Japan International Cooperation Agency (JICA)
Directorate General of Sea Communication (DGSC)
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Vol.3

Final Report

The Study on the Development Scheme for the Principal River Ports in Indonesia

May 2002

The Overseas Coastal Area Development Institute of Japan (OCDI)
Pacific Consultants International (PCI)

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Palaran Port (Samarinda) Master Plan (2025)

Samarinda Port (Samarinda) Master Plan (2025)

Volume 3 Master Plan and Short-term Plan of Samarinda Port

Part 6 Master Plan and Short-term Plan of Samarinda Port

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Master Plan and Short-term Plan of Samarinda Port

Part 6

Master Plan and Short-term Plan of Samarinda Port

Part 6 MASTER PLAN AND SHORT-TERM PLAN OF SAMARINDA PORT

25. PORT DEVELOPMENT SCENARIO

25.1 Industrial Development Potentials

25.1.1 Economic Activity

Population of East Kalimantan Province has been increasing at average growth rate of 3.5% during the last decade, and reached 2.5 million in 1999 (Table 25.1.1). Population density in East Kalimantan is quite low at around 10 persons per square kilometer, although Samarinda City and Balikpapan City have high population density at 700 to 1,000 persons per square kilometer (Table 25.1.2). Between 1993 and 1999, GRDP of East Kalimantan Province showed an increase at 1993 constant market price. The increase of GRDP from 1993 to 1999 was 36.1%, with the electricity/water supply and transportation/communication sector recording the highest increase of around 70 %. GRDP of East Kalimantan Province has been steadily growing and recorded Rp. 21,383,360 in 1999, with the manufacturing industry sector accounting for the largest portion, Rp.7,021,855 or 32.8% of the total GRDP, followed by mining and quarrying sector (Rp.6,738,547 or 31.5% of the total GRDP), and the trade, hotel and restaurant sector (Rp.1,906,007 or 8.9% of the total GRDP). The fourth largest sector within GRDP of East Kalimantan is the agriculture, livestock, forestry and fishery sector, which accounted for Rp.1,702,427 or 8.0% of the total GRDP. Table 25.1.3 and Table 25.1.4 show the GRDP of East Kalimantan Province by sector.

The regional income of East Kalimantan Province mainly relies on primary products such as mining and electricity. In particular, crude petroleum, natural gas and coal provide a great contribution to the national economy with export value of average US$ 4.7 billion recently. On the other hand, agriculture, livestock, forestry and fishery production have been relatively in a lower position in East Kalimantan Province.

25.1.2 Role of River Transportation

East Kalimantan Province has some geographical constraints for economic activities. Most of the land is mountainous terrain with many rivers, requiring bridges and water transportation. On the other hand, road transport development is limited. The Trans-Kalimantan Highway has been partly developed connecting the major cities in the region, but road strength is not endurable to heavy load of cargo vehicles except for the highway between Balikpapan and Samarinda. In addition, connection between the coastal area and the inland is not developed in East Kalimantan. This situation has made the region heavily rely on river transportation. River transportation is the most dominant mode to serve to transport mining, forest and plantation products. Samarinda has become an economic center serving district/sub-district areas along the Mahakam River. Due to sedimentation and tidal movement, some rivers are not navigable. Major ports in East Kalimantan are Samarinda, Balikpapan and Bontan. Among which, Balikpapan and Bontan are deep-sea ports, mainly developed by private sectors related to oil and natural gas exploitation. In addition to major ports mentioned above, cargo handling is carried

Table 25.1.1 Population by District in East Kalimanta

1990 - 1999

District	YEAR									
	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990
Pasir	301,414	292,384	286,770	242,643	232,893	232,421	230,388	215,978	215,551	211,658
Kutai	823,038	812,733	804,059	649,836	641,482	620,643	601,448	580,054	563,505	552,031
Berau	75,484	74,843	76,286	99,738	90,064	75,471	70,696	65,907	63,513	62,353
Bulungan	272,078	270,653	273,004	182,468	176,741	172,794	166,796	161,359	158,697	152,150
Balikpapan	442,060	432,079	433,494	362,121	350,332	343,762	343,517	342,168	341,276	310,537
Samarinda	602,406	576,256	567,402	459,153	444,698	440,329	436,025	410,710	406,435	407,897
Bulungan (Tarakan)	-	-	-	106,031	99,315	91,781	88,467	85,565	83,837	81,149
Kutai (Bontang)	-	-	-	85,366	73,463	71,780	69,596	70,301	66,353	66,976
Total	2,516,480	2,458,942	2,441,017	2,187,356	2,103,988	2,048,979	2,006,933	1,936,042	1,899,167	1,840,751

Source : BPS - Statistics of East Kalimantan Province

Table 25.1.2 Area and Population Density by District in East Kalimantan

1990 - 1999

District	Area		Population Density per KM^2									
	KM^2	%	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990
Pasir	15,150	7.134	19.90	19.30	18.93	16.02	15.37	15.34	15.2:	14.52	14.23	13.97
Kutai	97,936	46.119	8.40	8.30	8.21	6.64	6.55	6.34	6.14	5.92	5.75	5.64
Berau	25,328	11.927	2.98	2.95	3.01	3.94	3.56	2.98	2.79	2.60	2.51	2.46
Bulungan	71,769	33.797	3.79	3.77	3.80	2.54	2.46	2.41	2.32	2.25	2.21	2.12
Balikpapan	620	0.292	713.00	696.90	699.18	584.07	565.05	554.45	554.06	551.88	550.45	500.87
Samarinda	637	0.300	945.69	904.63	890.74	720.81	698.11	691.25	684.50	644.76	638.05	640.34
Bulungan (Tarakan)	507	0.239	-	-	-	209.13	195.89	181.03	174.49	168.77	165.36	160.06
Kutai (Bontang)	407	0.192	-	-	-	209.74	180.50	176.36	171.08	172.73	163.03	164.56
TOTAL	212,354	100.00	11.90	11.63	11.54	10.35	9.97	9.69	9.49	9.16	8.98	8.72

Source : BPS - Statistics of East Kalimantan Province

Table 25.1.3 GRDP by Field of Business at Constant Market Price of 1993 in East Kalimantan

No.	Field of Business	Year (million Rp)						
		1993	1994	1995	1996	1997	1998	1999
1,	Agriculture	1,364,606	1,417,812	1,659,717	1,794,162	1,853,156	1,533,919	1,702,427
2,	Mining	4,799,550	5,344,763	5,709,904	5,921,899	6,348,291	6,413,052	6,738,547
3,	Processing industry	5,399,868	6,068,511	5,819,098	6,349,795	6,439,542	6,683,649	7,021,855
4,	Electricity & Fresh Water	45,184	48,921	53,188	58,265	64,542	68,981	75,642
5,	Building	433,008	483,453	535,411	612,804	666,363	558,811	567,193
6,	Trading, Hotel & Restaurant	1,430,950	1,539,063	1,656,650	1,836,855	1,909,139	1,901,067	1,906,007
7,	Transportation & communication	1,355,092	1,565,416	1,794,548	2,049,261	2,169,404	2,181,588	2,257,788
8,	Financial, Leasing & Housing service	534,480	594,841	635,689	706,462	730,212	669,998	590,978
9,	Services	345,681	382,257	412,375	462,689	492,075	503,570	522,923
Total		15,708,419	17,445,037	18,276,580	19,792,192	20,672,724	20,514,635	21,383,360

Source : BPS – Statistical of East Kalimantan

Table 25.1.4 GRDP by Industrial Origin at Constant Market Price of 1993 in East Kalimantan

(Million Rupiah)

Industrial Origin	1990	1991	1992	1994	1995	1994	1993
1 Agriculture, Livestock, Forestry and Fishery	1,732,027	1,533,919	1,853,196	1,793,102	1,652,717	1,917,812	1,364,605
a. Farm Food Crops	283,091	290,585	314,820	303,124	308,481	252,955	255,656
b. Farm Estate Crops	35,091	88,475	97,231	85,705	78,565	87,179	45,185
c. Livestock and its Products	164,476	232,779	261,438	263,560	192,264	281,622	170,408
d. Forestry	876,334	810,613	951,467	866,443	879,771	785,046	796,712
e. Fishery	283,490	251,467	267,291	235,600	200,636	271,010	156,586
2 Mining and Quarrying	6,738,947	6,813,052	6,868,231	5,921,859	5,769,604	5,340,763	4,996,850
a. Crude Petroleum and Natural gas	5,101,160	4,886,708	4,969,257	4,746,769	4,646,380	4,350,129	4,048,052
b. Non Oil and gas mining	1,402,558	1,299,387	1,187,248	972,367	859,760	629,935	637,498
c. Quarrying	234,227	226,877	221,776	204,744	183,965	360,699	311,020
3 Manufacturing Industry	7,021,855	6,683,649	6,139,812	6,340,795	5,819,038	5,058,511	5,399,648
a. Oil and Gas Manufacturing	4,834,320	4,598,166	4,295,810	4,327,267	3,904,956	4,283,491	3,720,726
- Petroleum Refinery Manufacturing	1,616,826	1,682,311	1,577,269	1,731,851	1,528,950	1,742,919	1,605,968
- Liquid Natural Gas	3,217,501	2,915,855	2,718,541	2,595,416	2,380,995	2,540,553	2,114,758
b. Non oil and Gas Manufacturing	2,187,527	2,085,483	2,143,731	2,022,528	1,914,082	1,785,020	1,679,142
- Food Stuffs, Bev. And Tobacco	75,295	75,258	79,507	55,649	65,912	50,160	26,163
- Textiles, Leather Products & Footwear	15,276	14,815	15,056	12,773	12,474	11,138	6,680
- Wood Products & Other Prod. Forestry	1,463,900	1,410,769	1,402,283	1,303,572	1,253,851	1,208,205	1,169,302
- Paper and Printing	20,419	19,699	19,264	14,912	14,289	12,909	8,486
- Fertilizers, Chemical & Rubber	381,361	574,103	572,614	564,143	533,634	469,052	458,573
- Cement and Non Metalic Mineral	19,434	19,835	17,092	14,268	13,001	12,513	6,500
- Goods for Metals, Machine and its other Acces	37,469	32,412	32,126	27,211	22,967	19,009	13,038
4 Electricity and Water Supply	75,602	68,981	58,542	58,265	53,188	69,821	48,134
a. Electricity	66,357	60,313	50,192	50,211	46,185	42,097	39,028
b. Gas.	-	-	-	-	-	-	-
c. Water Supply	9,245	8,668	8,350	8,154	7,002	6,224	6,006
5 Construction	567,193	558,811	666,563	612,834	535,411	483,453	433,048
6 Trade, Hotel and Restaurant	1,906,007	1,901,067	1,909,139	1,816,858	1,656,650	1,539,063	1,430,930
a. Whole sale & retail Trade	1,615,269	1,614,959	1,633,766	1,583,813	1,422,212	1,318,201	1,209,103
b. Hotels	104,971	103,738	99,488	70,583	71,582	66,424	70,354
c. Restaurant	185,827	182,370	177,916	173,058	162,856	150,437	151,493
7 Transportation and Communication	2,257,789	2,181,585	2,169,401	2,039,961	1,794,548	1,508,716	1,395,692
a. Transportation	2,368,813	2,001,139	1,990,900	1,859,881	1,659,305	1,453,048	1,250,602
- Train Transportation	-	-	-	-	-	-	-
- Road Transportation	334,436	311,219	309,318	251,778	253,257	220,980	189,015
- Sea Transportation	457,941	449,960	449,266	450,202	371,093	305,561	240,319
- Sea Transportation	356,469	335,571	313,316	289,202	237,851	174,001	150,930
- Air Transportation	55,275	62,758	80,396	88,089	78,709	67,205	62,486
- Transportation Service	864,815	841,891	840,864	799,670	721,365	676,420	609,186
b. Communication	189,275	180,469	178,934	159,380	135,223	112,060	94,650
- Post and telekomunikasi	181,772	173,307	171,818	153,104	129,647	107,770	90,777
- Communication Service	7,503	7,162	7,086	6,276	5,576	4,508	3,873
8 Financial, Ownership & Business Service	590,998	569,998	790,212	906,462	436,689	504,341	834,480
a. Banking	71,256	175,849	225,938	225,871	186,337	152,629	125,510
b. Financial Institution non banking	60,452	38,836	35,911	33,227	30,137	20,225	20,003
c. Support Financial Service	369	382	340	90	86	74	73
d. Ownership of dwelling	409,383	385,502	372,776	264,332	329,901	318,722	310,350
e. Business Service	71,516	70,447	95,626	92,842	80,228	83,691	78,444
9 Service	522,923	509,590	492,075	462,689	412,375	392,257	365,581
a. Public Administration and Defence	361,254	350,019	342,486	331,007	292,342	267,196	250,183
- Public Administration and Defence	361,254	350,019	342,486	331,007	292,342	267,196	250,183
- Other Public Service	-	-	-	-	-	-	-
b. Non Government	161,669	159,571	149,591	131,683	120,033	115,062	95,397
- Social and Community Service	8,809	8,012	7,842	6,810	6,695	6,308	5,714
- Ammusement and Recreation service	33,445	33,768	31,051	29,481	29,402	29,278	26,095
- Personal and House Hold Service	119,415	117,792	110,697	95,392	83,936	80,476	63,709
Gross Domestic Regional Product	24,383,361	20,514,635	20,672,725	19,952,192	18,276,580	17,445,087	15,718,429

Source : BPS - Statistics of East Kalimantan Province

out at many special wharves (DUKS) along rivers. Actually, bulk cargo throughput of special wharves is much more than that of public ports in East Kalimantan.

River ports in East Kalimantan suffer from shallow stream, as a result, vessel size must be quite limited, and vessel navigation must greatly depend on the tide condition. Barge transport has also become one of the most dominant transport means. Despite those, international trade has been increasing. Exports from East Kalimantan by port reached 40,893,387 tons in 1995 with a value of US$ 4,646,534,000. Between 1991 and 1995, exports increased by 80% in volume and 28% in value. Imports reached 3,168,772 tons in 1995 with a value of US$ 906,436,000. During the same period, imports showed an increase of 78% in volume and an increase of 18% in value.

25.1.3 Capital Investments

Economic development of East Kalimantan has heavily relied on natural resources. Provincial and municipal government have tried to attract investors. Recently, investment in several sectors is increasing, including mining, forestry and agricultural processing.

Free trade agreement of ASEAN (AFTA), which will come into effect in 2003, is an opportunity to promote East Kalimantan to the world market. With an open economic policy, East Kalimantan Province could invite more investment. In line with the decentralization process currently underway, East Kalimantan Province should appropriately respond to this huge task.

Financing for economic development of East Kalimantan relies on four financial sources: (1) state budget, (2) national income and expenditure budget, (3) foreign loan, (4) local revenue and private investment. During the period of 1996 to 1999, the private sector's investment for financing infrastructure and physical development in East Kalimantan was high. During the same period, the value of total investment realized by all financial sources reached Rp.31 trillion, out of which Rp.29 trillion was invested by private sectors.

The direct foreign investment (PMA) and the domestic investment (PMDN) are also playing an important role. However, PMA and PMDN in East Kalimantan have been experiencing fluctuation year by year. According to the data from the Regional Investment Board for Domestic and Foreign during the period of 1991 to 2000, the largest investment (US$ 2,169,624,000) by PMA was financed in 1996. Foreign investment had not fallen sharply even at the time of economic crisis in Indonesia. PMDN had experiences the largest investment (Rp.6,413,103 million) in 2000. The trend of foreign and domestic investment clearly shows that the economic potential of East Kalimantan is very attractive from the private investor's point of view. The key factor for capital investment in East Kalimantan is sustainable natural resource exploitation and its industrial development.

Table 25.1.5 Volume of Export/Import by Port in East Kalimantan (Ton)

1990 - 1995

Ports	EXPORTS					
	1995	1994	1993	1992	1991	1990
Muara Pasir	47,290.00	196,598.00	40,978.00	272,766.00	318,268.00	299,549.00
Balikpapan	2,971,287.00	2,084,769.00	1,611,112.00	1,209,392.00	683,387.00	1,011,283.00
Samarinda	3,948,302.00	4,710,331.00	3,935,326.00	4,083,379.00	3,223,621.00	2,751,651.00
Tanjung Redeb	35,211.00	28,890.00	1,631.00	41.00	20.00	96.00
Lingkas Tarakan	132,384.00	130,511.00	132,498.00	98,440.00	76,782.00	49,196.00
Nunukan	365.00	213.00	-	-	-	-
Tanjung Santan	4,461,756.00	4,127,276.00	2,456,106.00	2,589,804.00	2,130,126.00	1,582,488.00
Bunyu	189,633.00	200,215.00	172,644.00	241,027.00	234,415.00	333,198.00
Tanjung Sangata	10,048,472.00	10,075,752.00	8,587,490.00	7,001,749.00	1,951,999.00	353,619.00
Bontang	15,331,042.00	15,510,093.00	13,203,537.00	12,718,753.00	12,482,347.00	10,945,515.00
Senipah	1,421,257.00	1,483,836.00	1,502,092.00	1,335,968.00	1,536,536.00	1,602,896.00
Dermaga Juwata	71,468.00	63,427.00	105,427.00	124,970.00	108,918.00	119,682.00
Others	2,231,920.00	1,944,781.00	997,448.00	165,538.00	205.00	343.00
Total	40,893,387.00	40,556,692.00	32,816,289.00	30,141,827.00	22,747,121.00	19,049,516.00
PORTS	IMPORTS					
	1995	1994	1993	1992	1991	1990
Balikpapan	2,987,103.00	2,303,373.00	1,118,446.00	1,323,913.00	1,636,422.00	969,841.00
Samarinda	101,676.00	65,207.00	57,795.00	97,059.00	82,984.00	81,811.00
Lingkas Tarakan	8,148.00	5,988.00	8,578.00	2,616.00	8,228.00	2,954.00
Nunukan	8,865.00	311.00	19,580.00	7,540.00	17,659.00	1.00
Tanjung Selor	9.00	2.00	7.00	188.00	2,079.00	209.00
Bontang	18,677.00	6,787.00	7,437.00	21,784.00	7,717.00	4,800.00
Samboja	11,260.00	71.00	1.00	7.00	1,973.00	748.00
Tanjung Redeb	37.00	6.00	5.00	781.00	400.00	4.00
Tanjung Aru	6,682.00	4,482.00	540.00	-	-	3.00
Other	76,315.00	15,833.00	20,134.00	24,961.00	23,095.00	14,702.00
Total	3,168,772.00	2,402,060.00	1,232,523.00	1,478,849.00	1,780,558.00	1,075,073.00

Source : BPS Statistics of East Kalimantan Province

Table 25.1.6 · Value of Export/Import by Port in East Kalimantan (Thousand US $)

1990 - 1999

Ports	EXPORTS								
	1999	1998	1997	1996	1995	1994	1993	1992	1991
Muara Pasir	52.00	27,979.00	67,766.00	6,290.00	6,179.00	22,893.00	4,634.00	38,704.00	48,063.00
Balikpapan	569,567.00	420,744.00	492,737.00	415,613.00	370,596.00	342,519.00	362,925.00	271,728.00	209,708.00
Samarinda	511,859.00	464,240.00	585,960.00	691,869.00	700,179.00	738,540.00	855,824.00	696,880.00	594,048.00
Tanjung Redeb	66,824.00	38,971.00	29,844.00	7,617.00	1,557.00	2,879.00	1,004.00	314.00	180.00
Lingkas Tarakan	80,745.00	107,080.00	142,281.00	133,302.00	123,262.00	131,062.00	117,677.00	70,180.00	54,297.00
Nunukan	-	161.00	263.00	78.00	1,899.00	2,429.00	-	-	-
Tanjung Santan	425,206.00	415,183.00	738,116.00	745,416.00	582,929.00	507,558.00	345,718.00	413,063.00	344,612.00
Bunyu	11,506.00	10,900.00	39,007.00	14,494.00	24,023.00	23,484.00	22,742.00	34,498.00	32,218.00
Tanjung Sangata	353,886.00	442,312.00	460,022.00	416,461.00	329,744.00	364,686.00	318,015.00	723,441.00	73,816.00
Bontang	2,950,674.00	2,293,317.00	2,859,741.00	2,616,952.00	2,244,215.00	1,991,313.00	1,940,102.00	1,938,208.00	2,040,936.00
Sangkulirang	279,756.00	160,309.00	254,790.00	217,178.00	181,710.00	175,755.00	205,749.00	284,655.00	228,986.00
Dermaga Juwata	7,303.00	6,691.00	2,647.00	6,518.00	8,068.00	6,191.00	7,130.00	9,422.00	7,608.00
Others	80,005.00	76,079.00	64,921.00	88,747.00	72,253.00	69,131.00	32,242.00	9,238.00	3,350.00
Total	5,337,383.00	4,403,900.00	5,738,095.00	5,390,535.00	4,646,534.00	4,372,380.00	4,213,962.00	4,490,331.00	3,637,819.00

PORTS	IMPORTS								
	1999	1998	1997	1996	1995	1994	1993	1992	1991
Balikpapan	615,368.00	458,643.00	842,448.00	797,549.00	548,042.00	476,384.00	300,260.00	343,215.00	413,891.00
Samarinda	177,434.00	136,319.00	189,113.00	232,649.00	245,974.00	131,125.00	126,995.00	136,638.00	209,572.00
Lingkas Tarakan	2,987.00	-	414.00	6,423.00	2,004.00	2,541.00	242.00	390.00	1,016.00
Nunukan	-		39.00	92.00	65.00	43.00	142.00	170.00	256.00
Tanjung Selor	-	-	301.00	16.00	124.00	70.00	748.00	395.00	5,803.00
Bontang	173,624.00	277,488.00	142,281.00	234,215.00	130,511.00	59,768.00	65,199.00	216,751.00	47,063.00
Samboja	-	-	-	2,648.00	2,490.00	96.00	51.00	91.00	3,277.00
Tanjung Redeb	1,327.00	1,040.00	340.00	460.00	149.00	75.00	144.00	93.00	422.00
Tanjung Aru	-	-	2,199.00	7,179.00	7,077.00	14,344.00	34.00	18.00	-
Others	164,538.00	137,814.00	220,059.00	179,730.00	89432r	56,285.00	44,523.00	59,382.00	101,479.00
Total	1,135,278.00	1,011,304.00	1,397,194.00	1,510,961.00	936,436.00	740,731.00	538,328.00	757,163.00	782,779.00

Source : BPS - Statistics of East Kalimantan Provinces

Table 25.1.7 Investment Plan of PMA and PMDN Approved in East Kalimantan Province (1991 to 2000)

Year	Direct Foreign Investment(PMA)		Domestic Investment(PMDN)	
	US$(1,000)	No. of Projects	Rp. (1,000)	No. of Projects
1991	4,000.0	1	1,284,330.0	17
1992	285,443.4	3	2,216,153.1	5
1993	19,305.0	2	1,989,065.8	15
1994	90,151.1	7	1,944,789.4	19
1995	1,975,551.1	12	3,661,172.0	27
1996	2,169,624.0	8	2,926,244.5	25
1997	704,417.8	13	3,690,961.6	31
1998	408,829.0	8	1,756,480.7	13
1999	40,993.8	3	893,134.2	11
2000	82,394.6	14	6,413,103.6	22

25.1.4 Prospects of Major Sectors

(1) Natural Resources

East Kalimantan Province has much potential for coal mining, oil, natural gas, forestry and agriculture. Among them, the dominant industries compose of oil, natural gas and coal mining at this moment. Oil, natural gas and coal are non-renewable resources that are exploited and predictably exhausted, while forestry and agricultural resources are renewable, accordingly, need to be utilized in a sustainable manner.

1) Oil and Natural Gas

Production of oil and natural gas in East Kalimantan slightly decreased in 1999, after greatly increasing from 1997 to 1998. Deposit of oil is 454,118 MMSTB in the land area, and 741,500 MMSTB in the offshore area. On the other hand, deposit of natural gas is 11,000,000 MMSCF in the land area, and 27,000,000 MMSCF in the offshore area. Oil and natural gas have been exploited by big six companies.

Table 25.1.8 Mineral Resources Production in East Kalimantan

Resources (Unit)	1997	1998	1999
Oil (MMSTB)	10,870	78,275	70,205
Natural Gas (MMSCF)	468,962	1,785,885	1,561,679
LNG ('000 M3)	34,376	36,913	NA

Table 25.1.9 Deposit of Mineral Resources in East Kalimantan

Resources (Unit)	Land Area	Offshore Area
Crude Oil (MMSTB)	454,118	741,500
Natural Gas (MMSCF)	11,000,000	27,000,000
Coal (Ton)	5,352,473,000	-

2) Coal

Production of coal has been rapidly increasing recently, and reached 33,652,982 tons in 1999. Deposit of coal in East Kalimantan is 5,352,473,000 tons, among which tested around 36.5%, estimated around 13.5%, and predicted around 50 %. The area of coal mining in 1999 is 133,571 hectares, and has been exploited by big four companies.

3) Forestry

The forest potential is playing an important role for East Kalimantan economy. The acreage under wood cutting from 1996 to 1999 reached 4,030,125 hectares. The acreage of potential forest remains 8,903,000 hectares with estimated wood production of 1,511440,308 m3 (169.77 m3/hectare). The annual log production in East Kalimantan is almost stable, and reached 5,534,000 m3 in 1999, in other words, 29% of Indonesia total. The plywood production in East Kalimantan is 1,196,552 m3 in 1999, 17% of Indonesia total (Table 25.1.10). Also production level of blockboard and moulding/dowel are relatively high. The forestry improvement in East Kalimantan from 1990 to 1999 is shown in Table24.1.11.

Table 25.1.10 Forest Production in East Kalimantan in 1999

Forest Products	East Kalimantan	Indonesia
Logs (m3)	5,534,000	19,027,000
Sawn Timber (m3)	188,582	2,707,221
Plywood (m3)	1,196,552	7,154,729
Veneer (m3)	21,621	NA
Chips (m3)	13,374	NA
Pulps (m3)	-	NA
Blockboard (m3)	91,329	NA
Moulding/Dowel (m3)	59,979	NA

4) Agriculture

Plantation, both state owned and small holders, is one of the major economic sectors of East Kalimantan Province. Main commodities of plantation are palm oil, rubber and coconut. These products are all export-oriented. Growing and largely produced plantation crop in East Kalimantan is palm oil. The planted area of oil palm increased from 92,000 hectares in 1998 to 117,000 hectares in 1999. Palm oil production was 227,000 tons in 1998, and 356,000 tons in 1999. Oil palm plantation can be found out in Pasir and Kutai Regencies located in the southern part of the Province, which are included within the Samarinda/Balikpapan port hinterland. Considering the substantial growth of the oil palm plantation in East Kalimantan, palm oil production is also expected to increase.

On the other hand, the agricultural area for food crops and horticulture is only 167 hectares. The performance of food crops and horticulture production is still very low. As a result, East Kalimantan has become a net importer of staple food, rice and vegetable from other region. This tendency is expected to continue for the time being. Table 25.1.12 shows planted area by kind of agricultural products.

Table 25.1.11 Forestry Improvement in East Kalimanta from 1990 to 1999

1990 - 1999

District/ Municipality	Forest Land Use Consensus	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990
Pasir	Protection Area Forest	184,711.00	184,711.00	133,700.00	184,711.00	184,711.00	184,711.00	184,711.00	184,711	184,711	184,711
	Park and Reserve Forest	53,800.00	53,800.00	105,000.00	53,800.00	53,800.00	53,800.00	53,800.00	53,800	53,800	53,800
	Limited Production Forest	185,556.00	185,556.00	233,250.00	185,556.00	185,556.00	185,556.00	185,556.00	527,356	527,356	189,556
	Divisitive Production Forest	314,938.00	314,941.00	294,130.00	314,941.00	314,941.00	314,941.00	314,941.00	432,420	432,420	314,943
	Total Definitive	554,297.00	554,297.00	672,430.00	554,297.00	739,008.00	739,008.00	739,008.00	993,169	993,169	738,005
	Research/education Forest	331,832.00	-	10,000.00	-	-	-	-	-	-	-
	Conversion Forest	-	331,832.00	645,000.00	33,832.00	331,832.00	331,832.00	331,832.00	379,366	435,762	331,932
Kutai	Protection Area Forest	1,500,681.00	1,806,981.00	1,426,780.00	1,762,128.00	1,762,128.00	1,726,128.00	1,806,988.00	1,806981	1,806,581	1,762,128
	Park and Reserve Forest	267,000.00	267,000.00	336,629.00	267,000.00	267,500.00	267,500.00	267,000.00	294560.00	282,560	267,000
	Limited Production Forest	2,684,444.00	2,688,444.00	2,951,001.00	2,685,440.00	2,874,500.00	2,874,500.00	2,662,809.00	2,662,809.00	2,716,500	2,722,344
	Divisitive Production Forest	3,108,854.00	3,108,854.00	2,550,494.00	3,103,851.00	3,027,751.00	3,027,754.00	3,258,488.00	4,238,652.00	3,705,07	2,935,221
	Total Definitive	6,009,298.00	5,792,555.00	8,062,185.00	5,434,895.00	7,931,882.00	7,931,882.00	7,995,279.00	8,001,092.00	8,564,276	7,886,693
	Research/education Forest	3,149,248.00	22,724.00	7,600.00	-	-	-	-	-	-	-
	Conversion Forest	22,724.00	3,127,248.00	1,917,780.00	2,398,597.00	2,874,500.00	2,874,500.00	2,806,532.00	1,481,485.00	3,167,936	2,883,340
Berau	Protection Area Forest	376,624.00	376,624.00	367,166.00	376,624.00	376,624.00	376,624.00	376,624.00	376,624.00	376,624	376,624
	Park and Reserve Forest	-	-	500.00	-	200.00	200.00	-	-	-	-
	Limited Production Forest	834,804.00	834,804.00	827,156.00	834,804.00	834,804.00	834,804.00	834,804.00	834,804.00	834,804	834,804
	Divisitive Production Forest	637,242.00	637,242.00	608,320.00	637,242.00	637,242.00	637,242.00	637,242.00	637,242.00	536,492	330,492
	Total Definitive	1,472,046.00	1,472,046.00	1,297,185.00	1,472,046.00	1,848,870.00	1,848,870.00	1,848,870.00	1,848,870.00	1,747,920	1,747,920
	Research/education Forest	379,079.00	-	-	-	-	-	-	-	-	-
	Conversion Forest	-	379,079.00	519,549.00	379,079.00	379,079.00	379,079.00	379,079.00	379,079.00	479,829	479,829
Bulungan	Protection Area Forest	1,004,068.00	1,004,068.00	1,004,068.00	1,004,068.00	1,004,068.00	1,004,068.00	1,004,068.00	1,096,374.00	1,096,374	1,038,068
	Park and Reserve Forest	1,706,100.00	1,706,400.00	1,706,400.00	75,234,791.00	1,600,000.00	1,600,000.00	1,706,600.00	1,706,400.00	1,706,100	1,706,600
	Limited Production Forest	1,123,789.00	1,123,789.00	1,123,789.00	1,123,789.00	1,123,789.00	1,123,789.00	1,123,789.00	1,089,189.00	1,089,189	1,089,189
	Divisitive Production Forest	1,387,947.00	1,387,947.00	1,387,947.00	1,387,947.00	1,387,947.00	1,387,947.00	1,387,947.00	1,387,947.00	1,359,787	1,359,787
	Total Definitive	4,218,136.00	4,218,136.00	4,218,136.00	77,746,534.00	5,115,804.00	5,115,804.00	5,222,204.00	5,279,910.00	5,194,844	5,194,844
	Research/education Forest	948,520.00	-	-	-	-	-	-	-	-	-
	Conversion Forest	-	948,520.00	1,957,456.00	94,852.00	948,520.00	984,520.00	488,520.00	948,520.00	946,680	955,680
Balikpapan	Protection Area Forest	65,406.00	65,406.00	16,500.00	65,406.00	65,406.00	65,406.00	65,406.00	7,600.00	8,600	65,306
	Park and Reserve Forest	-	-	-	-	-	-	-	-	-	1,836
	Limited Production Forest	141,682.00	142,682.00	-	141,682.00	141,682.00	141,682.00	141,682.00	-	-	141,782
	Divisitive Production Forest	117,479.00	117,479.00	3,300.00	117,479.00	117,479.00	117,479.00	117,479.00	-	-	117,479
	Total Definitive	259,161.00	259,161.00	3,300.00	259,161.00	324,567.00	324,567.00	324,567.00	7,600.00	7,600	326,403
	Research/education Forest	101,933.00	1,836.00	1,836.00	1,836.00	1,836.00	1,836.00	1,836.00	-	-	-
	Conversion Forest	1,836.00	101,933.00	31,054.00	101,933.00	101,933.00	101,933.00	101,933.00	54,400.00	61,020	101,933
Samarinda	Protection Area Forest	-	-	-	44,853.00	44,853.00	44,853.00	-	-	-	44,853
	Park and Reserve Forest	-	-	-	3,000.00	3,000.00	3,000.00	3,000.00	-	-	18,724
	Limited Production Forest	-	-	-	24,365.00	24,365.00	24,365.00	-	-	-	24,365
	Divisitive Production Forest	-	-	-	230,735.00	230,735.00	230,735.00	-	-	-	230,360
	Total Definitive	-	-	-	258,100.00	302,953.00	302,953.00	-	-	-	321,302
	Research/education Forest	-	-	303.00	22,724.00	22,724.00	22,724.00	22,724.00	-	-	-
	Conversion Forest	-	-	78,000.00	350,851.00	350,851.00	350,851.00	-	65,700.00	71,400	355,226
Total	Protection Area Forest	3,437,290.00	3,437,790.00	2,928,224.00	3,441,710.00	3,437,790.00	3,401,790.00	3,457,790.00	3,472,290.00	3,469,290.00	3,472,290.00
	Park and Reserve Forest	2,027,000.00	2,027,200.00	2,147,529.00	75,558,596.00	1,924,500.00	1,924,500.00	2,029,200.00	2,054,760.00	2,047,760.00	2,047,760.00
	Limited Production Forest	4,930,275.00	4,934,275.00	5,125,296.00	4,959,696.00	4,184,686.00	5,184,693.00	4,945,640.00	5,914,153.00	4,997,831.00	4,997,840.00
	Divisitive Production Forest	5,561,463.00	5,561,463.00	4,645,940.00	5,772,395.00	5,716,098.00	5,716,084.00	5,716,068.00	6,656,261.00	6,033,540.00	5,697,280.00
	Total Definitive	12,513,038.00	12,216,305.00	14,163,026.00	83,924,395.00	16,263,024.00	16,262,084.00	16,129,728.00	16,136,591.00	16,491,931.00	16,015,170.00
	Research/education Forest	4,510,612.00	24,960.00	19,136.00	24,560.00	24,560.00	24,560.00	24,560.00	-	-	-
	Conversion Forest	24,560.00	4,910,612.00	5,173,955.00	3,758,944.00	4,986,715.00	5,071,715.00	4,157,493.00	3,206,549.00	5,190,230.00	5,127,930.00

Source: BPS - Statistics of East Kalimantan Province

(2) Processing Industry

East Kalimantan Province is developing the industrial sector to strengthen its economic structure focusing on mining processing industry, forest industry and agricultural products processing industry. Among them, mining processing industry is the most successful economic sector in terms of the contribution to the regional economy as well as to the nation's economy. The estimated amount of oil, natural gas and coal deposits is quite enough and satisfactory. Thus, intensification of natural resource utilization in a sustainable way and steady industrialization by relevant private sector should be the basic policy to bring about economic success in East Kalimantan. On the other hand, forest and agricultural industry produce semi-finished products such as plywood, processed woods, and rubber. In order to make those industries more attractive to the regional economy, value-added industrialization is required. In addition, further industrial development requires efficient ports which can help distribute the products both domestically and internationally. Development of river ports aiming at export and import activities will realize the following benefits:

- To support the growth of the industrial sectors which require efficient export capacity.
- To realize reduction of the transportation costs by shifting a loading port from neighboring provinces to East Kalimantan Province.
- To provide efficient river transportation for various commodities including plantation products, forestry products and mining products.
- To help realize the relocation of industries from industrialized nations to East Kalimantan.

25.1.5 Prospects of East Kalimantan Economy

To sum up, the prospects of East Kalimantan economy in the next 5-10 years are promising, particularly in mining industry and agricultural development. On the other hand, appropriate measures should be taken to preserve the existing forests since the resources have been greatly depleted. Forest preservation will lessen the siltation in the rivers and can lead to the creation of an eco-tourism industry. Human resource development is also important to help the local labor force enter high value-added industries.

The competitive advantage of East Kalimantan is the availability of various raw materials for different types of industrial development. This advantage can become greater if transportation infrastructure is properly developed.

Table 25.1.12 Planted Area by Agricultural Product in East Kalimantan from 1990 to 1999 (Ha)

1990-1999

District/ Municipality	Kind Of Plant	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990
Pasir	Rubber	14,507.00	16,134.00	15,836.00	17,962.00	13,299.00	14,762.00	15,518.00	15,227.00	12,598.00	11,602.00
	Coconut	9,505.00	9, 585 . 50	9,430.00	9,430.00	9,430.00	9,430.00	9,430.00	7,618.00	7,197.00	6,787.00
	Coffee	4,741.00	4,690.00	4,602.00	4,602.00	4,552.00	4,502.00	4,452.00	4,183.00	4,049.00	3,005.00
	Pepper	665.00	665.00	610.00	610.00	610.00	610.00	610.00	444.50	381.00	371.00
	Cloves	22.00	-	-	-	497.00	720.00	720.00	583.00	580.00	580.00
	Cocoa	1,574.00	1,574.00	1,966.00	1,956.00	1,956.00	1,956.00	1,906.00	1,586.00	1,276.00	1,246.00
	Palm Oil	66,245.00	79,713.00	43,418.00	40,440.00	38,874.00	33,809.00	32,369.00	28,238.00	24,094.00	26670.00
	Others	316.00	475.00	329.00	243.00	206.00	206.00	212.00	261.00	276.00	270.00
Kutai	Rubber	35,230.00	33,395.00	32,185.00	28,819.00	25,269.00	23,405.00	20,833.00	21,863.00	21,257.00	20500.00
	Coconut	20,223.00	20,106.00	20,027.00	37,266.00	37,229.00	36,926.00	34,798.00	30,791.00	3,557.00	29850.00
	Coffee	4,360.00	4,232.00	4,441.00	5,061.00	5,026.00	5,026.00	4,899.00	4,619.00	4,602.00	4,430.00
	Pepper	7,175.00	6,729.00	6,811.00	10,491.00	9,540.00	9,840.00	9,751.00	8,732.00	8,492.00	7668.00
	Cloves	106.00	74.00	109.00	130.00	140.00	260.00	580.00	1,383.50	1,482.00	1,482.00
	Cocoa	7,128.00	6,857.00	7,299.00	12,899.00	11,745.00	11,744.00	10,242.00	8,175.00	8,492.00	8539.00
	Palm Oil	44,617.00	40,164.00	25,081.00	16,500.00	4,980.00	1,200.00	180.00	-	-	-
	Others	1,366.00	1,238.50	1,278.00	1,294.00	1,119.00	1,123.00	950.00	715.00	584.00	542.00
Berau	Rubber	754.00	754.00	750.00	750.00	750.00	712.00	712.00	258.00	258.00	258.00
	Coconut	11,645.00	11,155.00	11,132.00	10,851.00	10,806.00	10,744.00	10,730.00	10,356.00	10,174.00	10261.00
	Coffee	2,034.00	1,971.00	1,355.00	1,699.00	1,862.00	1,808.00	1,796.00	1,788.00	1,833.00	1,705.00
	Pepper	659.00	709.00	718.00	700.00	684.00	662.00	662.00	656.50	657.00	655.00
	Cloves	50.00	70.00	108.00	108.00	108.00	288.00	288.00	281.50	289.00	289.00
	Cocoa	5,452.00	4,585.00	4,870.00	3,685.00	3,668.00	3,569.00	3,444.00	3,549.00	2,295.00	1,424.00
	Palm Oil	4,027.00	3,685.00	2,200.00	1,300.00	-	-	-	-	-	-
	Others	920.00	728.00	208.00	202.00	177.00	188.00	202.00	194.00	121.00	98.00
Bulungan	Rubber	-	-	-	-	-	-	-	637.00	611.00	611.00
	Coconut	5,705.00	4,863.00	4,864.00	5,392.00	5,320.00	2,771.00	5,272.00	4,250.00	3,855.00	3,710.00
	Coffee	3,977.00	3,133.00	3,133.00	3,369.50	2,728.00	2,688.00	2,506.00	2,146.00	2,154.00	1,954.00
	Pepper	312.00	287.00	287.00	432.00	342.00	336.00	317.00	270.50	260.00	257.00
	Cloves	113.00	72.00	72.00	72.00	85.00	92.00	92.00	806.50	806.00	806.00
	Cocoa	14,730.00	15,248.00	15,248.00	15,408.00	14,391.00	13,991.00	12,177.00	9,931.50	9,546.00	7,613.00
	Palm Oil	2,199.00	4.00	4.00	4.00	4.00	4.00	4.00	-	-	-
	Others	434.00	728.00	728.00	566.00	547.00	272.00	248.00	86.00	96.00	68.00
Balikpapan	Rubber	1,339.00	196.00	229.00	250.00	266.00	287.00	321.00	380.00	367.00	361.00
	Coconut	1,654.00	1,676.00	1,461.00	1,382.00	1,280.00	1,196.00	1,340.00	1,130.00	1,038.00	1,038.00
	Coffee	177.00	168.00	192.00	177.50	153.00	120.00	190.00	150.00	127.00	74.00
	Pepper	94.00	92.00	229.00	220.00	205.00	192.00	325.00	350.00	342.00	331.00
	Cloves	50.00	63.00	135.00	165.00	170.00	180.00	206.00	220.50	231.00	221.00
	Cocoa	25.00	30.00	66.00	62.00	56.00	50.00	84.00	124.00	124.00	123.00
	Palm Oil	-	-	-	-	-	-	-	-	-	-
	Others	185.00	91.00	138.00	134.00	118.00	84.00	82.00	141.00	292.00	274.00
Samarinda	Rubber	279.00	256.00	672.00	882.50	586.00	904.00	864.00	849.00	1,089.00	811.00
	Coconut	1,062.00	1,021.00	1,627.00	1,843.00	1,612.00	1,136.00	1,110.00	903.00	900.00	947.00
	Coffee	630.00	601.00	829.00	862.00	878.00	1,074.00	1,066.00	940.00	921.00	914.00
	Pepper	240.00	95.00	219.00	144.00	362.00	432.00	521.00	503.50	532.00	451.00
	Cloves	22.00	11.00	25.00	11.00	91.00	123.00	149.00	146.00	155.00	134.00
	Cocoa	979.00	723.00	2,278.00	2,184.00	1,836.00	1,642.00	1,524.00	1,201.50	1,012.00	589.00
	Palm Oil	-	-	-	-	-	-	-	-	-	-
	Others	534.00	305.50	308.00	294.00	286.00	168.00	167.00	209.00	218.00	201.00
TOTAL	Rubber	52,129.00	50,735.00	49,672.00	48,663.50	40,170.00	40,070.00	38,268.00	39,188.00	36,131.00	34,143.00
	Coconut	49,794.00	48,409.00	48,441.00	65,864.00	66,171.00	62,193.00	62,680.00	60,008.00	27,024.00	51,557.00
	Coffee	15,315.00	14,796.00	15,143.00	15,491.00	15,196.00	15,218.00	14,839.00	13,823.00	13,686.00	12,082.00
	Pepper	9,343.00	8,778.00	8,868.00	12,597.00	12,293.00	11,771.00	12,186.00	10,961.00	10,864.00	9,733.00
	Cloves	363.00	290.00	449.00	486.00	1,051.00	1,665.00	2,027.00	3,420.00	3,543.00	3,512.00
	Cocoa	29,888.00	29,044.00	31,317.00	36,194.00	34,184.00	32,952.00	29,377.00	24,867.00	22,744.00	19,340.00
	Palm Oil	116,888.00	123,564.00	68,622.00	58,444.00	43,858.00	35,013.00	32,553.00	28,233.00	24,094.00	26,670.00
	Others	4,255.00	3,571.00	2,989.00	2,723.00	2,466.00	2,011.00	1,861.00	1,605.00	1,587.00	1,453.00

Source : BPS - Statistics of East Kalimantan Province

25.2 Development Target

The development target for Samarinda Port can be summarized as follows:

- To help achieve smooth and economical flow of cargo to/from East Kalimantan Province.
- To act as an impetus for the development of new industries in East Kalimantan Province.

Considering the present socioeconomic conditions of Indonesia as well as its policy of decentralization and privatization, the success of the development of Samarinda Port depends on whether it will answer the urgent need to decrease dependence on the government sector. The central government will play a smaller role in the development and maintenance of port infrastructure. Since Samarinda Port will continue to require maintenance dredging, a mechanism to realize sustainable port operation needs to be established. Competition with neighboring ports should be carefully examined as well to maximize the return of port development investment (Figure 25.2.1).

It is also important to determine an appropriate demarcation of roles among the ports in Indonesia. Since various port projects are underway around the principal river ports, careful examination is needed to avoid duplication of investments and to materialize balanced regional development of the country.

DGSC and IPC are jointly preparing the Network Development Plan of Port Infrastructure in the National Port Arrangement. This effort started inspired by the JICA Study on the Port Development Strategy (March 1999). A draft plan was made available to the Study Team. The areas taken up in the study were port development, port finance and private sector participation, as well as port administration and operation. The Draft Network Development Plan basically follows the study and elaborates on the port development strategy. It identifies criteria for classifying the nation's ports. These criteria are determined according to the cargo throughput in a port. The target ports are classified in the Draft Network Development Plan. This plan classifies Samarinda Port as a tertiary trunk port for most of the port functions.

Considering the economic activities alongside the Mahakam River as well as the lack of an efficient road network in the Province, Samarinda Port needs to serve as a key transportation facility of the Province. On the other hand, the shallow draft within the river and around the river mouth will not allow creation of a deep port. Consequently, the scale of port development at Samarinda should be large enough to serve the economic needs of East Kalimantan. However, excessive or unwarranted development needs to be avoided. This basically agrees with the port hierarchy proposed in the Draft Network Development Plan. Successful port development will bring about positive economic impacts through a sequence of events (Figure 25.2.2)

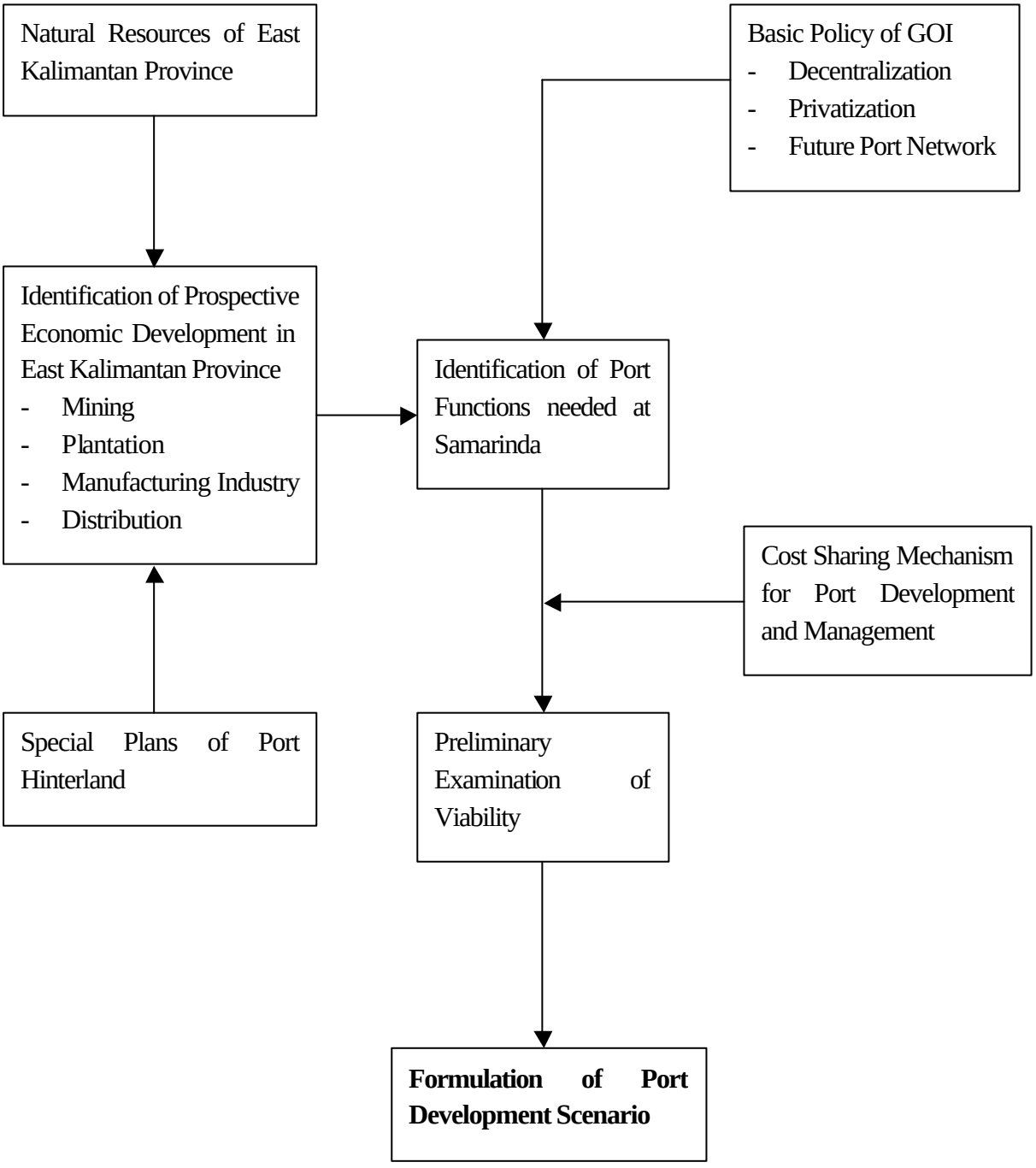


Figure 25.2.1 Formulation of Port Development Scenario

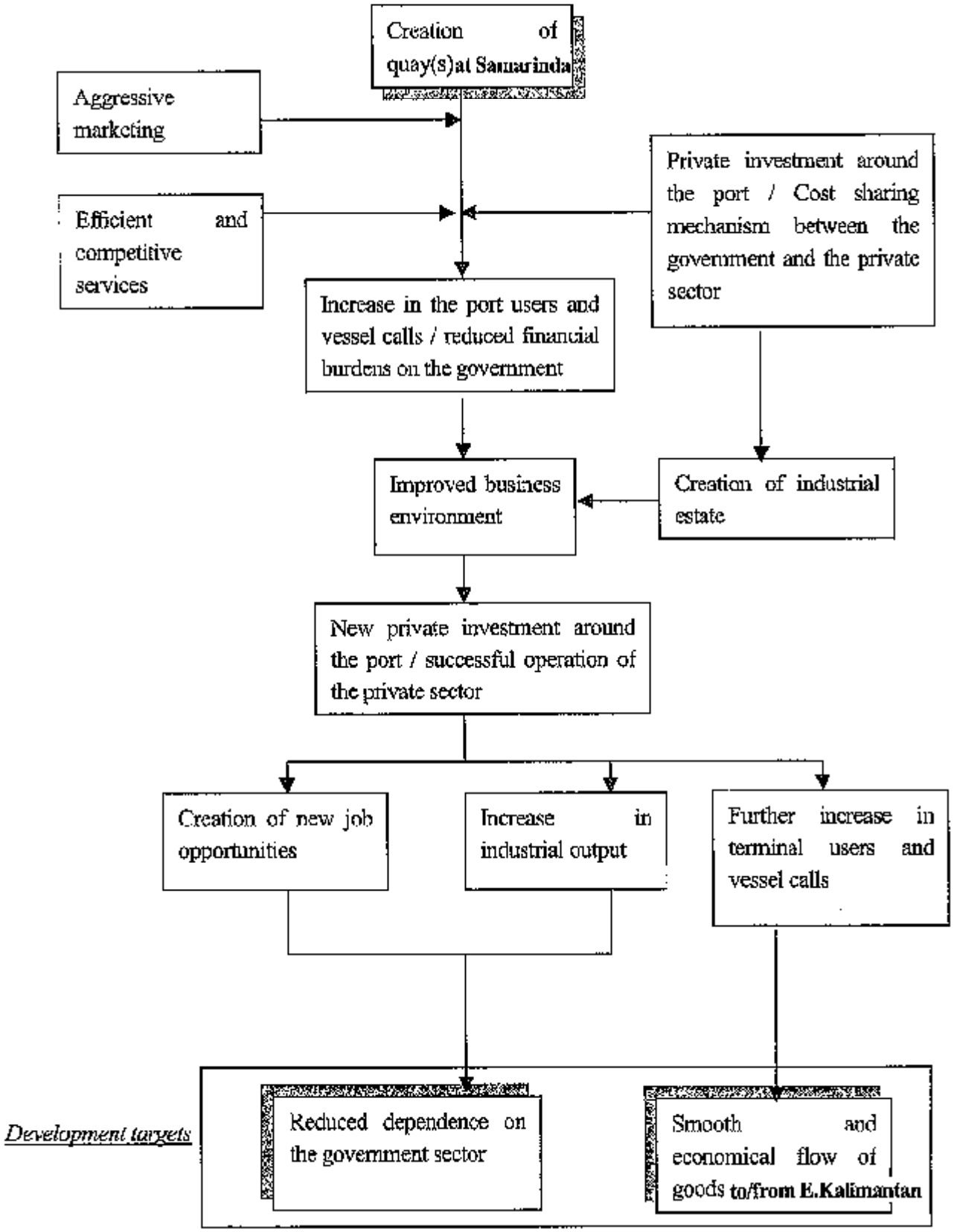


Figure 25.2.2 Development Targets of Samarinda Port

26. DEMAND FORECAST

26.1 Capacity of the Existing Port

26.1.1 Capacity of the Existing Port

In order to identify the need of port expansion, the Study Team identified the present capacity of the existing terminals. The baseline productivity (Table 26.1.1) and the maximum berth occupancy (Table 26.1.2) are the same as those used in evaluating the seven river ports.

Table 26.1.1 Baseline Productivity

Cargo type	Productivity
General Cargo	20 (t/gang/hour)
Bagged Cargo	25 (t/gang/hour)
Unitized Cargo	30 (t/gang/hour)
Liquid Bulk	120 (t/hour)
Dry Bulk	90 (t/hour)
Container (Full Container Terminal)	20 (TEU/crane/hour)
Container (Conventional Terminal)	10 (TEU/crane/hour)

Source: JICA Team

Table 26.1.2 Maximum Berth Occupancy

Number of berths in the group	Recommended Maximum Berth Occupancy
1	40 (%)
2	50 (%)
3	55 (%)
4	60 (%)
5	65 (%)
6-10	70 (%)

Source: Port Development, UNCTAD

26.1.2 Existing Terminal

The existing terminal of Samarinda has 2 container berths, 5 general cargo berths and 1 passenger terminal. The container wharves have no container crane system, thus requiring ship gear/mobile crane handling.

(1) Container

Exiting Facility	: 2 berths
Net Handling Productivity	:10 TEUs /hour
Working Days	: 365days
Operation Hours	: 16hours (8Hours x 2 Shifts)
Work Time Ratio	: 0.8

Recommended Berth Occupancy Ratio : 0.5 (Two-Berth Group)

Capacity = 2 berths x 365 days x 16hours x 0.8 x 10 TEU/hour x 0.5 = 47,000 TEU

(2) General Cargo

Exiting Facility	: 5berth
Net handling productivity	: 20t/hour/gang
Work time ratio	: 0.8
Working days	: 365days
Operation hours	: 16hours (8hours x 2 shifts)
Recommended berth occupancy ratio	: 0.65 (Five-berth Group)

Capacity = 5 berth x 365 days x 16hours x 0.8 x 20t/hour/gang x 2 gang x 0.65 = 607,000 ton

(3) Passenger

Exiting facility	: 1berth
Working days	: 365days
Berthing time	: 2 days
Passenger capacity	: 4,000 persons
Recommended berth occupancy ratio	: 0.4 (one-berth group)

Capacity = 1 berths x 365 days / 2 days x 4,000 persons x 0.4 = 292,000 persons

26.2 Socio Economic Framework

26.2.1 Economic Indicators

(1) Introduction

Economic indicators are important elements in this development study as they serve to underpin port transport with consideration of trends, fluctuations in cargo volumes, likely future traffic growth and future development needs.

The major socio-economic objectives of GBHN and Propenas are described in Chapter 2.

The socio-economic context or framework provides both a basis to plan transport investment and make investment decisions.

(2) National GDP

Until the economic crisis struck in 1997, the economy had been growing by over 7 percent in real terms per year between 1993 and 1997. The rapid expansion was due mainly to rapid increases in the non-oil manufacturing, construction and financial/business sectors. Between 1983 and 1997 these three sectors increased from under 25 percent to over 40 percent of the total economy.

In 1997 growth fell back, but in 1998 the economy contracted by about 13 percent. In 1999 marginal growth re-emerged and by 2000 growth had returned to the relatively substantial level of between 4 and 5 percent. Forecasts for 2001 indicate a reasonably healthy growth rate of a similar level.

Future potential prospects remain good. However, if the recent political and economic instability continues to be overcome and progress can be made in restructuring the financial and banking sectors, then the economic future is bright.

It is hoped that the recent events on September 11 in the USA with its consequent negative impact on the world economy will be relatively short lived. It is therefore assumed that by 2007 and the proposed opening of the port development projects, the Indonesian and world economies will be well back on track.

Table 26.2.1 GRDP Growth in 1993 to 2000

	GRDP (Rp Billions) at 1993 constant prices-Including Oil and Gas					
	1993	1996	1997	1998	1999	2000
West Kalimantan	5,150	6,714	7,220	6,879	7,066	2.5-4.8%
Central Kalimantan	3,068	4,036	4,290	3,993	3,987	<2.5
East Kalimantan	15,712	19,792	20,673	20,515	21,384	<2.5
Indonesia	320,908	407,314	425,614	375,949	380,763	
Annual Growth		26.9%	4.5%	-11.7%	1.3%	4.8%

Source : BPS; Preliminary figures for 1999 and especially 2000

(3) Population

The population of Indonesia increased from 119 million in 1971 to 195 million in 1995. The long term growth rate was about 2.1 percent per year. The overall growth rate has been declining, however, and this trend is common to most Asian countries.

On a regional basis, Sumatra and Kalimantan have grown faster than Java and this has been due both to regional variations in fertility and migration. Migration has been government stimulated because of agricultural and industrial development in these regions. Both factors have led to greater population growth in Sumatra and Kalimantan.

Table 25.2.2 Regional Population Growth

Region	Population (in Millions)		
	1980	1990 (% pa)	1995 (%pa)
Sumatra	28.0	36.5 (2.3 %)	40.8 (26 %)
Kalimantan	6.7	9.1 (2.9 %)	10.5 (3.0 %)
Indonesia	146.9	178.6 (1.7 %)	193.9 (1.9 %)

Source: BPS

(4) Macro Economic Trends

a. National Trends

After performing very strongly for many years, the Indonesian economy was badly hit by the economic crisis which started in mid 1997.

After GDP growth reached over 8 percent in the first half of the 1990s, growth slowed in 1997 before contracting by about 13 percent in 1998 with a very modest recovery in 1999. Recovery began in 2000, with growth between 4 and 5 percent, based largely on a bounce back in consumer spending and exports and this has continued into 2001 despite the political uncertainty in the middle of the year.

Before the crisis, the engines of growth differed by region of Indonesia. Java was fueled by manufacturing, construction and real estate. Kalimantan and Sumatra by oil and estate developments and Bali by tourism. Other, poorer areas were fueled by infrastructure spending

Exports grew by 13 percent in 1995 and by 10 percent in 1996 before falling back in 1997 to 7 percent. Exports in US dollar terms fell by 9 percent in 1998 before stabilising in 1999. Imports grew by 27 percent in 1996 and by 6 percent in 1997 but fell by 3, 34 and 13 percent in 1997, 1998 and 1999 respectively.

The socio economic impact of the crisis has various dimensions.

1) Imports have been reduced substantially, but as many imported goods are raw materials for processing of one kind or another, exports have also been affected.

2) Exports have not accelerated as fast as would be expected from the massive devaluation. Partly, the political and financial uncertainty has affected confidence and high interest rates have affected trade finance. However, export earnings in US$ terms have been affected, although export tonnages and earnings in Rupiah terms have reacted differently.

b. Sector Development Plans

High GDP growth in Indonesia was partly associated with 'bubble-type' industries including construction, utilities and services. Moreover, non-oil manufacturing had concentrated in electronics, shoes, textiles and garments, all of which relied heavily on imports of raw materials or components.

Domestically owned firms that relied on domestic inputs fared relatively badly; for example palm oil and wood based industries were subject to quotas and export taxes.

Oil and gas made up less than 20 percent of exports by value and were subject to volatile world prices, although being priced in US$ gave substantial support to the national budget,

c. Exports

Since 1995, total exports by value have increased by 2 percent per year but in tonnage terms have been declining marginally, reflecting higher value goods.

Due to the depreciation of the Rupiah, the value of exports in Rupiah terms has increased by over 350 percent between 1995 and 1999.

26.2.2 Purpose and Requirements for the Socio-Economic Framework

The purpose of the socio-economic framework is to provide a national development framework for the Study.

In particular, the framework helps in considering national goals from an economic perspective such as development of poorer areas, assistance to Eastern Indonesia and so on, thus ensuring that Study recommendations are consistent with the country's macroeconomic objectives.

The framework will assist in ensuring that priority port selection is consistent with national objectives. The development context forms a basis for a traffic forecasts.

26.2.3 Macro Economic Forecasts and Sources

(1) GOI/Bappenas

GOI/ Bappenas produced a short-term forecast of the economy in January 2001. This described recent relevant economic events and the political background.

Based upon various internal and external assumptions, this report indicated a base scenario for GDP growth of 5-6 % in 2001 and of 6-8 % if policies (and external events) turned out to be more successfully implemented than anticipated.

A number of risks were identified including exchange rate, oil price etc that would affect the projected macro economic performance.

In addition to the short term forecast for 2001, PROPENAS 2000-2004, which was previously summarised, indicated a growth rate forecast shown in the following table.

Table 26.2.3 Macro Economic Growth Scenarios

		Base Case			High Case		
	FY 00	2001	2001	2003	2001	2001	2003
GDP % pa	4.0	4.0	4.0	4.0	4.0	5.0	6.0

A high case would result from greater economic and political stability and faster implementation of the reform programme.

(2) ADB

Table 26.2.4 Key Economic Indicators in Indonesia

KEY ECONOMIC INDICATORS								
	FiscalYear				Calendar Year			
	1997/98	1998/99	1999/00	2000 (9 months)	2001	2002	2003	
Real GDP Growth								
(% pa 1993 Base)	2.1	-14.1	3.5	4.0	4.0	4.0	4.0	
Per Capita GDP	0.6	-15.3	2.0	2.5	2.6	2.6	2.6	
(% pa 1993 Base)								
US$ billions								
Exports	62.3	52.7	60.0	52.5	72.3	74.7	78.3	3.9%
Exports-Merchandise-FOB	56.2	48.4	55.2	48.4	66.7	68.7	72.0	4.2%
Imports	57.6	41.1	43.3	38.3	57.3	61.3	66.6	2.4%
Imports-Merchandise-FOB	42.7	30.7	32.6	29.1	43.5	46.3	50.2	2.7%

Source: ADB

(3) Consultants and Other Sources

Table 26.2.5 GRDP Projection by Province

GRDP (Rp Billions) at 1993 constant prices-Including Oil and Gas				
	1998	1999	2010	1999-2010 (% pa)
West Kalimantan	6,879	7,066	11,959	4.9
Central Kalimantan	3,993	3,987	6,269	4.2
East Kalimantan	20,515	21,384	35,070	4.6
Indonesia	375,949	380,763	658,089	5.1

Source: TSSS Intermediate Scenario and Consultants

The following table shows the projected GRDP for East Kalimantan up to 2025. Growth to 2010 is based on various national and international sources. After 2010, the Consultants have projected continuing and consistent growth. These data have been used as the basis for the regression analysis. However, the regression analysis was of limited use, for example, the main commodity forecasts are not related to GRDP and exports are related to world GDP or more specifically the GDP of importing countries. Imports and unloaded cargoes, which would be related to GRDP, were often relatively small in volume.

It should be noted that the East Kalimantan economy is over 5 times larger than Jambi's. Therefore, we would not expect the very rapid increases which might be expected elsewhere in Indonesia. The growth rates shown over a 25 year period are, nonetheless, significant.

Table 26.2.6 GRDP – Historical And Projected-East Kalimantan

Year	East Kalimantan GRDP
In Constant 1993 Prices in Rp. Billion	
1988	12,689
1989	13,013
1990	13,891
1991	14,775
1992	15,278
1993	15,712
1994	17,072
1995	18,432
1996	19,792
1997	20,673
1998	20,515
1999	21,384
2000	22,368
2007	30,644
2025	55,931

Annual Growth Rates in GRDP	
2000-2007	4.6 %
2007-2025	3.4 %

Sources: BPS, Bappenas, ADB, TSSS, Consultants

(4) Population

Population forecasts are based on assumptions about fertility, mortality, migration and economic development.

Current forecasts from sources such as UNDP, World Bank and GOI suggest that the longer term growth in population may be around 1.4 percent per year between 1995 and 2009. Regional growth is likely to remain higher in Sumatra and Kalimantan.

Table 26.2.7 Population Growth Forecasts By province

Province	Year			Growth Rate in % pa
	1999	2004	2009	
West Kalimantan	3.9	4.3	4.7	1.6
Central Kalimantan	1.8	1.9	2.1	1.7
East Kalimantan	2.6	2.9	3.3	2.3

Source: BPS

(5) Economic Prospects for Indonesia's Major Trading Partners

World Bank indicates that Indonesia's external environment is likely to become less favourable with world growth predicted to slow from 4% to 3 % by 2003. Further, the growth in the economies of Indonesia's largest trading partners is likely to slow or remain modest.

Indonesia's largest markets are:

1) North America
2) Japan
3) Europe and
4) Asia

Recent reports on the US economy indicate that a hard landing will be avoided and that there are signs of weak recovery at end 2001. The Japanese economy also remains relatively weak, with its own financial sector restructuring programme being only slowly implemented.

The European economy also shows signs of slowing, but seems likely to have a soft landing.

Asian markets are expanding but some of the developing countries in Asia have similar but not as serious structural problems as Indonesia. The newly industrialised countries in Asia have generally recovered strongly from the regional crisis that started in mid 1997. In 2000, the GDP growth in some of the NICs was strong (10% and 14% in Korea and China respectively) and this is expected to continue, albeit at more moderated levels.

Except for Indonesia and Thailand, GDP levels in Asia will likely recover to pre-crisis levels by end 2000. Developing Asia GDP as a whole is likely to reach 6.0 % in 2001.

(6) Macro economic Basis of the Forecasts

a. Overview

Detailed macro economic data on Samarinda province has been shown in Section 15.1, but the following provides an overview of macro-economic and industrial basis of the traffic forecasts.

The structure of East Kalimantan's economy is changing, but due to the economic crisis, has been changing quite slowly recently. Agriculture, mining and manufacturing are becoming more significant sectors of the economy. This was shown in the Section on Regional Development.

According to the East Kalimantan Investment Board, between 1993 and 1998, domestic investment totalled nearly 1 billion US$. In order of value these were in plantations, services, timber, chemicals, paper, metals, non metals and hotels.

Foreign investment totalled US$4.5 billion including paper, chemicals, services, utilities, plantations, food and metals. Most of these projects were in Kutai district and Samarinda Kota which are in the hinterland of Samarinda port rather than Balikpapan port.

East Kalimantan was the 6th highest provincial destination in Indonesia for both domestic and foreign investment between 1993 and 1998.

b. SASAMBA

Sasamba is an integrated economic development zone (KAPET) basically covering the area within and between Samarinda and Balikpapan. It has a population of 1.2 million (out of a provincial total of over 2.5 million) and an area of 4,400 Square Km. Currently, manufacturing dominates the non-oil economic activities of Kapet but this is expected to change in the future as agriculture, animals, forestry and fisheries play equally important roles.

The areas which could be developed within the Samarinda port hinterland have been identified as having good potential for agriculture, animal husbandry and land based-fisheries. Areas have also been identified for industrial development. Samarinda city, itself, has been developing as an industrial centre with processing of forestry and agricultural products. These activities have led to supporting industries which have further developed with the oil and gas industries north of Samarinda.

Natural resources include oil and gas, coal, sand and other minerals limestone, kaolin, clay, etc.

Land is also available and suitable for a wide range of crops, shrimp and fish farming and for beef and dairy cattle as well as poultry.

Light industry also has potential for high value added wood related products such as furniture. These can build on current activities in Samarinda which already include plastic and rubber products, chemicals, metal working and tools and cement, bricks and salt making.

Tourism is another sector that has potential and this would generate cargo for supply of tourist's needs and support other industries such as food, batik and handicrafts.

c. Development Implications For Port Development

The implications for port development are significant. The current system in which much of the bulk cargoes use private ports with loading at sea is likely to continue since much of the private cargo use Mahakam River. However, both in absolute terms and in value terms there will be an increasing need for common user port facilities for both incoming and outgoing traffic, much of which is likely to be containerised.

Both containerised and non-containerised cargo will consist of outgoing processed and semi-processed goods and incoming capital goods (machinery and equipment) and consumer goods for the growing economy.

26.3 Cargo Forecasts for Samarinda

26.3.1 Introduction and Methodology

The scope of work for this study requires the Consultants to forecast the future transport demand in the short term (by 2007) and in the longer term (by 2025).

In order to achieve that objective, various forecasting methodologies have been considered for this study, based on the technical requirements, the port and cargo characteristics, regional aspects and the stage of the study. River ports have rather different characteristics than conventional sea-ports and so this is a two (forecasting) stage study.

In the first stage, for the preliminary forecasts for seven ports, it is considered that trends provided a suitable basis for forecasts, supplemented by commodity based forecasts.

The regional development context prepared in the Progress Report, and further expanded in the two Interim Reports, forms an essential plank of these forecasts.

The preliminary socio-economic background prepared in the Progress Report remains valid but has been updated as a basis for forecasting traffic at the two priority ports.

As agreed, at Interim report 1 stage, the preliminary forecasts would be reviewed for the two priority ports, and further detailed and amended as necessary, based on the current information and the results of regression analysis. As was stated at that time, regression analysis can be helpful as a further indicator, but that for specific and bulk commodities it provides very little guidance.

The requirements for the two ports and the forecasts are based on the following factors:

1) The reviews on the preliminary forecasts (JICA, DGSC, IPCs, Regional Government)
2) Trends in cargo flows
3) Regression, where this was found to be statistically sound, based on the socio economic framework
4) Regional development plans and information
5) Trends in handling and especially container
6) Trends in public cargoes
7) Trends in non public cargo (khusus, rede, loading point)
8) Trends in the major commodities at each port
9) Discussions with major shipping, coal, timber, CPO and other companies in Jambi, Samarinda and Jakarta
10) Target commodity volumes in each location
11) Existing port master plans and definite (under design or construction) port facilities
12) National transport and port studies with up to date forecasts such as JICA Port Study (1999) and TSSS (2000/01)

26.3.2 Traffic Forecasts-General Approach

Cargo forecasts are made for each target year: namely, short term (2007) and long term (2025).

Estimates of long term cargo traffic will reflect the fact that cargo is not likely to expand indefinitely. For example, 7 % growth every year over 25 years means an increase of 5 times the base year volume.

The impact of any likely changes in the provision of port facilities, and their impact on port traffic are taken into account. This will include proposals by the public or private sector, and proposals that may be anticipated as part of this project's recommendations.

It should be remembered that the projections for 2025 are indicative estimates rather than definitive projections.

For each target year, the forecasts will be prepared for:

1) Total cargo, in tonnes, through the channel by:
   - International-by Imports and Exports
   - Domestic-by Unload and Load
2) Total cargo, in tonnes, at the public port facilities by:
   - Container
   - Remaining General cargo
   - Specific Bulk Cargoes, mainly coal, CPO and logs and timber

26.3.3 General Assumptions for the Cargo Forecasts for Samarinda

1) All forecasts are related to the port development scenarios in this report. However, the forecasts are unconstrained (i.e., limitations of berths, channel or other constraints on achieving the forecast are not taken into account).
2) Some impact is assumed by attraction or diversion of cargoes to/from other ports as, or Samarinda, we have a clear basis for making such an assumption.
3) For each port, trend-based and regression analysis were undertaken. Where the statistical relationships for cargo were strong (R^2 >0.75), they were used. However, if the relationships were weak, recent trend data, as well as master plans and other sources referred to above were used.
4) These forecasts will constitute a middle or best estimate scenario. Sensitivity analyses or other scenarios could be prepared for more optimistic and less optimistic total cargo scenarios in the feasibility study stage. In some cases, varied sub-scenarios for the division of public/private cargoes or distribution between port areas is considered.
5) The forecasts assume continued macro economic recovery, as noted in the Progress Report, and no major economic or social dislocation. Where regression or trends are used such recovery is implicit. The socio-economic framework in Section 6.2 provides the basis for the forecasts and assumes average national GDP growth of

between 4 and 5 % between 2001 and 2003 moving up to 5 % by 2005 and perhaps reaching 6 % to 7 % by 2009. On this basis, GDP and GRDP is expected to average about 5 % per year between 2000 and 2010.

6) The base year (i.e., using existing data) is 2000.

7) The target forecast years are 2007 and 2025.

8) Modification of the initial forecast of international and domestic cargo is then made to explicitly estimate:

    Major bulk commodities

    Containers

    Cargoes through the public berths

9) Commodities: We have now assessed all the commodities handled at Samarinda (as itemised by the port). For the main forecasts, we have included only those commodities that either make up a significant proportion of total traffic (i.e., more than 10% currently), or those that will become significant in the future. These commodities include logs and wood products, pulp, CPO, coal, fertiliser and fuel/oil.

    We have also prepared a further forecast, cross referenced against the initial one, that includes all the itemised commodities.

    This also includes an analysis of 'containerisability' which shows the likely maximum percentage of containerisation assuming that any commodity that can be containerised will be containerised. We then compare this theoretical maximum to our own container forecasts, and as this maximum is unlikely to be reached, the containerisability percentage acts as a check on our forecasts.

10) Containers: Container traffic has been expanding rapidly at most ports including at Samarinda. Containers are all handled at public (common user) port and we have assumed this will likely remain so into the future.

    Coversion to TEUs was made by assuming, from the medium term at the latest, 10 tonnes per TEU (average of full and empty) which is consistent with current port data in each port. This assumption is necessary because we note a wide variation in tonnes per TEU, even in the same port where containers are handled in different locations. Usually the lower the container volume the lower the tonnes per TEU. However, our review of the 7 river ports, other Indonesian sea ports and Jambi container operations show a remarkable tendency of 10.0 –11.0 tonnes on average per TEU and we have used 10.5 tonnes per TEU in the Samarinda port forecasts.

11) Public Berth Cargo Forecasts: Recent trends in public cargo movements are not consistent and often not well documented.

    We have also considered that, if new port facilities are provided, and management, marketing, productivity and tariffs are appropriate, then some private/khusus wharf operators may find it cheaper and more convenient to ship cargoes via the public port. A modern port will also encourage shipping companies to offer proper liner services,

rather than the sometimes ad hoc operations in smaller ports, and this in turn should attract some producing companies to use these services. The very nature of the change in the economic structure in Sumatra (and Kalimantan) to producing higher value added processed or semi-processed products will also encourage diversion to container and public port services.

Therefore, varying levels of diversion of non-public berth traffic to the public port is entirely appropriate and this was also the approach taken in the Samarinda port Master Plan.

> Note: Because a much higher proportion of bulk traffic will never use the public port at Samarinda, we have taken a lower percentage and implemented it years later than at Jambi.

Therefore, we have assumed that a proportion (7 % in Samarinda) of the forecast total cargoes will transfer to the public port. In order not to over estimate these transferred cargoes, such cargoes start from 2007, assuming new/upgraded facilities might be available from that date. They are also introduced at a reduced rate so that the maximum of 7 % is only reached in 2012.

26.3.4 Methodology for Samarinda Port Cargo Forecasts

The forecasts for Samarinda Port are prepared as follows.

1) Trends in port cargo are prepared for the previous 12 years (i.e., 1988 to 2000). This data covers all cargoes through the public port and registered by the port as using private wharves.
2) Cargo is also analysed by commodity from 1995 to 2000 and trends noted.
3) Meetings were held with shipping companies and major commodity producers to identify how and where cargo is handled, operational problems and opportunities that might affect public port usage in the future and trends in production and shipping.
4) Visits were also made to the public port and some private wharves areas to understand operational handling characteristics (i.e., how, what and where cargo is currently handled).
5) Total cargo (disaggregated by international and domestic) handled in previous years was also regressed against GRDP (Gross Regional Domestic Product) as well as national GDP to establish a correlation between cargo and economic factors. However, the regression analysis was of limited use since, for example, the main commodity forecasts are not related to GRDP and exports are related to world GDP, or more specifically, the GDP of importing countries. Imports and unloaded cargoes, which would be related to GRDP, were often relatively small in volume.

   Therefore, in some cases, the regression was a useful check on the forecasts made, but in other cases it was not. Cargo traffic was also shown not to be correlated with national GDP in most cases.

Where the regression could show a positive link (i.e., an R^2 of greater than 0.75) the resulting cargo forecast based on forecast GRDP (shown in the socio economic framework) was compared with the forecasts based on trends discussed in Chapter 7.

6) In the case of international cargoes, GRDP was shown to be correlated with cargo and the original forecasts were modified. However, in some cases the forecasts appeared excessive especially in the last 10 years of the period (2015 to 2025), and a compromise was made between realistic trends and the results of the regression.

26.3.5 Assumptions of the Samarinda Traffic Forecasts

We have made the following assumptions:

1) Cargoes will grow in line with the regional development trends identified above, and the specific commodity and economic trends identified in this section supporting the cargo forecast.
2) The port hinterland will be largely as it is now (i.e., Samarinda and the Mahakam basin). There will be some overlap with Balikpapan port for traffic generated by SASAMBA and for direct container movements when Kariangau is developed.
3) Coal volumes will continue to grow, and remain the major export commodity on the Mahakam river. There is also potential for the development of lower grade coals for domestic power stations.
4) Logs and timber products (the second most important commodity) will grow only slowly.
5) CPO is likely to increase in E Kalimantan, but more in the southern part such as in Kabupaten Pasir and on the Balikpapan side of Sasamba. While CPO has export potential, the domestic market may be equally dominant in the future.
6) Agricultural and industrial growth, leading to increased port use, is likely to be related to processing, and exporting, of natural resources and agricultural products, changing from the current situation of largely sending out raw materials and semi-finished products.
7) Some non-containerised and non-containerisable cargoes as shown in our analyses will remain.
8) However, container traffic will continue to grow reflecting trends in both world and Indonesia cargo handling.
9) The public port facilities will likely gain a limited amount of traffic from the dermaga khusus (both containerised and general cargo) as container services improve and expand.
10) Samarinda is likely to lose some traffic growth to Balikapapan (Kariangau) when that facility and the road infrastructure between Samarinda and Balikpapan is developed.
11) We have assumed that the proposed rail link between Samarinda and Balikpapan will be a long term project which will not impact port cargoes. If this project were

implemented, the impact on Mahakam river cargoes would be large, although it would probably have a lesser impact on the public port facilities.

12) It is assumed that the Kariangau container facility in Balikpapan will be built by 2007.
13) Balikpapan/Kariangau will attract container traffic from Samarinda's catchment area. It is assumed that approximately 20 % of the forecast Samarinda container traffic will transfer to Kariangau when that is built and operational. This percentage loss can only be broadly estimated at this stage. It represents the likely international container portion of future Samarinda traffic, although there is reason to believe that some international cargoes will still use Samarinda and some domestic container cargoes may use Balikpapan. It is also somewhat lower than the percentage diversion assumed by the ADB Balikpapan/Kariangau and represents the current situation as follows:

    Note: At the moment, about 20 % of Samarinda traffic is international and 80 % is domestic. Samarinda will still only provide feeder services. We therefore assume that all international cargoes will use Kariangau (after it is in operation) and Palaran will handle the remaining 80 % of predicted cargo.

    A limited amount of Samarinda international traffic may go via Palaran, but conversely, some Samarinda-generated domestic traffic in container may use Kariangau.

    We have no reason to believe the proportion of domestic and international traffic will change in the medium term. Hence, it is assumed that 80 % of predicted Samarinda traffic will use Palaran. Sensitivity analysis will look at the impact of changes in traffic volumes.

14) Bitung will become a hub port after 2010 and container traffic for Asia and West coast of the Americas will probably be transhipped there as well as at Balikpapan.
15) Domestic container volume has grown very rapidly since 1997/8, so the total 'potential' container volume is much larger than anticipated earlier.
16) The Balikpapan study assumed no major port/container development at Samarinda.
17) Sea passenger traffic at Samarinda will continue to grow, but at a moderate rate since Balikpapan is likely to attract passenger traffic from Samarinda due to its shorter travel time, even taking into account additional the travel time by road between Balikpapan and Samarinda.

The following table provides an overview of the traffic forecasts at Samarinda port and along the Mahakam river.

Table 26.3.1 Overall Cargo Forecasts for Samarinda

Public And Private Cargoes	Million Tonnes per Year			Average Growth Rate Per Year	
CARGO	2000 (Existing)	2007	2025	2000-2007	2007-2025
International Cargo	5.2	8.4	18.3	7.1 %	4.4 %
Domestic Cargo	3.1	4.4	7.8	5.1 %	3.2 %
All Cargo	8.4	12.8	26.0	6.4 %	4.0 %
Of which: Public Cargoes	1.2	2.3	6.3	9.7 %	5.8 %
NOTE: Public excluding bulk cargoes below					

Main Commodities (Total International and Domestic)					
Coal	4.5	6.6	16.2	5.6 %	5.1 %
Logs and Timber Products	2.5	2.7	2.9	1.1 %	0.4 %

Table 26.3.2 Summary Of The Samarinda Container Analysis

	Existing	Projected		% per year (Average)	
CARGO / YEAR	2000	2007	2025	2000-2007	2007-2025
Total Containers (Teus)	70,000	169,000	498,000	13.4 %	6.2 %
Assumed Diversion To Balikpapan	-	20 %	20%		
Containers Forecast To Be Handled At Samarinda (Teus)		160,000	399,000	n/a	5.2 %
Remaining General (Public) Cargo (In Tonnes)	344,000	455,000	1,065,000	4.1 %	4.8 %
Maximum Containerisability from Commodity Forecast (as % total of all cargoes)	30 %	36 %	29 %		
Per cent of total cargo Containerised in our forecasts by year	11 %	14 %	20 %		
Maximum Containerisability (in million tonnes)	2.5	4.6	7.5	9.1 %	2.8 %
Forecast Containerised (in million tonnes)	0.9	1.9	5.2	11.3 %	5.8 %

Notes:

1) We assume that the proportion of public containers which will divert to Balikpapan will be about 20%. This is based on the assumption that all international bound containers will divert to better container services which will be available at Kariangau by 2007. This is only an approximation as some international containers may still be transhipped in Surabaya or Jakarta ports. Also some higher value domestic uncontainerised cargoes may transit through Balikpapan.
2) Maximum containerisability is the maximu m theoretical level assuming that any commodity that can be containerised, will be containerised.

3) Percent containerised is the team's estimate of actual containerisation, being less than the maximum since not all containerisable cargoes will be actually containerised, for a number of reasons including cost.

Table 26.3.3 shows the cargo forecast in a different way, that is by commodity; the two sets of forecasts are internally consistent. The table also shows the level of 'containerisability' as explained above.

Naturally, as coal dominates the total cargo, the theoretical level of containerisability will be much lower in Samarinda than Jambi. However, it is a smaller percentage of a larger absolute number and thus the container forecast at Samarinda is higher than at Jambi.

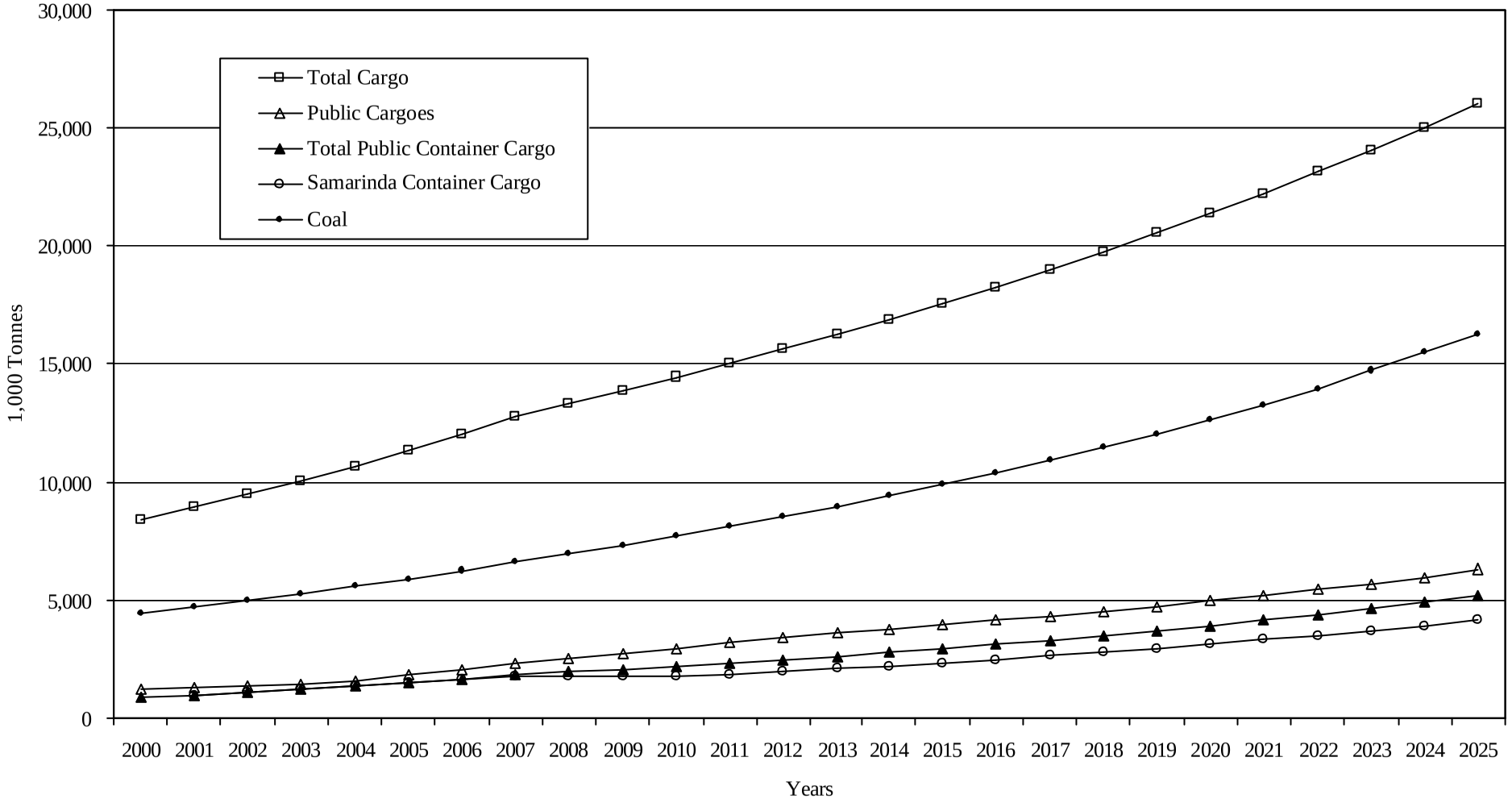

30,000
25,000
20,000
15,000
10,000
5,000
0
1,000 Tonnes
Total Cargo
Public Cargoes
Total Public Container Cargo
Samarinda Container Cargo
Coal
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025
Years

Table 26.3.3 Estimated Public and Container Cargoes at Samarinda Port

In 1,000 Tonnes or TEUs

Year	TOTAL SAMARINDA CARGO	PUBLIC BERTH CARGOES				Containers				Container Data			
		Based on Existing Cargoes*	Additional Cargoes** / Attracted Khusus***	Grand Total-Public Cargoes	Remaining General Cargo (non Containerised)	Tonnes (All Containers at Public Terminal)	TEUS (All Containers at Public Terminal)	Containers left for Samarinda after Diversion to Balikpapan (Same until 2007) TEUs	Containers left for Samarinda after Diversion to Balikpapan (Same until 2007) Tonnes	Tonnes/TEU	Annual Growth	Cont. as % public +transferred khusus	Container as % of total cargo
1988	4,122	495		**495**	495	-	-						
1989	5,374	645		**645**	645	-	-						
1990	5,503	660		**660**	660	-	-						
1991	5,389	647		**647**	640	7	1					1%	
1992	5,748	690		**690**	688	2	0			10	-73%	0%	0%
1993	5,750	711		**711**	704	7	1			10	264%	1%	0%
1994	7,180	717		**717**	694	23	2			10	247%	3%	0%
1995	6,661	812		**812**	797	15	1			10	-37%	2%	0%
1996	7,742	954		**954**	758	196	20			10	1239%	21%	3%
1997	8,352	1,055		**1,055**	354	701	33			21	257%	66%	8%
1998	9,837	921		**921**	245	676	23			30	-4%	73%	7%
1999	8,547	1,038		**1,038**	324	714	55			13	6%	69%	8%
2000	8,388	1,237	-	**1,237**	344	893	69			13.0	25.1%	72%	11%
2001	8,913	1,311		**1,311**	320	991	77	77	991	12.8	11.0%	76%	11%
2002	9,470	1,390		**1,390**	290	1,100	88	88	1,100	12.5	11.0%	79%	12%
2003	10,063	1,473		**1,473**	252	1,221	99	99	1,221	12.3	11.0%	83%	12%
2004	10,692	1,562		**1,562**	206	1,355	113	113	1,355	12.0	11.0%	87%	13%
2005	11,361	1,655	199	**1,854**	350	1,505	131	131	1,505	11.5	11.0%	81%	13%
2006	12,072	1,755	338	**2,093**	423	1,670	148	148	1,670	11.3	11.0%	80%	14%
2007	12,827	1,860	449	**2,309**	455	1,854	169	160	1,761	11.0	11.0%	80%	14%
2008	13,341	1,953	560	**2,513**	548	1,965	187	168	1,769	10.5	6.0%	78%	15%
2009	13,875	2,051	680	**2,731**	648	2,083	198	169	1,771	10.5	6.0%	76%	15%
2010	14,431	2,153	808	**2,961**	753	2,208	210	168	1,766	10.5	6.0%	75%	15%
2011	15,009	2,261	946	**3,206**	866	2,340	223	178	1,872	10.5	6.0%	73%	16%
2012	15,610	2,374	1,093	**3,467**	986	2,481	236	189	1,985	10.5	6.0%	72%	16%
2013	16,236	2,493	1,136	**3,629**	999	2,630	250	200	2,104	10.5	6.0%	72%	16%
2014	16,886	2,617	1,182	**3,799**	1,012	2,787	265	212	2,230	10.5	6.0%	73%	17%
2015	17,562	2,748	1,229	**3,977**	1,023	2,955	281	225	2,364	10.5	6.0%	74%	17%
2016	18,266	2,885	1,279	**4,164**	1,032	3,132	298	239	2,506	10.5	6.0%	75%	17%
2017	18,998	3,030	1,330	**4,360**	1,040	3,320	316	253	2,656	10.5	6.0%	76%	17%
2018	19,759	3,181	1,383	**4,564**	1,045	3,519	335	268	2,815	10.5	6.0%	77%	18%
2019	20,550	3,340	1,439	**4,779**	1,049	3,730	355	284	2,984	10.5	6.0%	78%	18%
2020	21,373	3,507	1,496	**5,003**	1,057	3,947	376	301	3,157	10.5	5.8%	79%	18%
2021	22,229	3,683	1,556	**5,239**	1,063	4,175	398	318	3,340	10.5	5.8%	80%	19%
2022	23,120	3,867	1,618	**5,485**	1,068	4,418	421	337	3,534	10.5	5.8%	81%	19%
2023	24,046	4,060	1,683	**5,743**	1,069	4,674	445	356	3,739	10.5	5.8%	81%	19%
2024	25,009	4,263	1,751	**6,014**	1,069	4,945	471	377	3,956	10.5	5.8%	82%	20%
2025	26,011	4,476	1,821	**6,297**	1,065	5,232	498	399	4,185	10.5	5.8%	83%	20%
						83%							
Growth Rates Per Year									704				16
1988-2000	6.1%	7.9%		7.9%	-3.0%								
1996-2000	2.0%	6.7%		6.7%		46.0%	36.7%			6.8%			
2000-2007	6.3%	6.0%		9.3%		11.00%	13.7%			-2.4%			
2007-2025	4.0%	5.0%	8.1%	5.7%		6.00%	6.2%	5.2%		-0.3%			
						5.80%							
2000-2025	4.6%	5.3%		6.7%		7.3%	8.2%			-0.9%			

Table 26.3.4 Cargo Forecast by Commodity and Maximum Containerisability

CARGO FORECAST BY COMMODITY AND YEAR							CONTAINERISABILITY				
YEAR	2000		2007		2025		2000		2007		2025
Exports											
Moulding	86		92		150		86		92		150
Fibre board	100		107		124		100		107		124
Plywood	1,139		1,100		1,100		1,139		1,100		1,100
Timber	10		11		13		10		11		13
Exports Other	127		750		1,900		127		750		1,900
Coal	3,600		6,000		14,417						
Plywood	-		-		-		-		-		-
Sawn Wood	103		111		111		103		111		111
Other Timber	52		200		350		52		200		350
Other	-		-		-		-		-		-
Total Exports	5,217		8,371		18,165						
Imports	28		45		98		28		45		98
									-		
UNLOAD									-		-
Rice	31		54		119		31		54		119
Sugar	28		48		106		28		48		106
Salt	11		18		40		11		18		40
Cooking Oil	14		23		51		14		23		51
Flour	27		46		101		27		46		101
Second hand goods	22		38		83		22		38		83
Other goods	111		190		420		111		190		420
Sand and Stone	44		89		354						
Ammonium Nitrate	15		30		121		15		30		121
Cement	156		314		851		78		157		426
Logs	1,000		970		1,000						
Other goods	200		490		826		200		490		826
Iron/concrete	24		48		131						
Fertilser	15		30		82		15		30		82
Total Unload	1,697		2,388		4,284						
							-		-		-
LOAD							-		-		-
Logs	200		200		200						
Coal	900		625		1,782						
General cargo	317		723		600		317		723		600
Coffee/Cocoa	14		50		120		14		50		120
Fuel	15		100		200		15				
Other			350		580				350		580
Total Load	1,446		2,048		3,482						
									-		-
Grand Total	8,388		12,851		26,029		2,542		4,663		7,520
							30%		36%		29%
							Maximum Containerisable				

26.4 Passenger Forecasts

26.4.1 Introduction

Sea passenger traffic in Indonesia has been increasing very rapidly over a number of years and this is also true for most of the subject ports.

The Consultants are aware of these long term high growth rates in passenger sea travel, whether by ferry under DGLC/ASDP and private companies and by DGSC/Pelni and private companies.

Such long-term trends provide an implicit basis for the forecasts, along with more recent trends.

It is assumed that there are several driving forces behind these trends, including movement for economic and social purposes between islands and especially between Java and Sumatra/Kalimantan, population movements (transmigration) and general economic development. The reduction in air capacity and the high cost of air travel has also impacted on sea transport demand in the initial years of the economic crisis.

Further, in recent years, GOI has purchased a fleet of modern large passenger vessels and this has no doubt encouraged or allowed rapid increases in passenger flows. In the current economic circumstances, slow expansion of the fleet may conversely curtail expected expansion of passenger volumes.

The existing and forecast passenger movements have implications for port planning in two ways. Firstly, there is the need to cater for these passengers and ships. Secondly, as the Pelni and private vessels generally use cargo port berths, there is the need to coordinate and organise facilities in a manner that is safe and efficient for both passengers and cargo.

Given the likely continued expansion of passenger volumes to the levels expected, this would probably mean the development of separate passenger facilities at all ports as soon as possible and as soon as passenger volumes justify it.

26.4.2 The Passenger Forecast Methodology

Given recent high demand and likely constraints on continued growth rates at this level, the Consultants have followed a middle course between these two conflicting influences.

Passenger forecasts have been made on the basis of trend analysis followed by a review of the results of this statistical analysis to take into account likely passenger developments. This should make the forecasts as realistic as possible.

Further, the recent very rapid passenger growth rates at most ports may be related to the economic crisis and may not continue at such high rates.

At a few ports in Indonesia, passenger growth has been minimal in recent years and this needs further explanation as to whether decline in demand is due to other modes (e.g., competition with express buses to/from Java), or other ferries providing services or general decline.

All river ports to some extent, suffer from quite long and slow passenger journeys on the river part of the trip from say Surabaya to Samarinda. For Samarinda passengers, one could imagine increasing competition over 25 years from Balikpapan port (and airport) in the future due to the time savings that would be made by travelling via Balikpapan and on by road to Samarinda.

Very few port studies include passenger forecasts and where there are forecasts, they are usually underestimated. It would however have been hard to predict the continued and substantial increases in sea passenger trips in the Krismon period. Therefore, our forecasts do not follow historical trends, but they still represent a robust level of demand, especially in the longer term by 2025.

Further, the forecasts will depend to some extent on the regulatory and tariff policies for sea passenger transport as well as the competitive air services and actual capacity provision for sea and air transport. Further, private sector participation and privatisation could have some impact on tariffs and capacity provision. Over 25 years, such policies and impacts are impossible to predict. Therefore, such long term forecasts are more indicative than for detailed planning purposes.

26.4.3 Passenger Ship Calls

Passenger ship calls are based upon the above passenger forecasts. The data on passenger ship size by GRT are very weak since these vessels are generally included in the domestic ship calls and are not disaggregated.

Nevertheless, ship calls are disaggregated by size in some ports and in others the number of calls is known. Further, the Pelni fleet, which transports a large proportion of, but not all, passengers, is also known in some detail.

Therefore, in some ways similar to the methodology for projecting cargo ship calls, the projected future passenger volume is divided by the expected passenger interchange per call. The interchange per call is based upon actual current data and supplemented by data on the existing Pelni vessel fleet.

As passenger volumes increase, it is assumed that larger vessels will be placed on these routes up to the existing maximum vessel capacity. If this does not occur, there will be a larger number of smaller vessels or demand will be suppressed or both of these could occur together.

The private sector passenger services which were badly affected on some routes may enter the market again in the future assuming appropriate conditions such as cost/profit based fares and encouragement of the shipping sector.

Overloading of passenger vessels is a problem and while the vessels are able to carry additional loads, safety is compromised in case of accidents at sea. While we have not assumed vessel interchange greater than capacity, use of maximum ship capacity does probably mean that at peak times vessels will still be overloaded.

26.4.4 The Passenger Forecasts

Table 26.4.1 below summarise the projected passenger traffic, together with the forecast ship calls. The tables also show the number of projected ship calls per day and this shows, in many cases, the likely large impact passenger forecasts have upon the need for port facilities.

All very long-term forecasts are likely to be affected by competing modes to varying extents.

Table 26.4.1 Passenger Forecasts for Samarinda

	Volumes per Year (1990 and 2000 actual)				Average Growth Rates per Year	
Year	1990	2000	2007	2025	2000-07	2007-25
Passengers	51,000	197,000	277,000	472,000	5.0 %	3.0%
Ship Calls (Both Ways)	101	99	139	157	5.0 %	0.7 %

It should be noted that the growth rate between 1990 and 2000 was over 14 percent per year. The reduction in ship calls is due to the introduction of newer, larger passenger vessels, which is expected to continue as passenger volumes continue to grow. We have not assumed larger vessels in 2007 and hence calls grow in line with passengers up to 2007. Thereafter, ship calls grow only slowly as larger vessels are introduced.

26.5 Projection of Calling Vessels

26.5.1 Introduction

These forecasts are based on the base data, the forecast cargo, and the forecast maximum ship size for each port provided to the economist.

In the Interim Report 1, ship calls were forecast by total ship calls (public and non-public) and disaggregated into international and domestic. In this report, we have improved upon the initial forecasts and due to the data needs of the Simulation model, also forecast calls by port location, public and private, and by container, general cargo and the major bulk commodities. Both methods are internally consistent with each other.

26.5.2 The Methodology for Estimating Ship Calls

1) Analyse the last 5 years ship call data by international and domestic to provide base year data on calls, average GRT, tonnes per interchange and load factors. Cargo data (either actual to 2000 or after 2000 from the forecasts) is related to total international cargo and total domestic cargo.
2) Estimate DWT from GRT by dividing by 0.7 (generally accepted ratio and confirmed by analysis of Indonesian ship data).
3) Show the average GRT, cargo tonnes per call (interchange), vessel load factors for 995-1999; (load factor is calculated by dividing the cargo tonnes handled by the total DWT capacity)
4) Estimate the maximum GRT for each port-either from navigation rules which are available for some ports or from the consultants estimates for the remainder
5) Estimate the average GRT for 2007 and 2025 (based on maximum and trends). Note that for domestic, the average is usually substantially less than the maximum so there is no problem for domestic shipping. For international ships, it is estimated that the average ship size in future is between 80-90 % of the maximum.
6) Estimate the future load factors for 2007 and 2025 by consultants estimates. For example if load factors are already high, no change; if low, some change based on trend.
7) Increase of cargo tonnes per call based on the forecast GRT and load factor growth.
8) Divide the cargo forecast by the forecast cargo tonnes per call to obtain ship calls per year.
9) To obtain channel movements, ship calls must be doubled (i.e., one port call involves a movement in and a movement out).
10) Using the output of the broader projection of ship calls, vessel sizes and the traffic forecast as a reference points, the more detailed projection is undertaken

26.5.3 Limitations of the Forecasts

1) The ship call baseline data is not very reliable for ship call projection and is often only sufficiently disaggregated for very broad estimates of total international and domestic ship calls.
2) 1995 to 1999 data includes the economic crisis in Indonesia (although 1995 and 1996 were normal years). While we see some variation in cargo volumes over that period, ship calls and ship sizes were more erratic.
3) Maximum/Average GRT is based on:
   a. existing navigation rules
   b. the consultants estimates based on ship sizes and channel characteristics
   c. adjustment where current average GRT is already very high, relative to provided or derived maximum GRT in a. or b. above.

Sometimes, the current, average GRT (especially for international ships) is greater than the stated or estimated maximum GRT. One reason is that ship calls at 'loading point at sea' or 'rede/channel loading' are included in total calls which would have the effect of over-estimating ship size. We have now excluded such traffic where it has a severely distorting affect. Tidal operations would also account for this disecrepancy and it is probable that both factors are at work.

Another reason may be because load factors for international ships appear quite low possibly suggesting larger vessels are part loaded when calling at smaller ports or data is inaccurate. We have reviewed the load factors for the period 1995 to 1999 and assessed any trend.

In Samarinda, it would not make sense to reduce the average GRT into the future to meet the estimated maximum GRT. Hence, we have tended to use the maximum recent average GRT in each port, rounded up to the nearest thousand GRT.

26.5.4 Other Factors

Whether ship calls increase, depends on the relative size of cargo growth relative to the increase in ship size or change in load factors. Therefore, the ship call forecast depends on both the growth in cargo and its absolute amount.

Passenger Ship Calls

In addition to the forecast of cargo ships, the passenger ship forecast, estimated above, is shown. At Samarinda, passenger ship calls are shown to complement the cargo calls.

The Ship Call Projections

The following tables show the estimated ship call and average GRT data, with the relevant assumptions attached to each table.

Table 26.5.1 Forecast of Ship Calls at Samarinda

(According to Location and Main Handling Type)

SHIP CALLS AND CARGOES 2000				
Handling Location	Cargo/Ship Type	Cargo Volume (000 tonnes) *or Passengers*	Ship Calls (Number)	Average GRT (Tonnes)
Public Port Areas	General	344	2,145	460
	Container	895	303	1,890
	Other	8	7	880
	Passenger	*197*	*50*	*6,020*
Private Wharves	Coal	4,500	2,210	5,000
	Timber & Logs	2,000	2,530	1,230
	Other	641	3,070	325
Total 2000	**All Cargoes**	**8,388**	**10,315**	**1,651**

Note: Assumed that all containers are handled at Palaran and general cargo at the existing port

SHIP CALLS AND CARGOES 2007				
Handling Location	Cargo / Ship Type	Cargo Volume (000 tonnes) or Passengers	Ship Calls (Number)	Average GRT (tonnes)
Public Port Areas	General	455	1,276	550
	Container	1,761	542	2,000
	Passenger	*297*	*70*	*6020*
Private Wharves	Coal	6,633	2,315	5,900
	Timber & Logs	2,674	2,357	1,525
	Other	1,304	4,863	350
Total 2007	**All Cargoes**	**12,827**	**11,423**	**1,852**

Note: 'Other' category in Public removed as very small

SHIP CALLS AND CARGOES 2025				
Handling Location	Cargo / Ship Type	Cargo Volume (000 tonnes) or Passengers	Ship Calls (Number)	Average GRT (tonnes)
Public Port Areas	General	1,065	1,185	920
	Container	4,185	985	3,346
	Passenger	*472*	*79*	*11,000*
Private Wharves	Coal	16,200	4,761	6,400
	Timber & Logs	2,900	1,491	1,750
	Other	1,661	3,661	470
Total 2025	**All Cargoes**	**26,011**	**12,161**	**3,293**

NOTE: These data have been adapted marginally to fit the simulation analysis's data requirements

All data in 'calls', hence must be doubled for in and out movements

27. NATURAL CONDITIONS SURVEY AT SAMARINDA

27.1 Natural Conditions Survey

As part of planning of this Study, the Natural Condition Survey at Samarinda as described below has been implemented by subcontracting with local consultants in Indonesia. To grasp the natural conditions of the Study sites, the survey items have been executed in both dry season and rainy season as shown in Table 27.1.1.

Table 27.1.1 Natural Condition Survey Items and Execution Period at Samarinda

Survey Items	Location	Survey in dry season	Survey in rainy season
		July – Aug. 2001	Nov. – Dec. 2001
1. Topographic survey (1:1,000)	Samarinda port	●	
	Palaran		●
2. Sounding survey (1:1,000)	Samarinda port	●	
	Palaran		●
3. Sounding survey (1:10,000) Including dual frequency sounding	Navigation channel	●	●
4. Current observation	Samarinda	●	●
	S. Mariam		●
	Pendingin	●	●
	Muara Kembang	●	●
	Muara Pegah	●	
5. Wave observation	Muara Pega	●	●
6. Tide observation	Samarinda	●	
	Muara Kembang	●	
7. Soil investigation and laboratory test	Samarinda port	●	
	Palaran		●
8. Seabed soil sampling and laboratory test	Navigation channel	●	
9. Existing wind data correction and analysis	Balikpapan	●	

27.2 Topographic Survey

27.2.1 Samarinda Port

Samarinda City is located on the flat land about 65 km upstream from the mouth of Mahakam River. Samarinda Port is situated most east of the center of Samarinda City on the left bank of Mahakam River.

Samarinda Port was constructed within Samarinda City and the site is extremely narrow (width about 50 to 70 m) because it is limited by the existing roads. The ground of Samarinda Port is soft and some port facilities foundation have subsided because they were constructed on reclaimed land on the left bank of Mahakam River. In particular, ground subsidence of 30 cm at maximum has been caused in the container yard by comparison with the pier height.

The results of topographic survey show that the height of the site within Samarinda Port

is about +3.2 m (NLLW). The water depth in front of Samarinda Port is about –6 m (NLLW). It is reported that dredging is made as it is needed.

27.2.2 Palaran

Palaran is located on the right bank of Mahakam River at about 13 km in a straight line to the southeast from the center of Samarinda City. As Palaran is on the opposite bank of Mahakam River to the center of Samarinda City, it is necessary to cross a bridge upstream of the River which takes about 45 minutes by vehicle. Most of the road from the center of Samarinda City to Palaran is paved except in the vicinity of the Project site. Some sections of this road are now undergoing the expansion work.

Palaran is located on flat land on the right bank of Mahakam River about 50 km upstream from the river mouth (about 15 km downstream from Samarinda City). A hill of about 50 m high is located about 500 m behind the riverbank line, and the road to Palaran from Samarinda City leads from the rear side of the hill. Palaran village is located on the upstream side of the project site and a factory is on the downstream side.

27.2.3 Topographic survey

For the planning and designing of the port facilities, 1:1,000 scale topographic maps at Samarinda Port and Palaran were prepared by terrestrial survey method.

The survey elements for this topographic survey are as follows:

1)	Projection	UTM (Universal Transverse Mercator) Zone No. 50
2)	Spheroid	WGS 84
3)	Datum elevation	NLLW (Nearly Lowest Low Water) decided by tide observation and harmonic analysis

For topographic mapping at Samarinda and Palaran, two benchmarks were established in each topographic survey area. The horizontal coordinates of these benchmarks were determined by GPS observation based on the existing GPS point near Samarinda. The horizontal coordinates and elevations of the newly established benchmarks in the topographic survey areas at Samarinda and Palaran are shown in Tables 27.2.1 and 27.2.2 respectively.

Table 27.2.1 Locations and Elevations of Benchmarks (Samarinda Port)

Point No.	Horizontal coordinates (UTM)		Elevation (m)
	E (m)	N (m)	
SMD 01	517,369.945	9,943,765.445	3.241
SMD 02	516,493.687	9,944,257.494	3.443

Table 27.2.2 Locations and Elevations of Benchmarks (Palaran)

Point No.	Horizontal coordinates (UTM)		Elevation (m)
	E (m)	N (m)	
PLR 01	520,674.390	9,937,484.230	3.800
PLR 02	520,552.658	9,937,593.952	3.377

27.2.4 Sounding survey

For the planning and designing of port facilities at the proposed port site and also for the study and planning of dredging at channel on Mahakam River, 1:1,000 scale bathymetric maps covering the water area in front of proposed port site and 1:10,000 scale bathymetric maps covering Mahakam River from Samarinda to river mouth were prepared.

The survey elements for this sounding survey are as follows:

1)	Projection	UTM (Universal Transverse Mercator) Zone No. 50
2)	Spheroid	WGS 84
3)	Datum elevation NLLW	NLLW (Nearly Lowest Low Water) decided by tide observation and harmonic analysis

27.2.5 Sounding survey by dual frequency

The sounding survey along Mahakam River and channel was carried out using two different frequencies (namely, 210 kHz and 33 kHz). The results of dual frequency sounding and visual observation of soil samples are shown in Table 27.2.3.

From these results, it is presumed that the uppermost part of riverbed and channel in Mahakam River and Outer Bar has a relatively soft clay or sand layer approximately 45 – 70 cm thick. From investigation by bottom sampling, it appears that clay is distributed at the river mouth, while the bed materials containing less clay and more sand are more upstream of Mahakam River. The thickness of this soft layer at river mouth is thicker than upstream.

Table 27.2.3 Dual-Frequencies Sounding and Visual Observation Result of Riverbed Soil Samples

Cross section No.	Sampling point No.	Depth by 210 kHz	Depth by 33 kHz	Width of soft layer	Length of core sample	Visual observation of soil samples
C-01	GS-01	-13.43 m	-14.02 m	0.59 m	0.51 m	Fine to medium **sand** with organic fragments
C-07	GS-02	-9.63 m	-10.22 m	0.59 m	0.68 m	Fine to medium **sand** with organic fragments
C-13	GS-03	-9.54 m	-10.17 m	0.63 m	0.75 m	Fine to medium **sand** with organic fragments
C-19	GS-04	-6.47 m	-7.00 m	0.53 m	0.51 m	Fine to medium **sand** with organic fragments
C-25	GS-05	-10.95 m	-11.52 m	0.57 m	0.61 m	Fine to medium **sand** wit organic fragments
C-31	GS-06	-10.30 m	-10.80 m	0.50 m	0.51 m	Very soft silty **clay** with organic fragments
C-37	GS-07	-10.59 m	-11.15 m	0.56 m	0.63 m	Fine to medium **sand** wit coral fragments
C-43	GS-08	-4.82 m	-5.30 m	0.48 m	0.48 m	Fine to medium **sand** with organic fragments
C-49	GS-09	-11.32 m	-11.77 m	0.45 m	0.48 m	Soft sandy **silt**
C-55	GS-10	-7.77 m	-8.22 m	0.45 m	0.43 m	Fine to medium **sand** with organic fragments
C-61	GS-11	-9.75 m	-10.21 m	0.46 m	0.46 m	Slightly sandy silty **clay**
C-73	GS-12	-8.81 m	-9.30 m	0.49 m	0.46 m	Slightly silty fine to medium **sand**
C-79	GS-13	-5.65 m	-6.13 m	0.48 m	0.51 m	Slightly clayey silty fine **sand**
C-85	GS-14	-9.05 m	-9.63 m	0.58 m	0.45 m	Soft silty fine **sand** with organic fragments
C-91	GS-15	-10.71 m	-11.30 m	0.59 m	0.74 m	Silty fine **sand**
C-97	GS-16	-5.41 m	-5.88 m	0.47 m	0.44 m	Very soft sandy **silt**
C-103	GS-17	-8.30 m	-8.74 m	0.44 m	----	Very soft slightly sandy silty **clay**
C-109	GS-18	-4.21 m	-4.65 m	0.44 m	----	Very soft clayey fine **sand**
C-115	GS-19	-5.04 m	-5.48 m	0.44 m	----	Very soft silty **clay**
C-121	GS-20	-5.78 m	-6.22 m	0.44 m	----	Very soft silty **clay** with organic fragments
C-127	GS-21	-5.47 m	-5.91 m	0.44 m	----	Very soft **clay**
C-133	GS-22	-2.83 m	-3.27 m	0.44 m	----	Fine to medium **sand** with shell fragments

Note: ---- Sampling by grab sampler. Therefore, no data of core sample length

Source: Results of natural condition survey by JICA

27.3 Subsoil Condition

27.3.1 Soil Investigation

To grasp the soil condition of the proposed port sites, offshore and onshore boring were executed at Samarinda Port and Palaran. Soil laboratory test, consisting of water content, grain size analysis, unit weight test, unconfined compression test and consolidation test, were executed using obtained disturbed and undisturbed soil samples.

27.3.2 Samarinda Port

The locations of new and existing boring points at Samarinda Port are shown in Figure 27.3.1. Figure 27.3.2 shows the results of onshore and offshore boring survey at Samarinda Port.

The layer from the ground surface to approximately –11 m depth (NLLW) consists of mainly soft silt or clay, however, the layer below –11 m depth consists of mainly fine to medium sand. The layer that is clearly the supporting layer with the N-Value of 50 or more consists of fine to medium sand and lies at approximately –73 m (NLLW).

Although this supporting layer lies at about –73 m in depth (NLLW) at the center and at the downstream part of Samarinda Port, it is located at –63 m in depth (NLLW) at the upstream part of Samarinda Port.

27.3.3 Palaran

The boring locations at Palaran are shown in Figure 27.3.3. Figure 27.3.4 shows the results of onshore and offshore boring survey at Palaran.

The layer from the ground surface to approximately –15 m depth (NLLW) consists mainly of soft silt or clay, however, the layer below –15 m depth (NLLW) to supporting layer consists of mainly fine to medium sand.

The layer that is clearly the supporting layer with N-Value of 50 or more consisting of clay lies at an approximately –25 m in depth (NLLW) at the center and downstream part of proposed port site, and at an approximately –41 m in depth (NLLW9 at the upstream part of proposed port site.

27.4 River Channel and Sedimentation

27.4.1 Riverbed Soil Sampling and Analysis

To investigate the soil materials of the riverbed on Mahakam River and the seabed on channel at Outer Bar, soil sampling was made at the intervals of approximately 3 km interval between Samarinda Port and Outer Bar. Soil laboratory tests, consisting of water content, grain size and unit weight, were executed on the obtained soil samples.

The soil sampling locations are shown in Figure 27.4.1. Gravity core sampler was used

for riverbed soil sampling at approximately 3 km intervals. Table 27.4.1 shows the summary of soil sampling and visual observations of the obtained soil samples.

From the investigation of the bottom soil samples, it is clear that clay and clayish sand is distributed at the river mouth, while the bed materials contained less silt and clay, and more sand are more upstream on the bottom of Mahakam River.

Table 27.4.1 Results of Soil Sampling of Riverbed and Channel at Mahakam River

Point No.	Location (U.T.M.)		Length of core sample	Material of river bed	
	E	N		Color	Soil condition
GS-01	516,452.1	9,943,951.4	0.51 m	Yellowish brown	Fine to medium **sand** with organic fragments
GS-02	517,454.9	9,941,292.8	0.68 m	Yellowish brown	Fine to medium **sand** with organic fragments
GS-03	519,430.7	9,939,162.4	0.75 m	Yellowish brown	Fine to medium **sand** with organic fragments
GS-04	522,090.4	9,937,845.2	0.51 m	Yellowish brown	Fine to medium **sand** with organic fragments
GS-05	524,891.3	9,936,730.7	0.61 m	Yellowish brown	Fine to medium **sand** wit organic fragments
GS-06	527,889.7	9,936,551.7	0.51 m	Greyish yellow	Very soft silty **clay** with organic fragments
GS-07	530,810.2	9,935,716.7	0.63 m	Yellowish brown	Fine to medium **sand** wit coral fragments
GS-08	532,568.6	9,933,314.7	0.48 m	Yellowish brown	Fine to medium **sand** with organic fragments
GS-09	533,234.3	9,930,422.5	0.48 m	Brownish grey	Soft sandy **silt**
GS-10	533,756.3	9,927,489.8	0.43 m	Brownish yellow	Fine to medium **sand** with organic fragments
GS-11	533,886.4	9,924,581.2	0.46 m	Greyish brown	Slightly sandy silty **clay**
GS-12	532,261.0	9,919,009.4	0.46 m	Yellowish brown	Slightly silty fine to medium **sand**
GS-13	532,621.1	9,916,222.8	0.51 m	Blackish brown	Slightly clayey silty fine **sand**
GS-14	532,345.8	9,913,411.0	0.45 m	Yellowish grey	Soft silty fine **sand** with organic fragments
GS-15	533,256.3	9,910,736.7	0.74 m	Yellowish brown	Silty fine **sand**
GS-16	533,473.2	9,907,881.8	0.44 m	Brownish grey	Very soft sandy **silt**
GS-17	533,752.8	9,905,021.7	----	Blackish brown	Very soft slightly sandy silty **clay**
GS-18	534,218.4	9,902,004.0	----	Blackish brown	Very soft clayey fine **sand**
GS-19	534,098.5	9899,019.3	----	Blackish yellow	Very soft silty **clay**
GS-20	534,426.7	9,896,035.7	----	Greyish brown	Very soft silty **clay** with organic fragments
GS-21	535,262.4	9,893,188.5	----	Greyish brown	Very soft **clay**
GS-22	536055.7	9,890,493.7	----	Brownish black	Fine to medium **sand** with shell fragments

Source: Results of natural condition survey by JICA

27.4.2 Soil laboratory test

Figure 27.4.2 shows the results of soil laboratory tests on the soil samples obtained by core sampler and dual frequencies sounding survey.

The characteristics of the riverbed and channel bottom materials are summarized as follows:

1) From the results of grain size analysis, the percentage of sand was less than 50 %, except GS-15 (81 %).
2) Grain size analysis shows that the riverbed materials near Tg. Sanga Sanga (from GS-06 to GS-08) and P. Kerbau (from GS-13 to GS-15) contain more sand and less clay compared to other locations.
3) The density of riverbed materials at the location of sedimentation in the river was estimated based on the soil laboratory test. The estimated densities of riverbed materials were between 1.4 g/cm^3 – 1.8 g/cm^3. It appears that the riverbed materials of upper layer of Mahakam River are relatively soft and loose.
4) The thickness of this soft and loose upper layer is estimated as approximately 45 cm – 70 cm from the results of dual frequency sounding survey and obtained core length.
5) The fluid mud on the top of riverbed was not detected. It is presumed that it had flowed away due to the high speed current (Maximum velocity is more than 1.0 m/sec and average velocity is more than 0.3 m/sec).

27.4.3 Relation between sounding survey and maintenance dredging

Since Mahakam River has a large volume of sediment in the river and its estuary, this river has been divided into five survey zones for yearly sounding surveys and for eventual maintenance dredging by IPC4. For this Study, existing sounding survey data is very useful for the estimation of riverbed change. Furthermore, for this Study, new sounding surveys were executed twice in July and November 2001.

The locations of sounding survey by IPC4 and maintenance dredging area are shown in Figure 27.4.3. The sounding surveys and maintenance dredging executed by PERIND from 1998 to 2001 are shown in Table 27.4.2 “Sounding and Maintenance Dredging from 1998 to 2001 at Samarinda”. It is possible to estimate the riverbed change comparing the sounding survey data results before and after maintenance dredging.

Table 27.4.2 Sounding and maintenance Dredging from 1998 to 2000 at Samarinda

Year	Month	Sounding／Dredging	Area-1	Area-II	Area-III	Area-IV	Area-V
1998	May	Predredge sounding	○	○	○	○	○
	----	Maintenance dredging	○	○	○	○	○
1999	Feb.	Final sounding	○	○	○	○	○
2000	March	Final sounding	○	○	○	○	○
	May	Predredge sounding	○	○	○	○	○
	----	Maintenance dredging	○	○	○	○	
	Oct.	Final sounding	○	○	○	○	

Source: Information from PT Pelabuhan Indonesia IV

27.4.4 Estimation of Riverbed Variation by the Existing Sounding Data

Using the existing sounding survey data, the cross section of each Spot and the longitudinal profiles of the channel were prepared. The water depths at the same Spot were compared to estimate the riverbed variation. As a result, the following features were verified.

1) In the maintenance dredging areas, Area Ia and Area Ib showed the most rise in the riverbed, which was approximately 80 cm or more per year at the center of the channel.
2) In the maintenance dredging areas, Area V Utara showed the least rise in the riverbed, which was approximately 10 cm or less per year at the center of the channel.
3) The rise in the riverbed was the most at the center of the channel and the rise of the riverbed was lower as the distance from the center of the channel increases.

The estimated riverbed variations per year are shown in Table 27.4.3.

Table 27.4.3 Estimation of Yearly Riverbed Variation at Mahakam River By the Existing Sounding Survey Data

Area	100 m left from canal center	25 m left from canal center	Canal center	25 m right from canal center	100 m right from canal center
Area Ia	+ 17 cm	+ 91 cm	+ 87 cm	+ 83 cm	+ 15 cm
Area Ib Selatan	+ 34 cm	+ 64 cm	+ 63 cm	+ 69 cm	+ 25 cm
Area Ib Utara	+ 10 cm	+ 89 cm	+ 87 cm	+ 94 cm	+ 16 cm
Area II	+ 5 cm	+ 44 cm	+ 35 cm	+ 38 cm	+ 8 cm
Area III Tenggara	+ 29 cm	+ 51 cm	+ 60 cm	+ 41 cm	-----
Area III Timur	----	+ 42 cm	+ 31 cm	+ 18 cm	- 7 cm
Area IV	- 3 cm	+ 21 cm	+ 23 cm	+ 23 cm	- 1 cm
Area V Selatan	+ 5 cm	+ 32 cm	+ 54 cm	+ 60 cm	+ 13 cm
Area V Utara	- 5 cm	+ 6 cm	+ 5 cm	+ 9 cm	+ 7 cm

Source: Analysis based on the results of sounding by PT Pelabuhan Indonesia IV

27.4.5 Estimation of riverbed variation by the new sounding survey data

Using the new sounding survey data (dry and rainy season), the cross sections at 500 m intervals and the longitudinal profiles of Mahakam River between Samarinda Port and river mouth were prepared. The depths at the same cross section lines were compared to estimate the riverbed variation. As a result, the following features were verified.

1) In each maintenance dredging area, riverbed had risen about 40 cm – 50 cm per year at the river and channel center, except Area V Utara.
2) In non-dredging area, the riverbed rise is very small. The estimated riverbed rise per year in non-dredging was less than 10 cm.

The estimated riverbed variation per year is shown in Table 27.4.4.

Table 27.4.4 Estimation of Yearly Riverbed Variation at Mahakam River By the New Sounding Survey Data

Area	100 m left from canal center	50 m left from canal center	Canal center	50 m right from canal center	100 m right from canal center
Area Ia	+ 13 cm	+ 53 cm	+ 67 cm	+ 60 cm	+ 40 cm
Area Ib Selatan	- 20 cm	+ 37 cm	+ 43 cm	+ 56 cm	+ 28 cm
Area Ib Utara	+ 20 cm	+ 56 cm	+ 44 cm	+ 56 cm	+ 32 cm
Area II	+ 69cm	+ 57 cm	+ 69 cm	+ 51 cm	+ 29cm
Area III Tenggara	+ 40 cm	+ 40 cm	+ 53 cm	+ 53 cm	+ 40 cm
Area III Timur	+ 32 cm	+ 56 cm	+ 40 cm	+ 48 cm	+ 32 cm
Area IV	+ 40 cm	+ 40 cm	+ 30 cm	+ 20 cm	- 10 cm
Area V Selatan	+ 48 cm	+ 40 cm	+ 48 cm	+ 40 cm	+ 24 cm
Area V Utara	+ 24 cm	+ 8 cm	+ 8 cm	- 16 cm	- 8 cm
Other area	- 4 cm	+ 5 cm	+ 18 cm	+ 8 cm	+ 2 cm

Source: Natural condition survey by JICA

27.5 Tide and Current

27.5.1 Current Observation

To determine the characteristics of current in Mahakam River and channel in Outer Bar, current observations were executed in both dry and rainy season at similar observation points in dry season.

The current observation points are shown in Figure 27.5.1 and Figure 27.5.

27.5.2 Relation between prevailing current direction and tide

The relations of prevailing current direction with the rise and fall of the tide as obtained from the observations are shown in Table 27.5.1 “Relation between Tide and Prevailing Current Direction”

Table 27.5.1 Relation between Tide and Prevailing Current Direction

Location	Current Observation Depth	Prevailing direction			
		Dry season (July 2001)		Rainy season (Nov. 2001)	
		Low⇒High	High⇒Low	Low⇒High	High⇒Low
Samarinda	4.5 m above river bed	315 degrees	135 degrees	----	----
	1.5 m above river bed	315 degrees	135 degrees	Not clear	135 degrees
Sungai Mariam	1.5 m above river bed	----	----	Not clear	110 degrees
Pendingin	4.5 m above river bed	350 degrees	170 degrees	----	----
	1.5 m above river bed	350 degrees	170 degrees	355 degrees	175 degrees
Muara Kembang	4.5 m above river bed	10 degrees	190 degrees	----	----
	1.5 m above river bed	10 degrees	190 degrees	5 degrees	Not clear
Muara Pegah	4.5 m above river bed	10 degrees	190 degrees	----	----
	1.5 m above river bed	10 degrees	190 degrees	----	----

Source: Results of natural condition survey by JICA

The prevailing current direction in dry season at Mahakam River and channel was the same as the flow line of Mahakam River and channel, and the current direction reversed

between the low tide to high tide and the high tide to low at the current observation point.

However, in rainy season, prevailing the prevailing current directions at the time from low tide to high tide at Samarinda, Sungai Mariam and Muara Kembang are not so clear.

27.5.3 Current velocity

Table 27.5.2 shows the average current velocity in scalar and maximum current velocity during the observation period.

Table 27.5.2 Average and Maximum Velocity of Current

Location	Current Observation Depth	Velocity (cm/sec)			
		Average velocity (m/sec)		Maximum velocity (m/sec)	
		Dry season	Rainy season	Dry season	Rainy season
Samarinda	4.5 m above river bed	0.25 m/sec	----	0.66 m/sec	----
	1.5 m above river bed	0.23 m/sec		0.74 m/sec	0.77 m/sec
S. Mariam	1.5 m above river bed	----		----	1.27 m/sec
Pendingin	4.5 m above river bed	0.31 m/sec	----	0.91 m/sec	----
	1.5 m above river bed	0.28 m/sec		0.98 m/sec	0.88 m/sec
Muara Kembang	4.5 m above river bed	0.31 m/sec	----	1.20 m/sec	----
	1.5 m above river bed	0.21 m/sec		0.88 m/sec	0.96 m/sec
Muara Pegah	4.5 m above river bed	0.26 m/sec	----	1.05 m/sec	----
	1.5 m above river bed	0.16 m/sec	----	0.74 m/sec	----

Source: Results of natural condition survey by JICA

The characteristics of current in the Study area are summarized as follows:

1) The average velocity of the upper layer (4.5 m above riverbed) was higher than the lower layer (1.5 m above riverbed).
2) The maximum velocity of the upper layer was higher than the lower layer.
3) The current velocity maximum occurred during the middle period from high tide to low tide and from low tide to high tide.
4) The prevailing current direction was the same direction of river flow of Mahakam River or channel.
5) The percentage of current direction toward upstream in the rainy season was very small compared to dry season.

27.5.4 Harmonic analysis of current

The harmonic analysis of current at Muara Pegah was executed to determine the characteristics of current at Mahakam River. The results of harmonic analysis are shown in Table 27.5.3.

Table 27.5.3 Tidal Constituent at Muara Pegah

Type	M2	S2	K1	O1	P1	N2	K2	M4	MS4
V (m/sec)	0.432	0.237	0.134	0.053	0.139	0.004	0.221	0.018	0.036
Phase lag (deg)	93.1	217.0	302.6	187.1	92.6	333.8	350.2	345.7	60.5

Source: Results of natural condition survey by JICA

27.5.5 Tide Observation and harmonic analysis

A tide gauge was installed at Samarinda Port and Muara Kembang to make a tide observations. To decide the datum elevation for topographic survey and sounding survey, tidal observations over a period of 30 days were executed.

Based on the observed tidal data at Samarinda, harmonic analysis was executed to calculate the tidal constituents. Nearly Lowest Low Water (NLLW) as a datum elevation for topographic survey and sounding survey was decided based on the calculated tidal constituents. The calculated values of tidal constituent at Samarinda are shown in Table 27.5.4. The calculated value of Z_o (the difference between the Mean Sea Level and NLLW) by harmonic analysis was 1.10 m.

Table 27.5.4 Results of harmonic Analysis of Tide at Samarinda

Type	M2	S2	K1	O1	P1	N2	K2	M4	MS4
Amplitude (m)	.511	.255	.161	.177	.075	.114	.125	.013	.030
Phase Lag (degree)	211.9	307.8	295.6	274.7	279.0	194.6	163.9	298.9	59.3

Source: Results of natural condition survey by JICA

27.5.6 Datum Level for sounding survey

According to the information of IPC-4, the datum level for sounding survey was –1.60 m below LWS. The value of Z_o shown in the tide table issued by the Government of Indonesia was also 1.3 m. However, the value of Z_o calculated by the harmonic analysis was 1.10 m. It is presumed that the reason of these differences was caused by the following:

1) Difference of the tide observation location
   According to the tide table of the Government of Indonesia, tide gauge was located at Samarinda City. The tide of this Study also set up at Samarinda Port. However, tide gauge of IPC-4 seems to be located at river mouth.
2) Difference of the tide observation period and season
   Due to the short Study period, the tide observation period of this Study is one month. However, tide observation period for tide table issued by the Government of Indonesia maybe be more than 1 year.
3) Influence of river flow
   The tide observation of this Study was executed in dry season (July – August). The water level of Mahakam River at dry season is lower than rainy season. To determine a more accurate datum level, it is necessary to execute more than one year's observations.

Figure 27.5.3 shows the relation among datum levels used for sounding survey by IPC4 and this Study.

MSL		
- 1.10 m	by the Study Team	(called NLLW)
- 1.30 m	Indonesian Tide Table	
- 1.60 m	IPC4	(called LWS)

Figure 27.5.3 Relation of Datum Level for Sounding Survey

27.6 Wave

27.6.1 Wave observation

A wave gauge was installed at the mouth of Mahakam River and 30 days continuous measurements of wave height and wave direction were made to obtain the basic data for the siltation modeling. The wave observation was carried out at the dry season (July - August 2001) and the rainy season (November 2001; this failed due to the trouble of the wave gauge).

27.6.2 Wave analysis

(1) Observed wave

The results of wave observation in dry season are shown in Figure 27.6.1. As seen in the diagram, the wave direction is nearly constant, mainly in the directions from S, but partially the waves from NE – E were seen. The outline of wave height and wave period is shown in Table 27.6.1.

Maximum wave height was less than 0.4 m and average wave height was 0.1 m. Wave period of the observed wave height was about 4 sec.

Table27.6.1 Results of Wave Observation at Outer Bar of Mahakam River

Item	Dry season		Rainy season	
	Wave height	Wave Period	Wave height	Wave Period
Maximum wave	0.38 m	3.5 sec		
Significant wave	0.08 m	4.0 sec		

(2) Wave hindcast

Wave hindcast at the offshore point of Mahakam River was carried out using the wind data at the airport of Balikpapan for four years (1998 – 2001). The outline of the hindcast wave height and wave period is shown in Table 27.6.2.

The hindcast wave height is rather low and is generally less than 0.1 m. Average wave height of the frequent high waves is about 0.4 m.

The wave period of hindcast wave is shorter than that of the observed wave. The MSB

method used for the wave hindcast could not replicate the features of the observed wave period .

Table27.6.2 Results of Wave Hindcast for Jambi

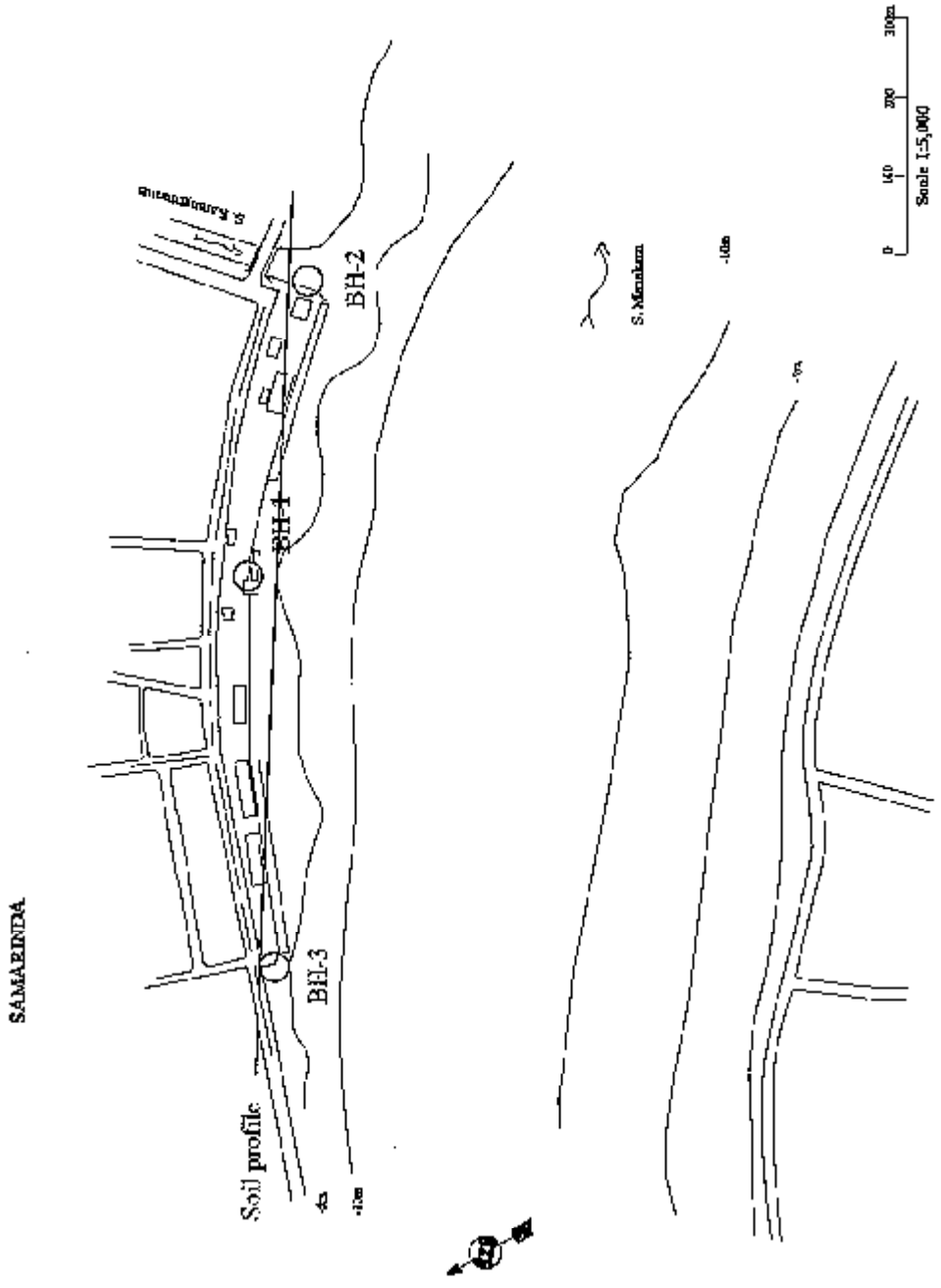
Item	1998 -2001	
	Wave height	Wave Period
Maximum wave	0.73 m	2.8 sec
Significant wave	0.24 m	1.7 sec

(3) Consideration of wave in siltation modeling

Average wave height at the Outer Bar area of Mahakam River is generally small and the frequency of the wave height exceeding 0.1 m was only 2.6 %.

The observed orbital velocity of water by waves is within 0.05 – 0.1 m/s, while the average velocity of tidal current at the Outer Bar area reaches 0.25 – 1.05 m/s (see Table 27.5.2).

The shear stress by wave action over the sediment at the Outer Bar area of Mahakam River is very small and less than 10 % of that of tidal current. The contribution of the wave action to the sediment transport is negligibly small at the Mahakam River.



INDEX

○ Boring point

BH-1 Boring point number

Figure 27.3.1 Location of Boring Point at Samarinda Port

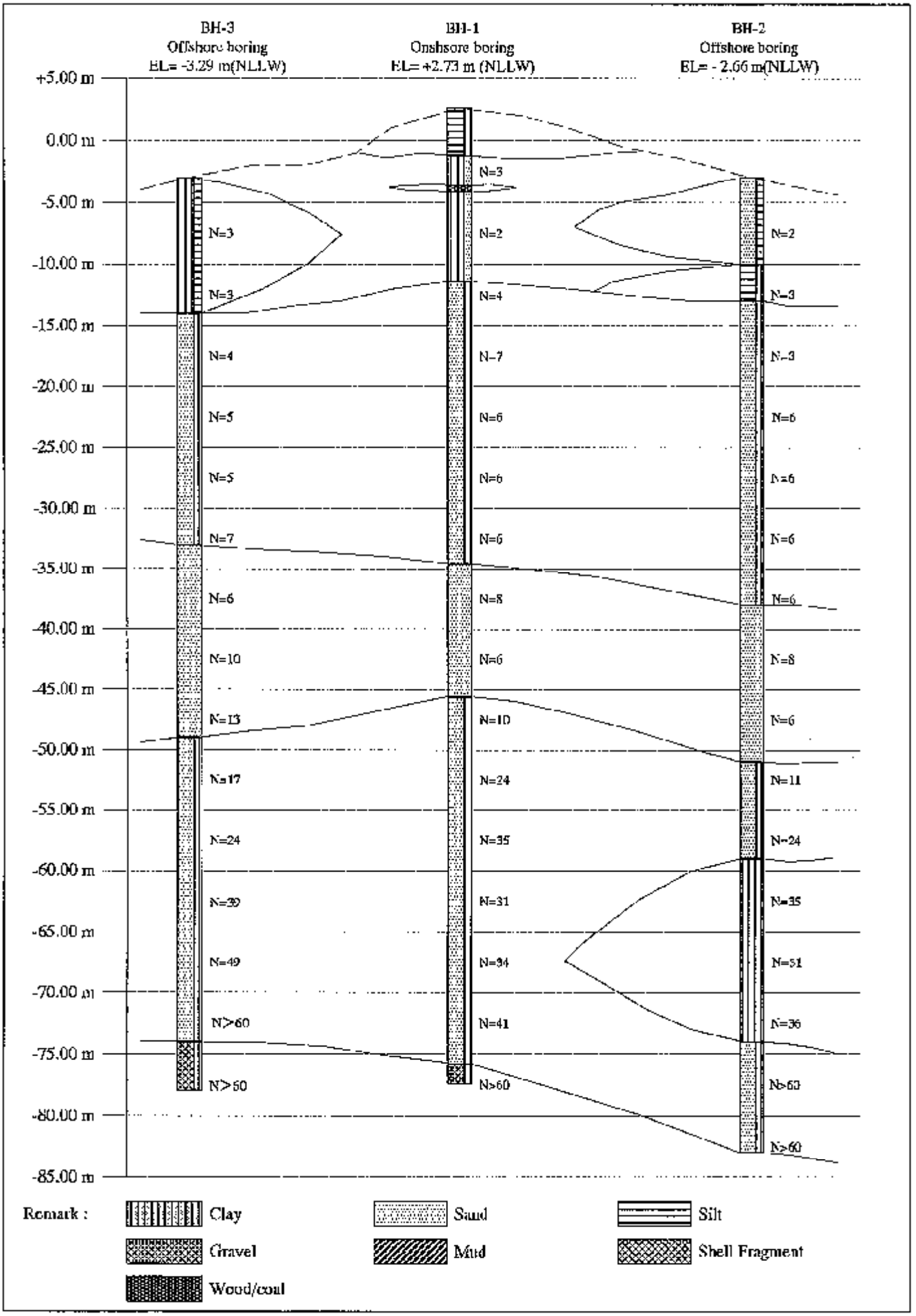


Figure 27.3.2 Soil Profile at Samarinda Port

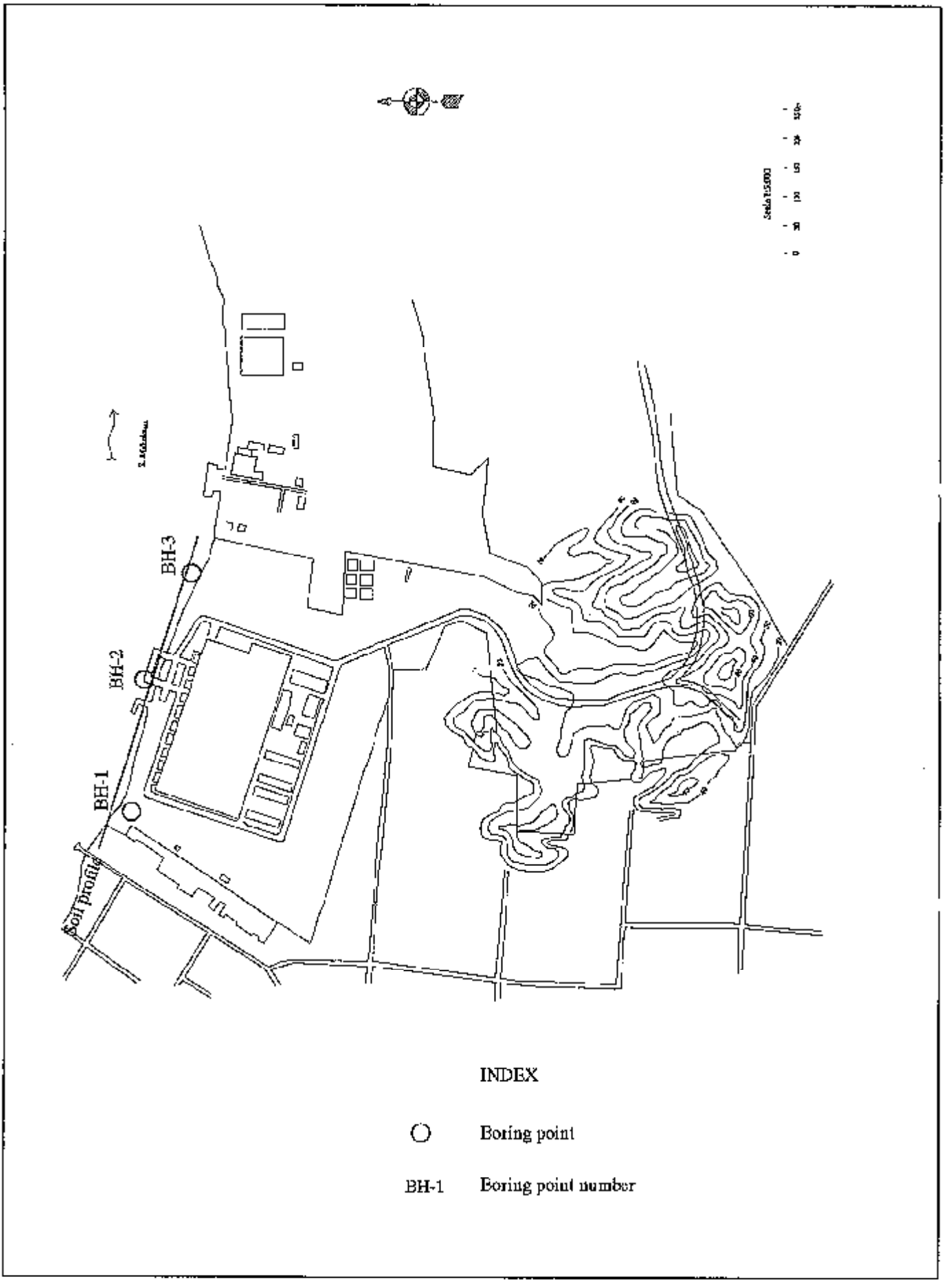


Figure 27.3.3 Location of Boring Points at Palaran

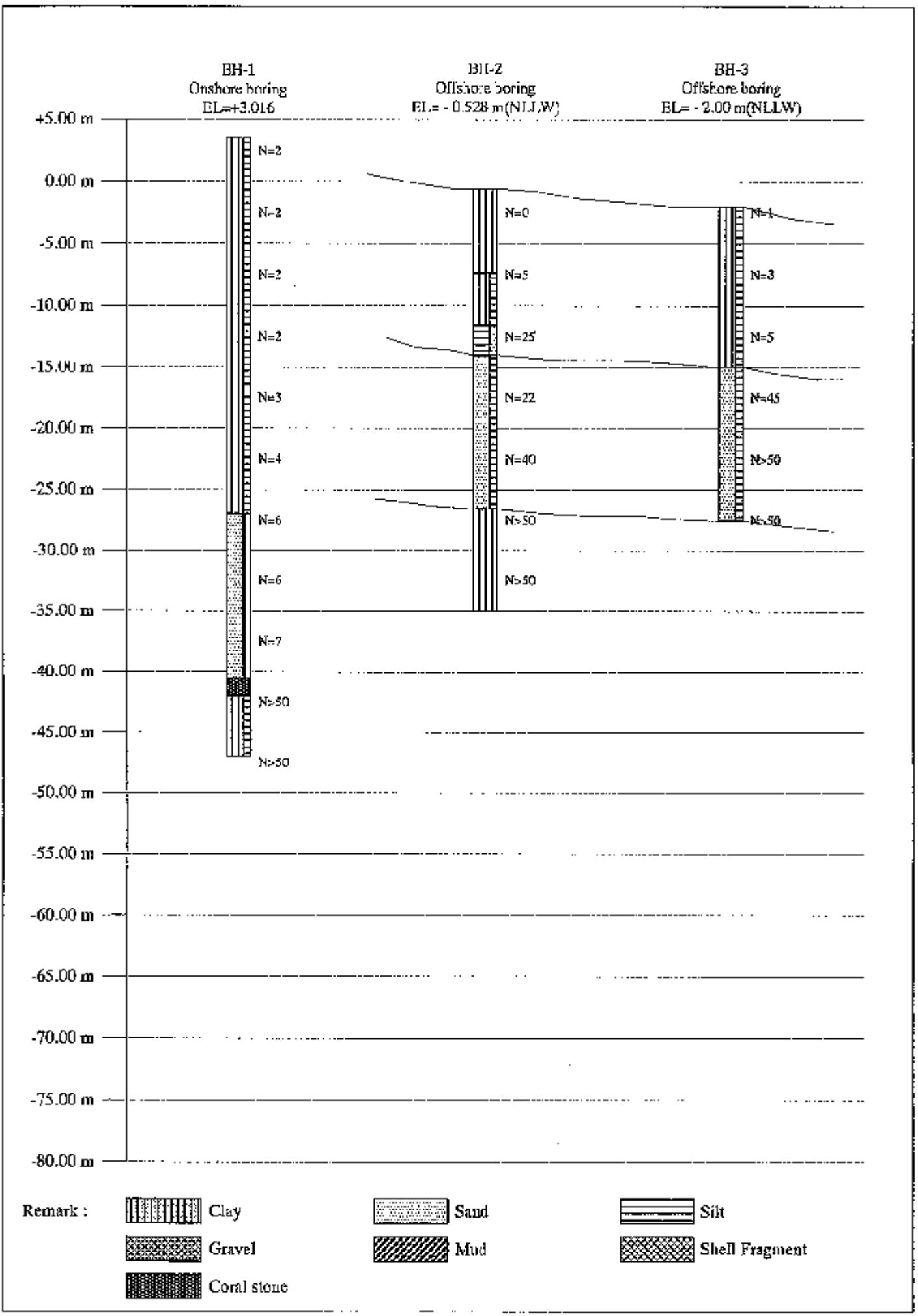


Figure 27.3.4 Soil Profile at Palaran

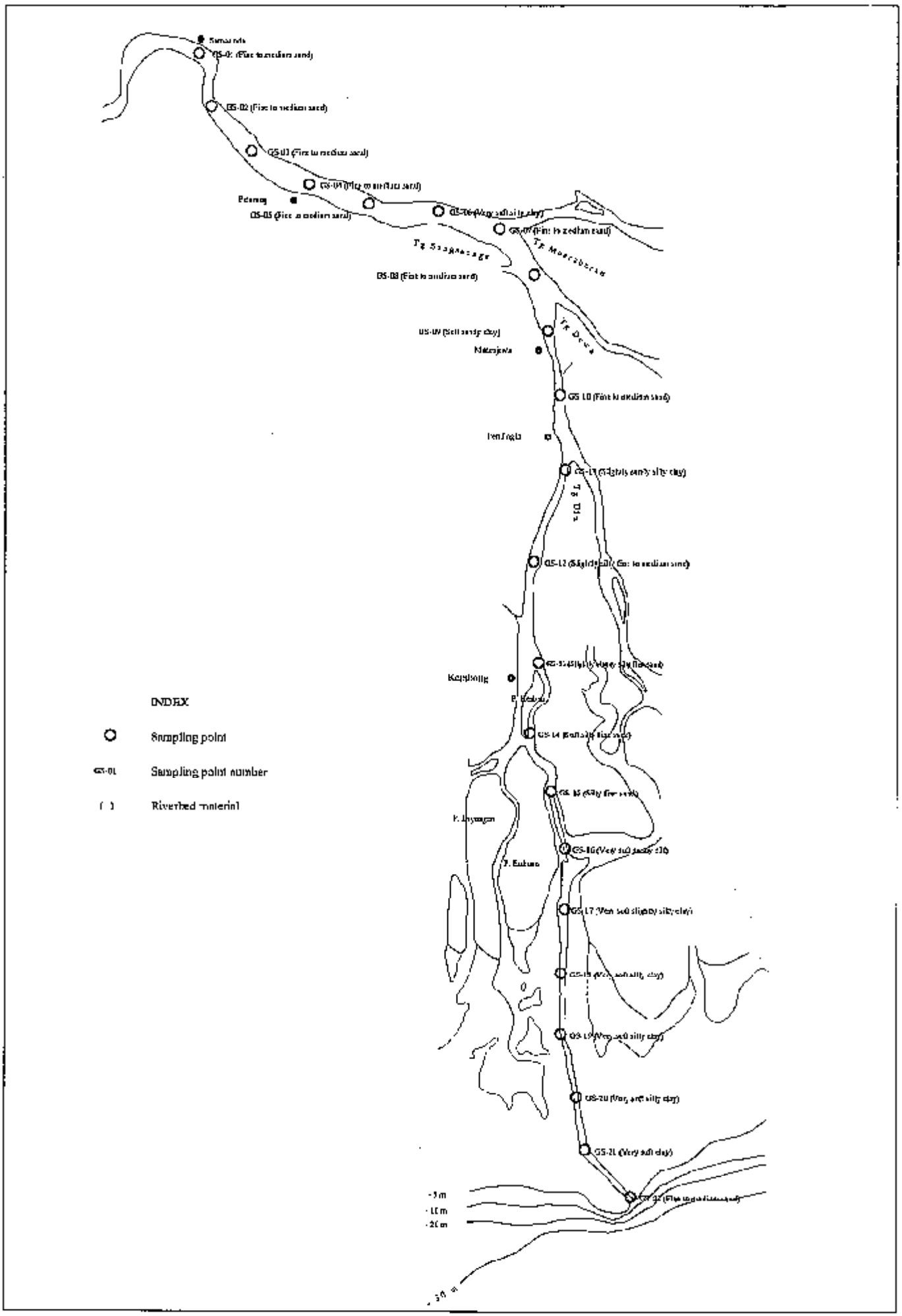
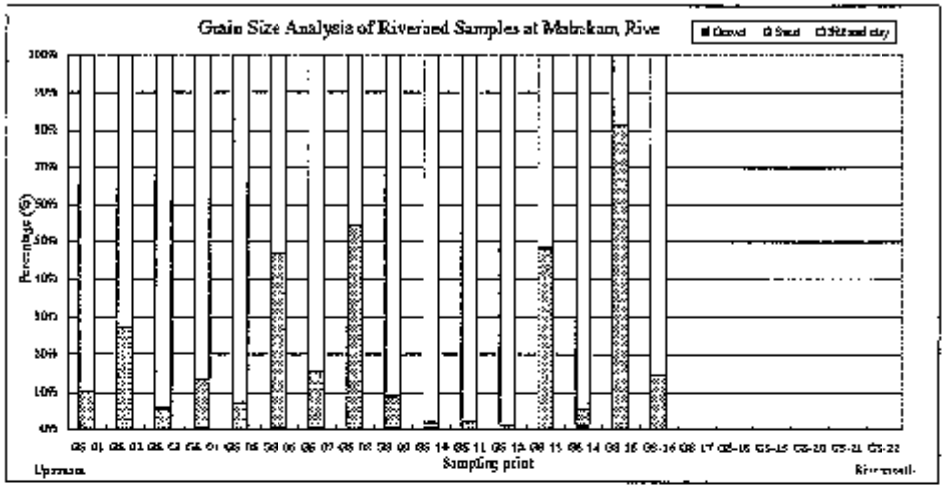
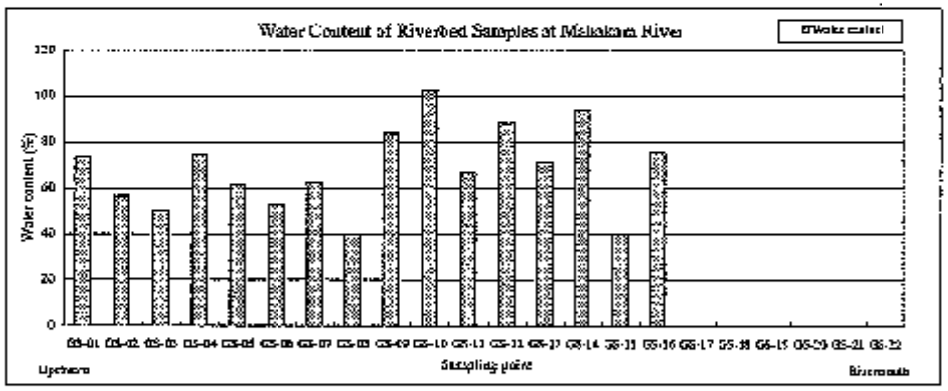


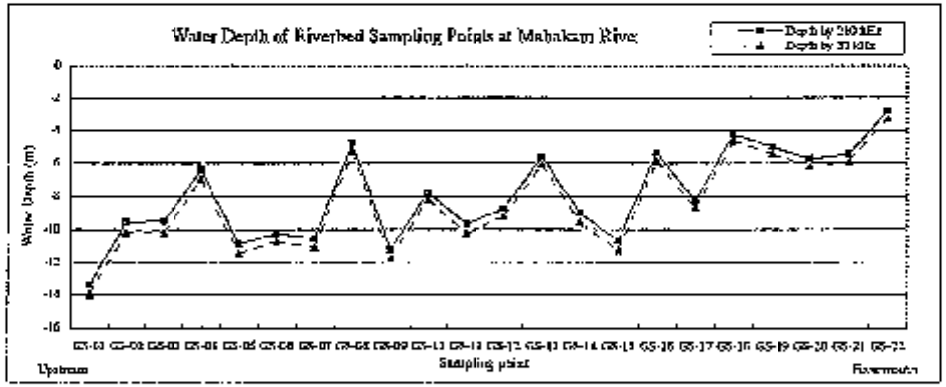
Figure 27.4.1 Location Map of Soil Sampling at Riverbed and Channel at Mahakam River

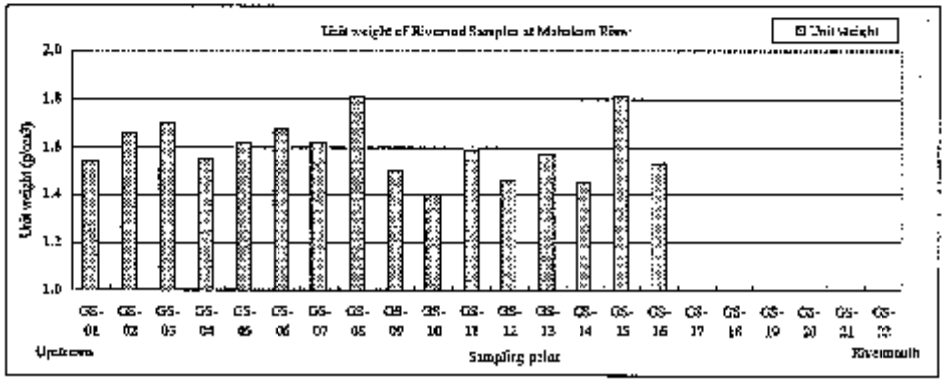


Soil Laboratory Test of Riverbed Soil Samples at Mahakam River

Soil sampling point No.	Cross section point No.	Depth by 210 kHz (m)	Depth by 33 kHz (m)	Width of top soft layer (m)	Grain size analysis (%)			Water content (%)	Unit weight (g/cm3)	Note
					Gravel	Sand	Silt & Clay			
GS-01	C-01	-13.42	-14.02	0.73	0.00	10.04	89.96	73.47	1.54	Upstream
GS-02	C-02	-9.46	-10.22	0.63	0.00	27.12	72.88	56.26	1.66	
GS-03	C-13	-9.51	-10.26	0.71	0.00	5.42	94.58	50.08	1.70	
GS-04	C-19	-5.41	-5.94	0.53	0.50	13.08	86.42	34.30	1.55	
GS-05	C-25	-10.05	-11.30	0.55	0.00	0.58	99.02	68.37	1.62	
GS-06	C-31	-10.33	-10.8	0.50	0.10	45.74	53.16	52.85	1.68	
GS-07	C-37	-10.59	-11.16	0.57	0.52	15.30	84.18	62.85	1.62	
GS-08	C-43	-4.81	-5.28	0.48	0.00	54.24	45.76	39.95	1.81	
GS-09	C-49	-11.31	-11.79	0.45	0.24	8.56	91.16	83.53	1.50	
GS-10	C-55	-7.77	-8.22	0.48	0.20	3.10	96.10	102.25	1.40	
GS-11	C-61	-9.74	-10.29	0.55	0.03	2.06	97.94	85.89	1.55	
GS-12	C-71	-8.91	-9.74	0.51	0.01	0.01	99.98	97.56	1.46	
GS-13	C-79	-5.61	-6.12	0.51	0.00	65.29	34.70	29.77	1.97	
GS-14	C-85	-9.04	-9.62	0.58	0.96	4.10	94.95	93.77	1.45	
GS-15	C-91	-10.7	-11.29	0.59	0.00	61.14	38.86	39.04	1.71	
GS-16	C-97	-5.8	-6.39	0.48	0.00	14.60	85.40	74.94	1.53	
GS-17	C-101	-6.25	-6.71	0.41						
GS-18	C-109	-5.97	-6.65	0.48						
GS-19	C-115	-5.04	-5.45	0.44						
GS-20	C-121	-5.73	-6.21	0.49						
GS-21	C-127	-5.40	-5.91	0.44						
GS-22	C-133	-2.93	-3.27	0.39						Rivermouth







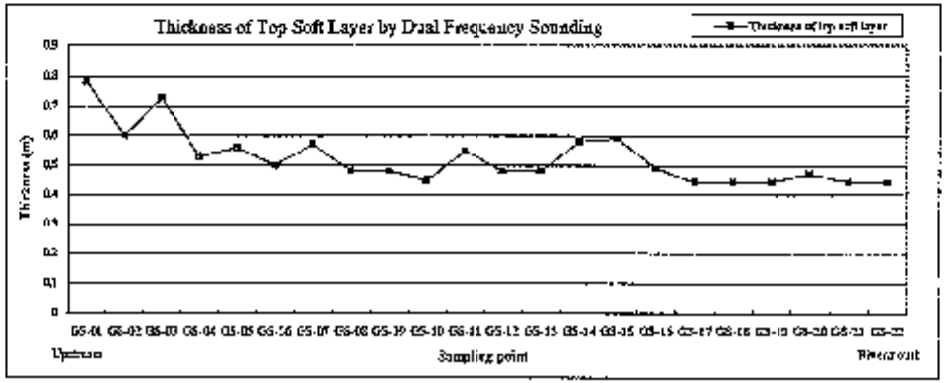


Figure 27.4.2 Results of Soil Laboratory Test for Soil Samples of Riverbed and Channel at Mahakam River

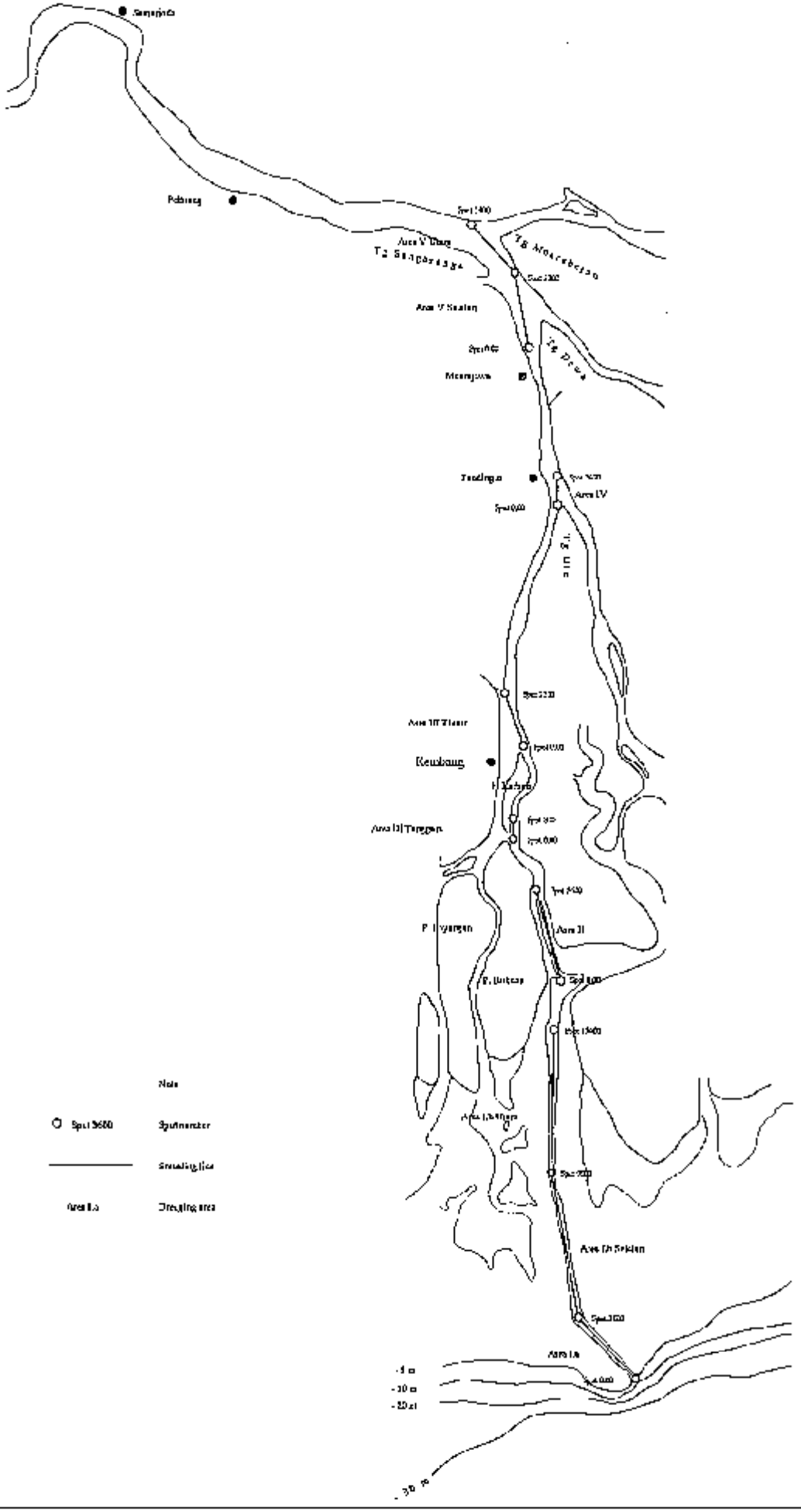


Figure 27.4.3 Location of Cross Section Points at Mahakam River

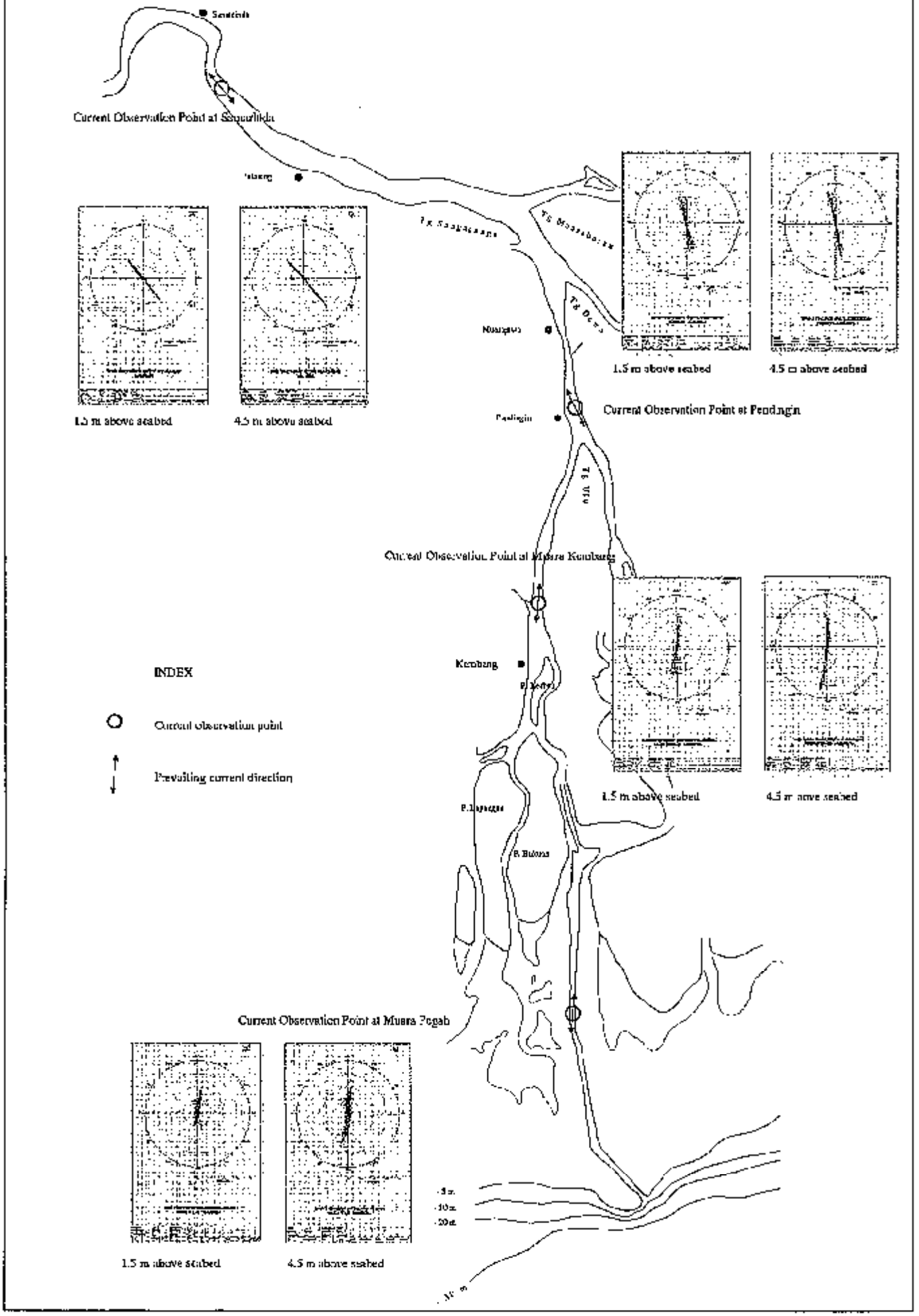


Figure 27.5.1 Prevailing Current Direction at Mahakam River (Dry Season)

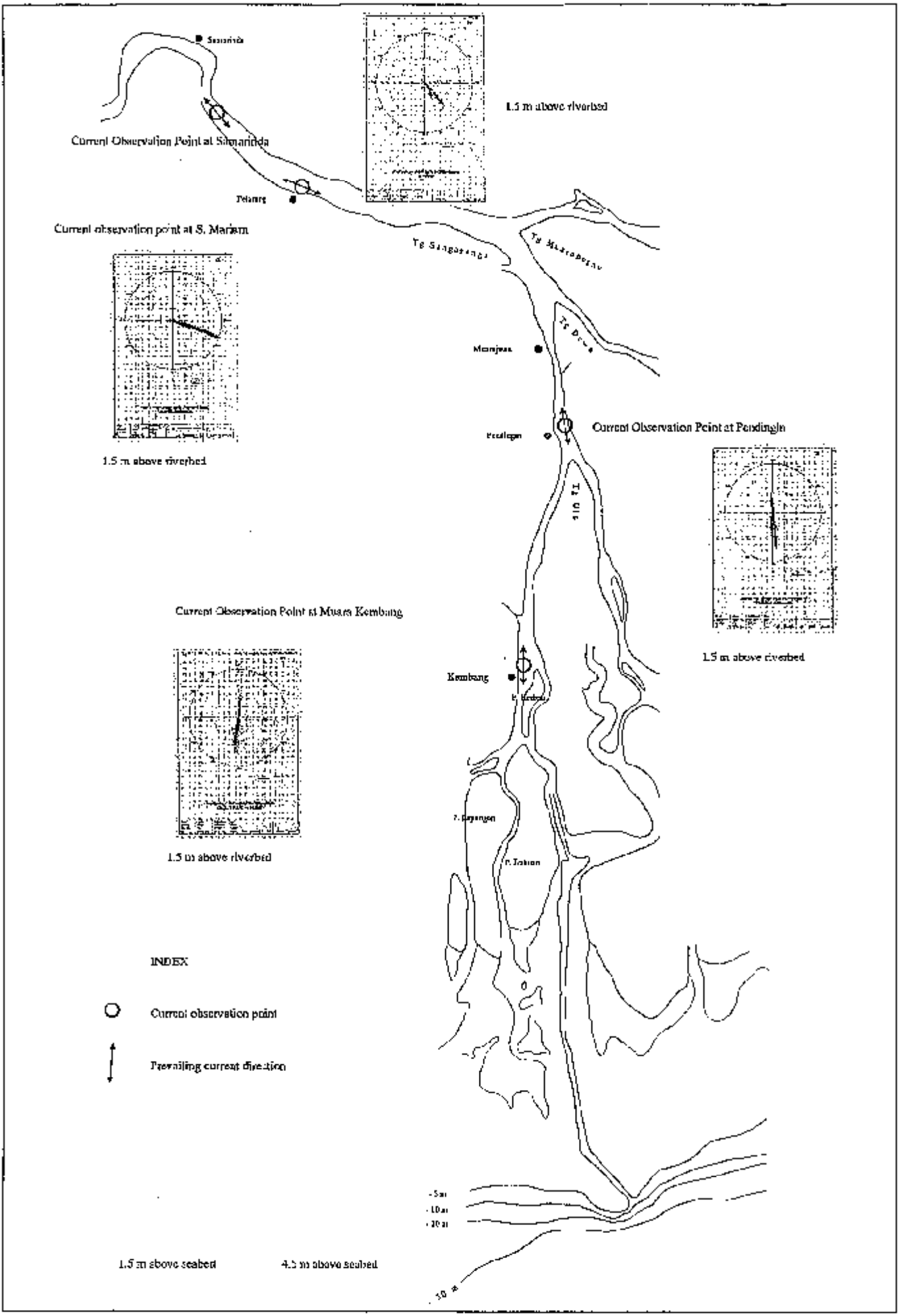


Figure 27.5.2 Prevailing Current Direction at Mahakam River (Rainy Season)

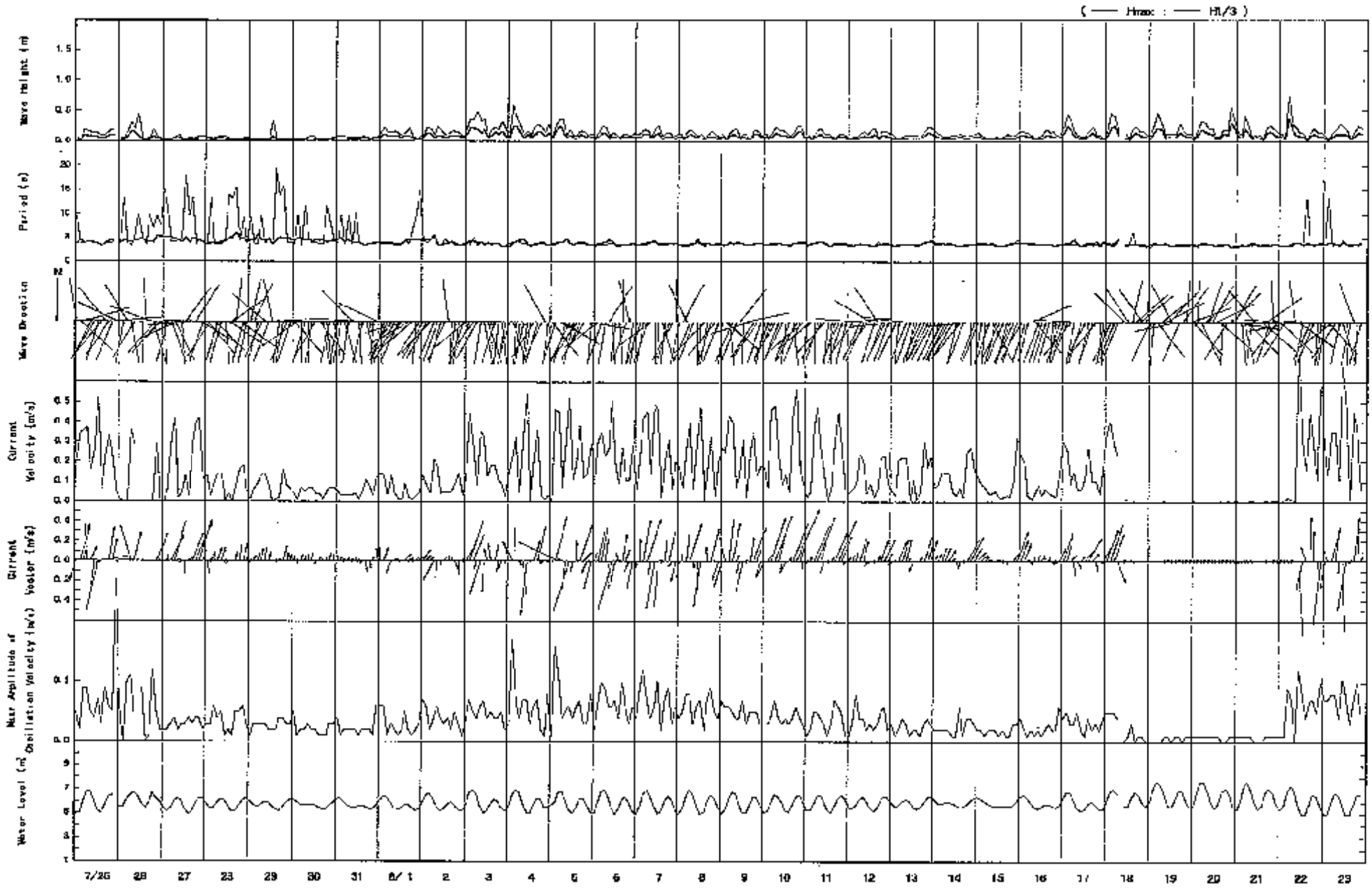


Figure 27.6.1 Time Series of Wave Height and Current (Samarinda, July-August 2001)