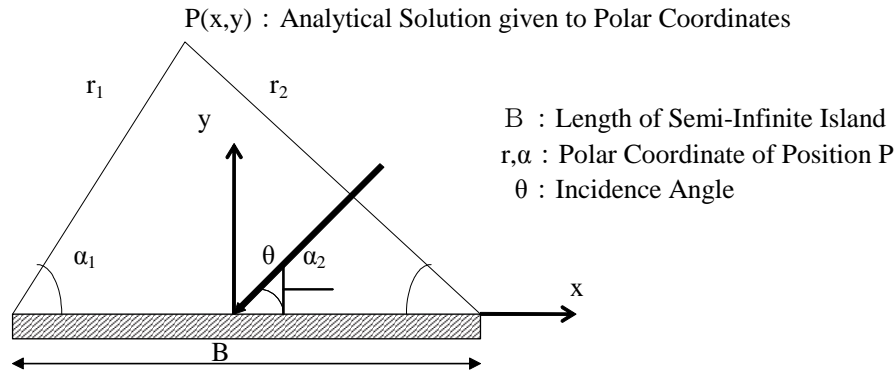
#### 2) Incident Wave from Harbor Entrance

The basic equation (1.1) using the diffraction theory of the optics by Sommerfeld (1896) is given by Penny and Price (1944) as follows:

$$\begin{aligned} \phi(r, \theta) = & \frac{1}{\sqrt{2}} \exp \left[ i \left\{ kr \cos(\theta - \alpha) + \frac{\pi}{4} \right\} \right] \times \left[ \left\{ C(\gamma_1) + \frac{1}{2} \right\} - i \left\{ S(\gamma_1) + \frac{1}{2} \right\} \right] \\ & + \frac{1}{\sqrt{2}} \exp \left[ i \left\{ kr \cos(\theta + \alpha) + \frac{\pi}{4} \right\} \right] \times \left[ \left\{ C(\gamma_2) + \frac{1}{2} \right\} - i \left\{ S(\gamma_2) + \frac{1}{2} \right\} \right] \end{aligned} \quad \text{eq. (1.1)}$$

### 3) Calculation of the Effects of Reflected Waves

The semi-infinite island reflection method, which is one of calculation methods to estimate the extent of the effects of waves reflected from the structure, can be applied for the estimation of reflected waves by means of diffraction diagrams as shown in Figure 2-1.

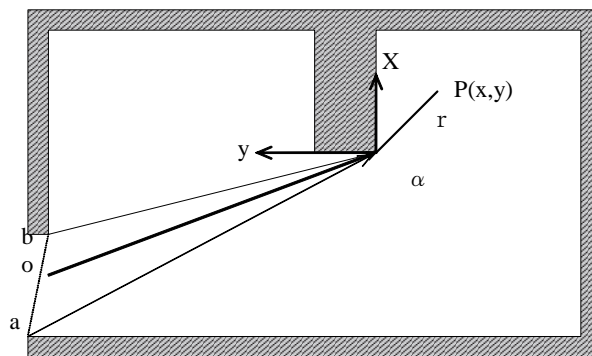


Source: Project Team

**Figure 2-1 Concept of Semi-Infinite Island Method**

### 4) Calculation of the Waves Diffracted by Inner Jetty or Quay

In the case where diffracted waves are met at a harbor entrance, there are some areas covered by an inner jetty or quay. The calculation of the diffracted waves can be estimated from considering the inner jetty or quay as a semi-infinite island as presented in Figure 2-2.



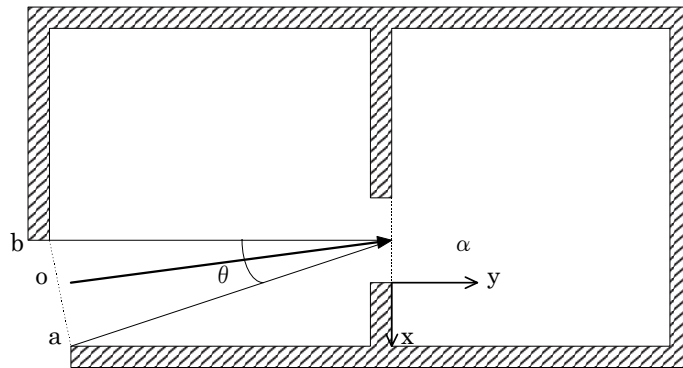
Source: Project Team

**Figure 2-2 Concept of the Effect of Diffracted Waves inside Harbor**

### 5) Calculation of the Waves Diffracted by Inner Breakwater

The calculation can be made by applying the semi-infinite island method to assume that the available range of incident angle at the opening of the inner breakwater is between  $a$  and  $b$  of the outer breakwater based on the line connected with the center of both openings as shown in Figure 2-3.





Source: Project Team

**Figure 2-3 Concept of Wave Diffraction for Opening of Inner Breakwater**

### 6) Calculation of Compounded Waves

Assuming that  $H_i$  is the significant wave height of  $n=i$  given, ratios among wave heights ( $K_d$ ) can be estimated by the composition of significant wave energies as shown in the equation below.

$$K_d = \sqrt{\left( \sum_{i=1}^n H_i^2 / n \right)} / H_{1/3} \quad (\text{A-4.2})$$

where  $n$  : number of wave groups for the waves reflected by quay or incident waves

$H_{1/3}$ : significant wave height of incident waves at opening

### 7) Setting of Reflection Ratio

Table 2-1 shows the referable reflection ratio of common port facilities.

**Table 2-1 Referable Ratio of Wave Reflection**

Item	Reflection Coefficient
Upright wall	0.7 - 1.0
Submerged upright breakwater	0.5 - 0.7
Rubble mound	0.3 - 0.6
Wave-dissipating blocks	0.3 - 0.5
Upright wave-dissipating structure	0.3 - 0.8
Natural beach	0.05 - 0.2

Source: Technical Standards and Commentaries for Port and Harbor Facilities (2007)

Referring to Table 2-1, this analysis applied the following reflection ratio for relevant port facilities for the present situation as described in Table 2-2.

**Table 2-2 Applied Ratio of Wave Reflection**

Item	Reflection Coefficient
Upright wall	0.9
Rubble mound	0.4
Wave-dissipating blocks	0.4
Natural beach	0.2

Source: Project Team

**(2) Procedure to Estimate Ratio of Wave Calmness**

Ratio of wave calmness in front of the quay was estimated through the following procedure:

- Collection of existing wave occurrence frequency table at the entrance of harbor
- Setting of typical waves
- Computation of wave height ratio distribution by each direction
- Setting of target wave height in front of quay
- Making the non-calmness ratio more than the target wave height from the occurrence frequency table
- Estimation of calmness ratio by deduction of the non-calmness ratio from the total wave occurrence frequency ratio

**3. Setting of Typical Waves**

**(1) Combined Wave Occurrence Frequencies at Entrance of Harbor**

Tables 3-1 and 3-2 respectively present combined wave occurrence frequencies at the harbor entrance of Sihanoukville Port, which were summarized in the detailed engineering services of the Multi-purpose Terminal. Generally, the values of wave height and period in these tables are comparatively bigger than those in the occurrence frequencies summarized in the 1996-1997 JICA M/S and F/S Study. However, considering the longer duration of wind observation and possible chronological change of wave occurrence, this analysis selected the combined occurrence frequencies.

**(2) Selection of Typical Waves**

Based on Tables 3-1 and 3-2, the following are the conditions of typical waves considered:

- Wind observation duration: 1985-1996 and 2000-2010
- Wave directions: SW, W, NW, N (W and NW are most dominant)
- Wave height:  $H=1.0$  meter (maximum value in classification including accumulated occurrence frequency of 97.5%)
- Wave period:  $T=4.0$  sec (corresponding to wave height as same)

**4. Calculation of Ratio of Wave Heights inside Harbor**

**(3) Study Cases**

Taking into account the future container terminal plans, related new breakwaters that might be necessary with the development of the container terminal, the quay type and dominant wave directions, study cases are determined as shown in Table 4-1. Figures 4.1 to 4-5 also describe formations in the study cases.

**Table 3-1 Wave Height Occurrence Frequency by Direction (1983-1996 & 2000-2010)**

Sihanoukville											ERR : 0.02	
H(m)	Deg.	NE	E	SE	S	SW	W	NW	N	CALM	Occurrence Frequency	Exceeding Occurrence Frequency
											(%)	(%)
CALM										27.10	27.10	27.10
~ 0.25		0.00	0.00	0.00	0.00	7.64	15.46	8.29	16.77		48.17	75.27
~ 0.50		0.00	0.00	0.00	0.00	1.15	7.84	4.95	2.66		16.60	91.87
~ 0.75		0.00	0.00	0.00	0.00	0.29	1.84	2.28	0.94		5.34	97.21
~ 1.00		0.00	0.00	0.00	0.00	0.04	0.38	0.86	0.05		1.33	98.54
~ 1.25		0.00	0.00	0.00	0.00	0.02	0.10	0.62	0.00		0.73	99.27
~ 1.50		0.00	0.00	0.00	0.00	0.00	0.04	0.13	0.00		0.17	99.44
~ 1.75		0.00	0.00	0.00	0.00	0.00	0.02	0.24	0.00		0.26	99.69
~ 2.00		0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00		0.16	99.86
~ 2.25		0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00		0.13	99.98
~ 2.50		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	99.98
~ 2.75		0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00		0.02	100.00
~ 3.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	100.00
3.00 ~		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	100.00
Total	(%)	0.00	0.00	0.00	0.00	9.14	25.66	17.68	20.42	27.10	100.00	

Source: Study Information by Detailed Engineering Services of Multi-purpose Terminal

**Table 3-2 Wave Period Occurrence Frequency by Direction (1983-1996 & 2000-2010)**

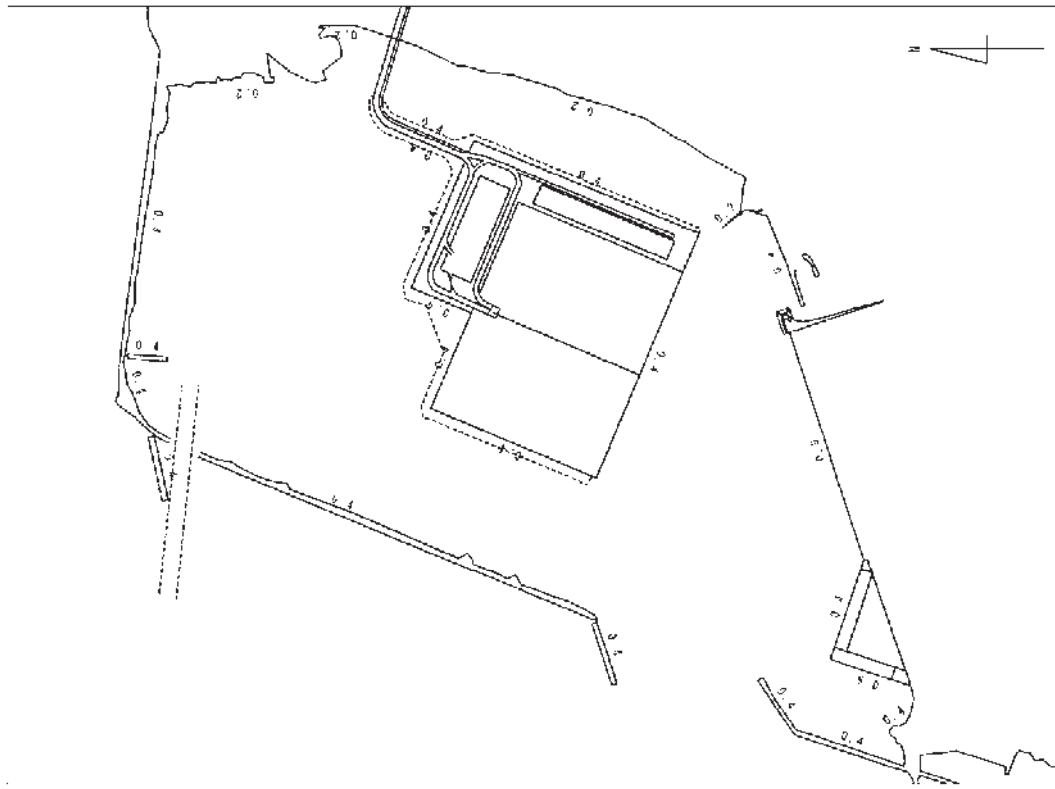
Sihanoukville											ERR : 0.02	
H(m)	Deg.	NE	E	SE	S	SW	W	NW	N	CALM	Occurrence Frequency	Exceeding Occurrence Frequency
											(%)	(%)
CALM										27.10	27.10	27.10
~ 0.25		0.00	0.00	0.00	0.00	7.64	15.46	8.29	16.77		48.17	75.27
~ 0.50		0.00	0.00	0.00	0.00	1.15	7.84	4.95	2.66		16.60	91.87
~ 0.75		0.00	0.00	0.00	0.00	0.29	1.84	2.28	0.94		5.34	97.21
~ 1.00		0.00	0.00	0.00	0.00	0.04	0.38	0.86	0.05		1.33	98.54
~ 1.25		0.00	0.00	0.00	0.00	0.02	0.10	0.62	0.00		0.73	99.27
~ 1.50		0.00	0.00	0.00	0.00	0.00	0.04	0.13	0.00		0.17	99.44
~ 1.75		0.00	0.00	0.00	0.00	0.00	0.02	0.24	0.00		0.26	99.69
~ 2.00		0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00		0.16	99.86
~ 2.25		0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00		0.13	99.98
~ 2.50		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	99.98
~ 2.75		0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00		0.02	100.00
~ 3.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	100.00
3.00 ~		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	100.00
Total	(%)	0.00	0.00	0.00	0.00	9.14	25.66	17.68	20.42	27.10	100.00	

Source: Study Information by Detailed Engineering Services of Multi-purpose Terminal

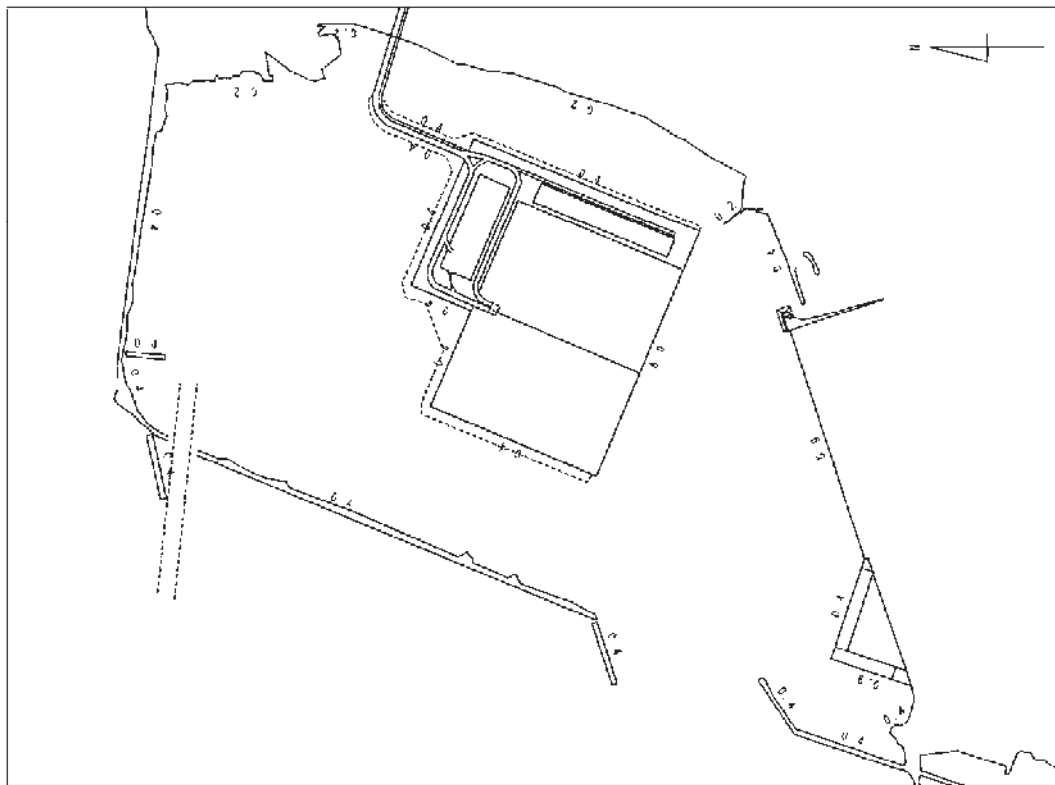
**Table 4-1 Study Cases for Calculation of Wave Height Ratio**

Case	Facility Formation			Quay Type	Wave Direction	Wave Distribution	Wave Calmness	Formation Drawing
	New Breakwater ①	New Breakwater ②	New Breakwater ③					
1a-1-1	○	○	-	Vertical Wall	W,NW	○	○	Fig. 1.4-1
1a-1-2	○	○	-	Wave Dissipating Block	W,NW	○	○	
1a-2-1	×	×	-	Vertical Wall	W,NW	○	○	Fig. 1.4-2
1a-2-2	×	×	-	Wave Dissipating Block	W,NW	○	○	
1b-1-1	○	-	○	Vertical Wall	NW	○		Fig. 1.4-3
1b-2-1	○	-	×	Wave Dissipating Block	NW	○		
2a-1-1	○	○	-	Vertical Wall	W,NW	○	○	Fig. 1.4-4
2a-1-2	○	○	-	Wave Dissipating Block	W,NW	○	○	
2a-2-1	×	○	-	Vertical Wall	W,NW	○	○	Fig. 1.4-5
2a-2-2	×	○	-	Wave Dissipating Block	W,NW	○	○	

Source: Project Team



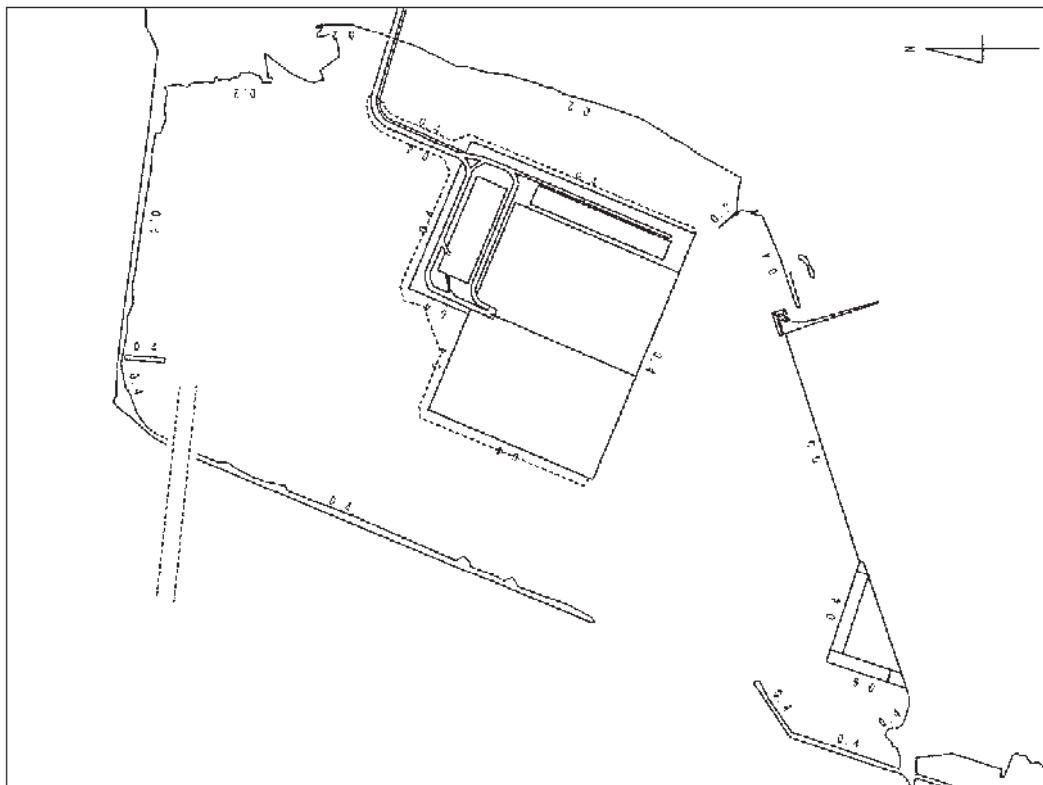
Case 1a-1-2



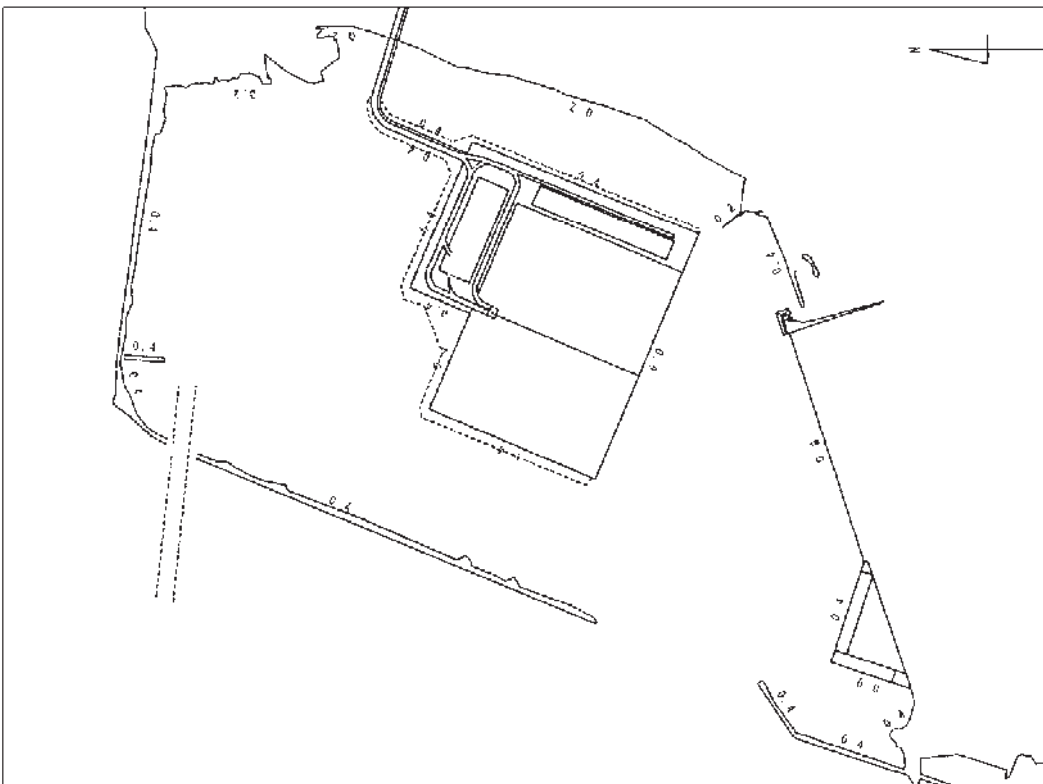
Case 1a-1-1

Source: Project Team

**Figure 4-1 Facility Formation Cases (1a-1-1 & 1a-1-2)**



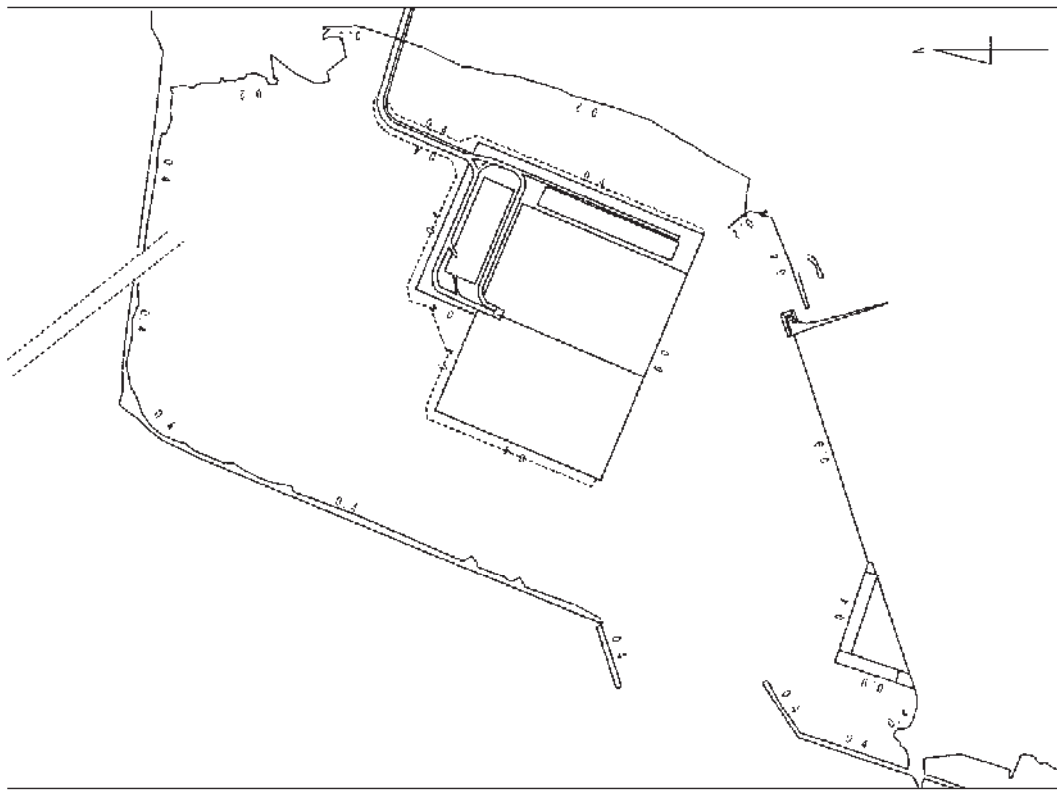
Case 1a-2-2



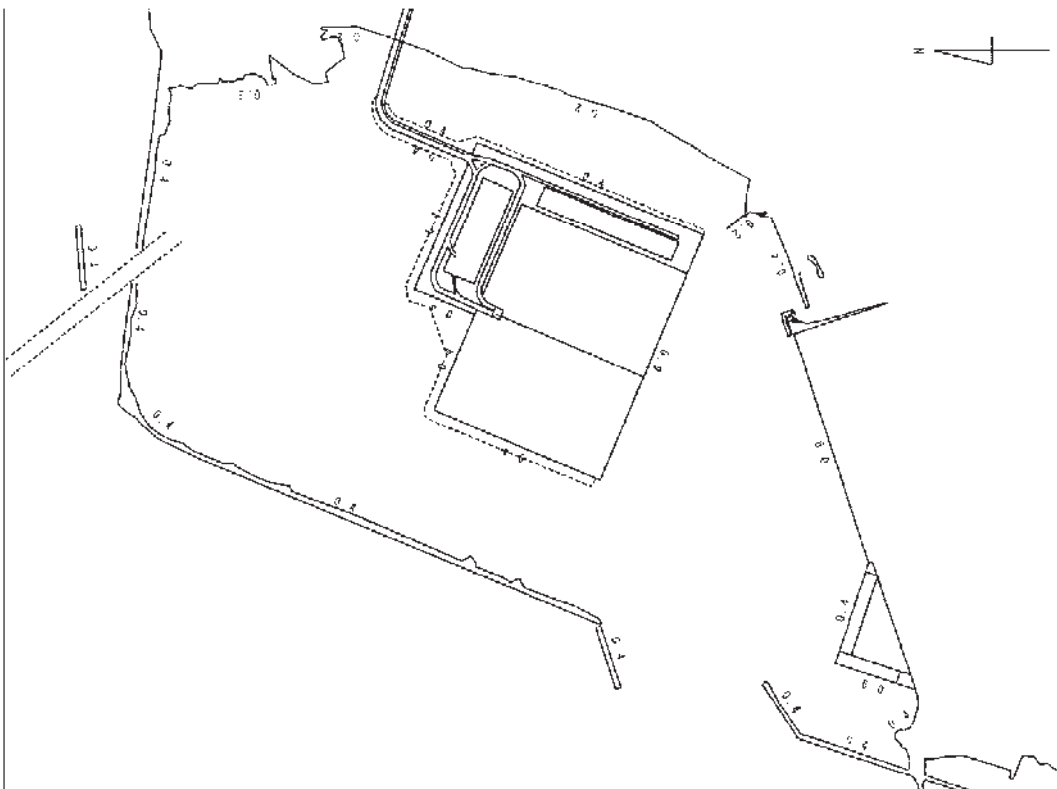
Case 1a-2-1

Source: Project Team

**Figure 4-2 Facility Formation Cases (1a-2-1 & 1a-2-2)**



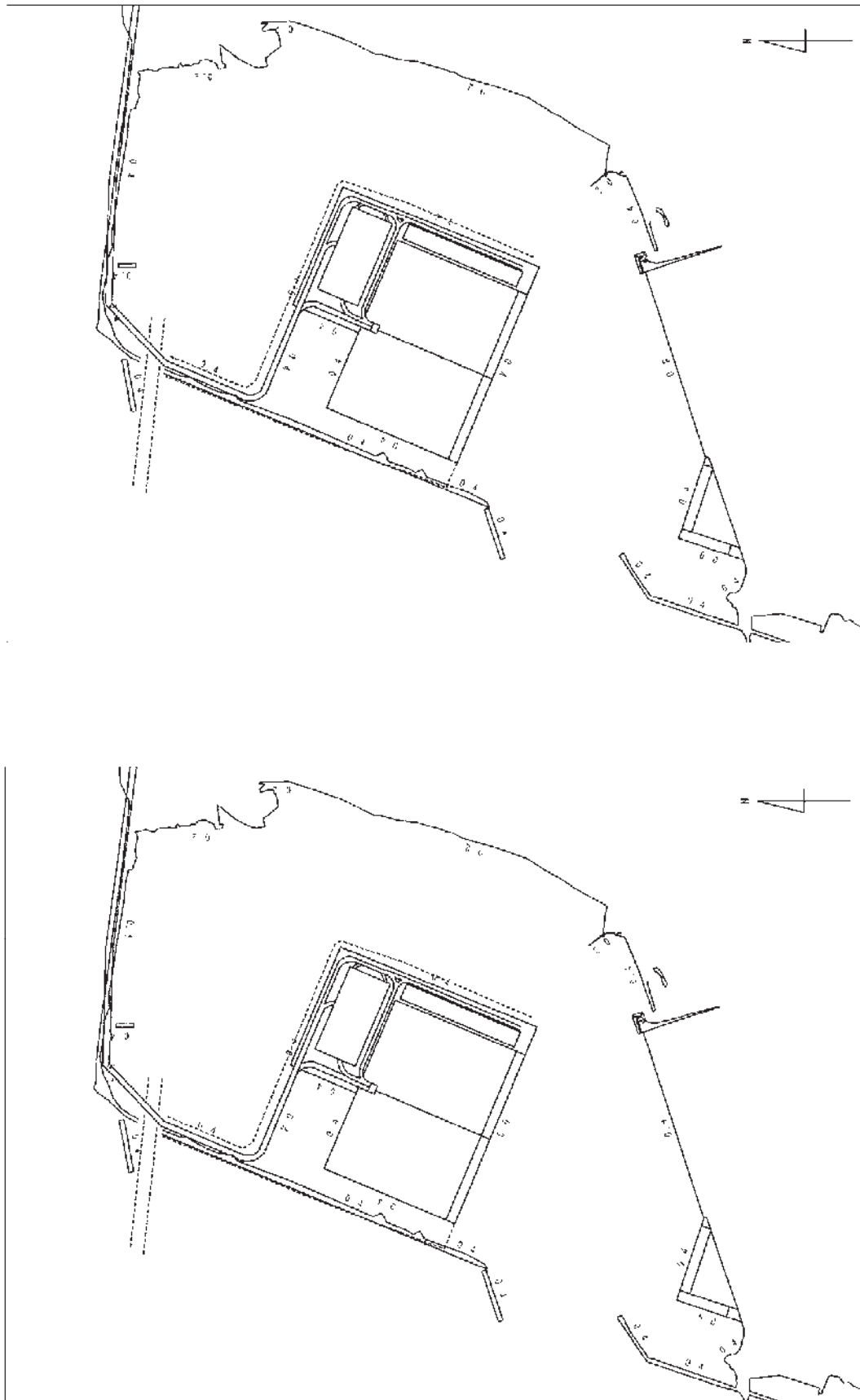
Case 1b-2-1



Case 1b-1-1

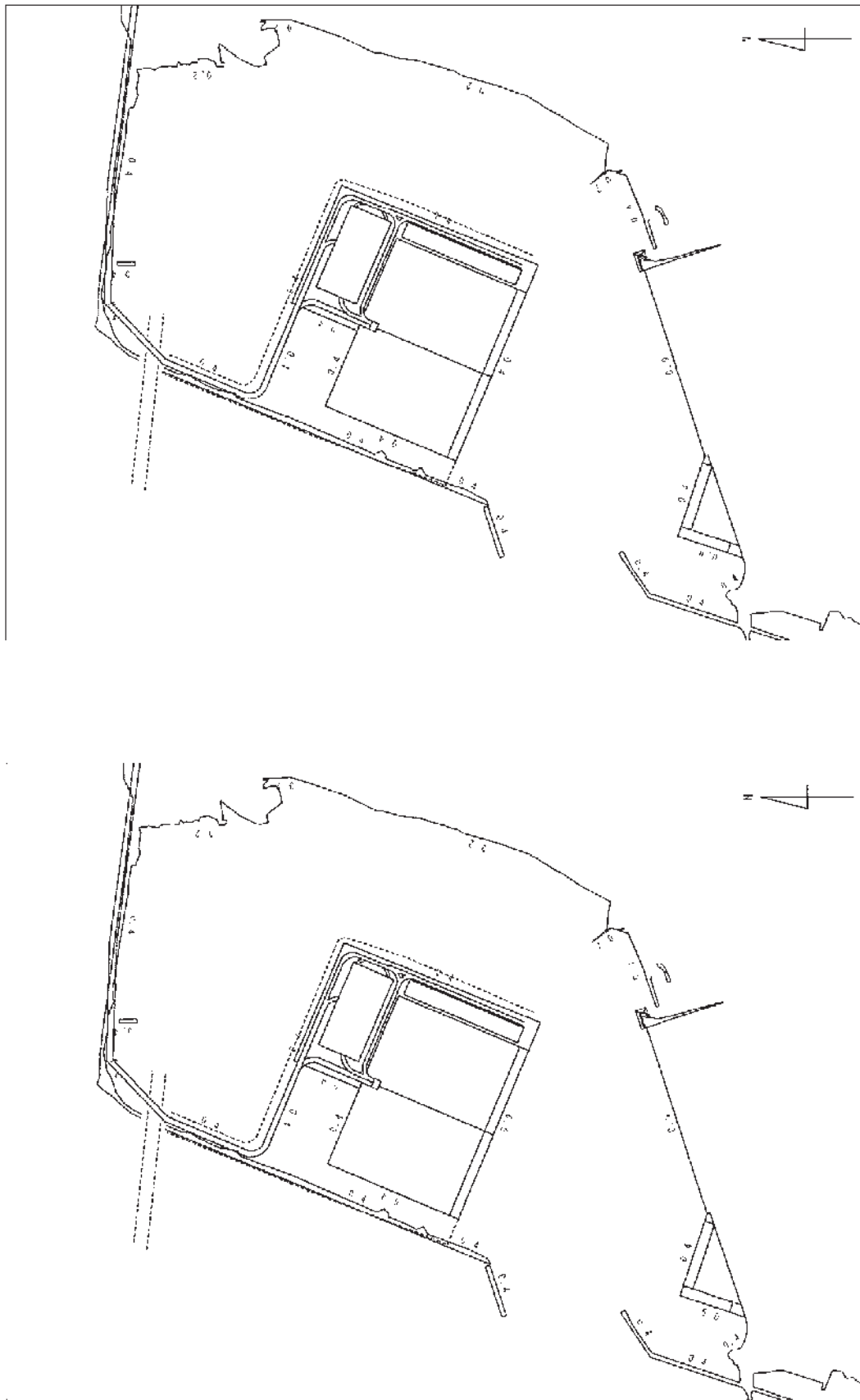
Source: Project Team

**Figure 4-3 Facility Formation Cases (1b-1-1 & 1b-2-1)**



Source: Project Team

**Figure 4-4 Facility Formation Cases (2a-1-1 & 2a-1-2)**



Case 2a-2-2

Case 2a-2-1

Source: Project Team

**Figure 4-5 Facility Formation Cases (2a-2-1 & 2a-2-2)**



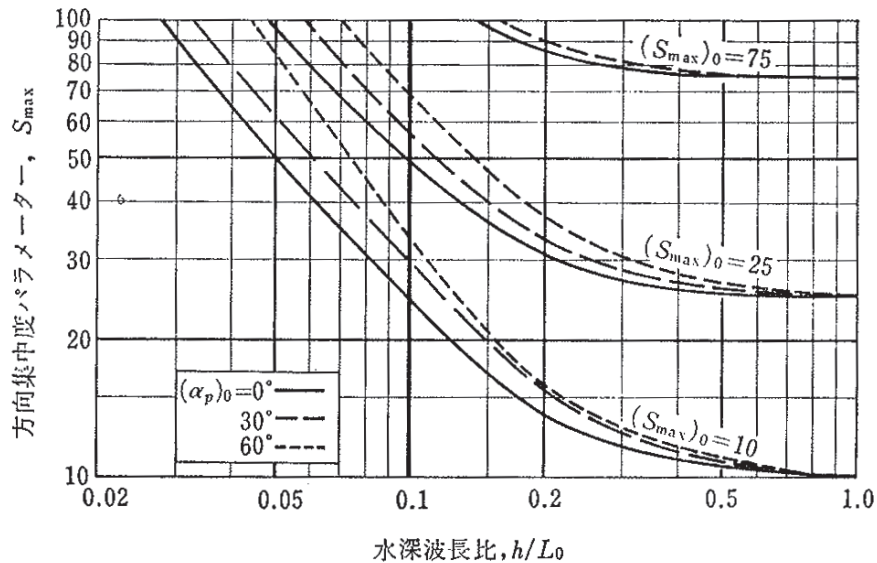
(4) Calculation Conditions

Table 4-2 presents the calculation conditions of wave diffraction and reflection and Figure 4.6 shows the estimation of spreading parameter ( $S_{max}$ ).

**Table 4-6 Calculation Conditions of Wave Diffraction and Reflection**

Description		Selected Condition	
Representing Wave Condition	Wave Direction	W, NW	
		degree	270.0, 315.0
	Wave Height	H (m)	1
	Wave Period	T (sec)	4
	Wave Length	L(m)	24.96
	Depth	(m)	14
	Tide	(m)	±0.00
	Ratio of Depth and Wave Length	h/L0	0.561
Smax		10 (Fig. 4-6)	
Number of Partted Frequency		3	
Number of Partted Wave Direction		50	
Formation and Reflection Coefficient		Fig. 4-1 - 4-5	
Degree of Reflection		1	
Computation Mesh (△X×△Y)		(m) 10	

Source: Project Team



Source: Technical Standards and Commentaries for Port and Harbor Facilities (2007)

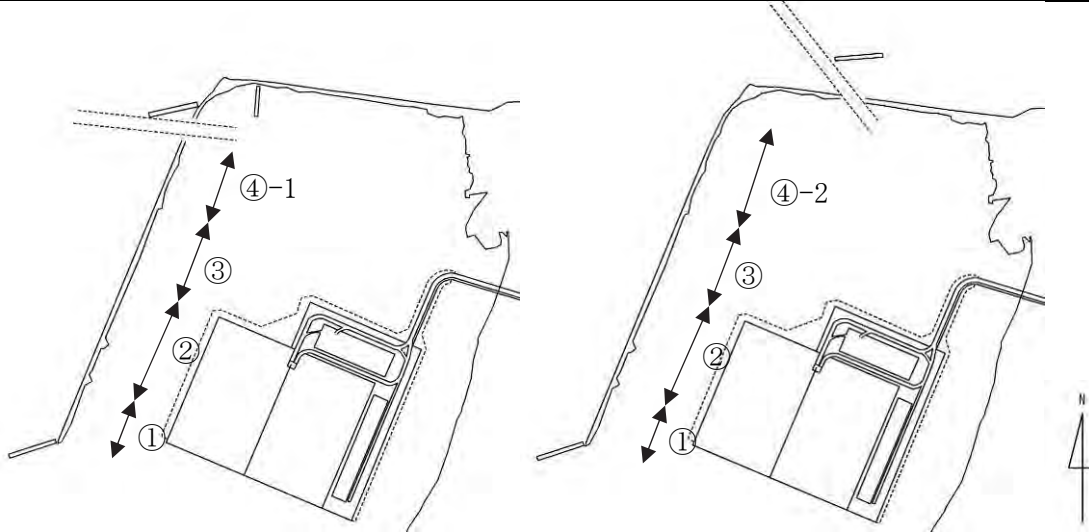
**Figure 4-6 Estimation of Spreading Parameter ( $S_{max}$ )**

(5) Calculation of Transmitted Wave Heights at North Breakwater (North)

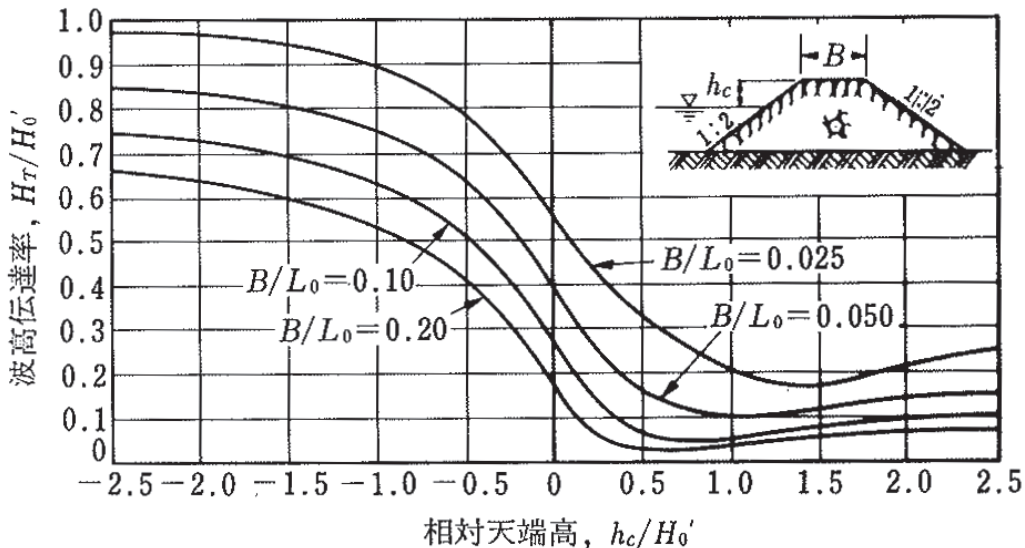
It is confirmed that the north breakwater (north) has incomplete sections on the west-side longer portion. Facility formation cases 1a and 1b considered transmitted waves through such sections inside the harbor. Typical waves were the incident waves for the computation and the transmitted waves were also considered for wave calmness analysis inside the harbor. Table 4-3 shows the results of the calculation and Figure 4-7 presents the estimation of the transmission ratio of a stone dick or breakwater.

**Table 4-3 Results of Calculated Transmitted Wave Heights inside Harbor**

Area Nr.	Length (m)	Equivalent Offshore Waves		Wave Length $L_0$ (m)	Width of Breakwater $B$ (m)	Height above Water $hc$ (m)	$B/L_0$	Correlated Height	Transmission Ratio	Transmitted Wave Height
		Height $H_0'$ (m)	Period $T_0$ (s)					$hc/H_0'$	$H_t/H_0'$	$H_t$ (m)
①	52.3	1	4	24.96	11	2.1	0.4407	1.68	0.071	0.07
②	647.5				14	0.5	0.5609	0.4	0.028	0.03
③	316.6				11	2.1	0.4407	1.68	0.071	0.07
④-1	344.7				14	0.5	0.5609	0.4	0.028	0.03
④-2	557.4				14	0.5	0.5609	0.4	0.028	0.03



Source: Project Team

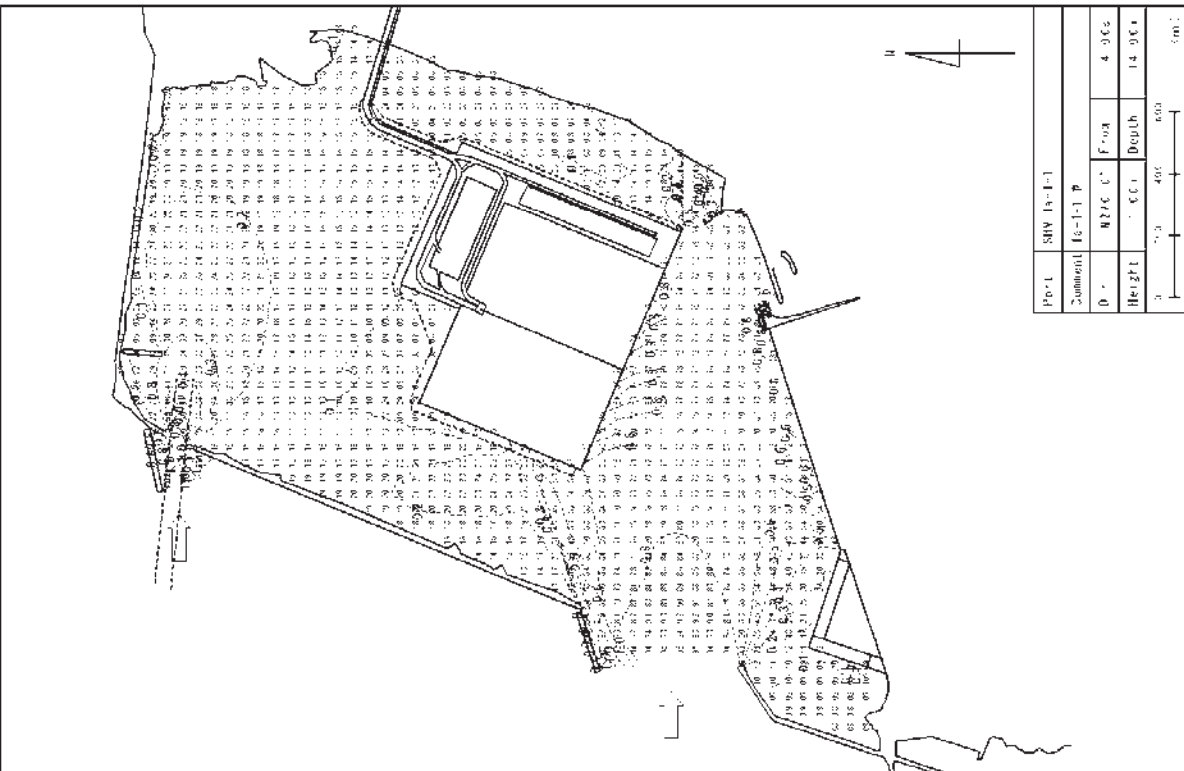
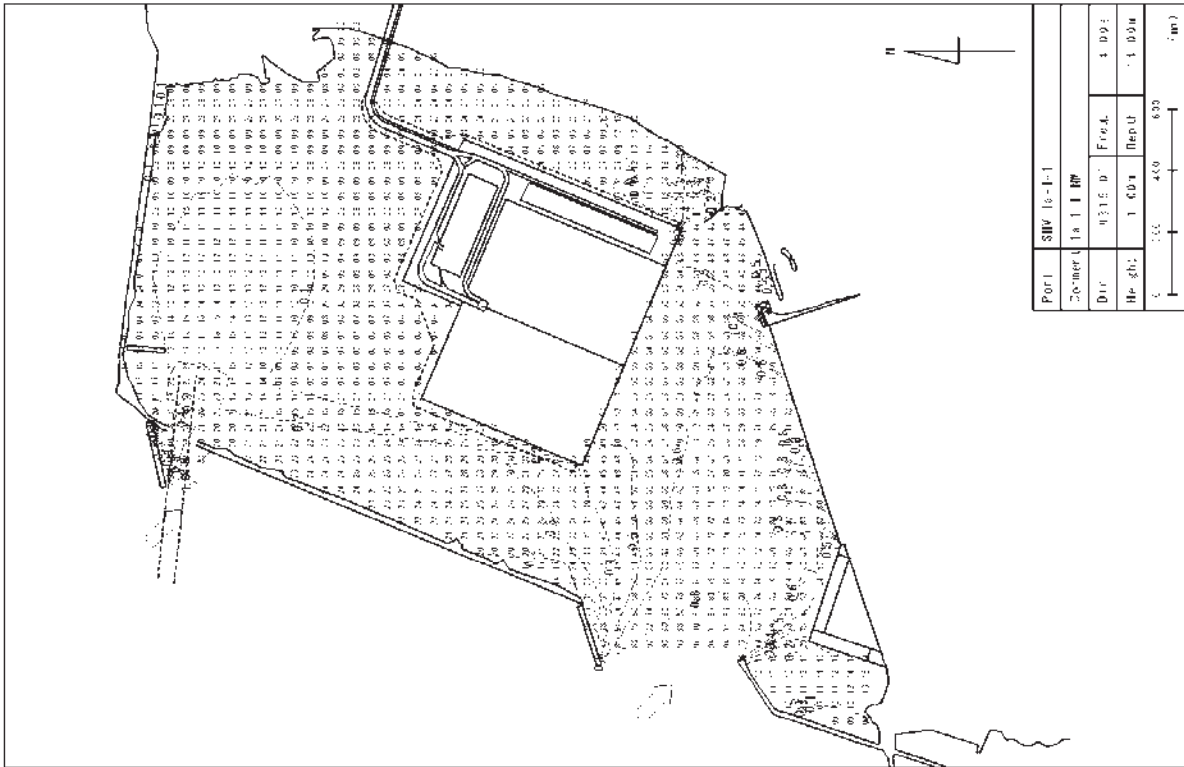


Source: Norio Tanaka, Journal of Coastal Engineering, 1976, pp154, JSCE

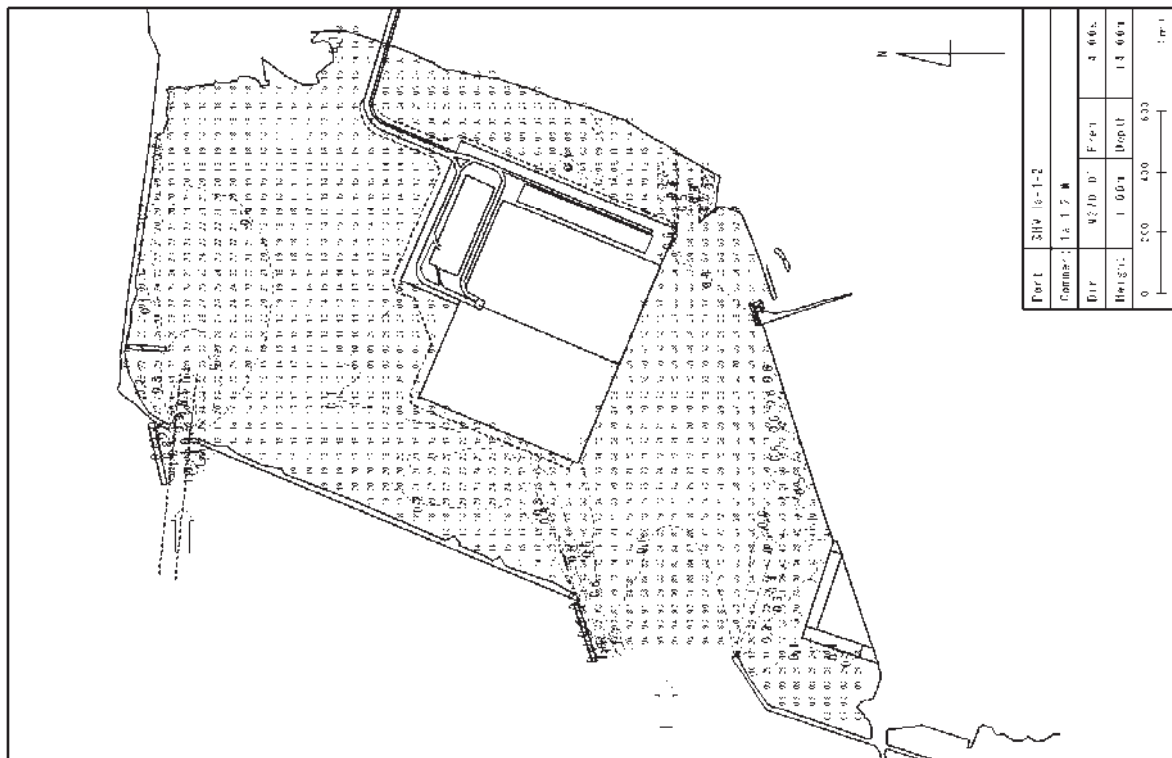
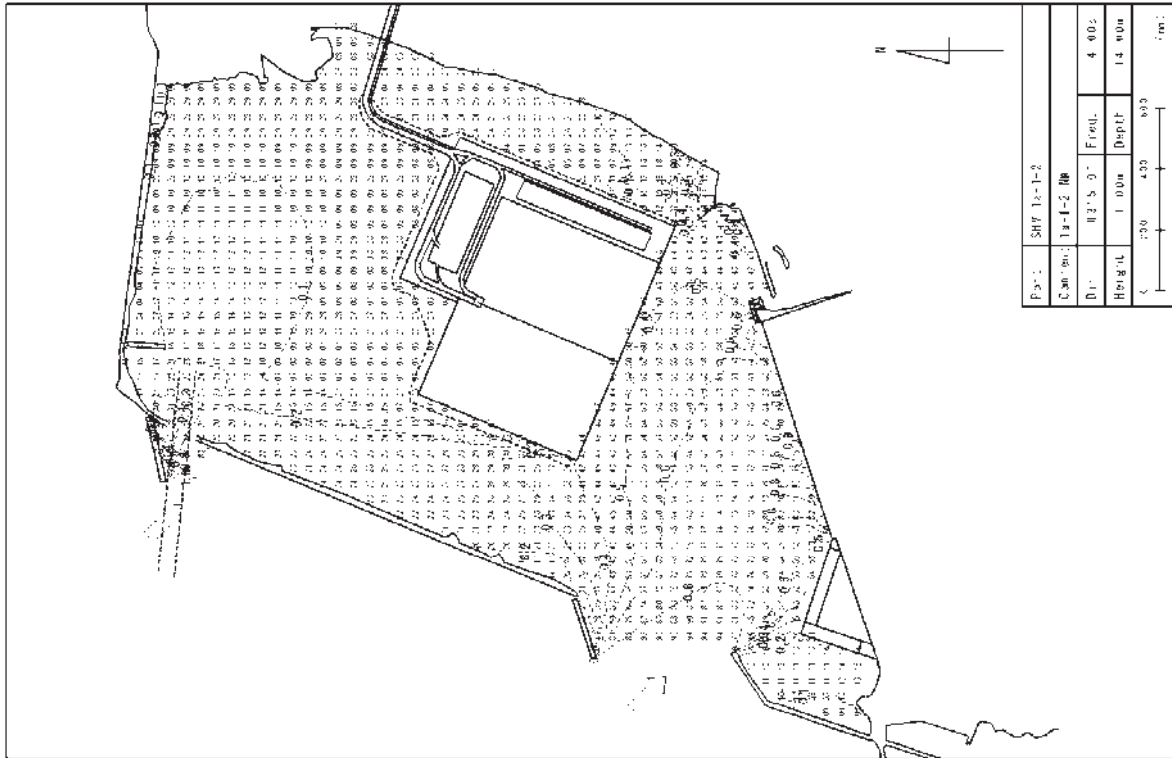
**Figure 4-7 Estimation of Transmission Ratio of Stone Dick or Breakwater**

**(6) Calculation Results of Wave Height Ratios inside Harbor**

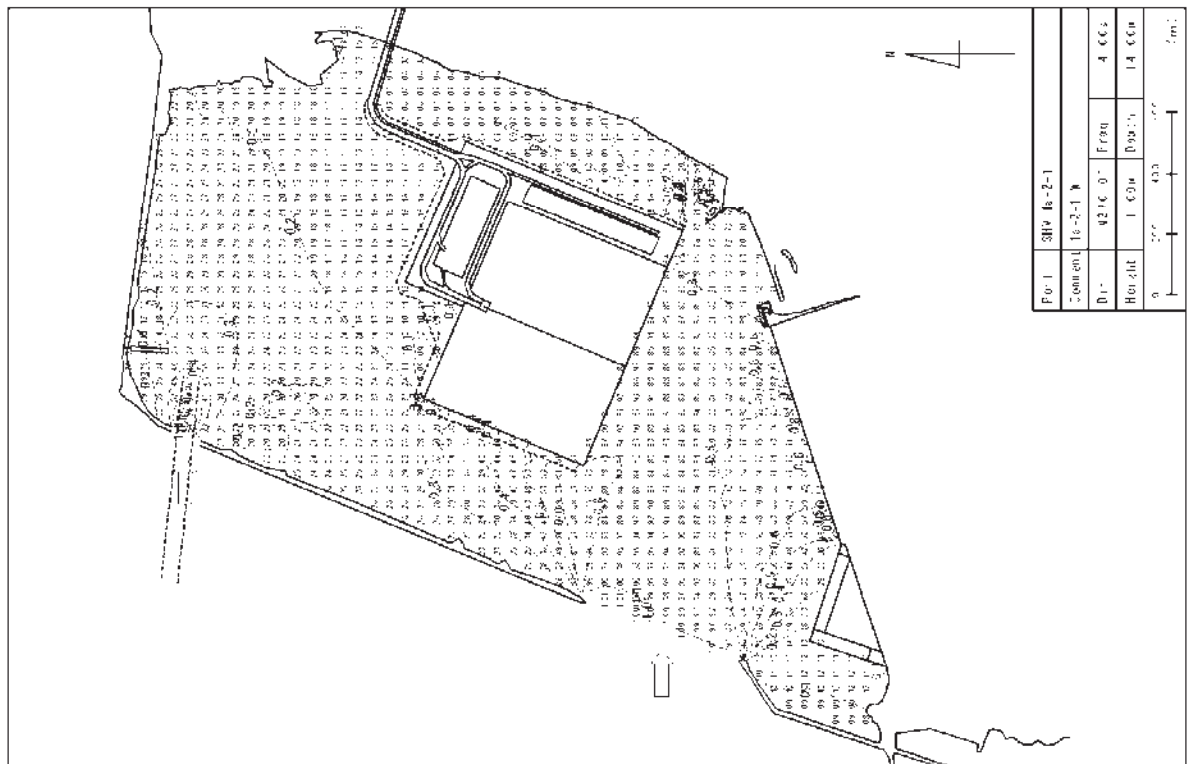
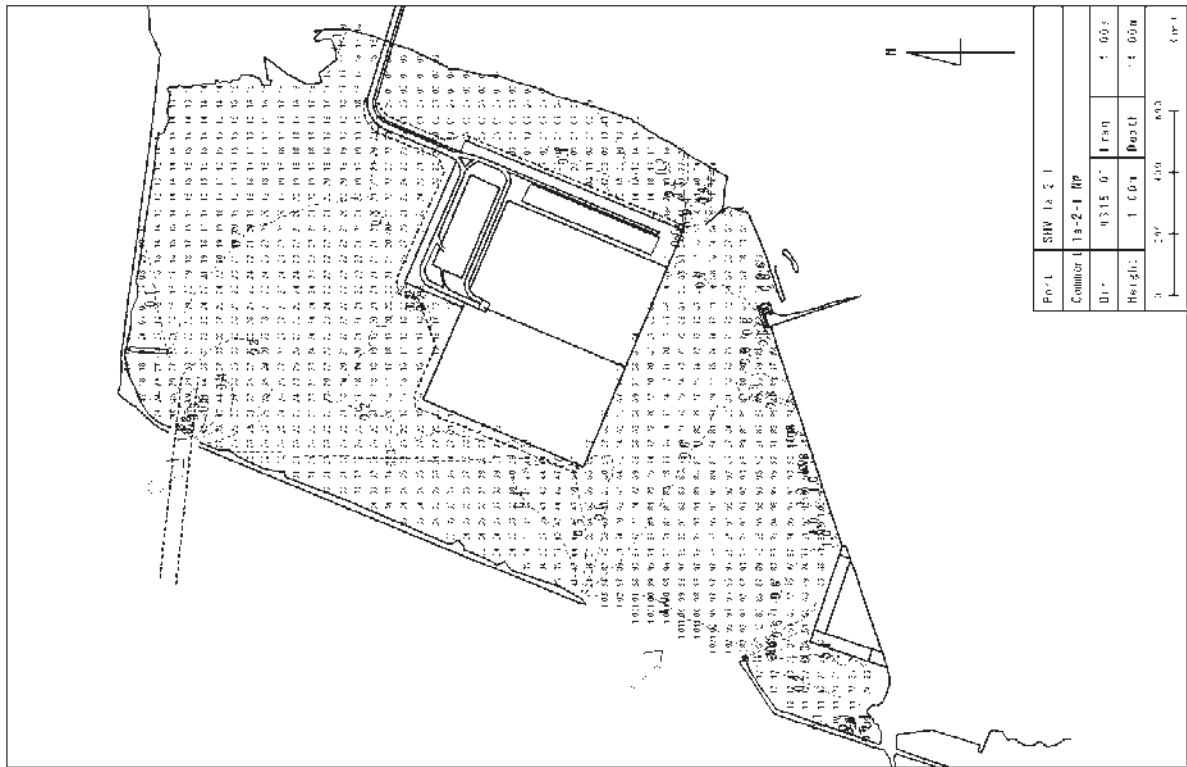
Figure 4-8 – 4-16 shows distributions of wave height ratios for each case. Also, for comparison to the present situation, Figure 4-17 introduces the distributions of wave height ratios without the new container terminal, which was studied in the detailed engineering services of the Multi-purpose Terminal.



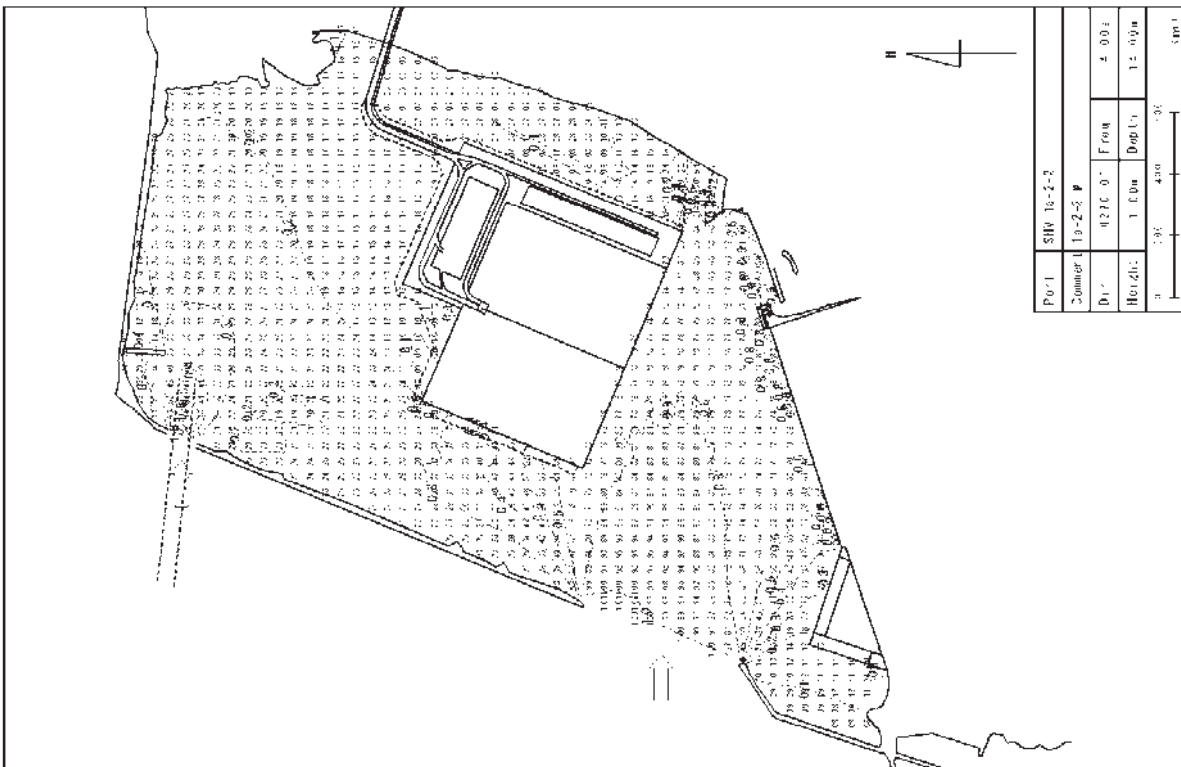
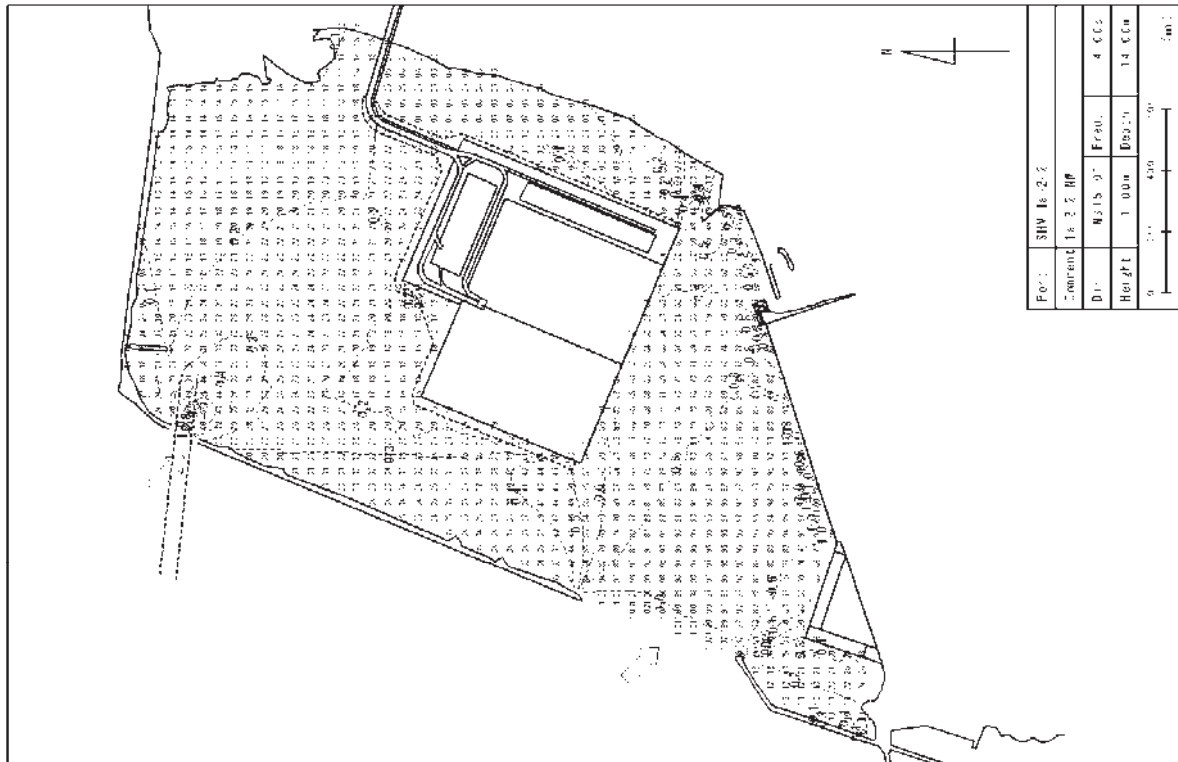
Source: Project Team  
**Figure 4-8 Distributions of Wave Height Ratios inside Harbor (1a-1-1:W & 1a-1-1:NW)**



Source: Project Team  
**Figure 4-9 Distributions of Wave Height Ratios inside Harbor (1a-1-2:W & 1a-1-2:NW)**

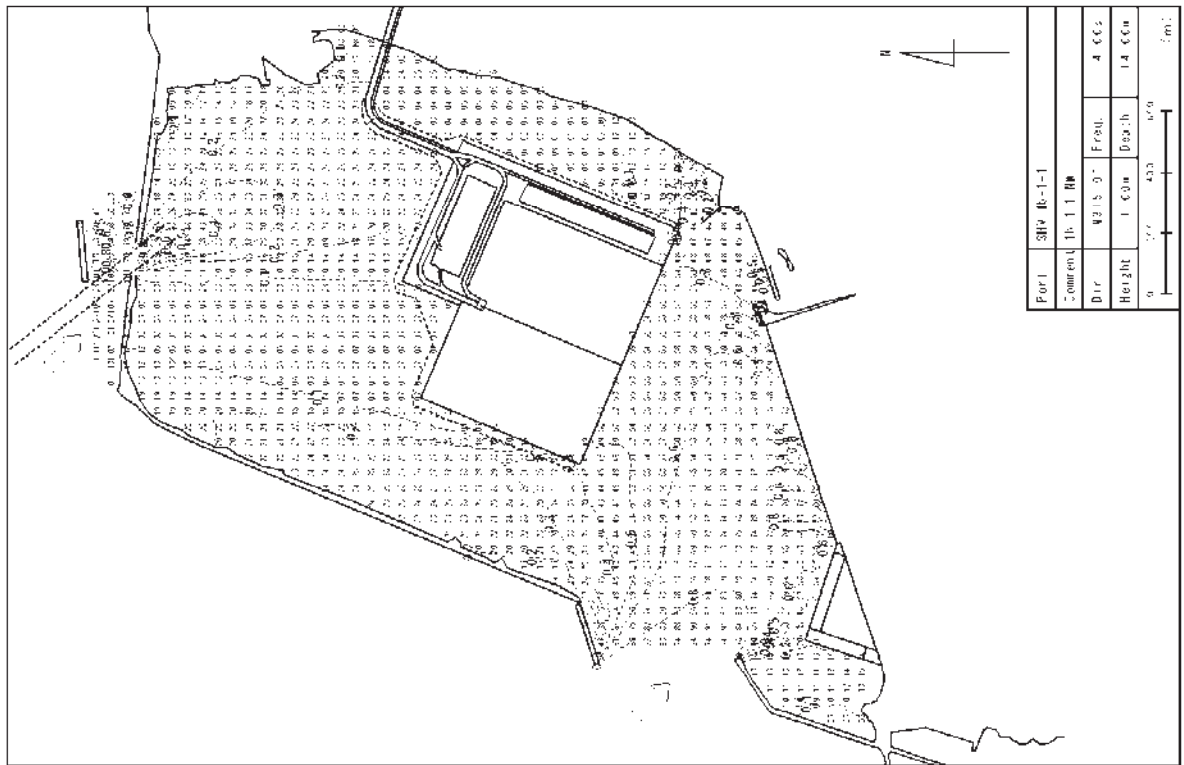
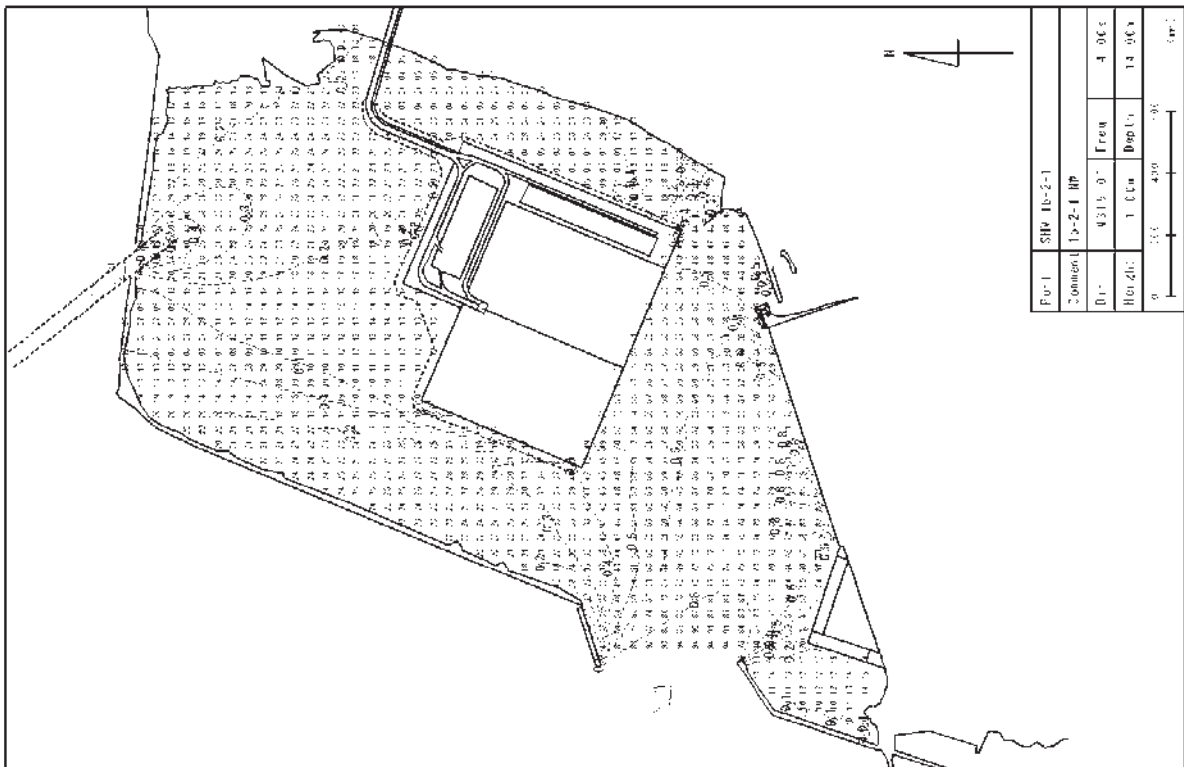


Source: Project Team  
**Figure 4-10 Distributions of Wave Height Ratios inside Harbor (1a-2-1:W & 1a-2-1:NW)**

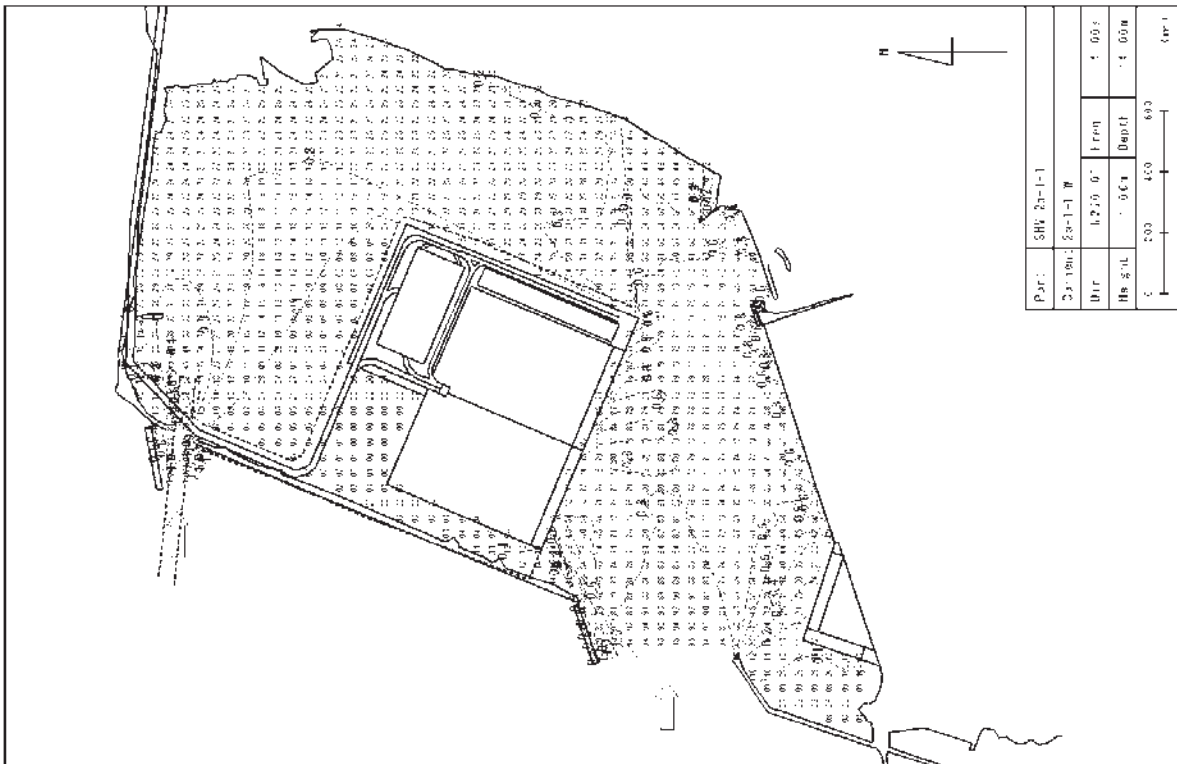
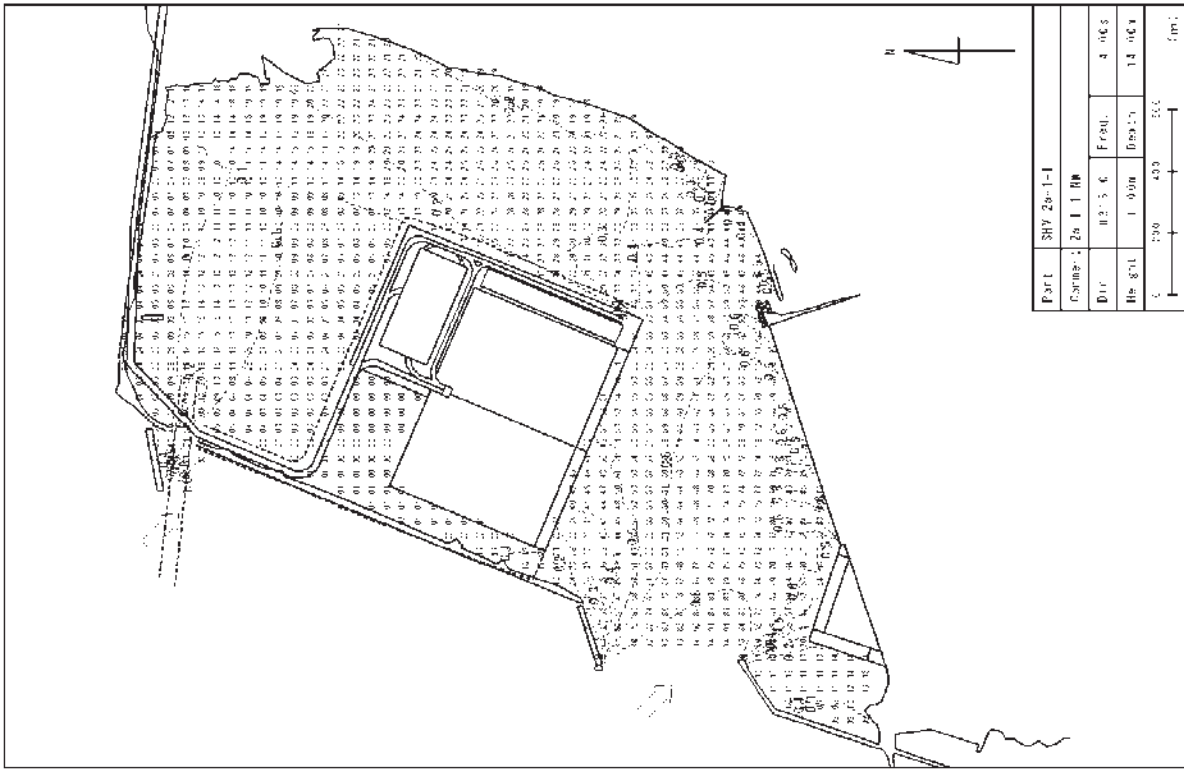


Source: Project Team

**Figure 4-11 Distributions of Wave Height Ratios inside Harbor (1a-2-2:W & 1a-2-2:NW)**

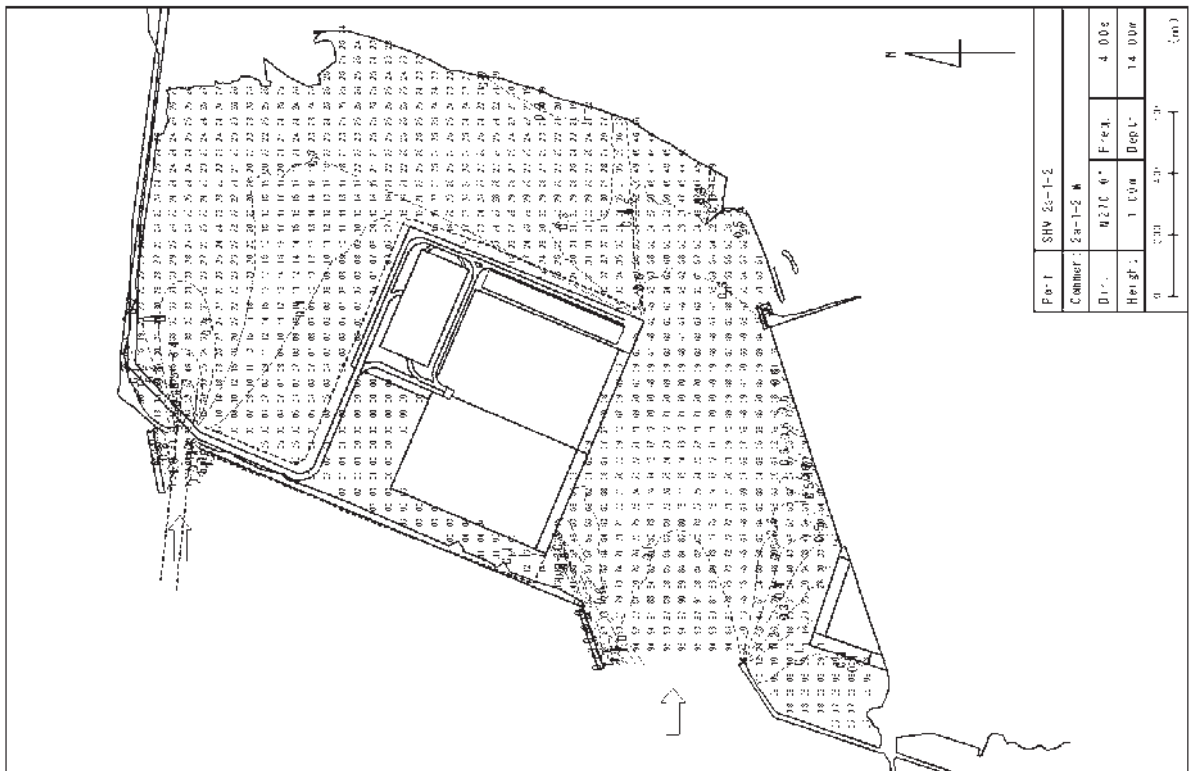
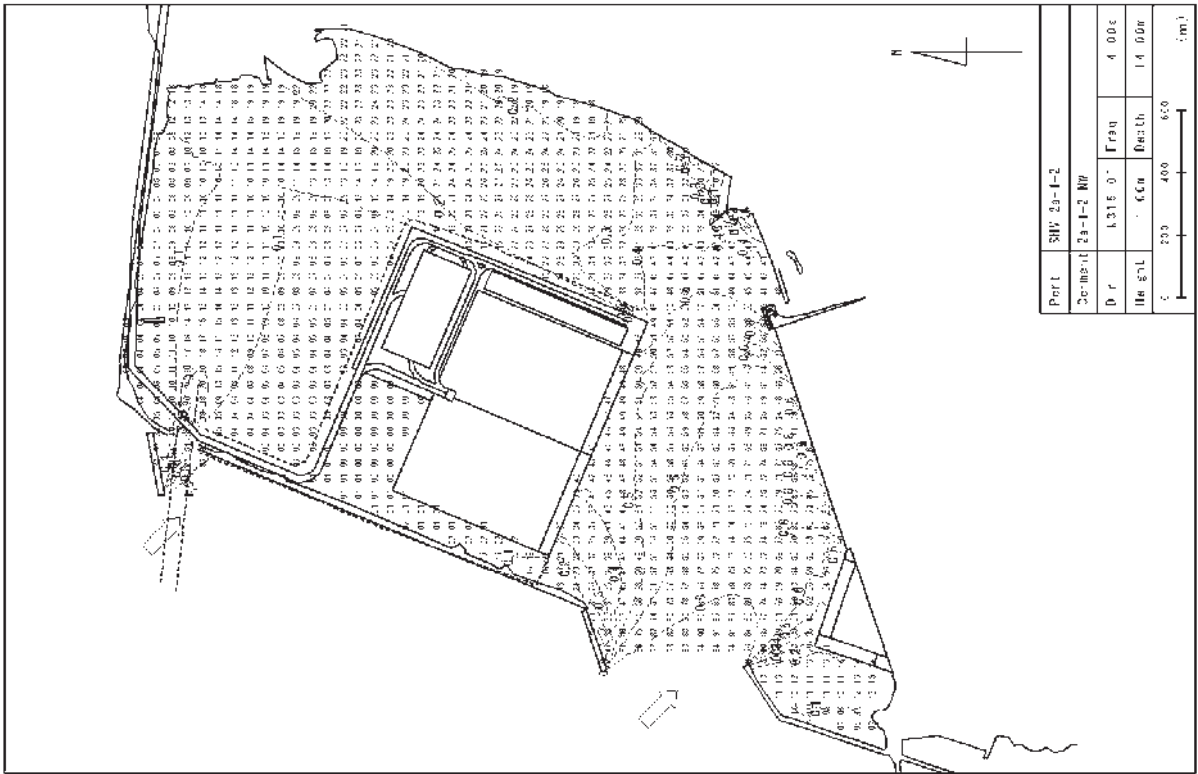


Source: Project Team  
**Figure 4-12 Distributions of Wave Height Ratios inside Harbor (1b-1-1:W & 1b-2-1:NW)**

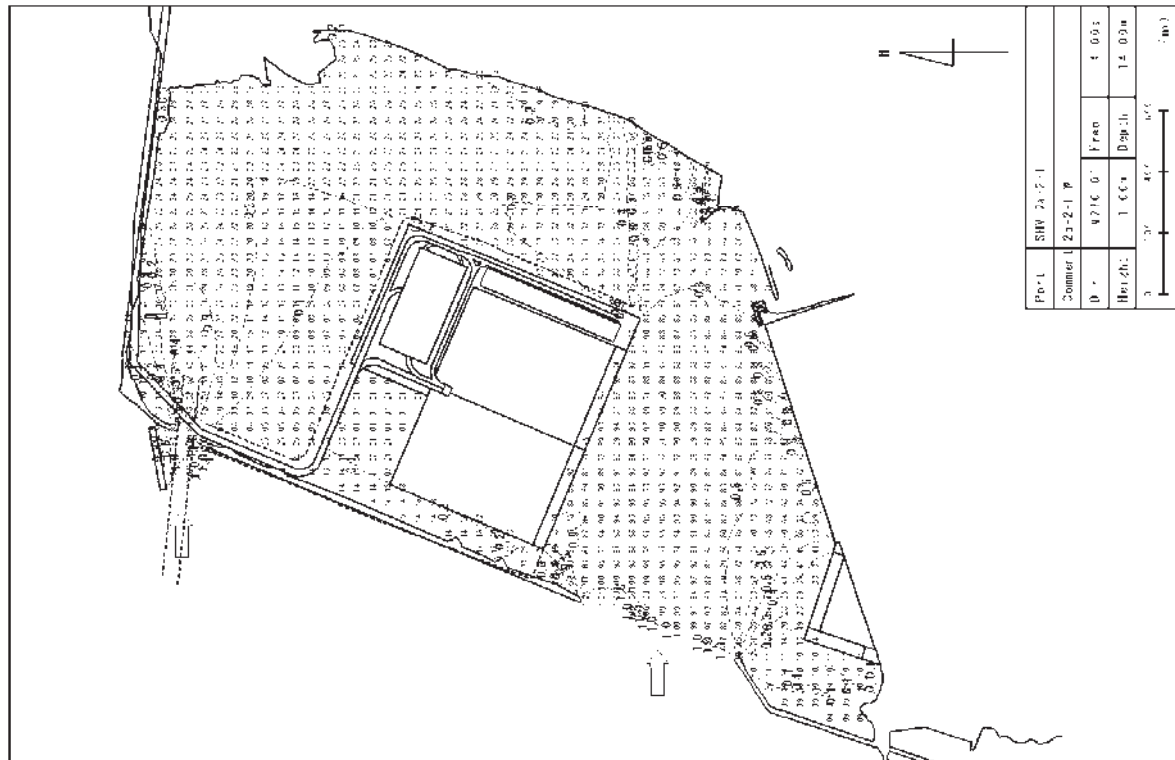
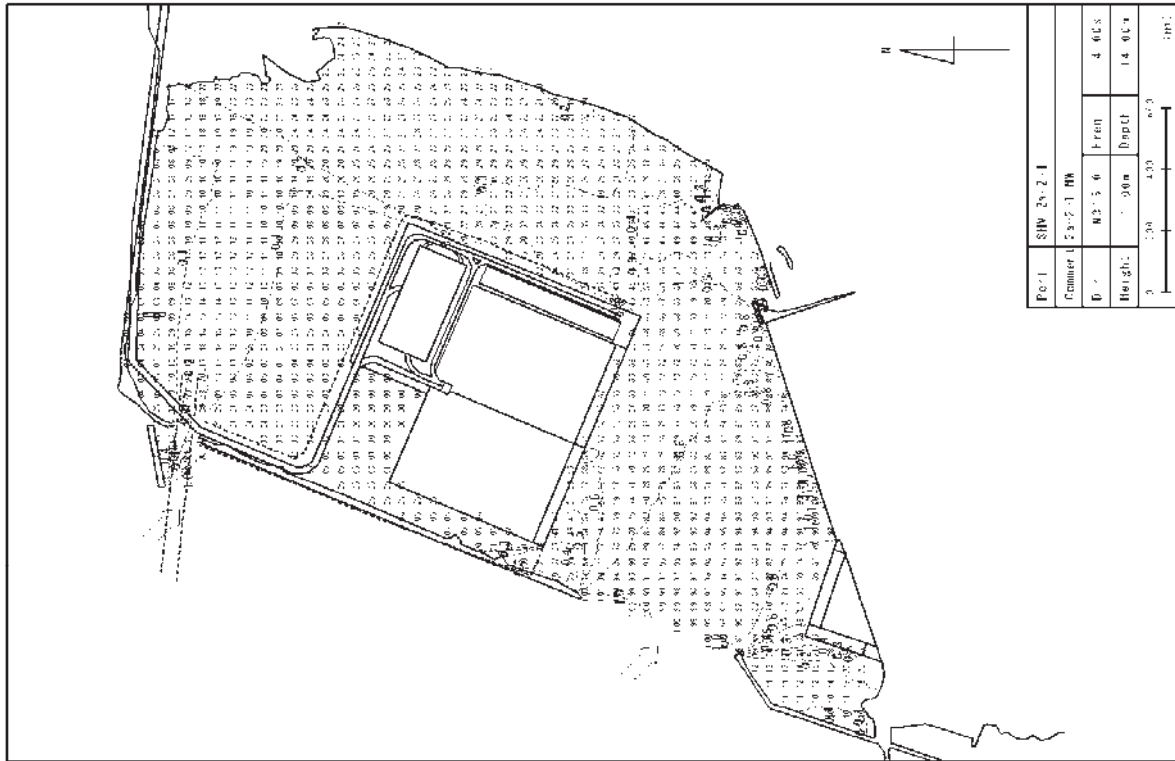


Source: Project Team  
**Figure 4-13 Distributions of Wave Height Ratios inside Harbor (2a-1-1:W & 2a-1-1:NW)**

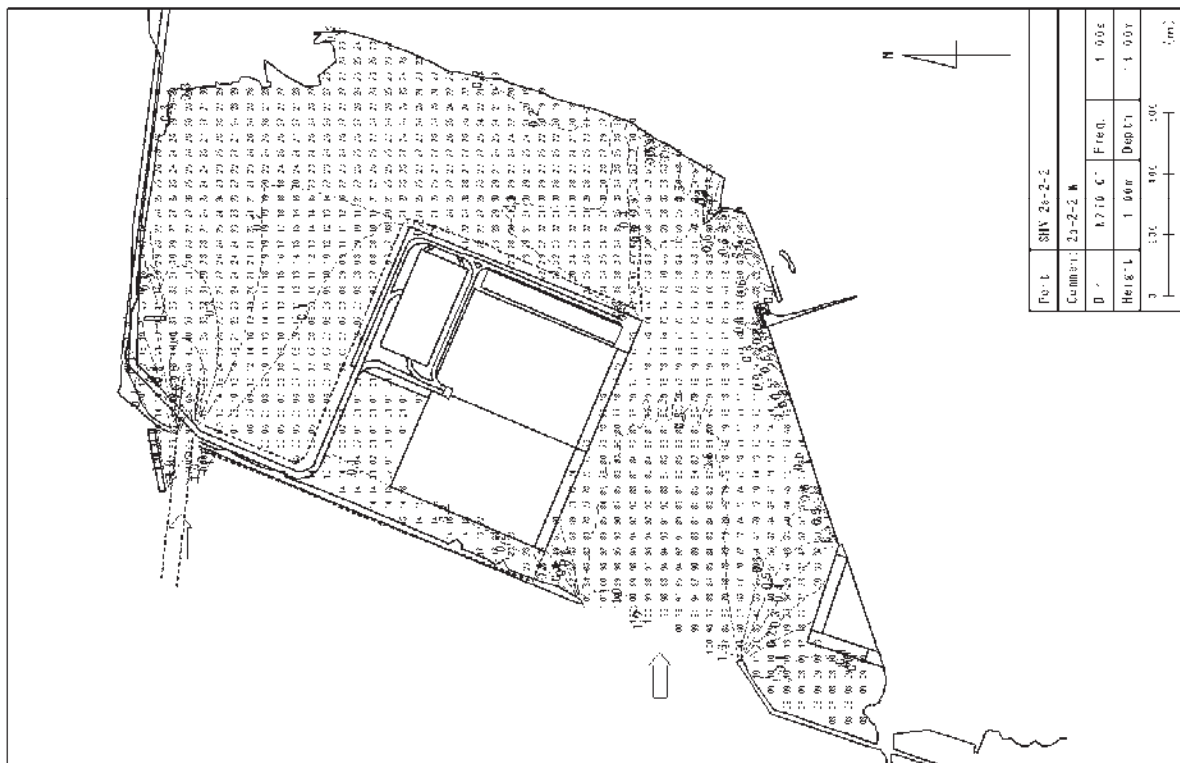
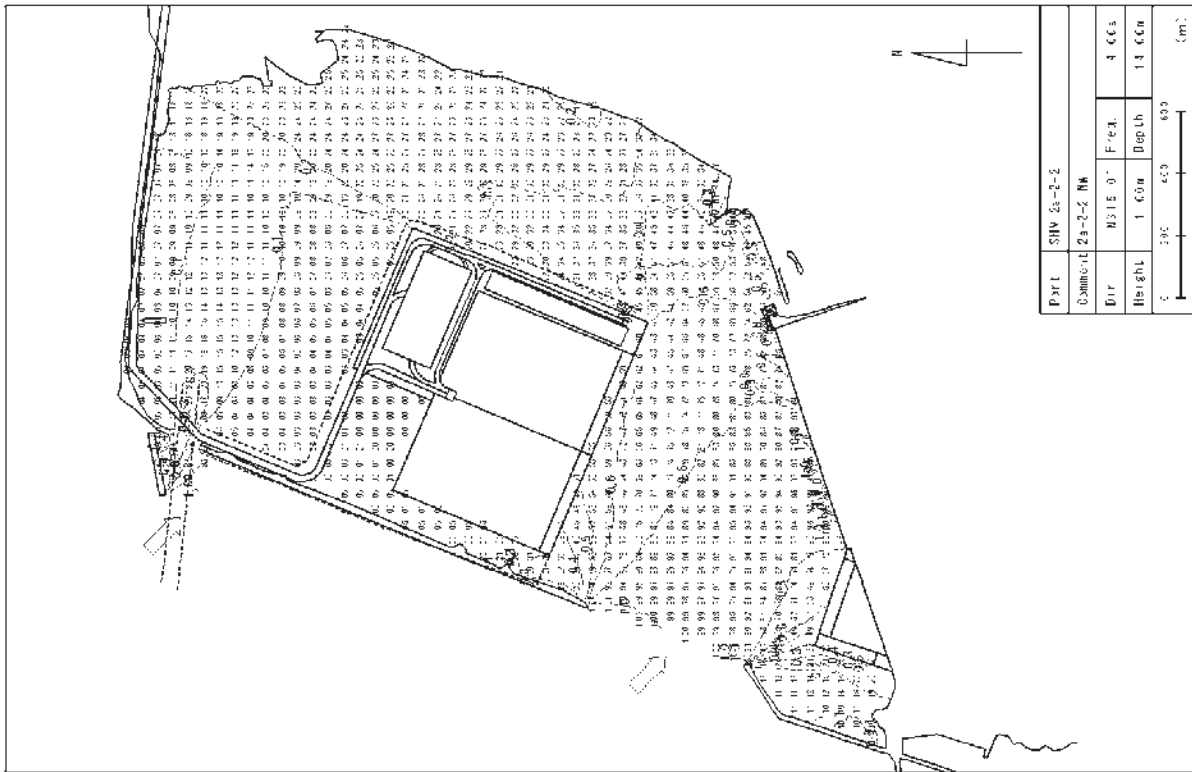




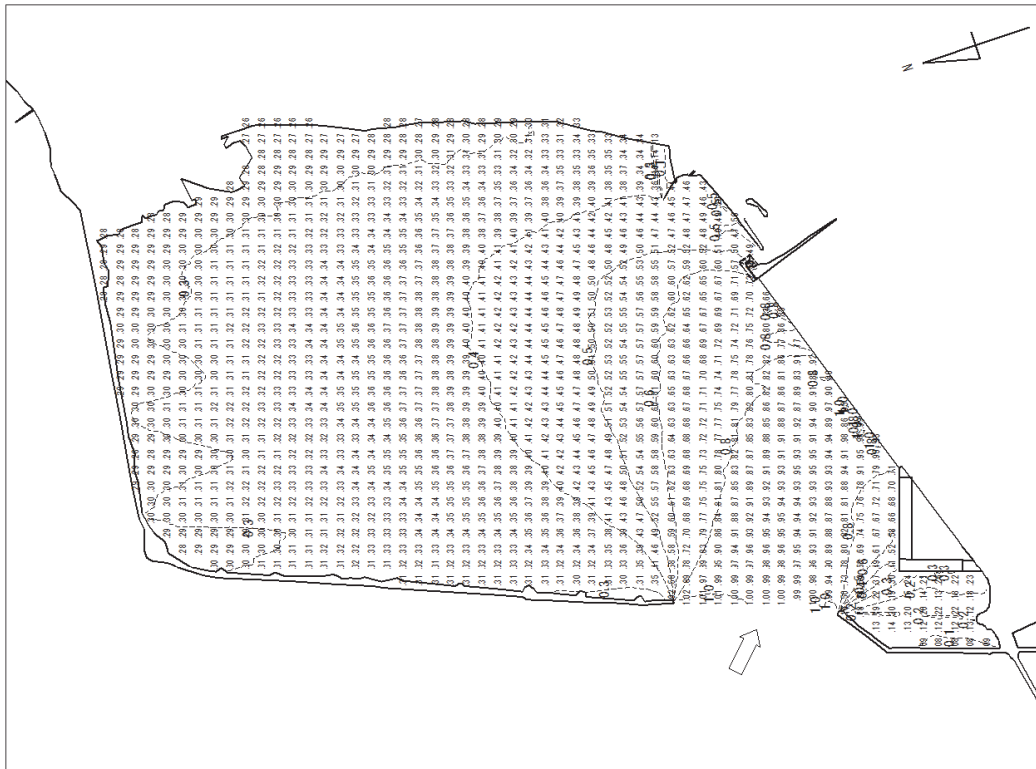
Source: Project Team  
**Figure 4-14 Distributions of Wave Height Ratios inside Harbor (2a-1-2:W & 2a-1-2:NW)**



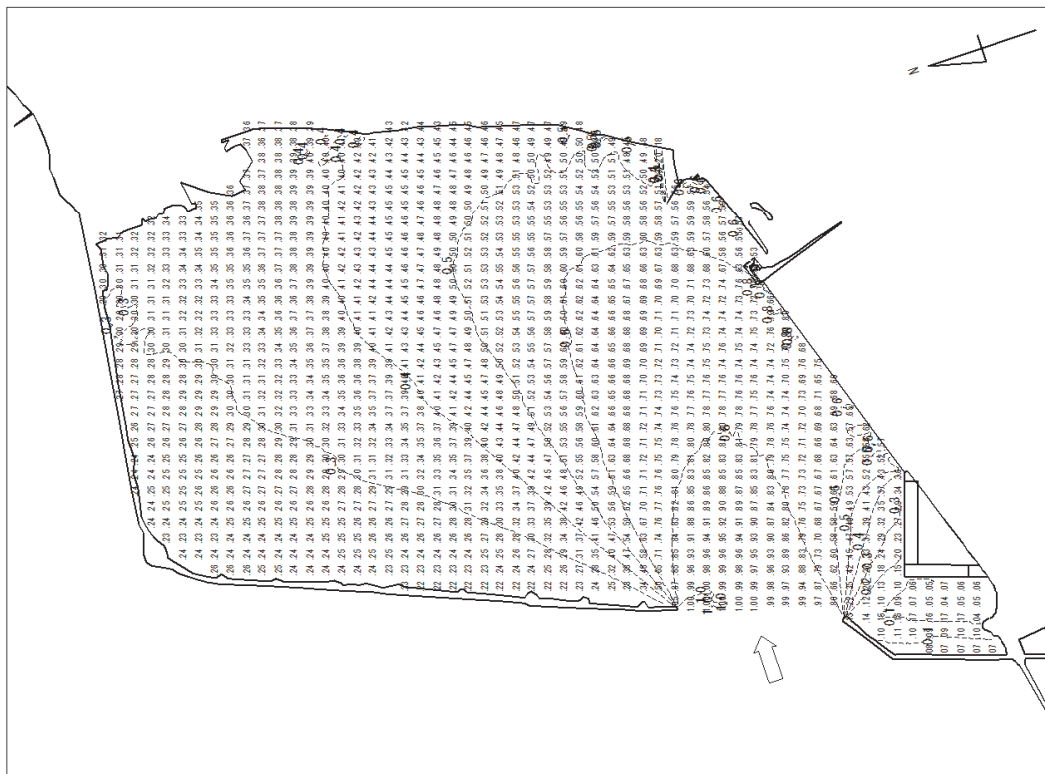
Source: Project Team  
**Figure 4-15 Distributions of Wave Height Ratios inside Harbor (2a-2-1:W & 2a-2-1:NW)**



Source: Project Team  
**Figure 4-16 Distributions of Wave Height Ratios inside Harbor (2a-2-2:W & 2a-2-2:NW)**



Present Situation (Multi-purpose Quay with Wave Dissipating Block : NW)



Present Situation (Multi-purpose Quay with Wave Dissipating Block : N)

Source: Study Information in Detailed Engineering Services of Multi-purpose Terminal  
**Figure 4-17 Distributions of Wave Height Ratios inside Harbor (Present Situation: N&NW)**

## 5. Calculation of Wave Calmness Ratio inside Harbor

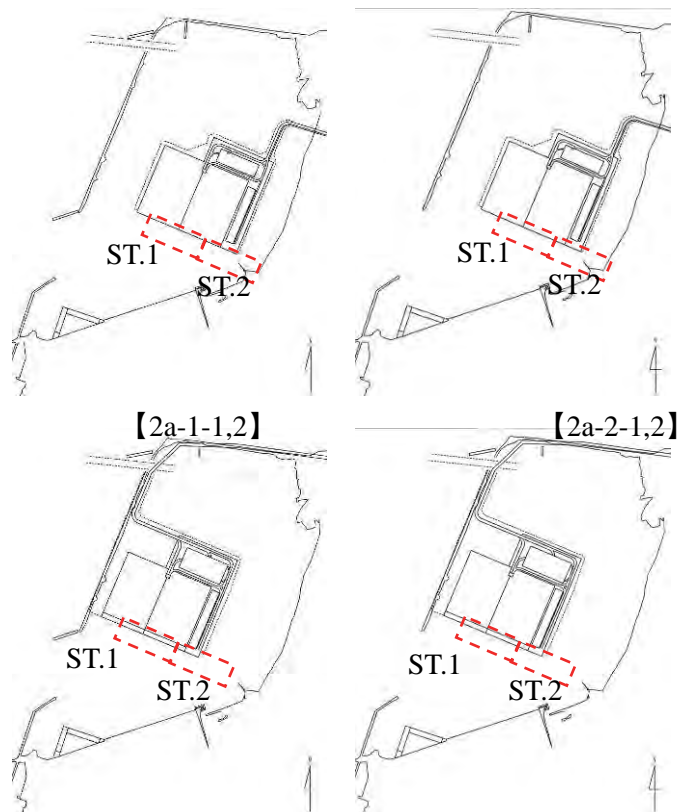
### (1) Target Wave Height, and Study Cases and Locations

In consideration of the minimum target vessel class (20,000 DWT) to be accommodated at the new quay, the target wave height was determined as  $H=0.5$  m. Table 5-1 shows study cases and Figure 5-1 presents locations to estimate the wave calmness ratio.

**Table 5-1 Study Cases for Calculation for Wave Calmness Ratio**

Formation Case	Case Combination			Quay Type
	New Breakwater ①	New Breakwater ②	New Breakwater ③	
1a-1-1	○	○	-	Vertical Wall
1a-1-2	○	○	-	Wave Dissipating Block
1a-2-1	×	×	-	Vertical Wall
1a-2-2	×	×	-	Wave Dissipating Block
2a-1-1	○	○	-	Vertical Wall
2a-1-2	○	○	-	Wave Dissipating Block
2a-2-1	×	○	-	Vertical Wall
2a-2-2	×	○	-	Wave Dissipating Block

Source: Project Team



Source: Project Team

**Figure 5-1 Locations for Calculation of Wave Calmness Ratio**

## (2) Results of Calculation of Wave Calmness Ratio

Based on distributions of wave height ratio inside the harbor as shown in Figure 4-8 – 4-16, wave calmness ratios were calculated at two locations in front of the new container quay (two berths) for each case.

Table 5.2 presents a summary of calculation results of wave calmness ratio and Table 5-3 – 5-10 show the results for calculation of wave calmness ratio for each case. As seen in the tables, in the case where breakwater ① does not exist, the calmness ratios for all cases do not satisfy the target ratio of 97.5%. In the case where breakwater ① exists and the quay type is a vertical wall, the calmness ratios do not satisfy the target ratio. On the other hand, in the case where breakwater ① exists and the quay type is wave dissipating block, the calmness ratios satisfy the target ratio.

From the above, it is concluded that Cases 1a-1-2 and 2a-1-2 which have breakwater ① and wave dissipating block type quays are the only cases that satisfy the target ratio. Furthermore, all Cases 2a tend to have better calmness than Cases 1a.

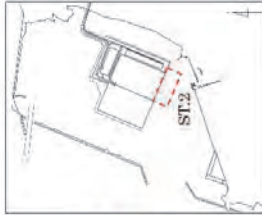
**Table 5-2 Summary of Calculation Results of Wave Calmness Ratio**

Formation Case	Case Combination			Quay Type	Wave Direction	Wave Calmness	
	New Breakwater ①	New Breakwater ②	New Breakwater ③			ST.1	ST.2
1a-1-1	○	○	-	Vertical Wall	W,NW	96.66	96.96
1a-1-2	○	○	-	Wave Dissipating Block	W,NW	97.84	98.07
1a-2-1	×	×	-	Vertical Wall	W,NW	95.46	95.76
1a-2-2	×	×	-	Wave Dissipating Block	W,NW	96.61	96.75
2a-1-1	○	○	-	Vertical Wall	W,NW	97.43	96.58
2a-1-2	○	○	-	Wave Dissipating Block	W,NW	98.56	97.91
2a-2-1	×	○	-	Vertical Wall	W,NW	96.01	95.55
2a-2-2	×	○	-	Wave Dissipating Block	W,NW	97.03	96.65

Source: Project Team


Table 5-3 Results for Calculation of Wave Calmness inside Harbor (ST.1 & ST.2: 1a-1-1)

Result of Wave Calmness Analysis [ST.2 : 1a-1-1]



Wave Dir.	Target Wave Height		Ratio of Wave Height	Allowable Wave Height		Exceeding Occurrence Frequency (%)	
	H(m)	H(m)		H(m)	H(m)		
W	0.50	0.78	0.64	0.64	1.40		
NW	0.50	0.55	0.91	0.91	1.64		
Non Calmness Ratio (%)						3.04	
Calmness Ratio (%)						96.96	

Result of Wave Calmness Analysis [ST.1 : 1a-1-1]



Wave Dir.	Target Wave Height		Ratio of Wave Height	Allowable Wave Height		Exceeding Occurrence Frequency (%)	
	H(m)	H(m)		H(m)	H(m)		
W	0.50	0.85	0.59	0.59	1.77		
NW	0.50	0.54	0.93	0.93	1.57		
Non Calmness Ratio (%)						3.34	
Calmness Ratio (%)						96.66	

Sihanoukville

H(m)	Deg.	Sihanoukville					N	NW	W	SW	Occurrence Frequency (%)
		CALM	SW	W	NW	N					
CALM										27.10	27.10
~ 0.25			7.64	15.46	8.29	16.77				48.17	48.17
~ 0.50			1.15	7.84	4.95	2.66				16.60	16.60
~ 0.75			0.29	1.84	2.28	0.94				5.34	5.34
~ 1.00			0.04	0.38	0.86	0.05				1.33	1.33
~ 1.25			0.02	0.10	0.62	0.00				0.73	0.73
~ 1.50			0.00	0.04	0.13	0.00				0.17	0.17
~ 1.75			0.00	0.02	0.24	0.00				0.26	0.26
~ 2.00			0.00	0.00	0.16	0.00				0.16	0.16
~ 2.25			0.00	0.00	0.13	0.00				0.13	0.13
~ 2.50			0.00	0.00	0.00	0.00				0.00	0.00
~ 2.75			0.00	0.00	0.02	0.00				0.02	0.02
~ 3.00			0.00	0.00	0.00	0.00				0.00	0.00
3.00 ~			0.00	0.00	0.00	0.00				0.00	0.00
Occurrence Frequency (%)			9.14	25.66	17.68	20.42				100.00	100.00
Exceeding Occurrence Frequency (%)			0.00	1.40	1.64	0.00				3.04	3.04


Sihanoukville

H(m)	Deg.	Sihanoukville					N	NW	W	SW	Occurrence Frequency (%)
		CALM	SW	W	NW	N					
CALM										27.10	27.10
~ 0.25			7.64	15.46	8.29	16.77				48.17	48.17
~ 0.50			1.15	7.84	4.95	2.66				16.60	16.60
~ 0.75			0.29	1.84	2.28	0.94				5.34	5.34
~ 1.00			0.04	0.38	0.86	0.05				1.33	1.33
~ 1.25			0.02	0.10	0.62	0.00				0.73	0.73
~ 1.50			0.00	0.04	0.13	0.00				0.17	0.17
~ 1.75			0.00	0.02	0.24	0.00				0.26	0.26
~ 2.00			0.00	0.00	0.16	0.00				0.16	0.16
~ 2.25			0.00	0.00	0.13	0.00				0.13	0.13
~ 2.50			0.00	0.00	0.00	0.00				0.00	0.00
~ 2.75			0.00	0.00	0.02	0.00				0.02	0.02
~ 3.00			0.00	0.00	0.00	0.00				0.00	0.00
3.00 ~			0.00	0.00	0.00	0.00				0.00	0.00
Occurrence Frequency (%)			9.14	25.66	17.68	20.42				100.00	100.00
Exceeding Occurrence Frequency (%)			0.00	1.77	1.57	0.00				3.34	3.34

Source: Project Team

Table 5-4 Results for Calculation of Wave Calmness inside Harbor (ST.1 & ST.2: 1a-1-2)

Result of Wave Calmness Analysis [ST.2 : 1a-1-2]

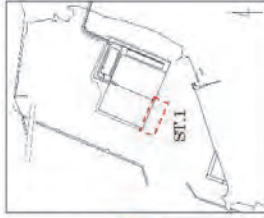


Wave Dir.	Target Wave Height (H(m))		Ratio of Wave Height	Allowable Wave Height (H(m))		Exceeding Occurrence Frequency (%)
	H(m)	H(m)		H(m)	H(m)	
W	0.50	0.67	0.75	0.75	0.60	0.60
NW	0.50	0.67	0.75	1.00	1.33	1.93
Non-Calmness Ratio (%)						1.93
Calmness Ratio (%)						98.07

Sihanoukville

H(m)	Deg.	ERR :							
		SW	W	NW	N	CALM	Occurrence Frequency (%)		
CALM						27.10		27.10	
~ 0.25		7.64	15.46	8.29	16.77		48.17		
~ 0.50		1.15	7.84	4.95	2.66		16.60		
~ 0.75		0.29	1.84	2.28	0.94		5.34		
~ 1.00		0.04	0.38	0.86	0.05		1.33		
~ 1.25		0.02	0.10	0.62	0.00		0.73		
~ 1.50		0.00	0.04	0.13	0.00		0.17		
~ 1.75		0.00	0.02	0.24	0.00		0.26		
~ 2.00		0.00	0.00	0.16	0.00		0.16		
~ 2.25		0.00	0.00	0.13	0.00		0.13		
~ 2.50		0.00	0.00	0.00	0.00		0.00		
~ 2.75		0.00	0.00	0.02	0.00		0.02		
~ 3.00		0.00	0.00	0.00	0.00		0.00		
3.00 ~		0.00	0.00	0.00	0.00		0.00		
Occurrence Frequency (%)		9.14	25.66	17.68	20.42	27.10	100.00		
Exceeding Occurrence Frequency (%)		0.00	0.60	1.33	0.00			1.93	

Result of Wave Calmness Analysis [ST.1 : 1a-1-2]



Wave Dir.	Target Wave Height (H(m))		Ratio of Wave Height	Allowable Wave Height (H(m))		Exceeding Occurrence Frequency (%)
	H(m)	H(m)		H(m)	H(m)	
W	0.50	0.70	0.71	0.71	0.89	0.89
NW	0.50	0.69	1.00	1.00	1.27	2.16
Non-Calmness Ratio (%)						2.16
Calmness Ratio (%)						97.84

Sihanoukville

H(m)	Deg.	ERR :							
		SW	W	NW	N	CALM	Occurrence Frequency (%)		
CALM						27.10		27.10	
~ 0.25		7.64	15.46	8.29	16.77		48.17		
~ 0.50		1.15	7.84	4.95	2.66		16.60		
~ 0.75		0.29	1.84	2.28	0.94		5.34		
~ 1.00		0.04	0.38	0.86	0.05		1.33		
~ 1.25		0.02	0.10	0.62	0.00		0.73		
~ 1.50		0.00	0.04	0.13	0.00		0.17		
~ 1.75		0.00	0.02	0.24	0.00		0.26		
~ 2.00		0.00	0.00	0.16	0.00		0.16		
~ 2.25		0.00	0.00	0.13	0.00		0.13		
~ 2.50		0.00	0.00	0.00	0.00		0.00		
~ 2.75		0.00	0.00	0.02	0.00		0.02		
~ 3.00		0.00	0.00	0.00	0.00		0.00		
3.00 ~		0.00	0.00	0.00	0.00		0.00		
Occurrence Frequency (%)		9.14	25.66	17.68	20.42	27.10	100.00		
Exceeding Occurrence Frequency (%)		0.00	0.89	1.27	0.00			2.16	

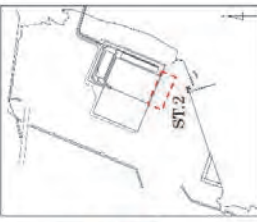
Source: Project Team



**Table 5-5 Results for Calculation of Wave Calmness inside Harbor (ST.1 & ST.2: 1a-2-1)**

**Result of Wave Calmness Analysis [ST.2 : 1a-2-1]**

Wave Dir	Target Wave Height H(m)		Ratio of Wave Height	Allowable Wave Height H(m)	Exceeding Occurrence Frequency (%)
	0.50	1.50			
W	0.50	1.50	0.33	0.56	1.29
NW	0.50	1.50	0.67	0.75	2.25
Non Calmness Ratio (%)					4.24
Calmness Ratio (%)					95.76

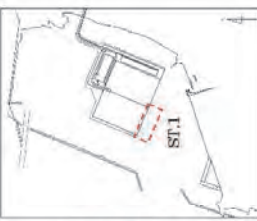


Sihanoukville

H(m)	Deg.	ERR :					Occurrence Frequency (%)
		SW	W	NW	N	CALM	
CALM						27.10	27.10
~ 0.25		7.64	15.46	8.29	16.77		48.17
~ 0.50		1.15	7.84	4.95	2.66		16.60
~ 0.75		0.29	1.84	2.28	0.94		5.34
~ 1.00		0.04	0.38	0.86	0.05		1.33
~ 1.25		0.02	0.10	0.62	0.00		0.73
~ 1.50		0.00	0.04	0.13	0.00		0.17
~ 1.75		0.00	0.02	0.24	0.00		0.26
~ 2.00		0.00	0.00	0.16	0.00		0.16
~ 2.25		0.00	0.00	0.13	0.00		0.13
~ 2.50		0.00	0.00	0.00	0.00		0.00
~ 2.75		0.00	0.00	0.02	0.00		0.02
~ 3.00		0.00	0.00	0.00	0.00		0.00
3.00 ~		0.00	0.00	0.00	0.00		0.00
Occurrence Frequency (%)		9.14	25.66	17.68	20.42	27.10	100.00
Exceeding Occurrence Frequency (%)		0.00	1.99	2.25	0.00		4.24

**Result of Wave Calmness Analysis [ST.1 : 1a-2-1]**

Wave Dir	Target Wave Height H(m)		Ratio of Wave Height	Allowable Wave Height H(m)	Exceeding Occurrence Frequency (%)
	0.50	1.50			
W	0.50	1.50	0.33	0.52	2.29
NW	0.50	1.50	0.67	0.75	2.25
Non Calmness Ratio (%)					4.54
Calmness Ratio (%)					95.46




Sihanoukville

H(m)	Deg.	ERR :					Occurrence Frequency (%)
		SW	W	NW	N	CALM	
CALM						27.10	27.10
~ 0.25		7.64	15.46	8.29	16.77		48.17
~ 0.50		1.15	7.84	4.95	2.66		16.60
~ 0.75		0.29	1.84	2.28	0.94		5.34
~ 1.00		0.04	0.38	0.86	0.05		1.33
~ 1.25		0.02	0.10	0.62	0.00		0.73
~ 1.50		0.00	0.04	0.13	0.00		0.17
~ 1.75		0.00	0.02	0.24	0.00		0.26
~ 2.00		0.00	0.00	0.16	0.00		0.16
~ 2.25		0.00	0.00	0.13	0.00		0.13
~ 2.50		0.00	0.00	0.00	0.00		0.00
~ 2.75		0.00	0.00	0.02	0.00		0.02
~ 3.00		0.00	0.00	0.00	0.00		0.00
3.00 ~		0.00	0.00	0.00	0.00		0.00
Occurrence Frequency (%)		9.14	25.66	17.68	20.42	27.10	100.00
Exceeding Occurrence Frequency (%)		0.00	2.29	2.25	0.00		4.54

Source: Project Team

**Table 5-6 Results for Calculation of Wave Calmness inside Harbor (ST.1 & ST.2: 1a-2-2)**

**Result of Wave Calmness Analysis [ST.2 : 1a-2-2]**




Wave Dir.	Target Wave Height		Ratio of Wave Height	Allowable Wave Height	Exceeding Occurrence Frequency (%)
	H(m)	H(m)			
W	0.50	0.76	0.66	1.26	1.99
NW	0.50	0.62	0.81	1.99	3.25
New Calmness Ratio (%)					96.75
Calmness Ratio (%)					96.75

Sihanoukville

H(m)	Deg.	SW	W	NW	N	CALM	Occurrence Frequency (%)
CALM						27.10	27.10
~ 0.25		7.64	15.46	8.29	16.77		48.17
~ 0.50		1.15	7.84	4.95	2.66		16.60
~ 0.75		0.29	1.84	2.28	0.94		5.34
~ 1.00		0.04	0.38	0.86	0.05		1.33
~ 1.25		0.02	0.10	0.62	0.00		0.73
~ 1.50		0.00	0.04	0.13	0.00		0.17
~ 1.75		0.00	0.02	0.24	0.00		0.26
~ 2.00		0.00	0.00	0.16	0.00		0.16
~ 2.25		0.00	0.00	0.13	0.00		0.13
~ 2.50		0.00	0.00	0.00	0.00		0.00
~ 2.75		0.00	0.00	0.02	0.00		0.02
~ 3.00		0.00	0.00	0.00	0.00		0.00
3.00 ~		0.00	0.00	0.00	0.00		0.00
Occurrence Frequency (%)		9.14	25.66	17.68	20.42	27.10	100.00
Exceeding Occurrence Frequency (%)		0.00	1.26	1.99	0.00		3.25

**Result of Wave Calmness Analysis [ST.1 : 1a-2-2]**



Wave Dir.	Target Wave Height		Ratio of Wave Height	Allowable Wave Height	Exceeding Occurrence Frequency (%)
	H(m)	H(m)			
W	0.50	0.78	0.64	1.40	1.99
NW	0.50	0.62	0.81	1.99	3.39
New Calmness Ratio (%)					96.61
Calmness Ratio (%)					96.61


Sihanoukville

H(m)	Deg.	SW	W	NW	N	CALM	Occurrence Frequency (%)
CALM						27.10	27.10
~ 0.25		7.64	15.46	8.29	16.77		48.17
~ 0.50		1.15	7.84	4.95	2.66		16.60
~ 0.75		0.29	1.84	2.28	0.94		5.34
~ 1.00		0.04	0.38	0.86	0.05		1.33
~ 1.25		0.02	0.10	0.62	0.00		0.73
~ 1.50		0.00	0.04	0.13	0.00		0.17
~ 1.75		0.00	0.02	0.24	0.00		0.26
~ 2.00		0.00	0.00	0.16	0.00		0.16
~ 2.25		0.00	0.00	0.13	0.00		0.13
~ 2.50		0.00	0.00	0.00	0.00		0.00
~ 2.75		0.00	0.00	0.02	0.00		0.02
~ 3.00		0.00	0.00	0.00	0.00		0.00
3.00 ~		0.00	0.00	0.00	0.00		0.00
Occurrence Frequency (%)		9.14	25.66	17.68	20.42	27.10	100.00
Exceeding Occurrence Frequency (%)		0.00	1.40	1.99	0.00		3.39

Source: Project Team

Table 5-7 Results for Calculation of Wave Calmness inside Harbor (ST.1 & ST.2: 2a-1-1)

Result of Wave Calmness Analysis [ST.2 : 2a-1-1]




Wave Dir.	Target Wave Height		Ratio of Wave Height	Allowable Wave Height	Exceeding Occurrence Frequency (%)
	H(m)	H(m)			
W	0.50	0.86	0.58	0.58	1.85
NW	0.50	0.54	0.54	0.53	1.57
Non-Calmness Ratio (%)					3.42
Calmness Ratio (%)					96.58

Sihanoukville

H(m)	Deg.	ERR :					Occurrence Frequency (%)
		SW	W	NW	N	C.ALM	
CALM							27.10
~ 0.25		7.64	15.46	8.29	16.77		48.17
~ 0.50		1.15	7.84	4.95	2.66		16.60
~ 0.75		0.29	1.84	2.28	0.94		5.34
~ 1.00		0.04	0.38	0.86	0.05		1.33
~ 1.25		0.02	0.10	0.62	0.00		0.73
~ 1.50		0.00	0.04	0.13	0.00		0.17
~ 1.75		0.00	0.02	0.24	0.00		0.26
~ 2.00		0.00	0.00	0.16	0.00		0.16
~ 2.25		0.00	0.00	0.13	0.00		0.13
~ 2.50		0.00	0.00	0.00	0.00		0.00
~ 2.75		0.00	0.00	0.02	0.00		0.02
~ 3.00		0.00	0.00	0.00	0.00		0.00
3.00 ~		0.00	0.00	0.00	0.00		0.00
Occurrence Frequency (%)		9.14	25.66	17.68	20.42	27.10	100.00
Exceeding Occurrence Frequency (%)		0.00	1.85	1.57	0.00		3.42

Result of Wave Calmness Analysis [ST.1 : 2a-1-1]



Wave Dir.	Target Wave Height		Ratio of Wave Height	Allowable Wave Height	Exceeding Occurrence Frequency (%)
	H(m)	H(m)			
W	0.50	0.78	0.64	1.40	1.40
NW	0.50	0.47	1.00	1.17	1.17
Non-Calmness Ratio (%)					2.57
Calmness Ratio (%)					97.43

Sihanoukville


H(m)	Deg.	ERR :					Occurrence Frequency (%)
		SW	W	NW	N	C.ALM	
CALM							27.10
~ 0.25		7.64	15.46	8.29	16.77		48.17
~ 0.50		1.15	7.84	4.95	2.66		16.60
~ 0.75		0.29	1.84	2.28	0.94		5.34
~ 1.00		0.04	0.38	0.86	0.05		1.33
~ 1.25		0.02	0.10	0.62	0.00		0.73
~ 1.50		0.00	0.04	0.13	0.00		0.17
~ 1.75		0.00	0.02	0.24	0.00		0.26
~ 2.00		0.00	0.00	0.16	0.00		0.16
~ 2.25		0.00	0.00	0.13	0.00		0.13
~ 2.50		0.00	0.00	0.00	0.00		0.00
~ 2.75		0.00	0.00	0.02	0.00		0.02
~ 3.00		0.00	0.00	0.00	0.00		0.00
3.00 ~		0.00	0.00	0.00	0.00		0.00
Occurrence Frequency (%)		9.14	25.66	17.68	20.42	27.10	100.00
Exceeding Occurrence Frequency (%)		0.00	1.40	1.17	0.00		2.57

Source: Project Team

**Table 5-8 Results for Calculation of Wave Calmness inside Harbor (ST.1 & ST.2: 2a-1-2)**

Result of Wave Calmness Analysis [ST.2 : 2a-1-2]

Wave Dir.	Target Wave Height		Ratio of Wave Height	Allowable Wave Height	Exceeding Occurrence Frequency (%)
	H(m)	H(m)			
W	0.50	0.72	0.69	0.72	0.82
NW	0.50	1.02	0.49	1.02	1.37
Non Calmness Ratio (%)					2.09
Calmness Ratio (%)					97.91




Sihanoukville

H(m)	Deg.	Calmness Ratio (%)					N	NW	W	SW	ERR : Occurrence Frequency (%)
		CALM	SW	W	NW	N					
CALM		27.10				16.77	8.29	15.46	7.64	27.10	27.10
~ 0.25			7.64	15.46	8.29	16.77	8.29	15.46	7.64		48.17
~ 0.50			1.15	7.84	4.95	2.66	4.95	7.84	1.15		16.60
~ 0.75			0.29	1.84	2.28	0.94	2.28	1.84	0.29		5.34
~ 1.00			0.04	0.38	0.86	0.05	0.86	0.38	0.04		1.33
~ 1.25			0.02	0.10	0.62	0.00	0.62	0.10	0.02		0.73
~ 1.50			0.00	0.04	0.13	0.00	0.13	0.04	0.00		0.17
~ 1.75			0.00	0.02	0.24	0.00	0.24	0.02	0.00		0.26
~ 2.00			0.00	0.00	0.16	0.00	0.16	0.00	0.00		0.16
~ 2.25			0.00	0.00	0.13	0.00	0.13	0.00	0.00		0.13
~ 2.50			0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00
~ 2.75			0.00	0.00	0.02	0.00	0.02	0.00	0.00		0.02
~ 3.00			0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00
3.00 ~			0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00
Occurrence Frequency (%)		9.14	25.66	17.68	20.42	27.10	20.42	25.66	9.14		100.00
Exceeding Occurrence Frequency (%)		0.00	0.82	1.27	0.00	0.00	0.00	0.82	0.00		2.09

Result of Wave Calmness Analysis [ST.1 : 2a-1-2]

Wave Dir.	Target Wave Height		Ratio of Wave Height	Allowable Wave Height	Exceeding Occurrence Frequency (%)
	H(m)	H(m)			
W	0.50	0.52	0.66	0.76	0.52
NW	0.50	0.92	0.43	1.16	0.92
Non Calmness Ratio (%)					1.44
Calmness Ratio (%)					98.56




Sihanoukville

H(m)	Deg.	Calmness Ratio (%)					N	NW	W	SW	ERR : Occurrence Frequency (%)
		CALM	SW	W	NW	N					
CALM		27.10				16.77	8.29	15.46	7.64	27.10	27.10
~ 0.25			7.64	15.46	8.29	16.77	8.29	15.46	7.64		48.17
~ 0.50			1.15	7.84	4.95	2.66	4.95	7.84	1.15		16.60
~ 0.75			0.29	1.84	2.28	0.94	2.28	1.84	0.29		5.34
~ 1.00			0.04	0.38	0.86	0.05	0.86	0.38	0.04		1.33
~ 1.25			0.02	0.10	0.62	0.00	0.62	0.10	0.02		0.73
~ 1.50			0.00	0.04	0.13	0.00	0.13	0.04	0.00		0.17
~ 1.75			0.00	0.02	0.24	0.00	0.24	0.02	0.00		0.26
~ 2.00			0.00	0.00	0.16	0.00	0.16	0.00	0.00		0.16
~ 2.25			0.00	0.00	0.13	0.00	0.13	0.00	0.00		0.13
~ 2.50			0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00
~ 2.75			0.00	0.00	0.02	0.00	0.02	0.00	0.00		0.02
~ 3.00			0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00
3.00 ~			0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00
Occurrence Frequency (%)		9.14	25.66	17.68	20.42	27.10	20.42	25.66	9.14		100.00
Exceeding Occurrence Frequency (%)		0.00	0.52	0.92	0.00	0.00	0.92	0.52	0.00		1.44

Source: Project Team


Table 5-9 Results for Calculation of Wave Calmness inside Harbor (ST.1 & ST.2: 2a-2-1)

Result of Wave Calmness Analysis [ST.2 : 2a-2-1]



Wave Dir.	Target Wave Height (m)		Ratio of Wave Height	Allowable Wave Height (m)	Exceeding Occurrence Frequency (%)
	H(m)	(%)			
W	0.50	0.96	0.52	1.00	2.29
NW	0.50	0.66	0.76	1.00	2.16
Sea Calmness Ratio (%)					4.45
Calmness Ratio (%)					95.55

Result of Wave Calmness Analysis [ST.1 : 2a-2-1]



Wave Dir.	Target Wave Height (m)		Ratio of Wave Height	Allowable Wave Height (m)	Exceeding Occurrence Frequency (%)
	H(m)	(%)			
W	0.50	0.92	0.54	1.00	2.14
NW	0.50	0.85	0.85	1.00	1.85
Sea Calmness Ratio (%)					3.99
Calmness Ratio (%)					96.01

Sihanoukville

H(m)	Deg.	Occurrence Frequency (%)					ERR (%)
		SW	W	NW	N	CALM	
CALM						27.10	27.10
~ 0.25		7.64	15.46	8.29	16.77		48.17
~ 0.50		1.15	7.84	4.95	2.66		16.60
~ 0.75		0.29	1.84	2.28	0.94		5.34
~ 1.00		0.04	0.38	0.86	0.05		1.33
~ 1.25		0.02	0.10	0.62	0.00		0.73
~ 1.50		0.00	0.04	0.13	0.00		0.17
~ 1.75		0.00	0.02	0.24	0.00		0.26
~ 2.00		0.00	0.00	0.16	0.00		0.16
~ 2.25		0.00	0.00	0.13	0.00		0.13
~ 2.50		0.00	0.00	0.00	0.00		0.00
~ 2.75		0.00	0.00	0.02	0.00		0.02
~ 3.00		0.00	0.00	0.00	0.00		0.00
3.00 ~		0.00	0.00	0.00	0.00		0.00
Occurrence Frequency (%)		9.14	25.66	17.68	20.42	27.10	100.00
Exceeding Occurrence Frequency (%)		0.00	2.29	2.16	0.00		4.45


Sihanoukville

H(m)	Deg.	Occurrence Frequency (%)					ERR (%)
		SW	W	NW	N	CALM	
CALM						27.10	27.10
~ 0.25		7.64	15.46	8.29	16.77		48.17
~ 0.50		1.15	7.84	4.95	2.66		16.60
~ 0.75		0.29	1.84	2.28	0.94		5.34
~ 1.00		0.04	0.38	0.86	0.05		1.33
~ 1.25		0.02	0.10	0.62	0.00		0.73
~ 1.50		0.00	0.04	0.13	0.00		0.17
~ 1.75		0.00	0.02	0.24	0.00		0.26
~ 2.00		0.00	0.00	0.16	0.00		0.16
~ 2.25		0.00	0.00	0.13	0.00		0.13
~ 2.50		0.00	0.00	0.00	0.00		0.00
~ 2.75		0.00	0.00	0.02	0.00		0.02
~ 3.00		0.00	0.00	0.00	0.00		0.00
3.00 ~		0.00	0.00	0.00	0.00		0.00
Occurrence Frequency (%)		9.14	25.66	17.68	20.42	27.10	100.00
Exceeding Occurrence Frequency (%)		0.00	2.14	1.85	0.00		3.99

Source: Project Team

Table 5-10 Results for Calculation of Wave Calmness inside Harbor (ST.1 & ST.2: 2a-2-2)

Result of Wave Calmness Analysis [ST.2 : 2a-2-2]




Wave Dir	Target Wave Height (Hm)		Ratio of Wave Height	Allowable Wave Height (Hm)	Exceeding Occurrence Frequency (%)
	0.50	0.78			
W	0.50	0.64	0.78	0.64	1.40
NW	0.50	0.61	0.61	0.82	1.95
Non Calmness Ratio (%)					3.34
Calmness Ratio (%)					96.65

Sihanoukville

H(m)	Deg.	ERR (%)							
		CALM	SW	W	NW	N	CALM	Occurrence Frequency (%)	
CALM								27.10	27.10
~ 0.25			7.64	15.46	8.29	16.77			48.17
~ 0.50			1.15	7.84	4.95	2.66			16.60
~ 0.75			0.29	1.84	2.28	0.94			5.34
~ 1.00			0.04	0.38	0.86	0.05			1.33
~ 1.25			0.02	0.10	0.62	0.00			0.73
~ 1.50			0.00	0.04	0.13	0.00			0.17
~ 1.75			0.00	0.02	0.24	0.00			0.26
~ 2.00			0.00	0.00	0.16	0.00			0.16
~ 2.25			0.00	0.00	0.13	0.00			0.13
~ 2.50			0.00	0.00	0.00	0.00			0.00
~ 2.75			0.00	0.00	0.02	0.00			0.02
~ 3.00			0.00	0.00	0.00	0.00			0.00
3.00 ~			0.00	0.00	0.00	0.00			0.00
Occurrence Frequency (%)			9.14	25.66	17.68	20.42		27.10	100.00
Exceeding Occurrence Frequency (%)			0.00	1.40	1.95	0.00			3.35

Result of Wave Calmness Analysis [ST.1 : 2a-2-2]



Wave Dir	Target Wave Height (Hm)		Ratio of Wave Height	Allowable Wave Height (Hm)	Exceeding Occurrence Frequency (%)
	0.50	0.77			
W	0.50	0.65	0.65	0.91	1.33
NW	0.50	0.55	0.55	0.64	1.64
Non Calmness Ratio (%)					2.97
Calmness Ratio (%)					97.03

Sihanoukville

H(m)	Deg.	ERR (%)							
		CALM	SW	W	NW	N	CALM	Occurrence Frequency (%)	
CALM								27.10	27.10
~ 0.25			7.64	15.46	8.29	16.77			48.17
~ 0.50			1.15	7.84	4.95	2.66			16.60
~ 0.75			0.29	1.84	2.28	0.94			5.34
~ 1.00			0.04	0.38	0.86	0.05			1.33
~ 1.25			0.02	0.10	0.62	0.00			0.73
~ 1.50			0.00	0.04	0.13	0.00			0.17
~ 1.75			0.00	0.02	0.24	0.00			0.26
~ 2.00			0.00	0.00	0.16	0.00			0.16
~ 2.25			0.00	0.00	0.13	0.00			0.13
~ 2.50			0.00	0.00	0.00	0.00			0.00
~ 2.75			0.00	0.00	0.02	0.00			0.02
~ 3.00			0.00	0.00	0.00	0.00			0.00
3.00 ~			0.00	0.00	0.00	0.00			0.00
Occurrence Frequency (%)			9.14	25.66	17.68	20.42		27.10	100.00
Exceeding Occurrence Frequency (%)			0.00	1.33	1.64	0.00			2.97

Source: Project Team

## **Appendix-7**

### **Geotechnical Investigation**

---





Geotechnical Investigation (Sep. 2011 by JICA Project Team)

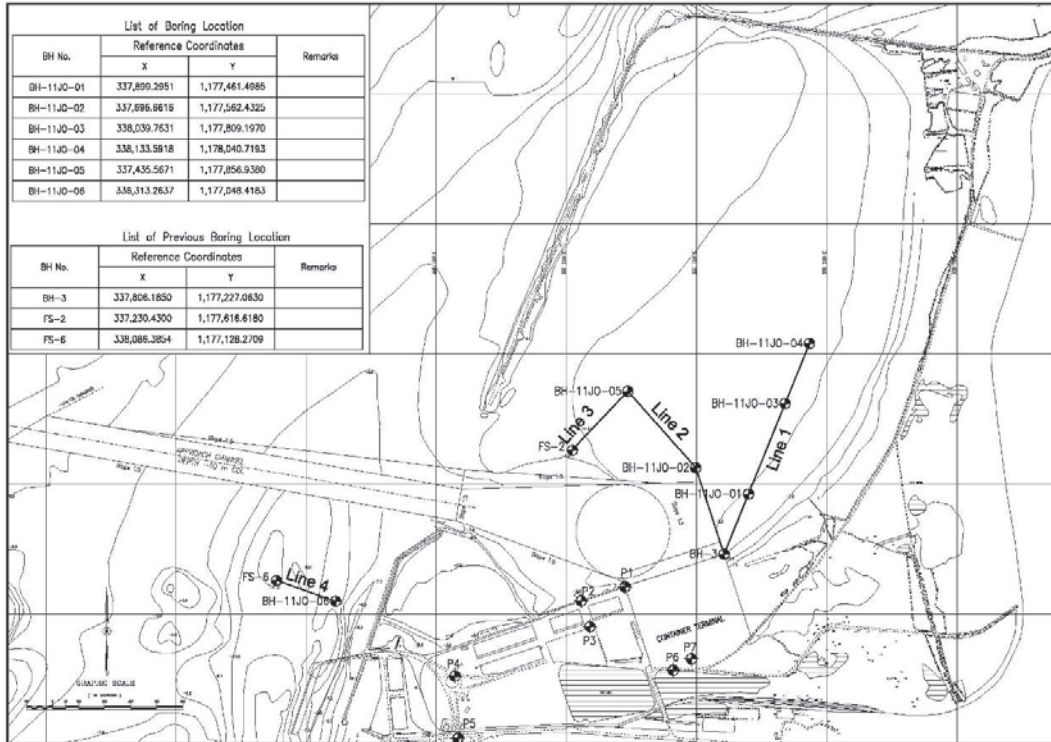


Figure A 0-1 Location of bore holes and soil profiles

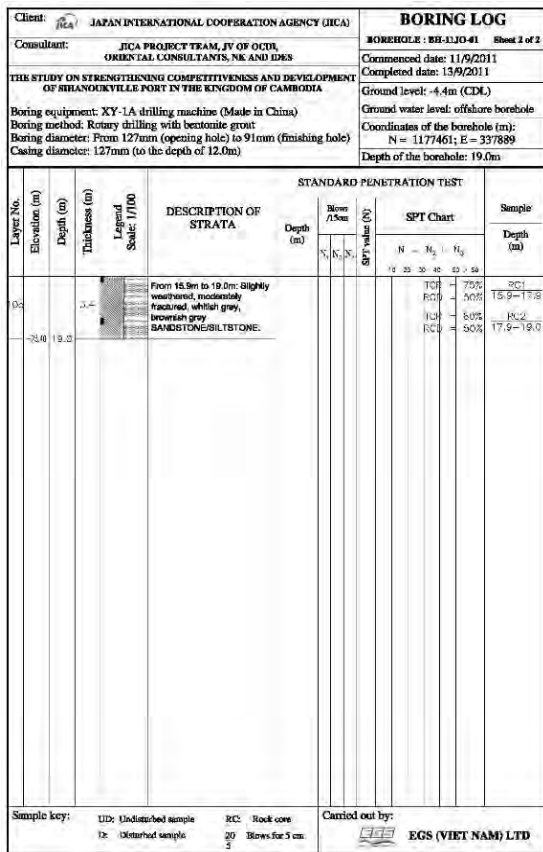
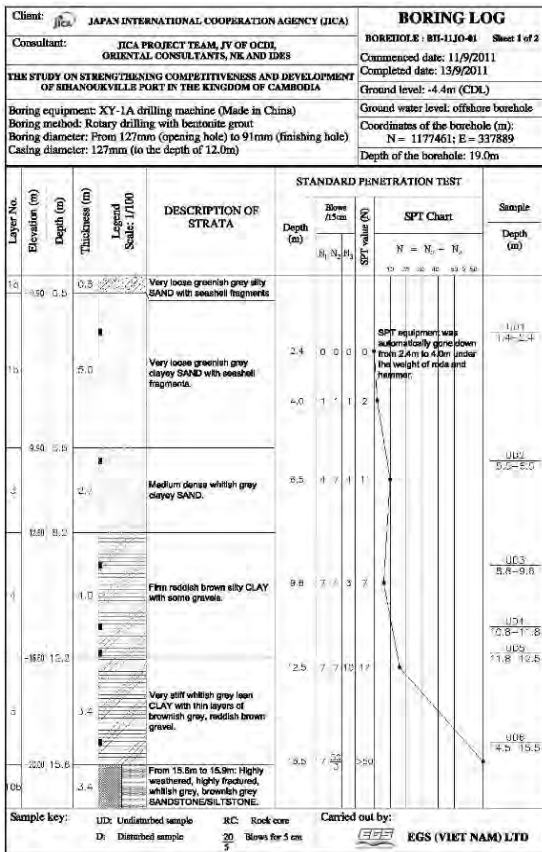


Figure A 1-2 Boring log for BH-11JO-01

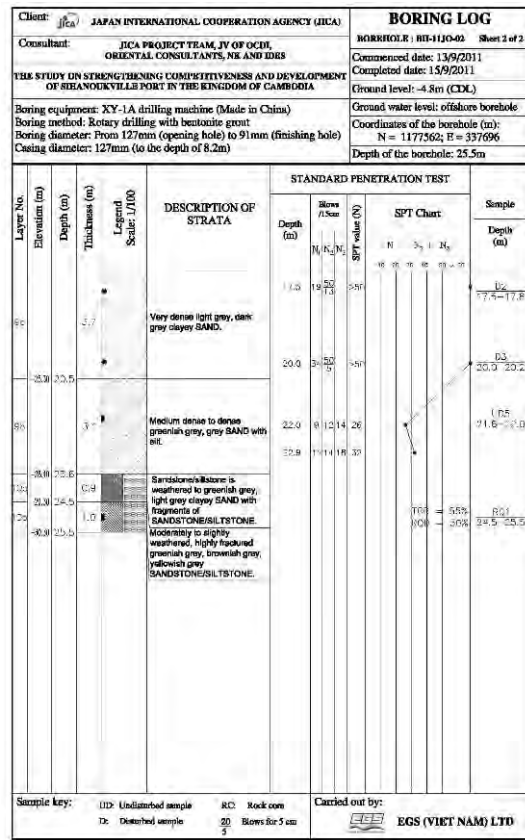
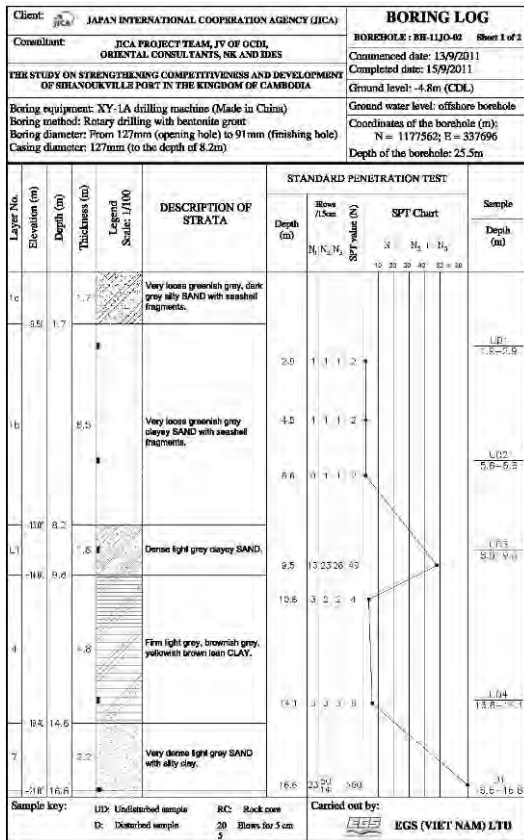


Figure A 1-3 Boring log for BH-11JO-02

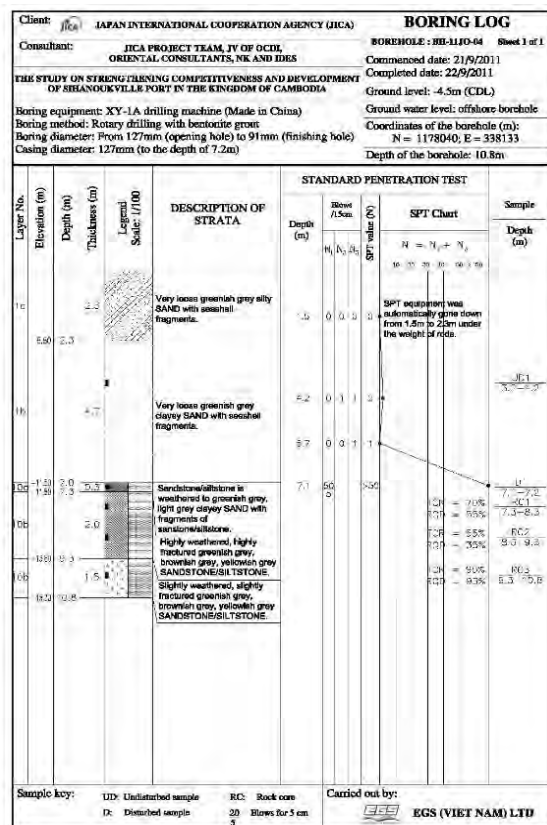
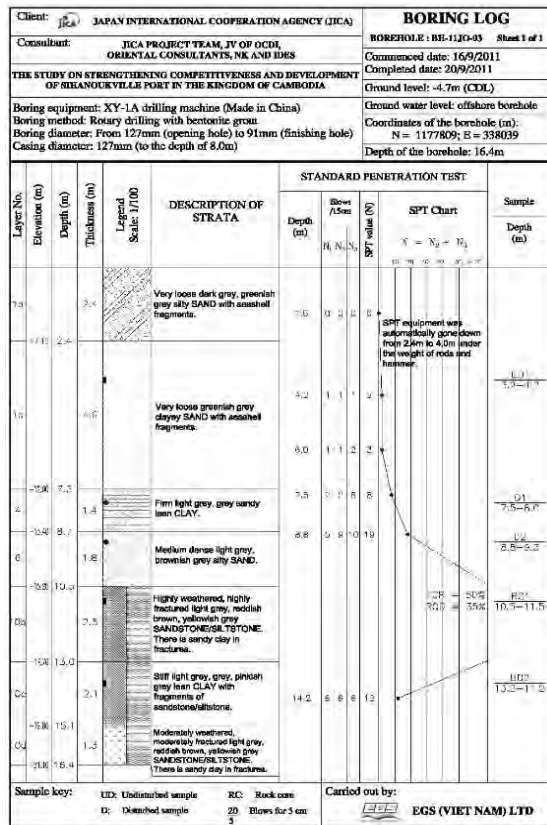


Figure A 1-4 Boring log for BH-11JO-03 and BH-11JO-04

The Project for the Study on Strengthening Competitiveness and Development of Sihanoukville Port in the Kingdom of Cambodia

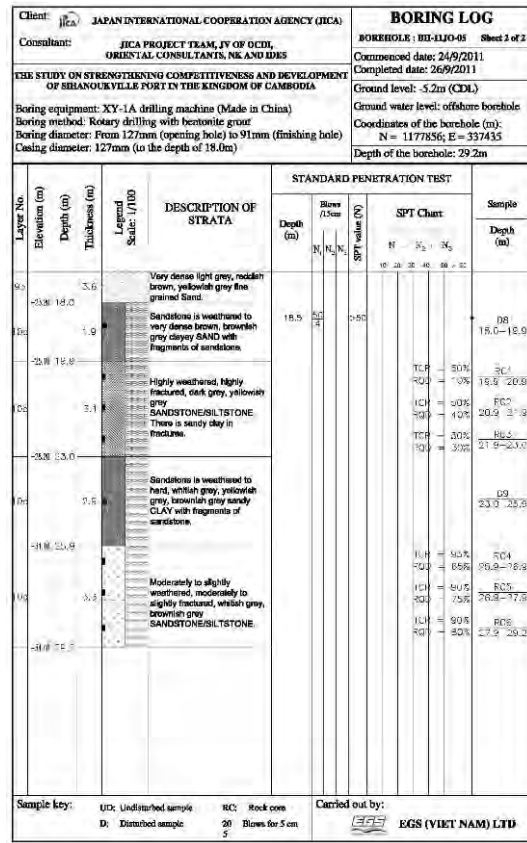
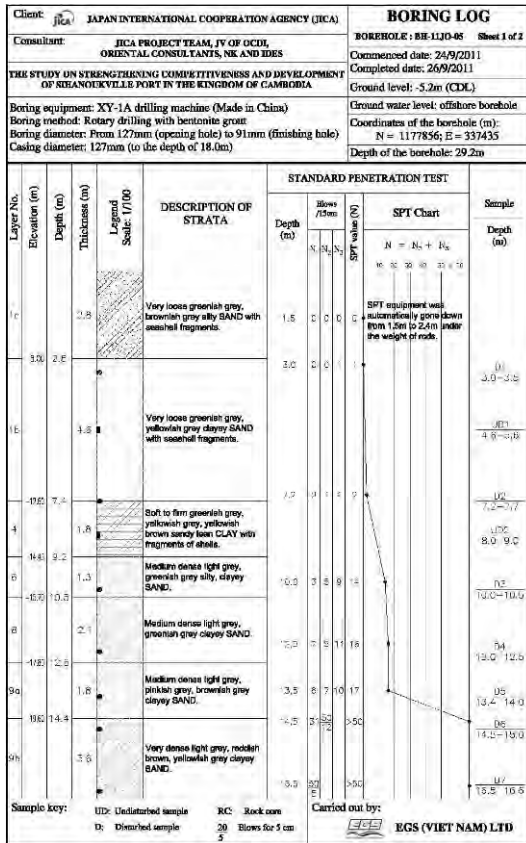


Figure A 1-5 Boring log for BH-11JO-05

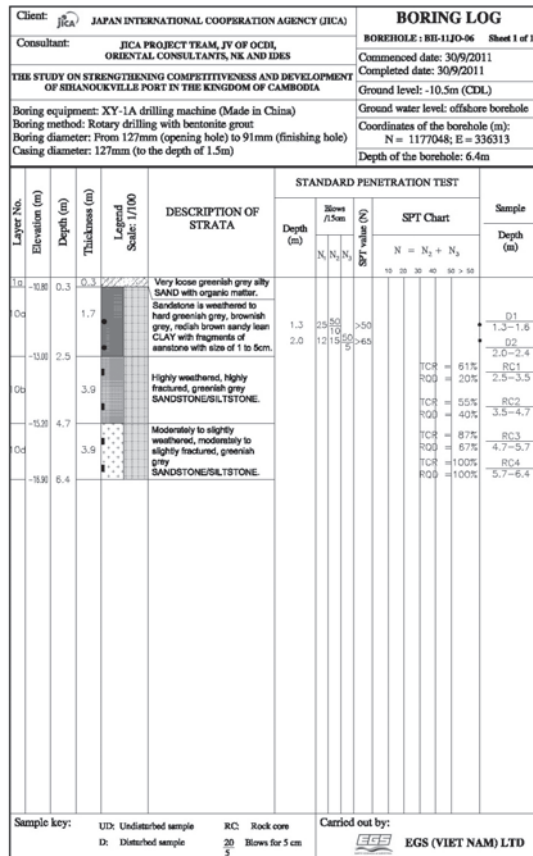


Figure A 1-6 Boring log for BH-11JO-06

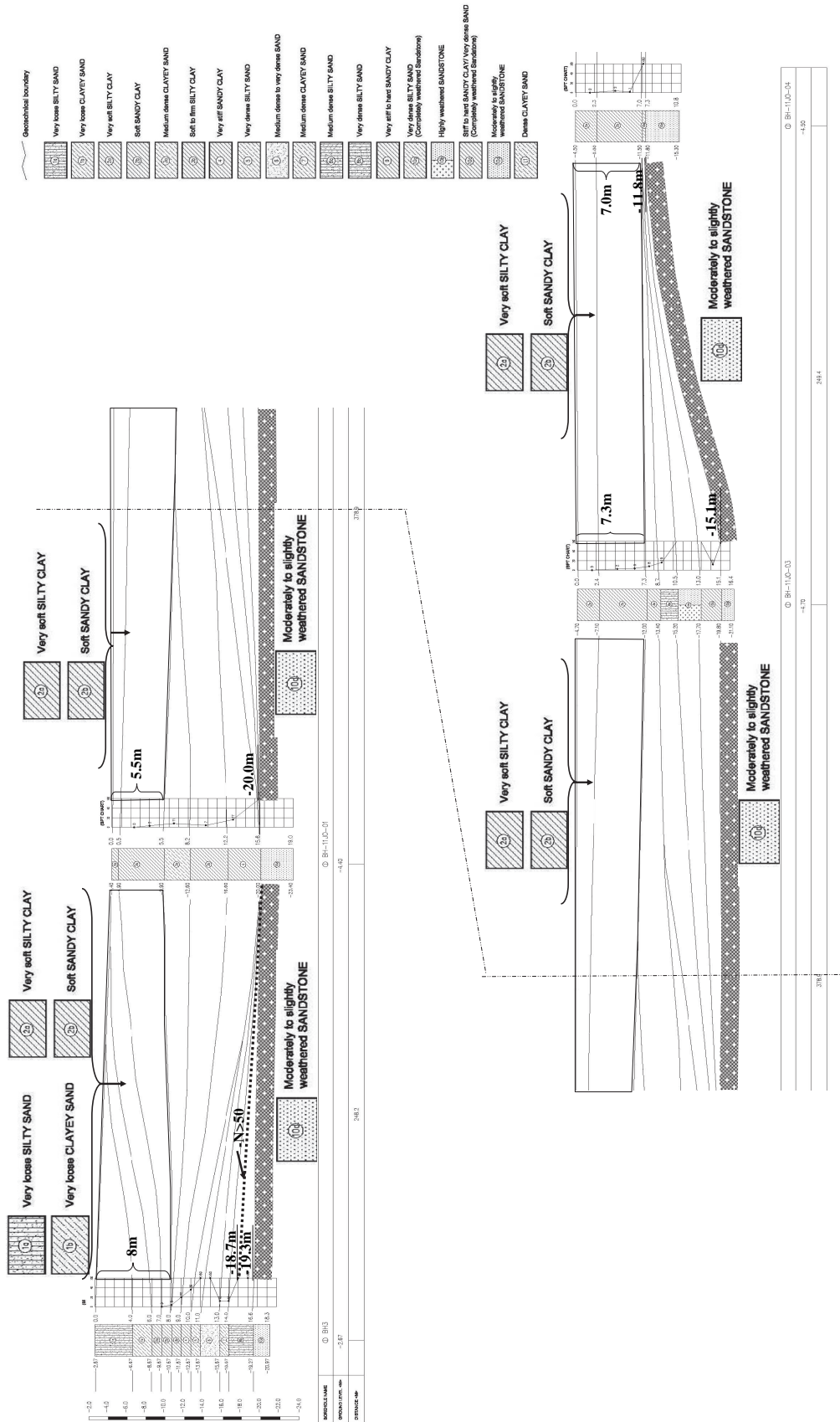
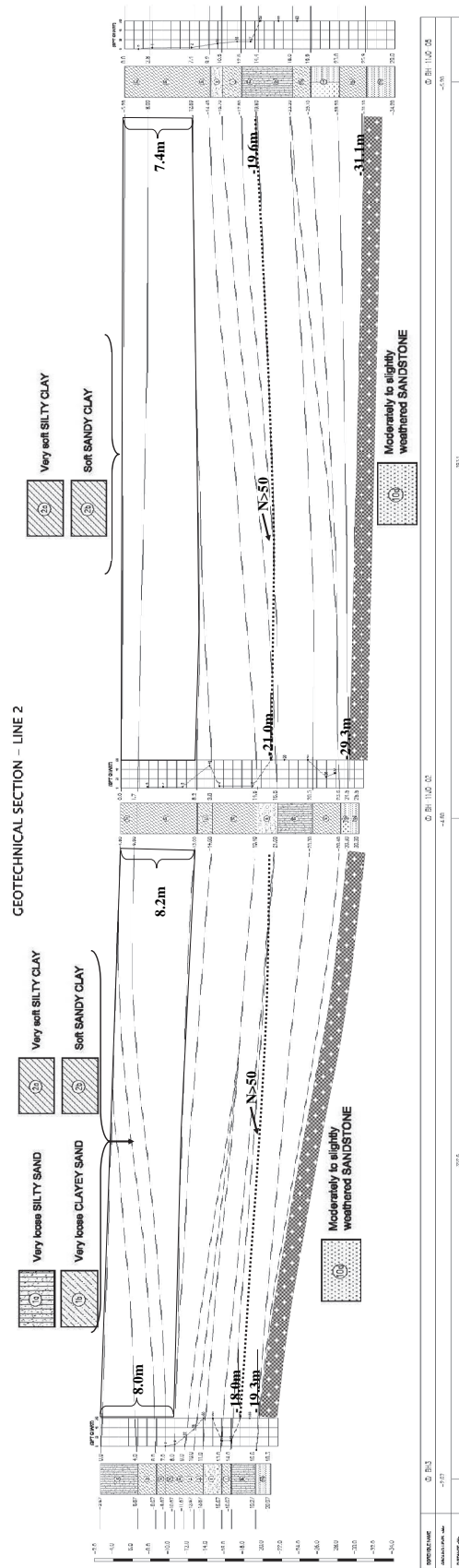
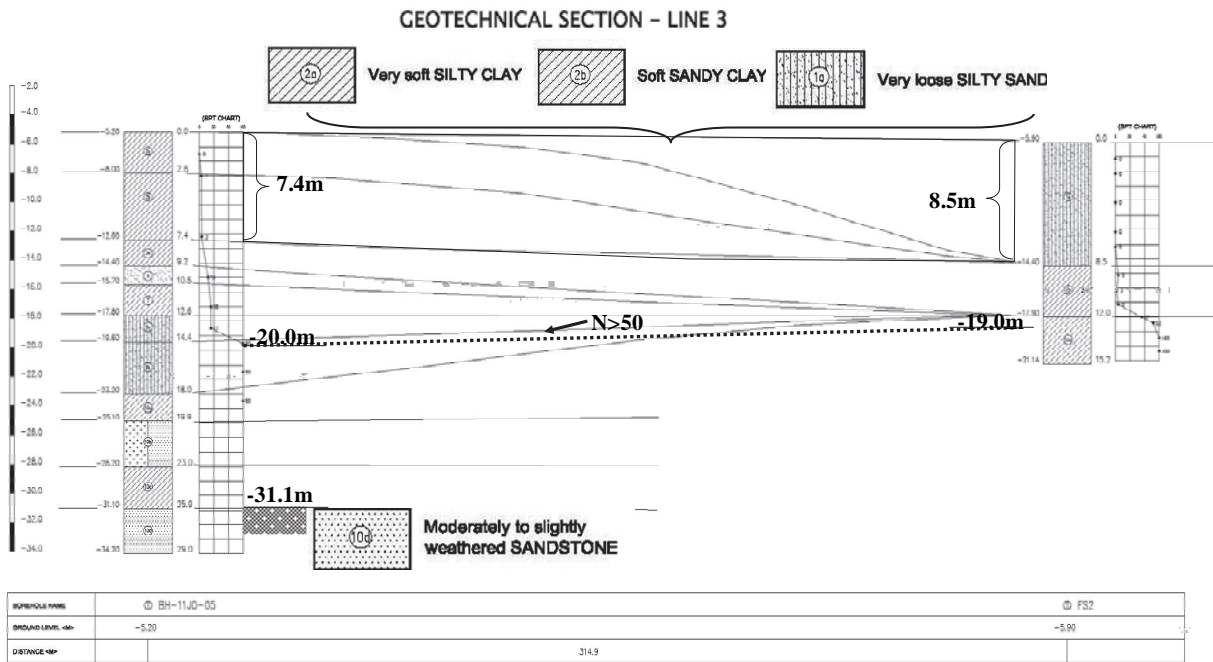


Figure A 1-7 Soil Profile (Line 1)

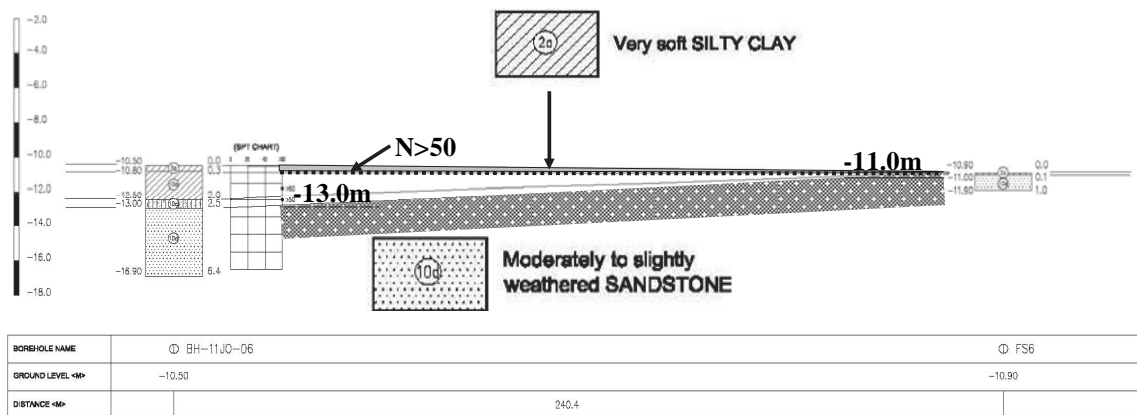


**Figure A 1-8 Soil Profile (Line 2)**



**Figure A 1-9 Soil Profile (Line 3)**

**GEOTECHNICAL SECTION - LINE 4**



**Figure A 1-10 Soil Profile (Line 4)**

**Table A 1-1 Summary of laboratory test (part 1)**

Lab. No.	Borehole No.	Sample No.	Depth of Sample		Particle Size Distribution - P (%)														Natural Moisture Content	Absorption	Specific Gravity	Unit Weight		Liquid limit	Plastic limit					
					Gravel		Sand						Silt		Clay		Natural	Dry												
			From	To	>9.50	4.75 to 9.50	2.36 to 4.75	2.00 to 2.36	1.18 to 2.00	0.60 to 1.18	0.425 to 0.60	0.30 to 0.425	0.15 to 0.30	0.075 to 0.15	0.010 to 0.075	0.005 to 0.010	0.002 to 0.005	< 0.002				W	W <sub>ab</sub>			Γ <sub>s</sub>	Γ <sub>w</sub>	Γ <sub>d</sub>	W <sub>L</sub>	W <sub>p</sub>
			m	m	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm				%	%			g/cm <sup>3</sup>	g/cm <sup>3</sup>	g/cm <sup>3</sup>	%	%
BCP1	BH-11JO-01	UD1	1.4	2.4				0.3	1.8	3.1	14.3	37.0	18.3	12.4	2.3	3.2	7.3	29.5		2.66	1.93	1.49	23.8	16.4						
BCP2	BH-11JO-01	UD2	5.5	6.5			0.1	0.4	1.7	2.6	13.7	34.2	21.4	12.0	2.6	3.3	8.0	30.8		2.65	1.91	1.46	24.6	17.0						
BCP3	BH-11JO-01	UD3	8.8	9.8				0.2	2.4	4.0	14.6	32.0	19.8	14.2	1.5	2.0	9.3	15.6		2.65	2.12	1.83	18.9	13.9						
BCP4	BH-11JO-01	UD6	14.5	15.5				0.1	0.2	0.2	0.3	1.0	1.0	28.5	9.6	12.3	46.8	24.7		2.71	1.98	1.59	46.5	20.9						
BCP9	BH-11JO-01	RC1	15.9	17.7														0.34	5.5	2.68	2.32	2.31								
BCP5	BH-11JO-02	UD1	1.9	2.9					0.6	1.7	7.5	21.2	11.8	18.9	3.8	6.5	28.0	17.1		2.67	2.07	1.77	25.7	12.6						
BCP6	BH-11JO-02	UD2	5.6	6.6				0.2	1.5	2.6	13.2	32.9	16.5	12.4	2.6	6.2	11.9	34.5		2.67	1.87	1.39	27.0	16.6						
BCP10	BH-11JO-02	UD3	8.5	9.5	1.4	2.0	0.5	0.0	0.3	1.2	2.1	7.3	33.1	16.8	15.1	4.2	5.9	10.1	32.2		2.66	1.89	1.43	30.6	16.4					
BCP7	BH-11JO-02	UD4	13.6	14.1							0.1	0.9	3.2	36.1	7.0	9.4	43.3	17.0		2.72	2.10	1.79	44.2	19.7						
BCP8	BH-11JO-02	UD5	21.6	22.0			0.1	0.5	4.7	17.6	16.7	23.3	20.8	5.5	4.6	0.9	1.1	4.2	19.8		2.66	2.09	1.74	CAT						
BCP11	BH-11JO-02	D1	16.6	16.8		0.2	0.1	0.2	0.9	3.2	6.7	19.4	51.8	8.2	3.8	1.2	2.2	2.1	19.0		2.66			21.7	16.7					
BCP12	BH-11JO-02	D3	20	20.2								2.3	47.8	31.9	6.7	2.7	2.1	6.5	20.2		2.65			24.8	16.9					
BCP13	BH-11JO-02	RC1	24.5	25.5														0.42	4.80	2.69	2.35	2.34								
BCP14	BH-11JO-03	UD1	3.2	4.2			0.1	0.1	0.6	2.1	3.8	10.1	42.7	17.9	10.0	3.6	3.5	5.5	26.1		2.65	1.97	1.56	24.3	16.8					
BCP15	BH-11JO-03	D1	7.5	8.0				0.1	0.8	1.9	7.2	25.9	10.4	10.5	1.8	6.9	34.5	22.4		2.65		0.00	24.6	13.1						
BCP16	BH-11JO-03	D2	8.8	9.3			0.1	0.1	0.9	2.6	5.7	21.3	52.1	7.7	3.8	1.3	1.9	2.5	18.2		2.64			21.5	16.3					
BCP17	BH-11JO-03	RC1	10.5	11.5														0.52	4.90	2.67	2.34	2.33								
BCP18	BH-11JO-03	UD2	13.2	14.2								0.1	0.3	0.3	39.2	9.7	13.8	36.6	20.4		2.69	2.07	1.72	40.3	19.6					
BCP19	BH-11JO-04	UD1	3.2	4.2			0.1	0.3	1.9	4.4	11.6	41.5	15.5	13.4	1.2	4.3	5.8	37.2		2.67	1.84	1.34	23.6	16.8						
BCP20	BH-11JO-04	RC1	7.3	8.3														0.53	4.60	2.65	2.36	2.34								
BCP21	BH-11JO-05	UD1	4.6	5.6				0.1	0.7	1.4	4.3	26.4	19.1	19.5	6.1	11.1	11.3	49.1		2.64	1.72	1.15	38.7	20.6						
BCP22	BH-11JO-05	UD2	8.0	9.0		0.6	0.5	0.0	0.1	0.2	0.5	1.9	12.3	14.3	20.3	4.8	6.8	37.7	25.8		2.71	1.98	1.57	33.2	16.4					
BCP23	BH-11JO-05	D3	10.0	10.5	1.5	0.0	0.0	0.0	0.2	1.8	3.4	9.2	45.0	20.8	7.5	0.6	2.0	8.0	22.3		2.65			24.4	17.5					
BCP24	BH-11JO-05	D4	12.0	12.5				0.1	1.5	16.4	10.8	11.8	24.6	8.6	4.8	0.8	1.3	19.3	23.6		2.68			24.3	12.9					
BCP25	BH-11JO-05	D5	13.4	14.0			0.1	0.1	0.2	0.7	2.2	32.0	35.6	8.6	5.1	1.3	2.3	11.8	21.4		2.65			24.4	15.1					
BCP26	BH-11JO-05	D6	14.5	15.0		0.2	0.4	0.1	0.3	0.9	1.3	4.7	41.3	23.4	12.8	1.7	2.1	10.8	20.0		2.65			23.0	14.1					
BCP27	BH-11JO-05	RC2	20.9	21.9														1.10	5.22	2.68	2.34	2.31								
BCP28	BH-11JO-05	RC4	25.9	26.08														0.52	3.54	2.68	2.42	2.41								
		RC4b	26.10	26.67														1.40	10.30	2.68	2.13	2.10								
BCP29	BH-11JO-06	D2	2.0	2.4	13.0	6.2	4.3	0.8	1.4	2.1	1.2	1.8	7.9	9.3	20.8	5.0	8.8	17.4	21.2		2.72			25.0	14.4					
BCP30	BH-11JO-06	RC2	3.5	4.7														0.79	2.16	2.70	2.56	2.54								
BCP31	BH-11JO-06	RC4	5.7	6.4														0.48	2.29	2.73	2.57	2.56								

**Table A 1-2 Summary of laboratory test (part 2)**

No.	Lab. No.	Borehole No.	Sample No.	Plasticity Index	Porosity	Void ratio	Consistency	Degree of saturation	Unconfined Compressive Test			Consolidation Test						Soil Classification According to ASTM D2487	Group symbol									
									U.C.S	U.C.S (SATUR.)	Axial Strain	Coefficient of Consolidation	Compression Index	Recompression Index	Swell Index	Coefficient of Permeability	Preconsolidation Pressure											
																				q <sub>u</sub>	q <sub>us</sub>	e <sub>r</sub>	C <sub>v1,2</sub>	C <sub>c</sub>	C <sub>r</sub>	C <sub>s</sub>	K <sub>v1,2</sub>	P <sub>c</sub>
																				kg/cm <sup>2</sup>	kg/cm <sup>2</sup>	%	10 <sup>-2</sup> cm <sup>2</sup> /s	-	-	-	10 <sup>-2</sup> cm/s	kg/cm <sup>2</sup>
1	BCP1	BH-11JO-01	UD1	7.4	44.0	0.785	1.77	100.0	0.16		7.57	0.95	0.15	0.06	0.02	0.22	0.94	Clayey sand	SC									
2	BCP2	BH-11JO-01	UD2	7.6	44.9	0.815	1.81	100.0	0.07		10.90	1.24	0.11	0.08	0.01	0.24	0.66	Clayey sand	SC									
3	BCP3	BH-11JO-01	UD3	5.0	30.9	0.448	0.34	92.3	1.01		3.42	1.18	0.036	0.019	0.011	0.08	1.09	Silty clay	CL-ML									
4	BCP4	BH-11JO-01	UD6	25.6	41.3	0.704	0.15	95.1	1.27		15.00	0.36	0.189	0.064	0.037	0.10	1.01	Lean clay	CL									
5	BCP9	BH-11JO-01	RC1		13.7	0.159		92.7	688	586								Sandstone	Rock									
6	BCP5	BH-11JO-02	UD1	13.1	33.7	0.508	0.34	89.9	0.69		14.75	0.30	0.130	0.046	0.018	0.07	1.00	Sandy lean clay	CL									
7	BCP6	BH-11JO-02	UD2	10.4	47.9	0.921	1.72	100.0	0.40		4.39	0.78	0.309	0.112	0.037	0.32	1.08	Clayey sand	SC									
8	BCP10	BH-11JO-02	UD3	14.2	46.2	0.860		99.6	0.62		3.51	1.37	0.240	0.079	0.030	0.42	1.20	Clayey sand	SC									
9	BCP7	BH-11JO-02	UD4	24.5	34.0	0.515	-0.11	89.8	3.75		15.07	0.50	0.131	0.060	0.021	0.06	1.51	Lean clay	CL									
10	BCP8	BH-11JO-02	UD5		34.4	0.525		100.3				1.15	0.036	0.018	0.008	0.08	0.87	Well-graded sand with silt	SW-SM									
11	BCP11	BH-11JO-02	D1	5.0			0.46											Poorly graded sand with silty clay	SP-SC									
12	BCP12	BH-11JO-02	D3	7.9			0.42											Clayey sand	SC									
13	BCP13	BH-11JO-02	RC1		13.0	0.149		86.7	688	586								Sandstone	Rock									
14	BCP14	BH-11JO-03	UD1	7.5	41.0	0.696	1.24	99.4	0.21		8.30	1.3	0.070	0.038	0.023	0.15	0.81	Clayey sand	SC									
15	BCP15	BH-11JO-03	D1	11.5														Sandy lean clay	CL									
16	BCP16	BH-11JO-03	D2	5.2														Poorly graded sand with silty clay	SP-SC									
17	BCP17	BH-11JO-03	RC1		12.8	0.147		89.0										Sandstone	Rock									
18	BCP18	BH-11JO-03	UD2	20.7	36.1	0.564	0.04	97.3	2.38		15.12	0.45	0.171	0.073	0.033	0.07	1.75	Lean clay	CL									
19	BCP19	BH-11JO-04	UD1	6.8	49.8	0.993	3.00	100.0	0.06		7.04	0.54	0.182	0.092	0.042	0.31	0.33	Silty, clayey sand	SC-SM									
20	BCP20	BH-11JO-04	RC1		11.5	0.130		93.8	706	563								Sandstone	Rock									
21	BCP21	BH-11JO-05	UD1	18.1	56.4	1.296	1.57	100.0	0.05		12.48	0.39	0.393	0.269	0.053	0.23	0.80	Clayey sand	SC									
22	BCP22	BH-11JO-05	UD2	16.8	42.1	0.726	0.56	96.3				0.45	0.263	0.087	0.024	0.15	1.18	Sandy lean clay	CL									
23	BCP23	BH-11JO-05	D3	6.9			0.70											Silty, clayey sand	SC-SM									
24	BCP24	BH-11JO-05	D4	11.4			0.94											Clayey sand	SC									
25	BCP25	BH-11JO-05	D5	9.3			0.68											Clayey sand	SC									
26	BCP26	BH-11JO-05	D6	8.9			0.66											Clayey sand	SC									
27	BCP27	BH-11JO-05	RC2		13.8	0.160		87.4	164	91								Sandstone	Rock									
28	BCP28	BH-11JO-05	RC4		10.1	0.112		84.7	670	567								Sandstone	Rock									
			RC4b		21.6	0.276		100.0	6.37	0.00								Siltstone	Rock									
29	BCP29	BH-11JO-06	D2	10.6			0.64											Sandy lean clay with gravel	CL									
30	BCP30	BH-11JO-06	RC2		5.9	0.063		92.6	408	356								Sandstone	Rock									
31	BCP31	BH-11JO-06	RC4		6.2	0.066		94.7	317	174								Sandstone	Rock									