Appendix 14A Additional Natural Condition Surveys

A14A.1 General

The Study Team carried out the natural condition surveys (Phase 2) in the Red River Segment and the Duong River by sub-letting to the local consulting firm during wet season in 2002, to establish necessary information not only for planning and designing of the required facilities including port facility, groin, revetments or riverbank slopes but also for the study on navigation channel stabilization related to the Feasibility Study.

The natural condition surveys (Phase 2) can be divided into the followings:

(1) Natural Condition Surveys in the Red River Segment
   1) Measurement of river water flow and suspended solid,
   2) Measurement of river bed materials,
   3) Topographic and bathymetric survey, and
   4) Geotechnical investigation.

(2) Natural Condition Surveys for Additional Studies in the Duong River
   5) Topographic and bathymetric surveys,
   6) Geotechnical investigation, and
   7) Bridge structural survey of existing Duong bridge.

A14A.2 Measurement of river water flow and suspended solid

The Study Team carried out the measurements of water flow and suspended solid one time at each point during the some three hours.
Measuring points consist of seven (7) main points (obtained for input data for implementation of simulation of navigational channel stabilization in case of wet season) and six (6) supplemental points (obtained for checking numerical values computed from simulation) as seen in **Figure A14A.2.1** and **Table A14A.2.1**.

- Main measuring points

Water flow and suspended solid were measured at 0.5m water depth intervals at two (2) points out of main points named " key points" (one point locating at the end of upstream (V2) and another point locating at the end of downstream (V12) in the Red River segment,

Two (2) current meters of high specifications were used exclusively at two (2) key

points to measure water flow and suspended solid at 0.5 m water depth intervals for obtaining vertical distribution data.
At the same time water flow and suspended solid were measured at five (5) points of the remaining main points and six (6) supplemental points at the following three (3) water depths:

Surface layer: 0.5 meter below the surface of water
Middle layer: Intermediate depth between the surface and the bottom
Bottom layer: 0.25 meter above the surface of river bed

Distribution map of the speed of river water flow measured at 0.25 m above river bed is shown in **Figure A14A.2.1** as well. During the above measurements were being carried out, water level were simultaneously measured at intervals of every ten (10) minutes starting from 00 minute at the eight (8) units of leveling stuff set up at the points of riverside near waterline.

As can be seen in **Figure A14A.2.2**, gradient of water surface is computed at about 1/15,000 in a part of thirty (30) km distance of the Red River segment from Giay outlet to Khuyen Luong port. The results of measurements of river water flow and suspended solid are respectively summarized in **Table A14A.2.2** and **Table A14A.2.3**.

Table A14A.2.1 Coordinates of Measuring Points of Water Flow/Suspended Solid

Name	Coordinates		Location
	Easting (m)	Northing (m)	
V1	578335	2334098	Thuong Cat port
V2	578434	2334282	
V3	578546	2334485	
V4	580889	2333918	Chem temple
V5	583505	2334212	Tam Xa
V6	587435	2332434	Duong estuary
V7	589196	2331145	Duong river
V8	589540	2328085	Hanoi
V9	590694	2324143	Ha Noi port
V10	594405	2320758	Bat Trang
V11	592520	2318150	Khuyen Luong
V12	592639	2318083	
V13	592780	2317995	

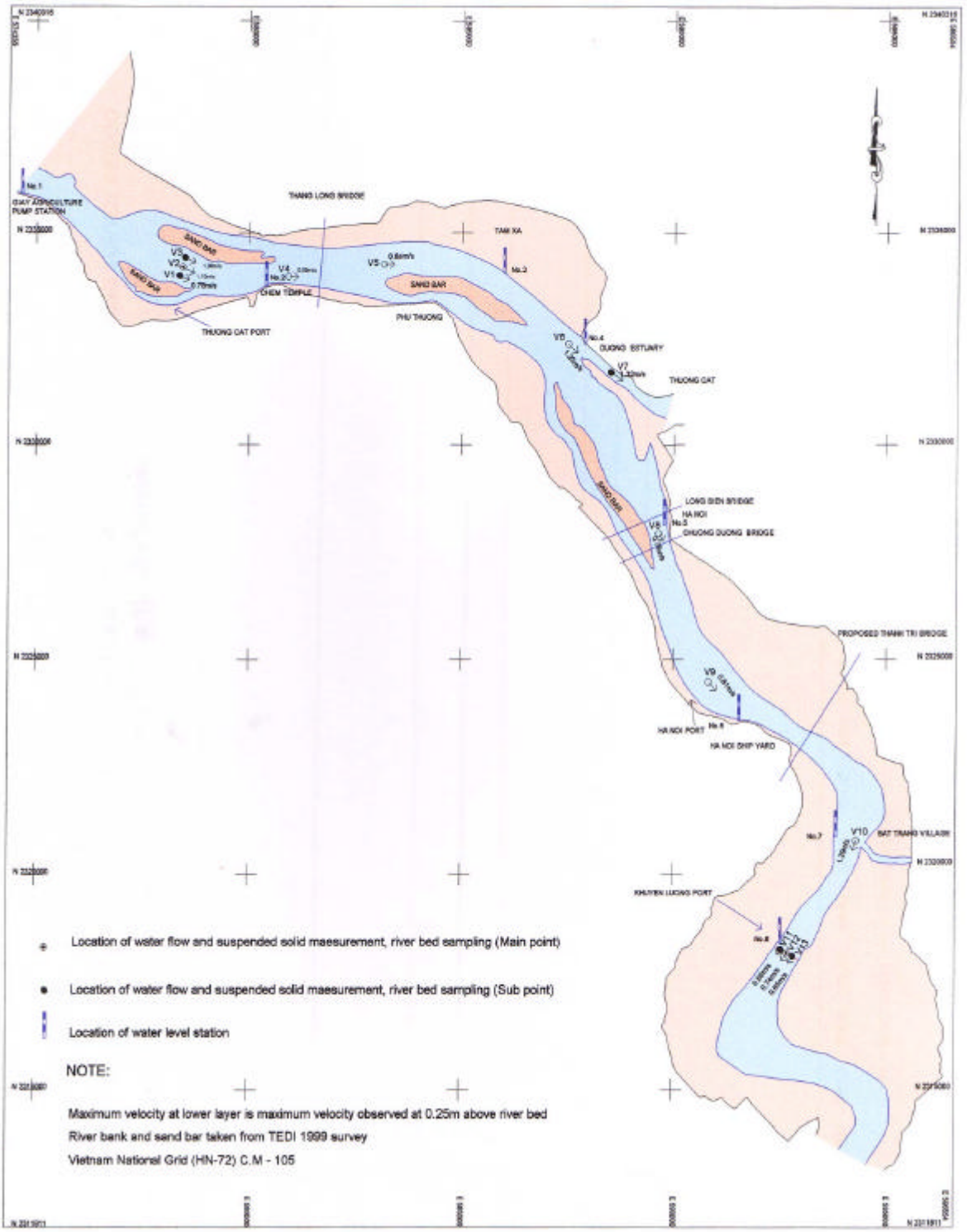


Figure A14A.2.1 Distribution Map of Speed of River Water Flow at 0.25 m above River Bed

Source) JICA Study Team, measured on August 8, 2002

Table A14A.2.2 Water Flow in the Red River Segment

Water Depths	Speed (m/s)												
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13
0.5 m below water surface	1.06	1.51	1.62	1.50	1.25	1.40	2.11	0.99	1.34	1.61	0.98	1.78	1.79
Middle depth	0.98	1.33	1.58	1.44	1.17	1.34	1.64	0.96	1.22	1.63	0.92	1.51	1.45
0.25 m above river bed	0.78	1.10	1.08	0.59	0.84	1.22	1.32	0.79	0.81	1.29	0.68	0.74	0.66

Source) JICA Study Team, measured on August 8, 2002

Table A14A.2.3 Concentration of Suspended Solid (SS) in the Red River Segment

Water Depths	Suspended Solid (SS) (mg/l)												
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13
0.5 m below water surface	563.6	606.8	676.6	555.8	667.4	635.2	625.0	694.8	492.6	634.6	681.8	619.0	689.8
Middle depth	612.8	773.0	812.2	564.6	705.8	773.2	739.0	725.8	640.2	679.2	686.6	710.0	695.0
0.25 m above river bed	622.0	638.8	928.6	580.4	780.8	774.8	780.8	745.4	949.8	914.0	696.0	824.4	740.0

Source) JICA Study Team, measured on August 8, 2002

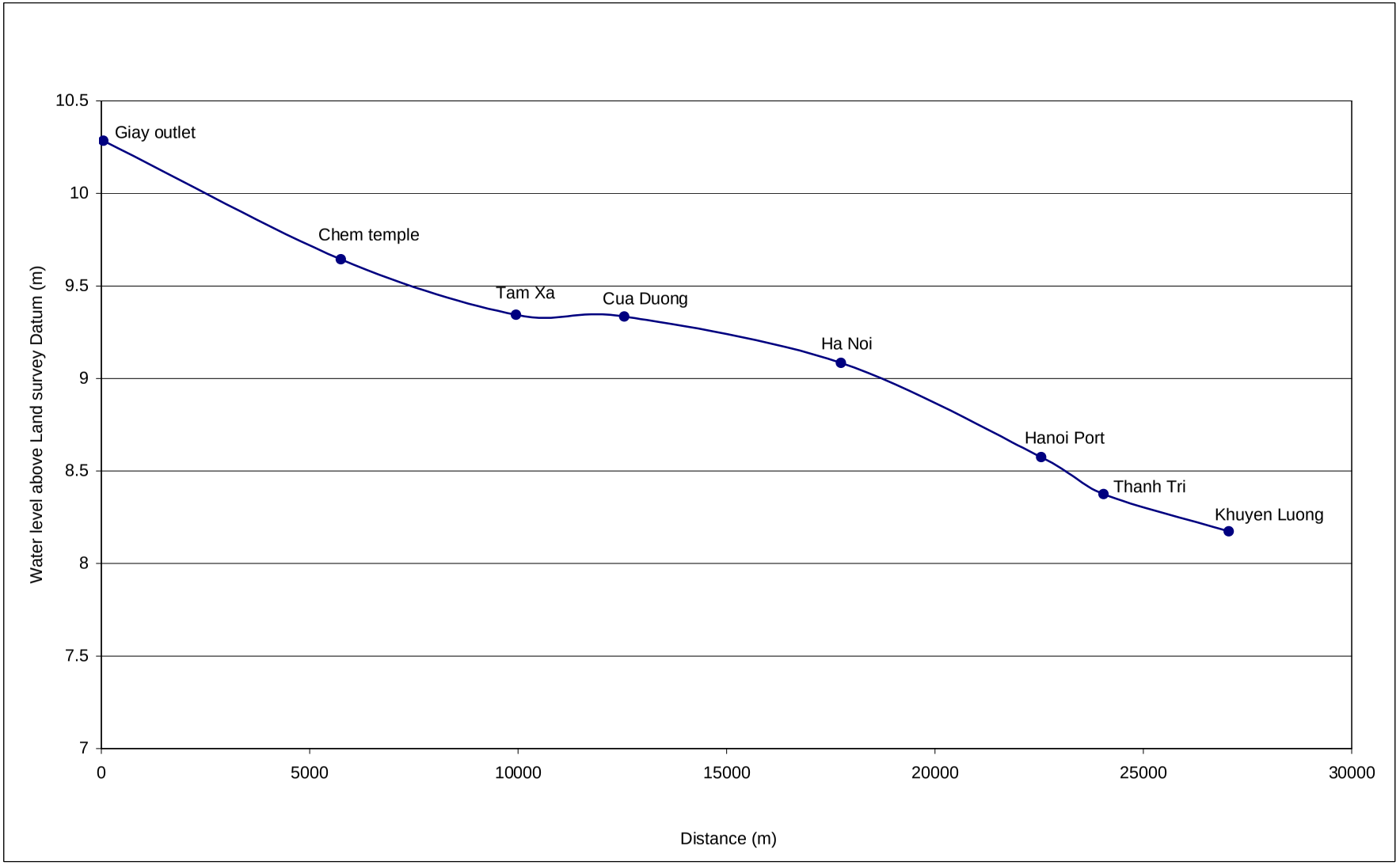


Figure A14A2.2 Gradient of Water Surface in the Red River Segment through Hanoi

Source) JICA Study Team, measured on August 8, 2002

A14A.3 Measurement of river bed materials

The Study Team carried out measurement of river bed materials, these samples were taken from the same thirteen (13) points as the measurements of river water flow as seen in **Figure A14A.3.1**.

These samples were taken from two (2) depths comprising the surface of river bed and 0.50 below the ground. Specific gravity and analysis of grain size distribution by sieve test and hydraulic test were carried out at the laboratory to identify grain sizes (diameter) of soil particles of d25, d50 (median diameter) and d75 as seen in **Table A14A.3.1**.

These values are indispensably needed for analysis of navigation channel stabilization. Distributions map of d50 (median diameter) at surface of river bed in the Survey Area is shown in **Figure A14A.3.1** as well**.**

As can be seen in **Table A14A.3.2** below, these sizes (d_{50}) at surface of river bed varies from 0.011 to 0.295 mm (0.133 to 0.283 mm in case of dry season of Phase 1).

Table A14A.3.2 Median Diameter of River Bed Materials in the Red River Segment

Diameter	Median Diameter d50 (mm)			
	Surface of River Bed		0.5 m below River Bed	
	Dry Season	Wet Season	Dry Season	Wet Season
Maximum	0.283	0.295	0.301	0.305
Average	0.133	0.219	0.120	0.223
Minimum	0.007	0.013	0.010	0.013

Source) JICA Study Team

In addition to the above-mentioned river bed material, samples of bed load were taken at representative five (5) points to provide the fundamental information for the study on navigation channel stabilization as seen in **Table A14A.3.3.**

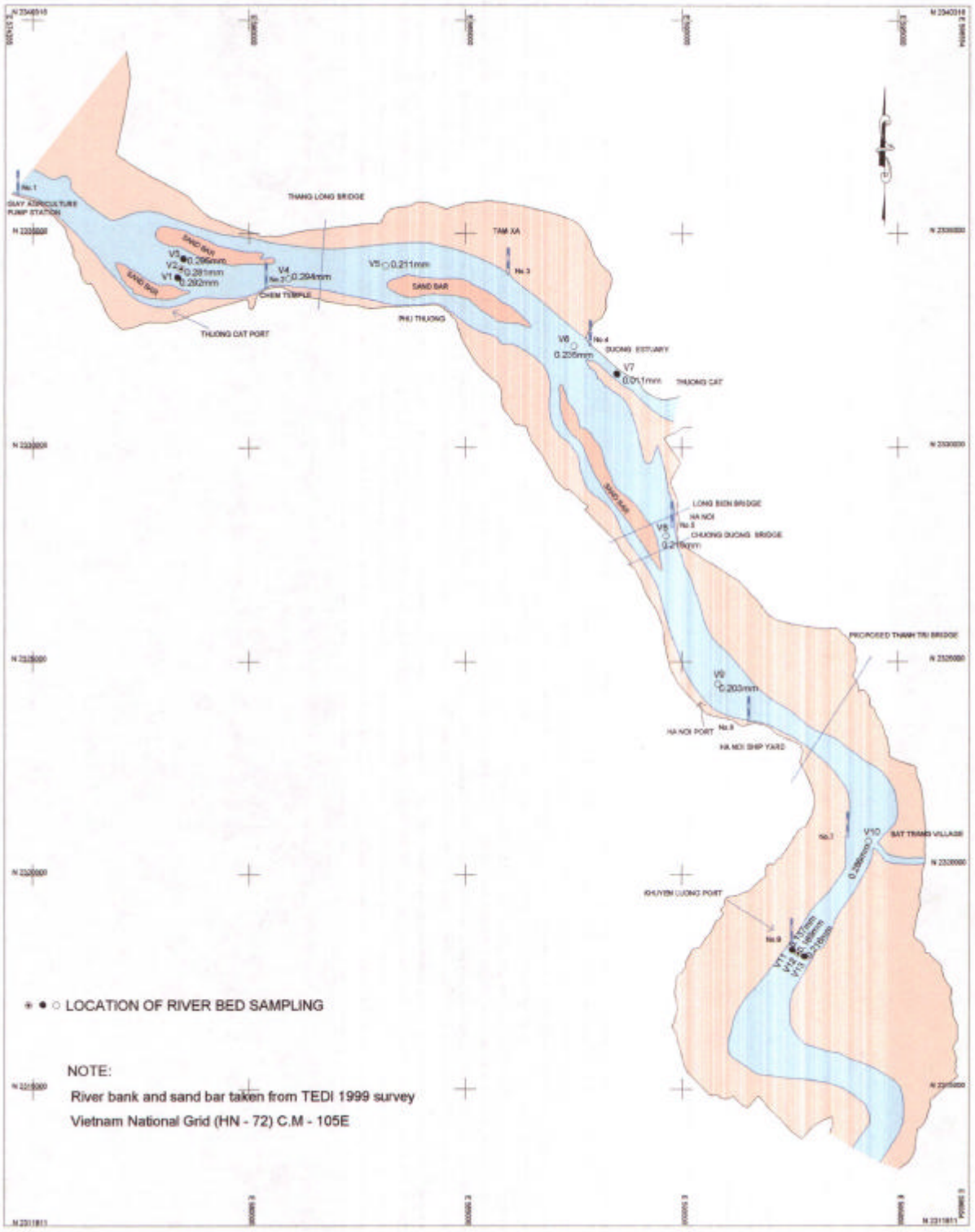


Figure A14A.3.1 Distribution Map of Grain Size
(d=50: Median Diameter)
at Surface of River Bed

Source) JICA Study Team, measured on August 30, 2002

Table A14A.3.1 River bed Materials in the Red River Segment

(Unit: mm)

Ground Depths	d (%)	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13
Surface of river bed	d25	0.241	0.216	0.252	0.251	0.118	0.193	0.00	0.151	0.170	0.233	0.112	0.144	0.182
	d50	0.292	0.281	0.295	0.294	0.211	0.235	0.011	0.216	0.203	0.286	0.137	0.169	0.216
	d75	0.339	0.338	0.337	0.338	0.233	0.314	0.027	0.291	0.232	0.331	0.160	0.210	0.249
0.5 m depth below surface level	d25	0.257	0.245	0.263	0.250	0.187	0.197	0.00	0.164	0.152	0.243	0.110	0.141	0.185
	d50	0.303	0.293	0.305	0.293	0.210	0.238	0.013	0.231	0.195	0.301	0.138	0.161	0.218
	d75	0.349	0.339	0.347	0.335	0.233	0.311	0.029	0.309	0.226	0.356	0.160	0.183	0.252

Source) JICA Study Team, measured on August 30, 2002

Table A14A.3.3 Bed Load in the Red River Segment

(Unit: mm)

Sampler Depth	d (%)	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13
Above surface of river bed	d50	-	0.227	0.189	-	-	-	-	-	-	-	0.212	0.165	0.213
	d90	-	0.342	0.245	-	-	-	-	-	-	-	0.282	0.232	0.283

Source) JICA Study Team, measured on August 8, 2002 for samples at V2, V3 and September 2, 2002 for samples V11, V12, V13

A14A.4 Topographic and bathymetric survey

In order to provide the one of the fundamental design conditions of topographic and bathymetric maps for the planning/designing of the required facilities and for the study on navigation channel stabilization, the Study Team carried out the said surveys in the following sites at intervals of fifty (50) m measuring lines in topographic survey and at hundred m (100) in bathymetric survey.

The survey areas can be divided into the following two categories from a viewpoint of the purpose of the survey.

1) At the planned construction sites consisting of ports, mobile bridge, groin, revetment and slope protection.
- New north port, Hanoi port, Khuyen Luong port and New east port (Phu Dong site),
- Duong bridge, and
- Red River segment.

2) Throughout the Red River segment to collect the necessary data of bathymetric map for the study on navigation channel stabilization.

Vietnam National Grid (HN-72) was applied as detailed in **A14.6,** and all levels are referred to National Land Survey Datum (NLSD) in this survey.

The results of the survey at the planned construction sites were incorporated in topographic and bathymetric maps in A1 size with a scale of 1/2,000, which were used for the base map of the design of the structures.
- New north port: 2 sheets,
- Hanoi port: 2 sheets,
- Khuyen Luong port: 2 sheets,
- New east port (Phu Dong site): 2 sheets, and
- Duong bridge: 1 sheet.

And twenty one (21) cross sections were constructed for the planned sites consiting of structures consisting of groin, revetment and slope protection.

And that of the Red River segment was incorporated in six (6) drawings of bathymetric maps with a scale of 1/20,000 and forty two (42) cross sections.

A14A.5 Geotechnical investigation

(1) General

The Study Team carried out geotechnical investigation at the following seven (7) sites consisting of four (4) holes of under-water boring and six (6) holes of on-land boring as summarized in **Table A14A.5.1** below and **Figure A14A.5.1(1)** to **(4)**.

Table A14A.5.1 Coodinates and Elevation of Boring Holes

No.	Location	Boring No.	Coordinates (m)		Ground Elevation (m)	Depth of Borehole (m)	Under-water or On-land
			E	N			
1	New north port	NP1	584427.18	2334866.40	10.71	32.0	On-land
		NP2	584450.00	2334623.00	0.80	25.5	Under-water
2	Van Dong site	VD1	590049.028	2324851.263	-1.25	37.0	Under-water
3	Hanoi port	HN1	590675.919	2323913.651	+11.00	40.5	On-land
		HN2	590376.200	2324320.472	+1.55	32.5	Under-water
4	Bat Trang bank	BT1	594848.820	2321044.950	+10.73	50.0	On-land
		BT2	594918.210	2321357.630	+4.59	39.5	Under-water
5	Khuyen Luong port	KL1	591636.300	2317536.900	+10.46	46.0	On-land
6	Duong bridge	DB1	594361.45	2332097.55	+1.33	30.0	On-land
7	New east port	PD1	598273.500	2327403.200	+9.40	37.5	On-land

Source) JICA Study Team

A series of laboratory test is carried out in accordance with the requirements indicated in **Table A14.7.5**.

The purpose of this geotechnical investigation is to provide the design soil conditions for the required structures in the Feasibility Study comprising port facilities, revetment, groin and slope protection and the like. Main points to be identified are:

- To confirm elevation of bearing layer for pile foundation structures, and
- To establish design soil conditions including strength, unit weight, consolidation characteristics of each soil layer.

Based on the results of a series of field and laboratory tests, general geotechnical characteristic of the Survey Area could be briefed as follows:

- Soft to stiff layer group (N-value < 50 blows)

This layer group consists of all soft to stiff soils including cohesive and cohesionless materials.

- .Hard layer group (N-value ≥ 50 blows)

This indispensable layer group distributes throughout the Survey Area at elevation from -19.09m (NP1) to -36.27m (VD1). The results of particle size analysis show that the soil of the layers belong to well-graded gravel (GW), poorly graded gravel (GP), well graded gravel with sand and silt (GW-GM), silty sand (SM), silty clayey sand (SC-SM).

1) Confirmation of bearing layer

For easy understanding, soil profiles are shown in **Figure A14A.5.2 (1)** to **(5).** It can be seen that the hard layer, might belong to *Hanoi formation ($Q_{II-III}hn$)*, with N-value being more than 50 appears from about –19 m to –36 m as summarized in **Table A14A.5.1** below and **Figure A14A.5.3.**

Table A14A.5.1 Distribution of Hard Layer

No.	Borehole	Elevation (m)			N-value (blow)	
		Ground/ River bed	Top of the hard layer	Bottom of borehole	Min	Max
1	NP1	10.71	-19.09	-21.29	58	>50
2	NP2	0.80	-21.90	-24.70	52	54
3	VD1	-1.25	-36.05	-38.25	53	56
4	HN1	11.00	-27.40	-29.50	50	52
5	HN2	1.55	-27.95	-30.95	50	55
6	BT1	10.73	-36.27	-39.27	54	56
7	BT2	4.59	-34.91	-36.91	52	55
8	KL1	10.46	-32.04	-35.54	42	>50

Source) JICA Study Team

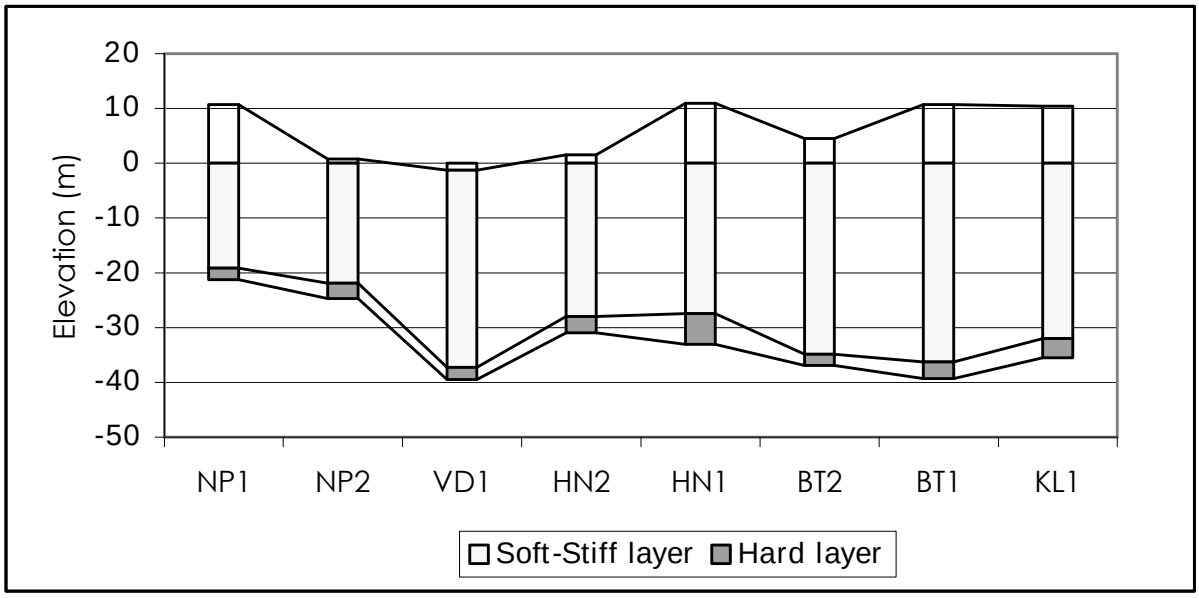
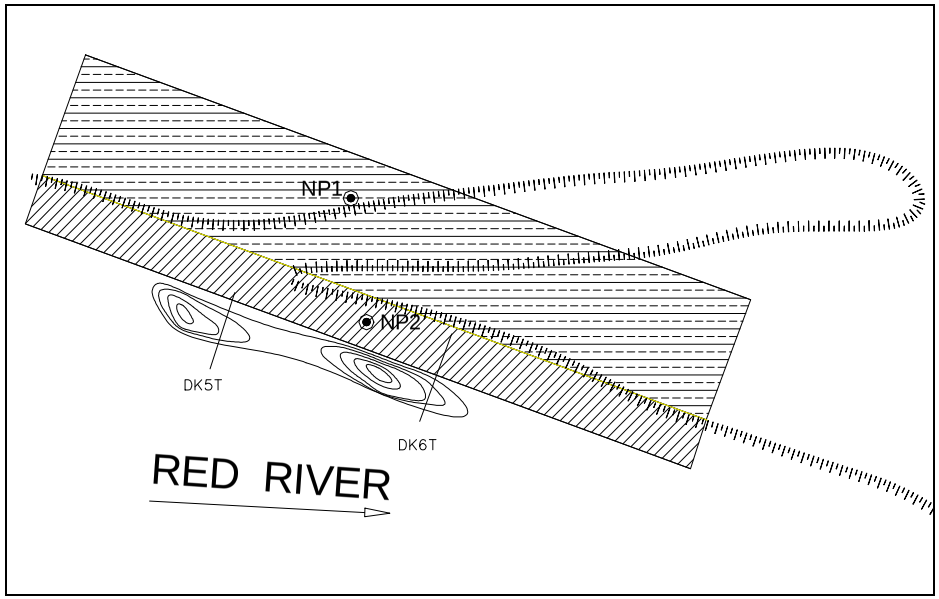


Figure A14A.5.3 Distribution of Soil Layers throughout the Red River Segment

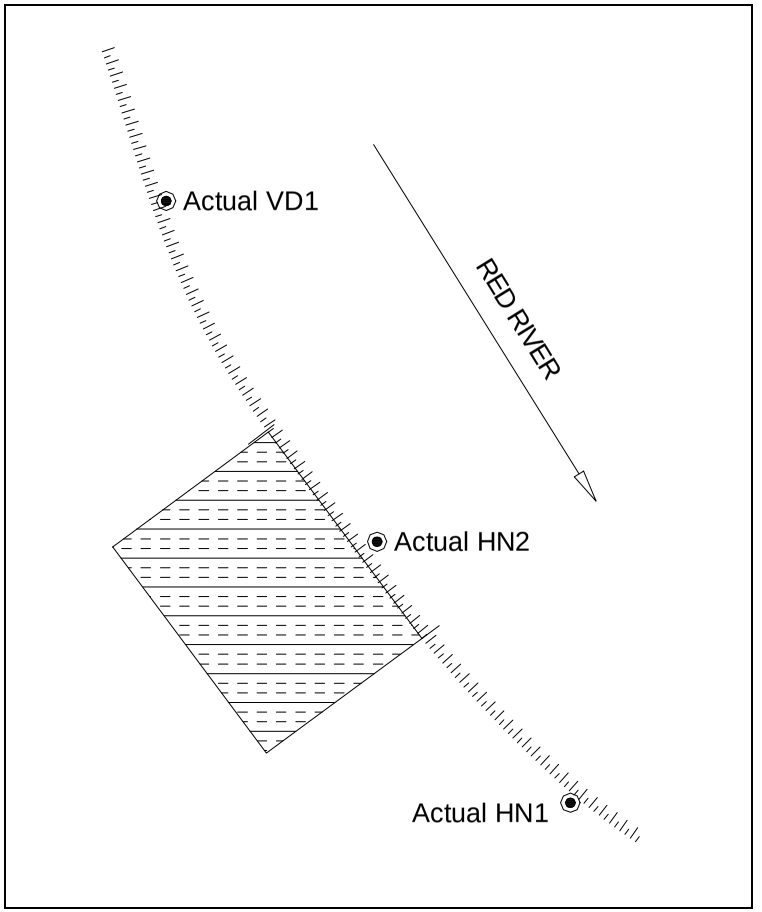
Source) JICA Study Team

2) Establishment of design soil conditions

Based on the results of field investigation and laboratory test, the design soil conditions, which have been applied in designing, were established as seen in **Figure 38.2.1** in the separated main report.



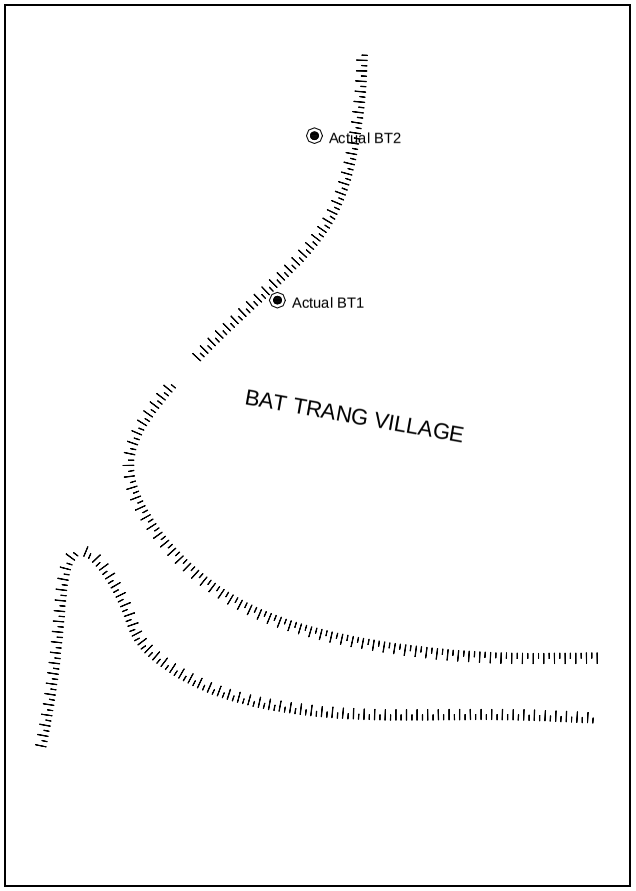
New North Port



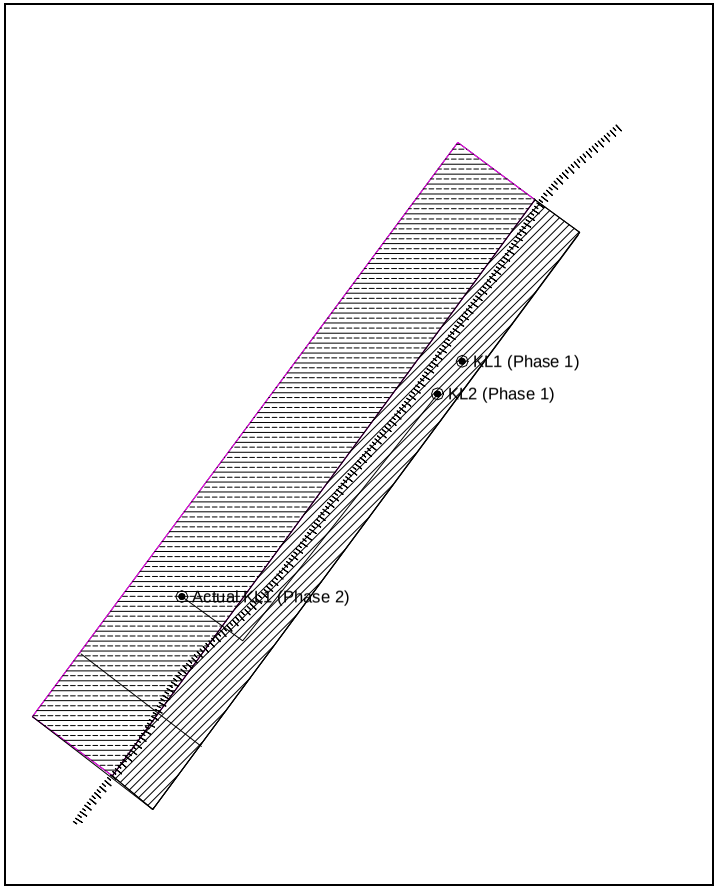
Van Dong site and Hanoi Port

Figure A14A.5.1 (1) Location Map of Boring Log at New North Port and Van Dong Site and Hanoi Port

Source) JICA Study Team



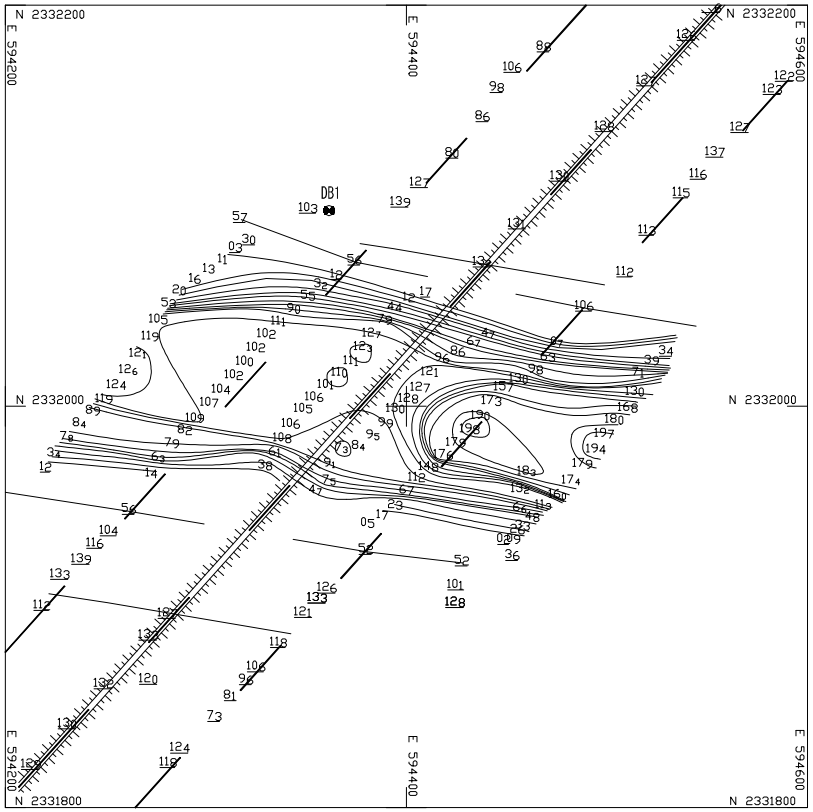
Bat Trang Site



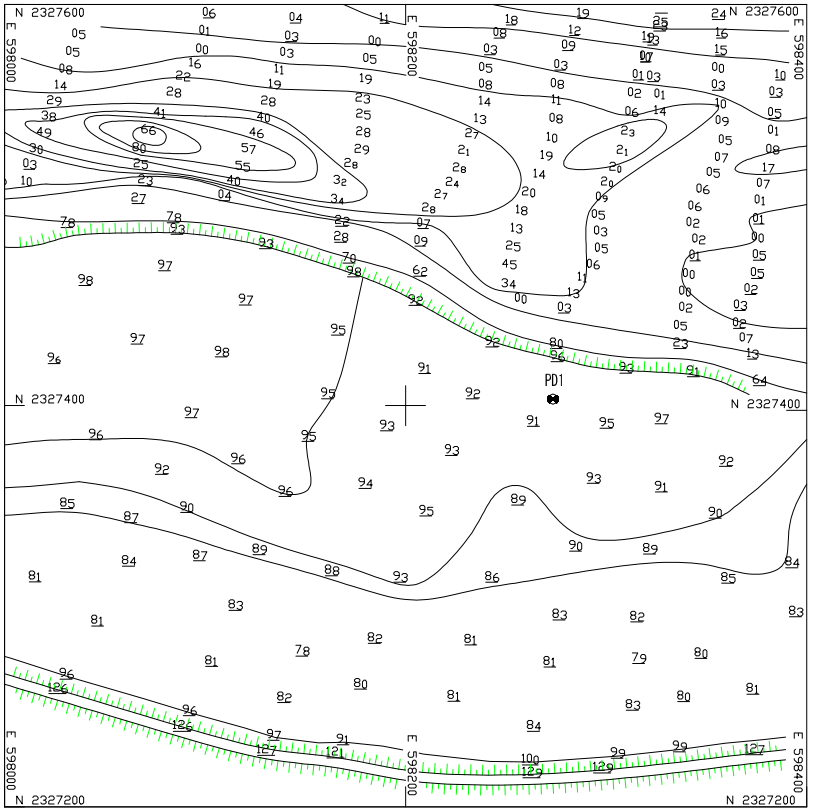
Khuyen Luong Port

Figure A14A.5.1 (2) Location Map of Boring Log at Bat Trang Site and Khuyen Luong Port

Source) JICA Study Team



Duong Bridge



New East Port (Phu Dong Site)

Figure A14A.5.1 (3) Location Map of Boring Log at Duong Bridge and New East Port (Phu Dong Site)

Source) JICA Study Team

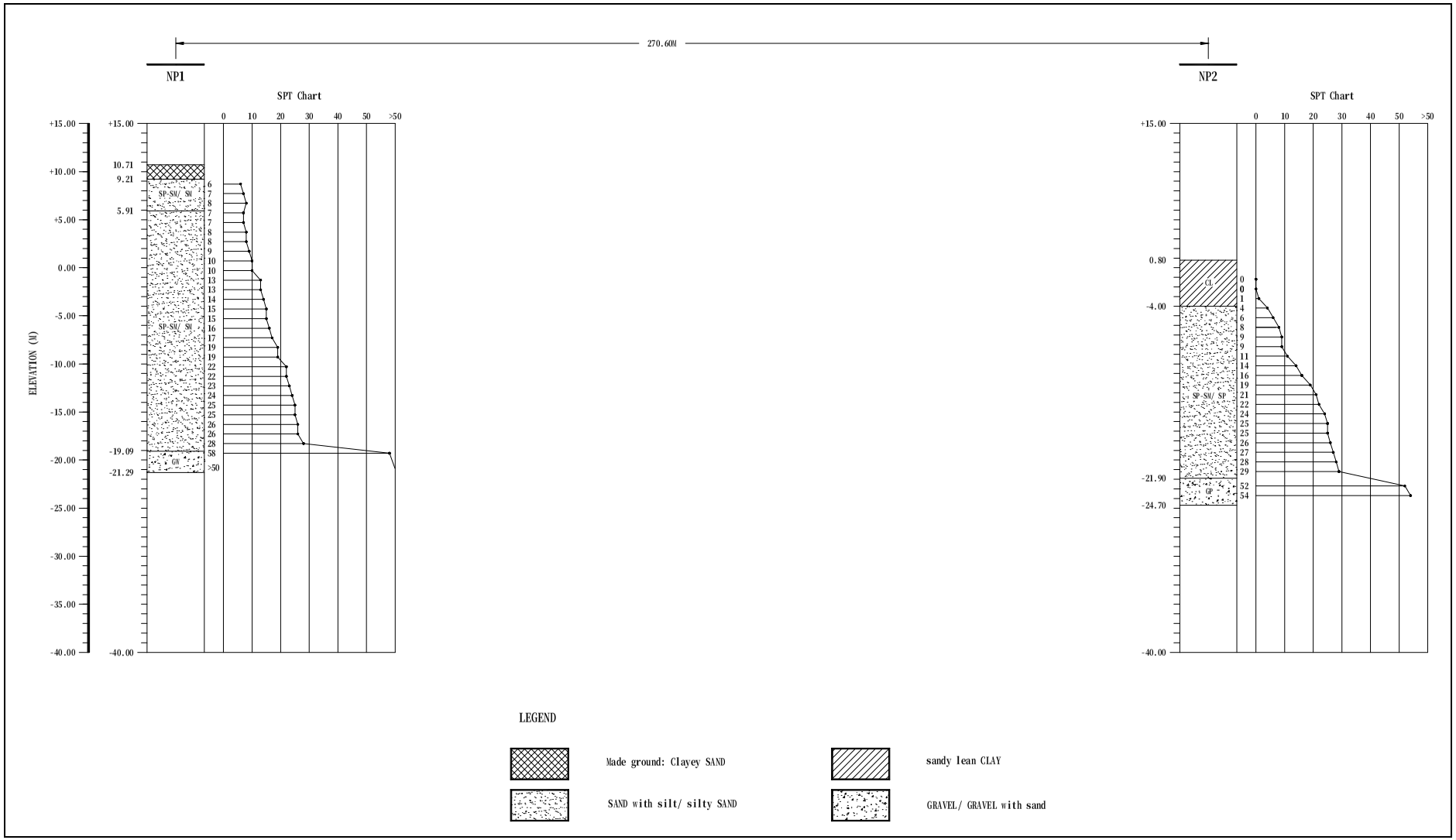


Figure A14A.5.2 (1) Soil Profile at New North Port

Source) JICA Study Team

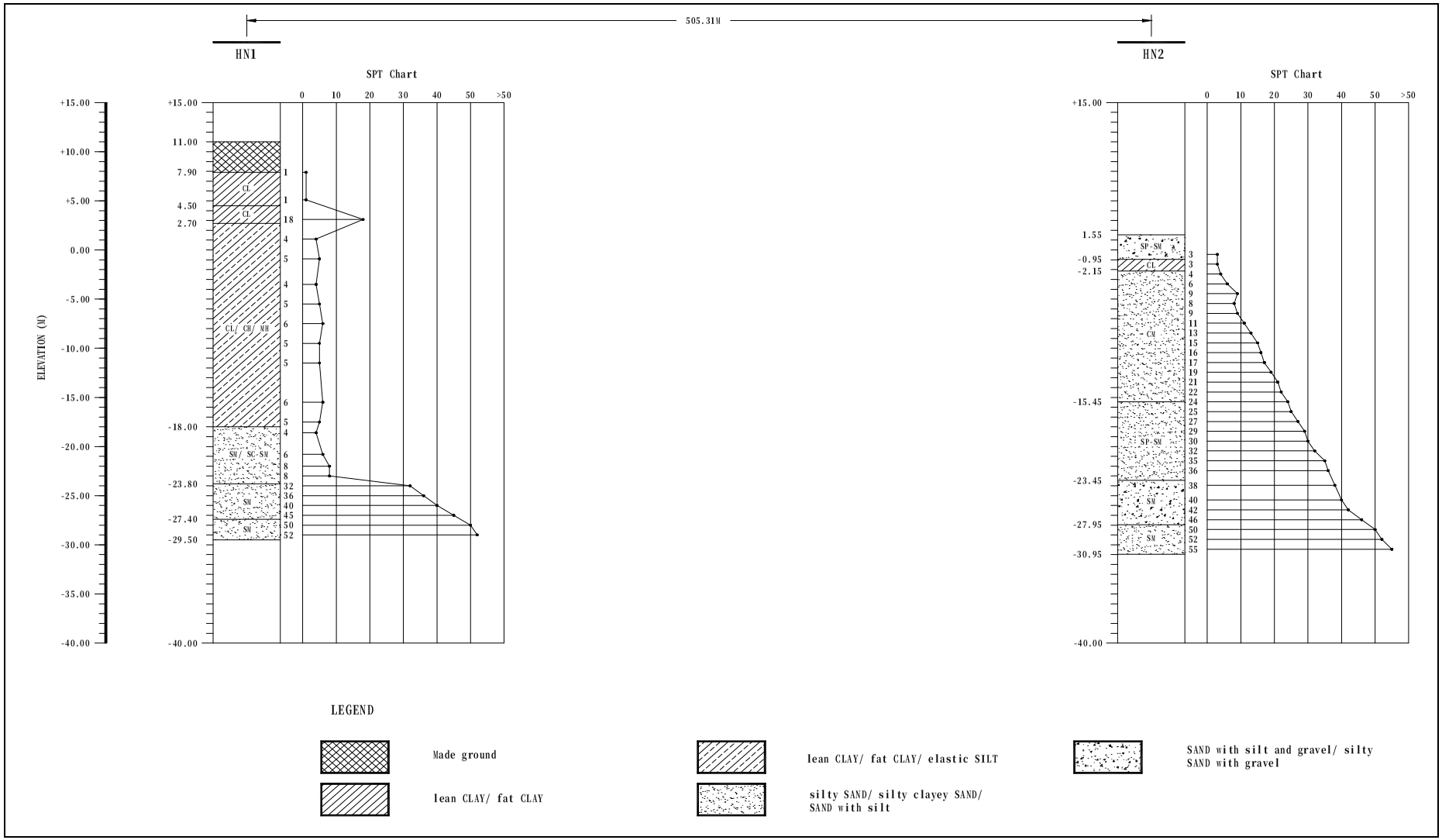


Figure A14A.5.2 (2) Soil Profile at Hanoi Port

Source) JICA Study Team

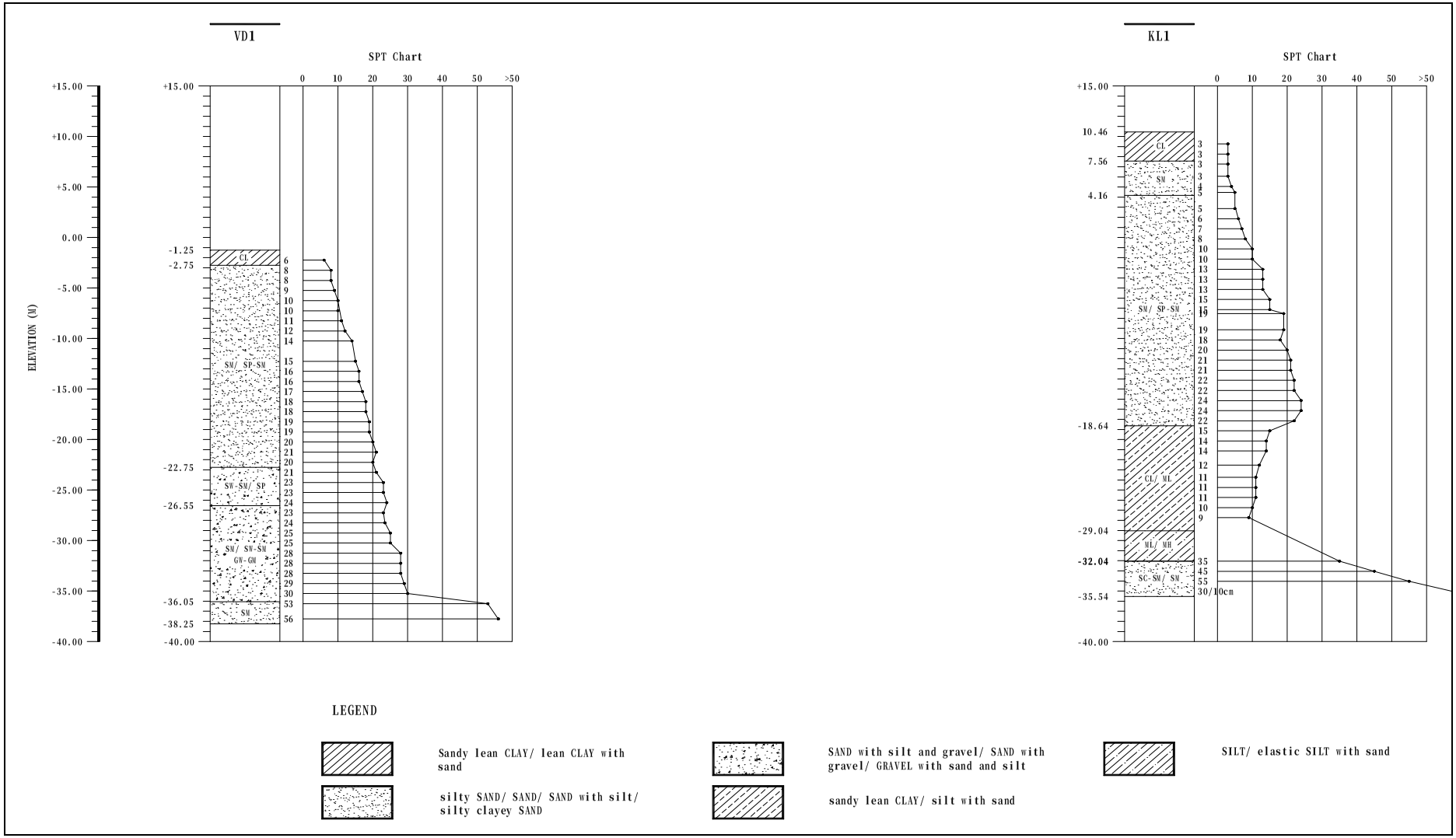


Figure A14A.5.2 (3) Soil Profile at Van Dong and Khuyen Luong Port

Source) JICA Study Team

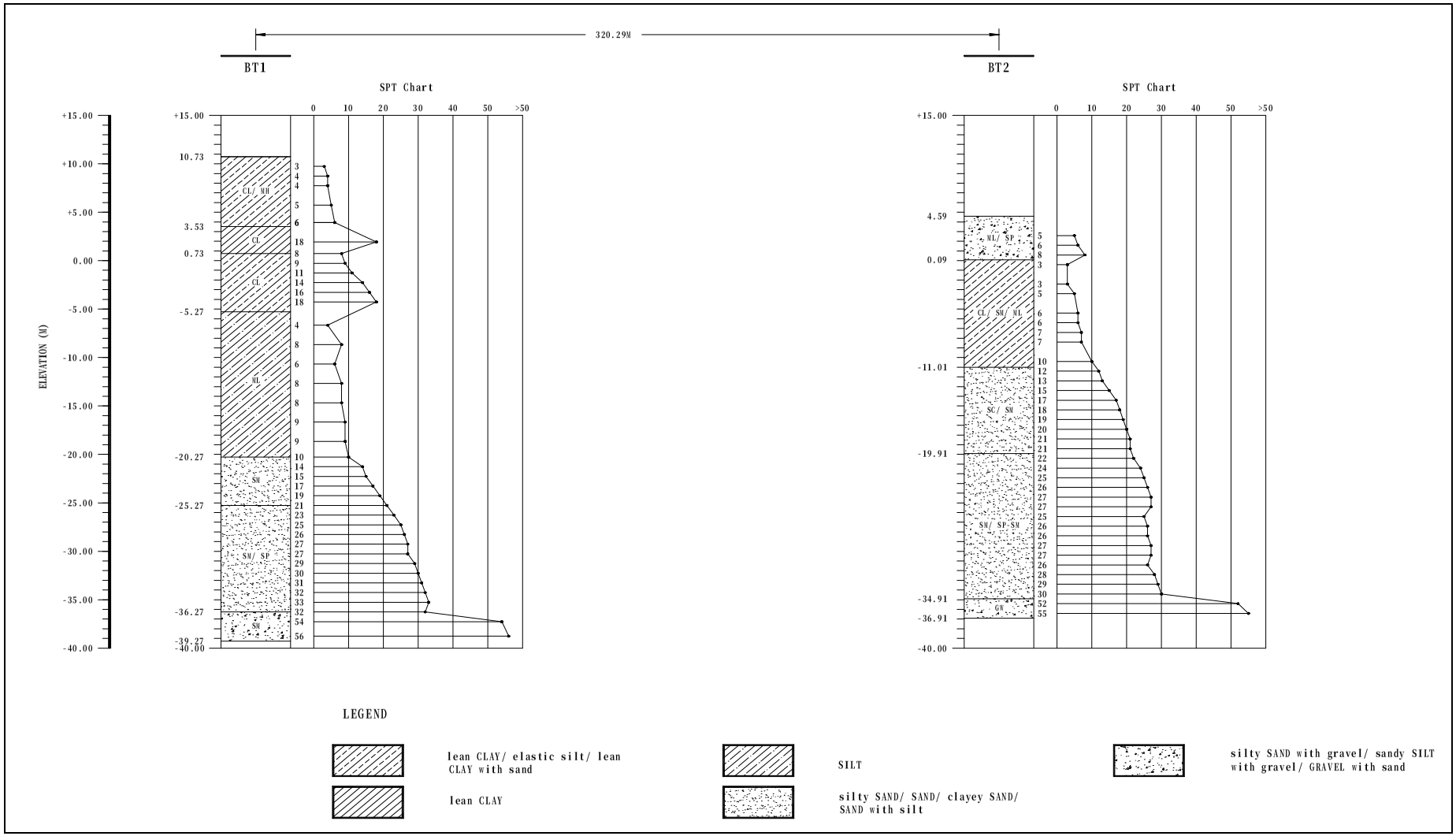


Figure A14A.5.2 (4) Soil Profile at Bat Trang

Source: JICA Study Team

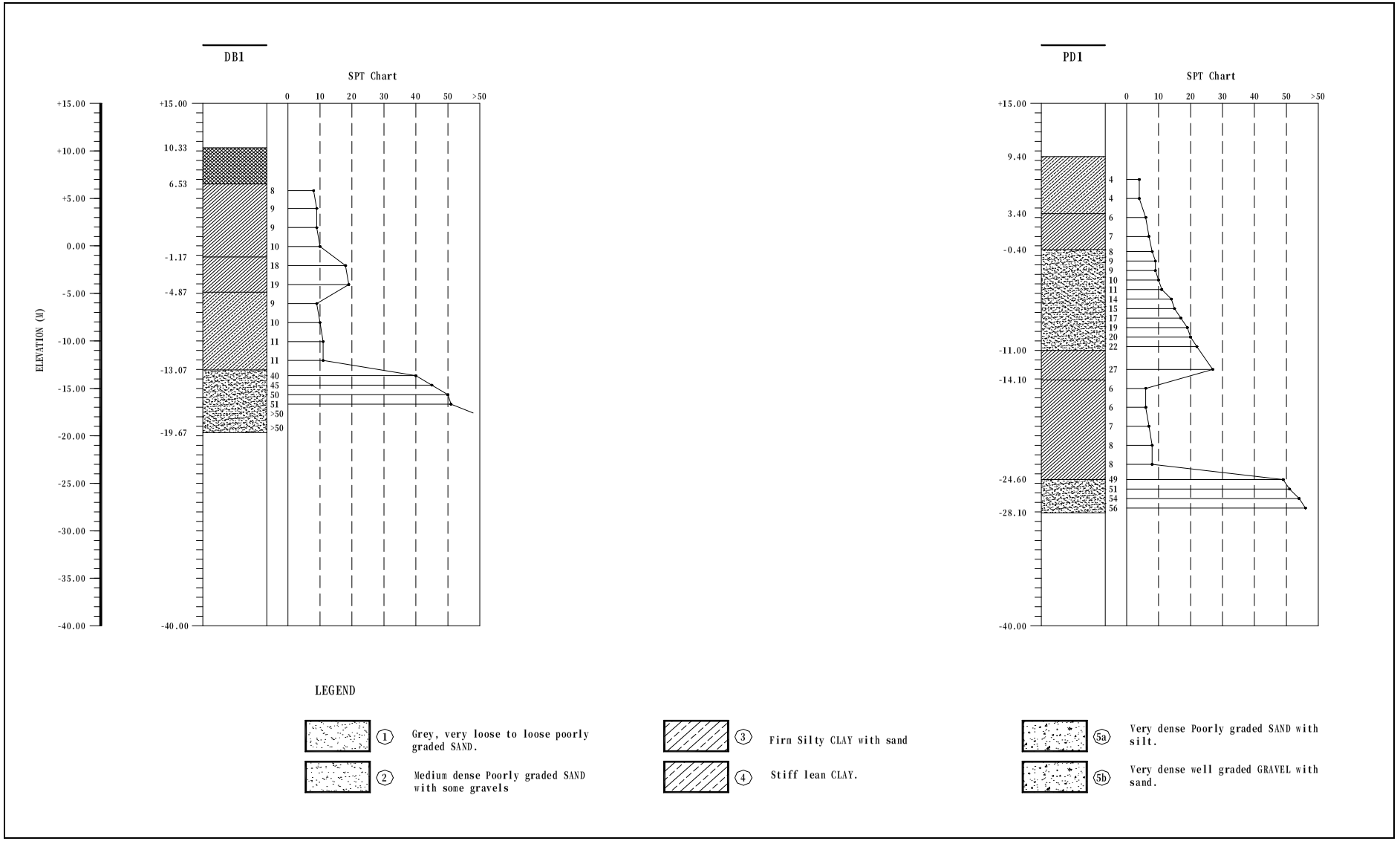


Figure A14A.5.2 (5) Soil Profile at Duong Bridge and New East Port (Phu Dong Site)

Source) JICA Study Team

A14A.6 Bridge structural survey of existing Duong bridge

A14A.6.1 General

The Duong Bridge is laid downstream from the Red River divergence to the Duong River in 8-km. This bridge is a railway and highway combined bridge. Duong Bridge was composed of the truss of four reams, and the superstructure was re-constructed in 1980.

The clearance under the deck is 2.88m at the Duong Bridge. Bridge elevation is +11.78 m and water level of H 5% is 8.9m(11.78 - 8.9 = 2.88m). Therefore, the clearance under the deck is low, sailing limitation is implemented in 75 days in the year time. If the ship which sails from Hanoi to Hai Phong can sail in the Duong river through year, a large amount of water transportation can be possible.

This movable bridge plan is examined in 1998 by the TA investigation of ADB (Greater Mekong Sub-region Investigation, the consultant are Haskoning companies). In the examination of ADB investigation, a site investigation of the nature of soil investigation etc. had not been executed, and the design is a level of the concept.

In this regard, PMU-Waterways officially requested JICA to carry out the more detailed study including the natural condition surveys comprising topographic/bathymetric surveys and soil investigation, and performance of the basic design, cost estimate of movable bridge.

In this section, the results of the surveys on the existing structure of Duong Bridge, and on traffic are described to provide the design condition and necessary information required for planning/designing of movable bridge had been carried out by the Study Team.

A14A.6.2 Overview of Duong bridge in the investigation of ADB

Width of bridge:	5.5 m*2 (the roadway) + 5.0 m (train)
Arrangement:	L=45.14+64.64+69.78+44.50=224.06m
Design load :	Road = H13、X60 train= T16
Superstructure :	All spans of the bridge are simple supported warren truss girders with distance between two main trusses of 5.75m and the width of cantilevers used for motorized and non-motorized vehicles of 5.5m

Substructure: Reinforced concrete abutments and piers with caisson foundation by reusing the structure of old bridge and strengthening and expanding

Elevation of top rail: +13.71m

Elevation of bottom of girder: +11.78m

Navigation water level

HWL (H5%): +8.2m

HWL (H95%): +2.8m

Horizontal clearance of navigation span: 57.0m

A14A.6.3 Investigation result of present bridge situation

The Duong bridge is improved in 1980 and equal to or more than 20 years are lapsing by it. A structural size of the bridge was investigated this time. Compared with the last investigation of ADB. As a result, some differences were seen by the span etc.

There is roughly healthily a situation of a present bridge. However, rust is generally seen about the main body of the bridge girder. The concrete floor slab of the road is destroyed overall.
On the other hand, when a large-sized motor vehicle passes because traffic increased in recent years, a stringer of the road and an abnormal sound because of sliding between bearings has been generated.

Moreover, when the train passes, an excessive vibration has been generated in the bridge girder. It is thought that the smooth defect between the actual really cure degree and the rail of the wheel that the train wheel originates in a defective grinding is a cause.

The present structure of Duong bridge is shown in **Figure A14A.6.1** based on the result of the survey.

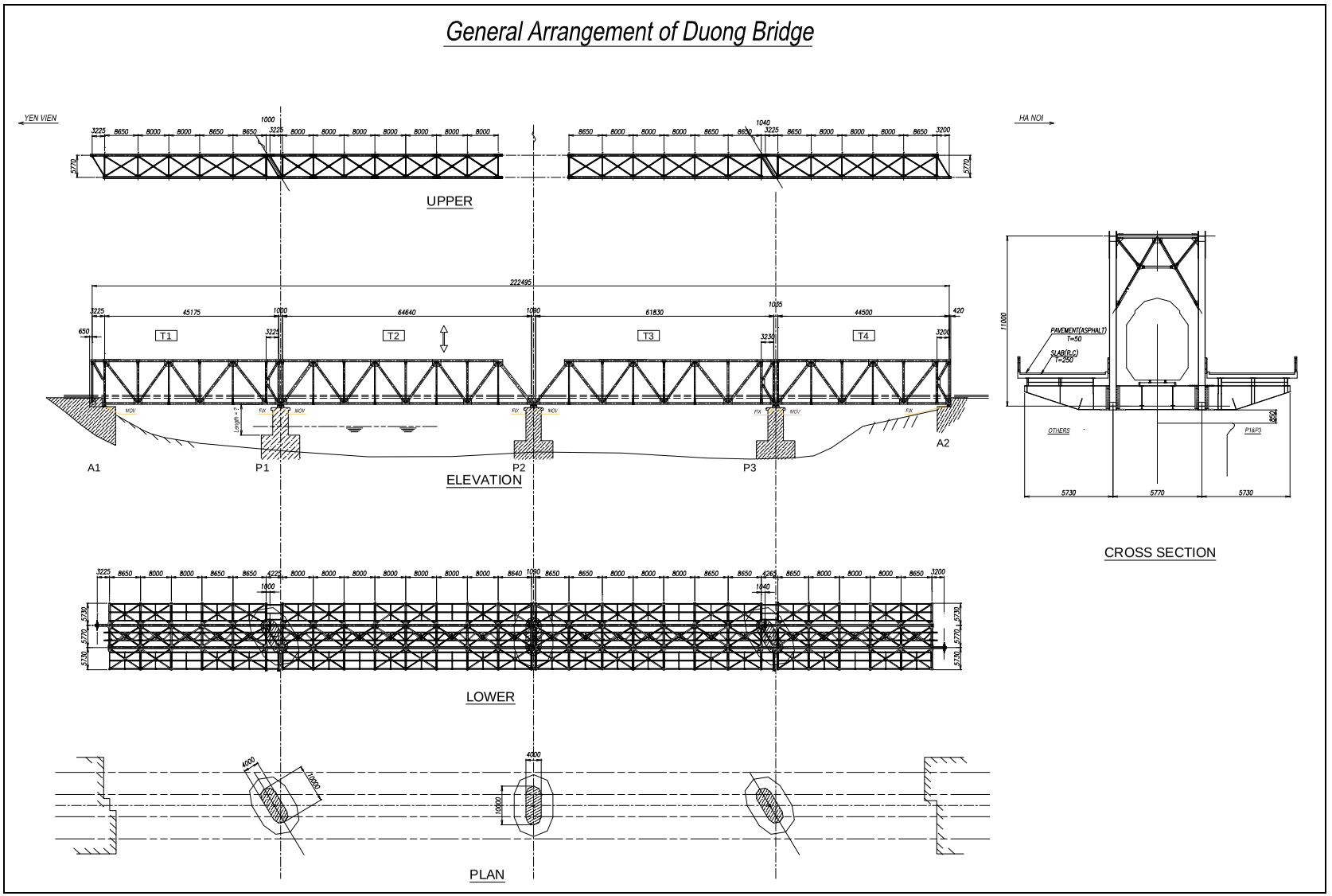


Figure A14A.6.1 General Arrangement of Duong Bridge

Source) JICA Study Team

A14A.6.4 Train operation situation

The operation situation of the train is summarized in **Table A14A.3.2** below. Among these, from 9:05 trains to 16:47 trains are the result of site investigations on the 30th and July 31, 2002. Besides, it is what examined from the timetable published by Railway company. The operation of the freight train and the locomotive at nighttime is not included in this table. It seems that actual operation is more than these.

Table A14A.3.2 Passage Time of the Trains

No	Time	From Hanoi	To Hanoi	Kind of Train
1	3:56		○	Train
2	6:10	○		Train
3	6:22	○		Train
4	7:16	○		Train
5	9:05	○		Independent Locomotive
6	9:25		○	Train
7	9:50		○	Freight train
8	10:45	○		Independent Locomotive
9	11:05		○	Independent Locomotive
10	11:15		○	Train
11	11:30		○	Train
12	11:40		○	Independent Locomotive
13	13:25	○		Train
14	14:05	○		Train
15	14:45		○	Freight train
16	16:00		○	Freight train
17	16:47		○	Train
18	19:11		○	Train
19	19:24		○	Train
20	22:17	○		Train

Source) JICA Study Team

A14A.6.5 Vehicle passage status

The traffic of the vehicle and the motorcycle was measured by method of the eye measurement on July 31, 2002.

The traffic volume of ten minutes was measured with eye, six was multiplied, and the measurement was assumed to be traffic an hour as seen in **Table A14A.6.2**. It is said that In the trunk line road, there is quite a lot of traffic volume.

The total traffic of the vehicle and the motorcycle was 4,500 an hour. It is a stand at ten o'clock when traffic was comparatively little. It was 7,100 per 16 o'clock of the commuting time zone in the morning and the evening.

Table A14A.6.2 Land Traffic Passing Duong Bridge

Time zone / Type of the car	Number of car (Unit/hour)	
	Level at 10 o'clock	Level at 16 o'clock
Vehicle (The equal to or more than 4-ring vehicle)	720	840
Bicycle and motorcycle	3,720	6,300