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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

DEVELOPMENT STRATEGY INSTITUTE
MINISTRY OF PLANNING AND INVESTMENT
THE SOCIALIST REPUBLIC OF VIETNAM

THE STUDY ON THE HOA LAC AND XUAN MAI AREAS URBAN DEVELOPMENT PROJECT IN THE SOCIALIST REPUBLIC OF VIETNAM PHASE - 1

APPENDIX (VOLUME - 4)

MARCH 1999

PACIFIC CONSULTANTS INTERNATIONAL
JAPAN INDUSTRIAL LOCATION CENTER
NIPPON KOEI CO., LTD.

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N I P P O N K O E I C O., L T D.

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Foreword

A dire economic situation gripping many Asian countries is now rippling over the other parts of the world including Japan. And while the Study for the Hoa Lac and Xuan Mai Areas Urban Development Project is in progress by the "Japan International Cooperation Agency (JICA)" since its commencement in December 1997, it is even becoming more serious at the turn towards the 21st century.

In effect, the situation can be ascribed to many factors and reasons, but one thing to be learnt from the bitter experience is that the developing world needs to reorient its development path towards a more "endogenous direction". Many Asian countries have adopted to date a development path, which is overly dependent upon foreign capital resources and imported technologies, but without internalizing them properly. The endogenous development path implies to place more emphasis on domestic capital formation, exploitation of domestic market, utilization of domestic resources, human resource development, institutional building, promotion of science and technology, and so on.

The Hoa Lac and Xuan Mai Areas Urban Development is, in fact, responsive to these needs in that it will build a national center in the country for human resource development as well as the promotion of science and technology. The former is to realize the relocation and expansion of the Vietnam National University (VNU), and the latter is to develop the Hoa Lac High-tech Park (HHTP) in the Hoa Lac Area. Taking these principal objectives into consideration, the development is of truly national importance and significance, and hence, it should be regarded and treated as a "national project".

Given the difficult fiscal situation of the Government however, the development will face formidable challenges in light of the massive investment required for its implementation. As a solution to reconcile its necessity as a national project to the tight fiscal situation of the Government, an "Action Plan", which is, in fact, of the initial cost minimizing alternative, was proposed as a consequence of the Study. The Action Plan includes only core facilities of VNU, HHTP, and supporting urban infrastructure at a considerably reduced scale and cost.

As a matter of fact, in the circumstances where the Lang-Hoa Lac Highway linking the Hanoi Central Area and the Hoa Lac Area will be open for use very shortly, the Vietnam side is highly desirous to commence the development as early as possible. Towards this end, the continuous technical and financial assistance of the Japanese Government seems to be mandatory to put the development onto a right implementation track.

It will be more than a happy moment, if the JICA Master Plan can be of substantial help for the initiation of this highly strategic and important project. Also, the effective and efficient cooperation extended over the study period by the Vietnam side to the JICA Study Team is very much appreciated at the occasion of ending the Study.

March 1999, in Tokyo

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APPENDIX 7 Institutional Building

List of Abbreviation

A

ACSR ---------- Aluminum Cable Steel Reinforced
AFTA ---------- ASEAN Free Trade Area
AIT ---------- Asian Institute of Technology
ASEAN ---------- Association of Southeast Asia Nations

B

BFT ---------- Bank for Foreign Trade
BOT ---------- Build, Operate and Transfer
BT ---------- Build and Transfer

C

CAA ---------- Civil Aviation Administration
CAD ---------- Computer Added Design
CBD ---------- Central Business District
C-21 ---------- Corridor 21
C-21DA ---------- The Corridor 21 Development Authority
CNC ---------- Computer Numeric Control
COD ---------- Chemical Oxygen Demand
C/P ---------- Concept Plan

D

DA ---------- Development Authority
DSI ---------- Development Strategy Institute

E

EIA ---------- Environmental Impact Assessment
EIRR ---------- Economic Internal Rate of Return

EPZ ---------- Export Processing Zone
E&T ---------- Education and Training
EVN ---------- Electricity of Vietnam

F

FDI ---------- Foreign Direct Investment
Fe ---------- Iron
FIRR ---------- Financial Internal Rate of Return
FOT ---------- Faculty of Technology
F/S ---------- Feasibility Study

G

GDP ---------- Gross Domestic Product
GDPT ---------- General Department of Post and Telecommunications
GOJ ---------- Government of Japan
GOV ---------- Government of the Socialist Republic of Vietnam
GRDP ---------- Gross Regional Domestic Product
GSO ---------- General Statistical Office

H

ha ---------- hectare
HCMC ---------- Ho Chi Minh City
HDF ---------- Housing Development Fund
HHTC ---------- High-Tech Center
HHTP ---------- Hoa Lac High-Tech Park
HHTP-ST ----------HHTP JICA Study Team
HMA ---------- Hanoi Metropolitan Area
HN-PC ---------- Hanoi People's Committee
HRD ---------- Human Resource Development
HSEDP ---------- Ha Tay Socio-Economic Development Plan
HT-PC ---------- Ha Tay People's Committee
HUT ---------- Hanoi University of Technology
HWL ---------- High Water Level

I

IBRD ---------- International Bank for Reconstruction and Development
IDC ---------- Infrastructure Development Company
IP ---------- Industrial Park
ISDN ---------- Integrated Services Digital Network
ISI ----------International Statistical Institute
IT ---------- Information Technology
IZ ---------- Industrial Zone

J

JICA ---------- Japan International Cooperation Agency
J/S ---------- Joint Stock
J/V ---------- Joint Venture

K

kg ---------- kilogram
km ---------- kilometer
kV ---------- kilo-Volt
kVA ---------- kilo-Volt-Ampere
kW ---------- kilo-Watt
kWh ---------- kilo-Watt-hour

L

LAN ---------- Local Area Network
LRT ---------- Light Rail Transit

M

m ---------- meter
MARD ---------- Ministry of Agriculture and Rural Development
MB ---------- Management Board
MCI ---------- Ministry of Culture and Information

m^3/d ---------- Cubic meter per day
MOC ---------- Ministry of Construction
MOET ---------- Ministry of Education and Training
MOFA ---------- Ministry of Foreign Affairs
MOF ---------- Ministry of Finance
MOI ---------- Ministry of Industry
MOLISA ---------- Ministry of Labor, Invalids and Social Affairs
MOSTE ---------- Ministry of Science, Technology and Environment
MOT ---------- Ministry of Transport
M/P ---------- Master Plan
MPI ---------- Ministry of Planning and Investment
MRT ---------- Mass Railway Transit
MU ---------- Manganese
MVA ---------- Mega-Volt-Ampere
MSL ---------- Mean Sea Water Level
MW ---------- Mega-Watt

N

NC ---------- Numeric Control
NCHRT ---------- National Center for High-tech Research and Training
NCST ---------- National Center for Natural Sciences and Technology
NDP ---------- National Development Plan
NHDC ---------- National Housing Development Corporation
NIURP ---------- National Institute of Urban and Rural Planning
NPIP ---------- North Phu Cat High-Tel integrated Industrial Park
NR ---------- National Road
NR21A ---------- National Road 21A
NSC ---------- National Steering Committee
NUDC ---------- New Urban Development Corporation
NUHDC ---------- New Urban Housing Development Corporation

O

ODA ---------- Official Development Assistance
OECD ---------- Organization for Economic Cooperation and Development
OECF ----------Overseas Economic Cooperation Fund, Japan
OJT ---------- On the Job Training
PTA ---------- Provincial Transport Authority

P

PC ---------- People's Committee
PCU ---------- Passenger Car Unit
pH ---------- Potential of Hydrogen
PMB ---------- Project Management Board
P/S ---------- Power Station

R

R&D ---------- Research and Development
RICCC ----------Railway Investment Constructions and Consulting Company
RID ---------- Research Institute of Development
RIST ---------- Research Institute of Science and Technology
RR ----------Ring Road
RRD ---------- Red River Delta
RRD MP ---------- Red River Delta Master Plan
RTMD ---------- Road Transport Managing Department

S

SC ---------- Steering Committee
SEZ ---------- Special Economic Zone
SOE ---------- State-owned Enterprise
SPM ---------- Suspended Particulate Matte
SME ---------- Small- and Medium-Enterprise
S/S ---------- Sub-Station
S&T ---------- Science and Technology

T

TDS ---------- Total Dissolved Solids
TDSI ---------- Transport Development and Strategy Institute
TEDI ---------- Transport Engineering Design Incorporated
TQM ---------- Total Quality Management
TUPWS ---------- Transport and Urban Public Works

U

UDA ---------- Urban Development Area
UNESCO ---------- United Nations Educational, Scientific and Cultural Organization

V

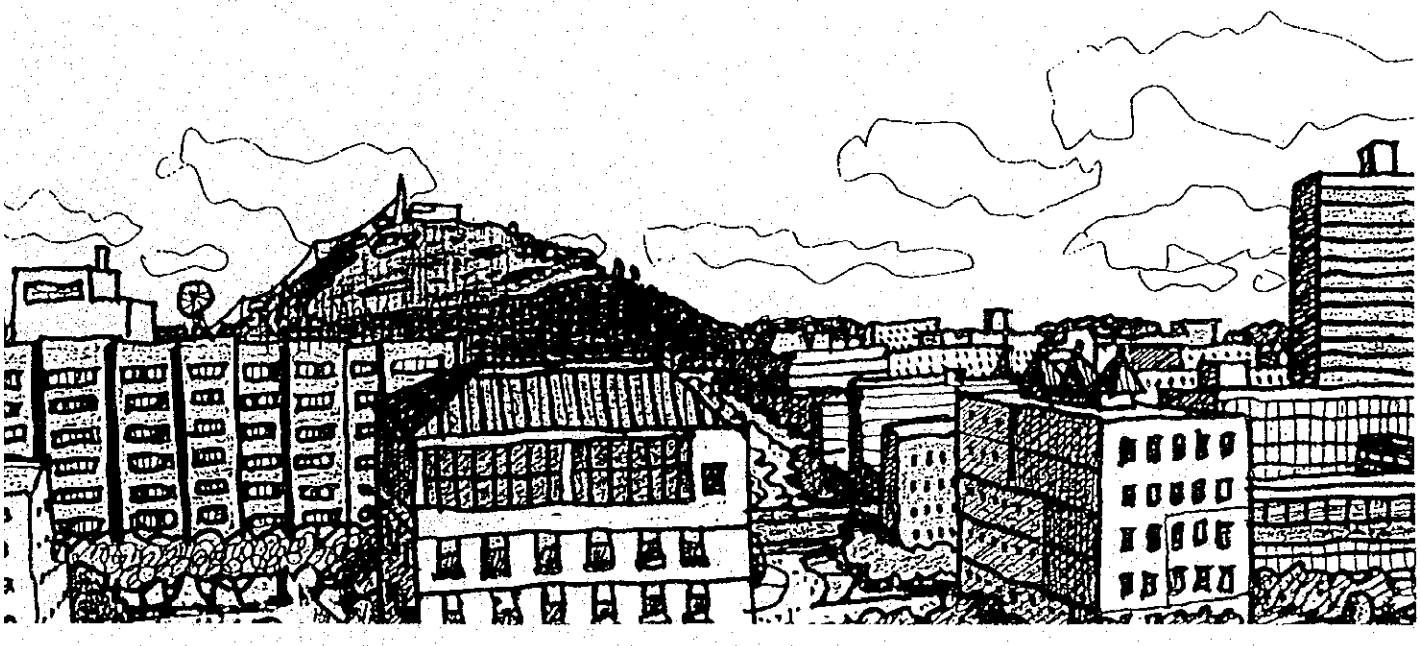
VAT ---------- Value Added Tax
---------- Vinamari Vietnam Maritime Bureau
VN ---------- Vietnam
VND ---------- Vietnamese Dong
VN-M/P&F/S ----------
VNU ---------- Vietnam National University, Hanoi
VRA ---------- Vietnam Road Administration
VRU ---------- Vietnam Railway Union
VTC ---------- Vocational Training Center

W

WHO ---------- World Health Organization

APPENDIX 1

Major Findings of The Sub-Contracted Survey (Pumping Test Survey)



APPENDIX 1 Major Findings of the Sub-Contracted Survey (Pumping Test Survey)

1.1 Scope of Survey of Pumping Test

The terms of reference including the scope of the survey was as follows:

(1) The objective of the survey is to conduct pumping test to acquire the basic data concerning the groundwater potential.

(2) Five borings up to 100 meters depth with pumping test and water quality analysis shall be carried out in Son Tay (one place), Hoa Lac (two places), Xuan Mai (one place) and Mieu Mon (one place).

(3) Specifications:

- Test wells: 5 holes, 100 meters depth, 110 mm diameter each
- Pumping test: Continuous pumping test and recovery test at five test wells

1.2 Pumping Test Analysis in the Study Area

The pumping tests were conducted by the Institute of Science Information under the National Institute of Natural Science and Technology.

The test wells were placed in Mieu Mon, Xuan Mai, Phu Cat and Son Tay areas (see Location Map of Test Well).

Pumping tests were carried out, immediately after completion of wells construction result of which are given below and in diagrams of "Results of Pumping Test".

Table A-1.2.1 Results of Pumping Test

Well	(Unit)	K1	K2	K3	K4	K5
Static water level	(m)	3.05	2.93	1.35	0.65	0.95
Flow rate	(liter/sec)	0.50	15.13	0.52	0.57	3.57
Drawdown	(m)	19.53	4.07	21.61	3.17	4.45
Specific capacity	(liter/sec/m)	0.025	3.720	0.024	0.810	0.802
Water level of recovery	(m)	3.06	2.95	1.37	0.65	0.97

Source: JICA Study Team

It has been hound as the results that groundwater in this area does not generally meet the water source for public water supply system, from viewpoint of flow rate. However, as groundwater is found available at some places with some extent capacity, it can be used for local private use.

At for water quality, the groundwater meets to drinking water standards except iron concentration and bacteria (see table of "Groundwater Quality of Well".)

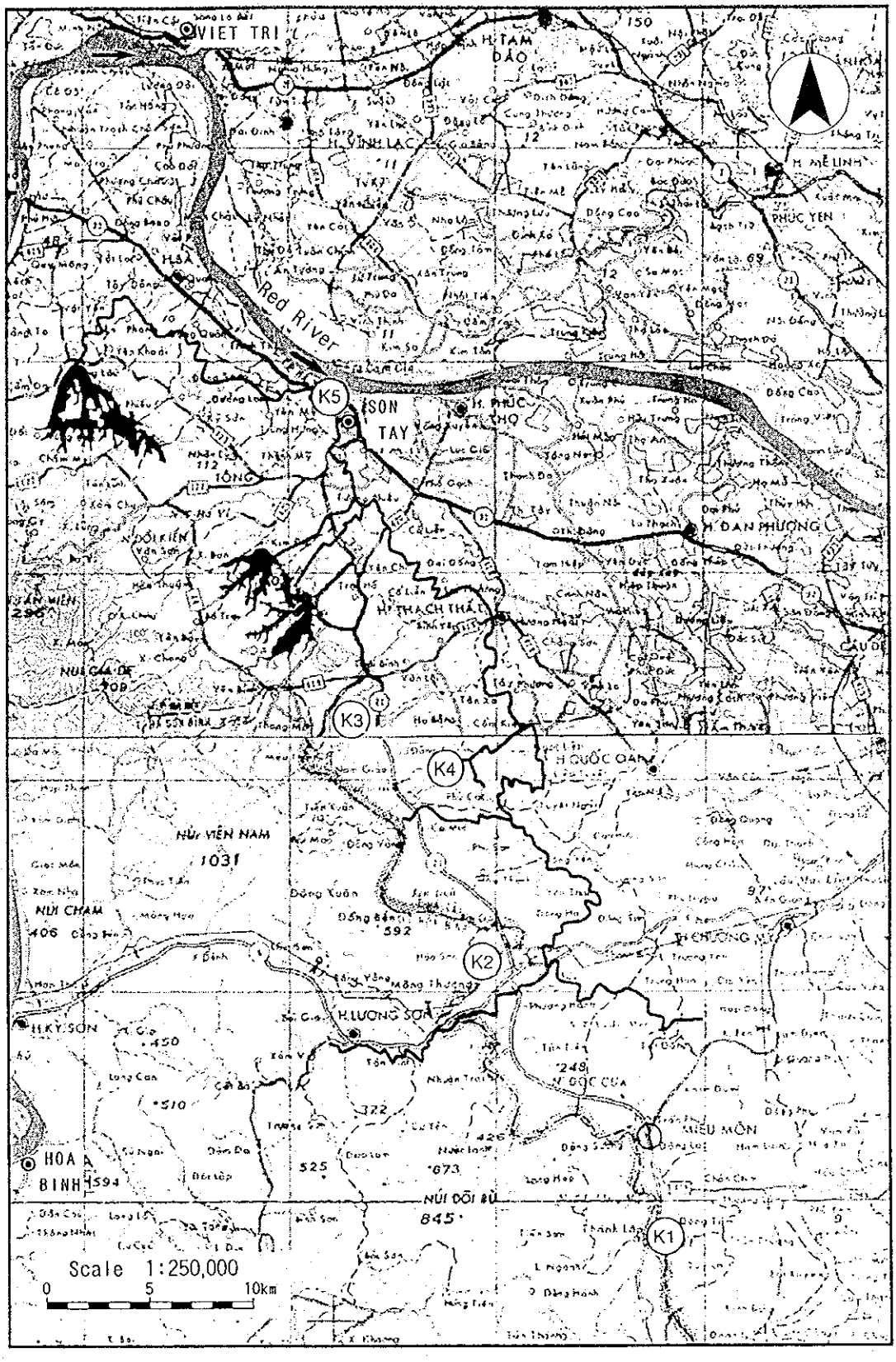


Figure A-1.2.1 Results of Pumping Test

Table A-1.2.2 Groundwater Quality of Well (K1): Mieu Mon

No.	Parametres	Unit	Test result	Remark
1	Temperature	℃		
2	pH		8.3	
3	Total iron (Fe)	mg/l	0.98	
4	Manganese (Mn)	mg/l	0.082	
5	Ammonium nitrogen (NH_4-N)	mg/l	0.072-0.054	second is N-content calculated from total NH_4
6	Nitrate nitrogen (NO_3-N)	mg/l	0.097-0.0197	second is N-content calculated from total NO_3
7	Nitrite nitrogen (NO_2-N)	mg/l	0.008-0.020	second is N-content calculated from total NO_2
8	Carbonate (CO_3^-)	mg/l	6.000	
9	Alkalinity as $CaCO_3$	mg/l	190	
10	Total hardness as $CaCO_3$	mg/l	1.84	
11	Phosphorous (PO_4^{-2})	mg/l	0.28	
12	Sulphate (SO_4^{-2})	mg/l	7.59	
13	Conductivity	microS/cm	455.3	calculated from TDS
14	Coliform group	MPN/100ml	2.3-9.3	
15	TDS	mg/l	286.85	
16	COD	mg/l	2.8	
17	Turidity		0.000	
18	Heavy metal			
	-Arsenic	mg/l	0.001290	
	-Cadmium	mg/l	0.000108	
	-Fluorine	mg/l	0.000096	
	-Chromium	mg/l	0.000530	
	-Lead	mg/l	0.003050	
	-Mercury	mg/l	0.000170	
	-Zinc	mg/l	0.001050	
	-Copper	mg/l	0.004660	
	-Selenium	mg/l	0.003340	
19	Odor		0.00	

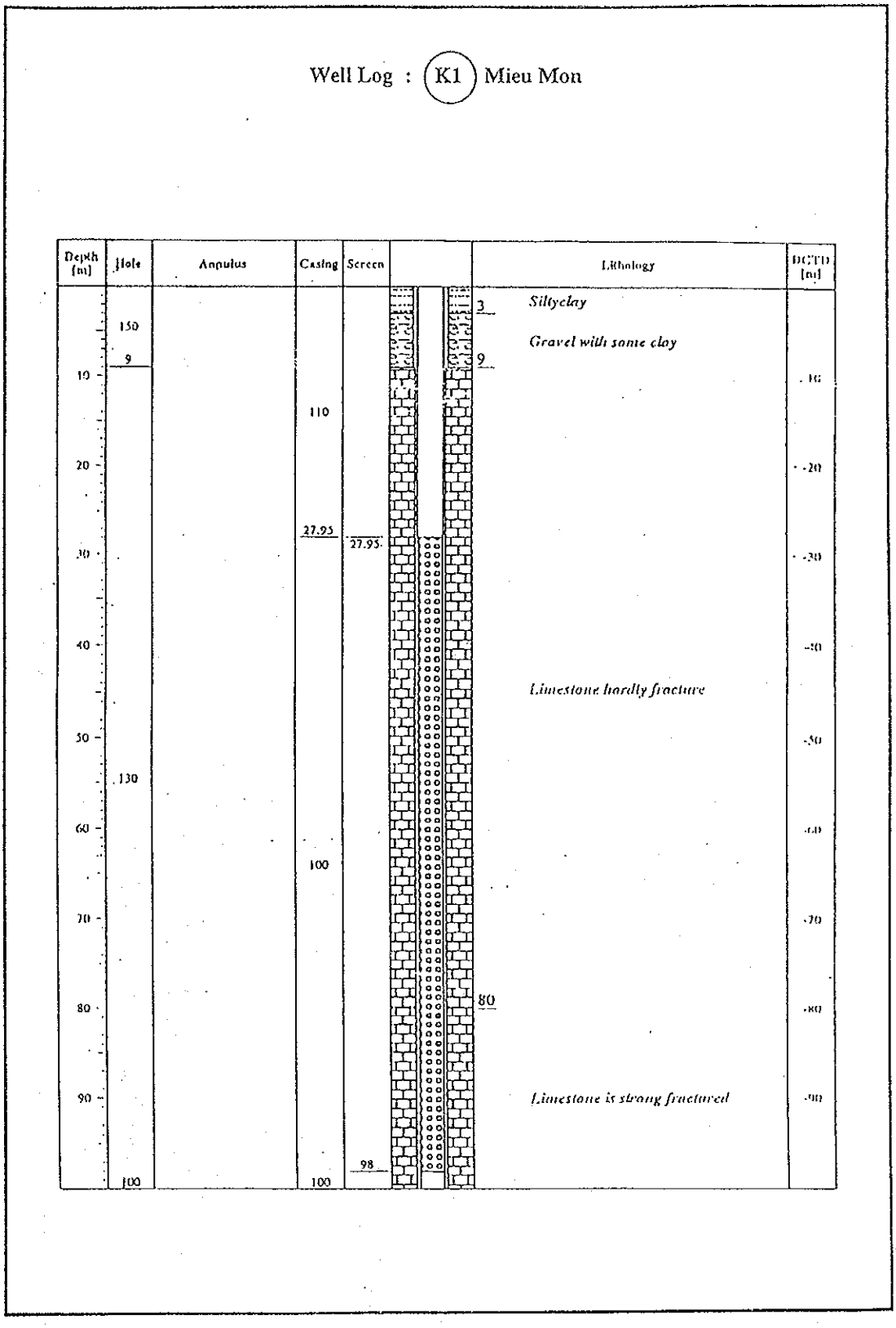


Figure A-1.2.2 Well Log (K1): Mieu Mon

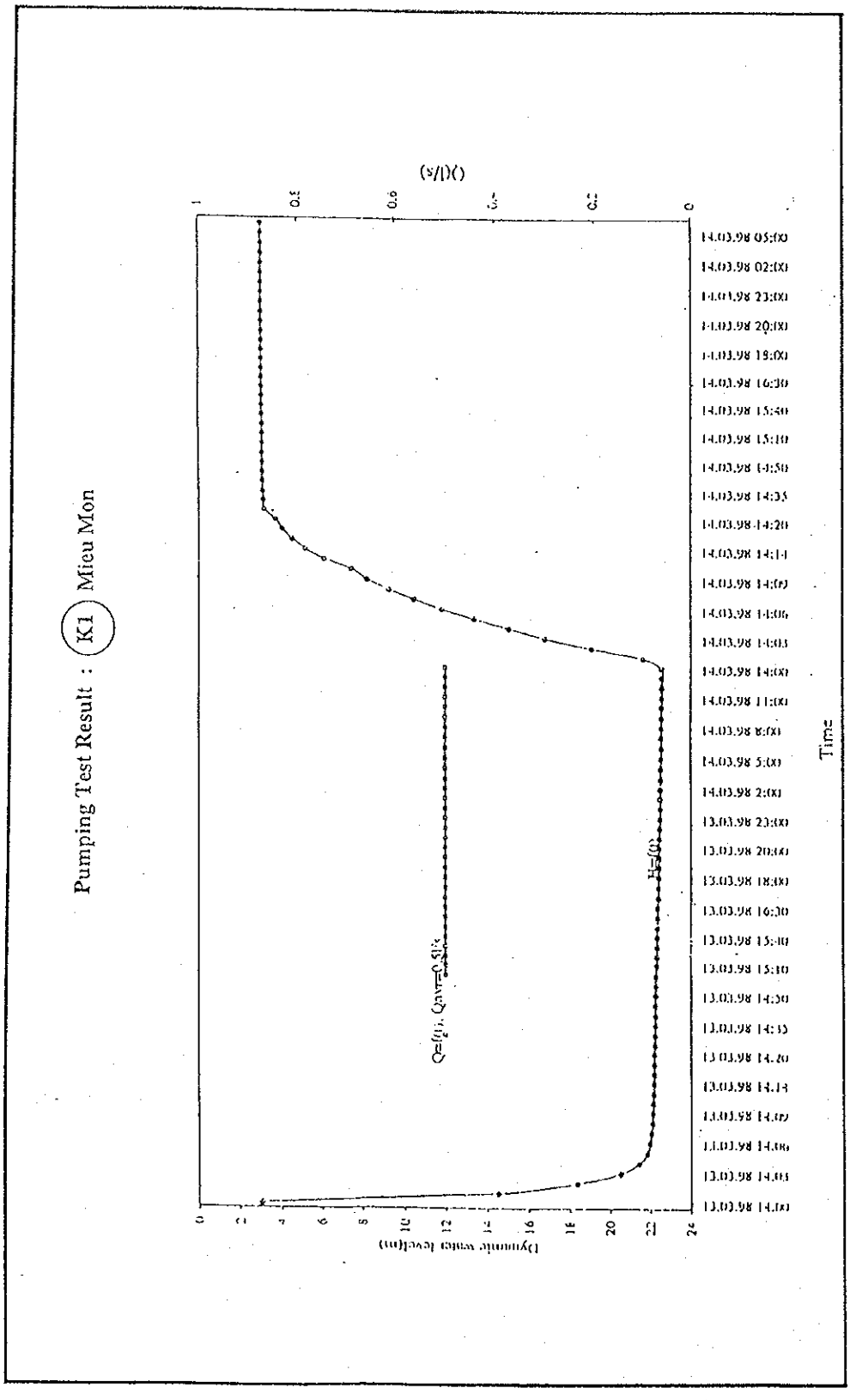


Figure A-1.2.3 Pumping Test Result (K1): Mieu Mon

Table A-1.2.3 Groundwater Quality of Well (K2): Xuan Mai

No.	Parametres	Unit	Test result	Remark
1	Temperature	℃		
2	pH		8	
3	Total iron (Fe)	mg/l	0.72	
4	Manganese (Mn)	mg/l	0.06	
5	Ammonium nitrogen (NH_4-N)	mg/l	0.060-0.038	second is N-content calculated from total NH_4
6	Nitrate nitrogen (NO_3-N)	mg/l	0.077-0.0185	second is N-content calculated from total NO_3
7	Nitrite nitrogen (NO_2-N)	mg/l	0.009-0.022	second is N-content calculated from total NO_2
8	Carbonate (CO_3^-)	mg/l	5.600	
9	Alkalinity as $CaCO_3$	mg/l	170	
10	Total hardness as $CaCO_3$	mg/l	1.89	
11	Phosphorous (PO_4^{-2})	mg/l	0.32	
12	Sulphate (SO_4^{-2})	mg/l	7.32	
13	Conductivity	microS/cm	390.28	calculated from TDS
14	Coliform group	MPN/100ml	2.1-9.2	
15	TDS	mg/l	266.72	
16	COD	mg/l		
17	Turidity		2.6	
18	Heavy metal			
	-Arsenic	mg/l	0.000000	
	-Cadmium	mg/l	0.001395	
	-Fluorine	mg/l	0.000115	
	-Chromium	mg/l	0.000089	
	-Lead	mg/l	0.003423	
	-Mercury	mg/l	0.000172	
	-Zinc	mg/l	0.001030	
	-Copper	mg/l	0.000510	
	-Selenium	mg/l	0.004728	
19	Odor		0	

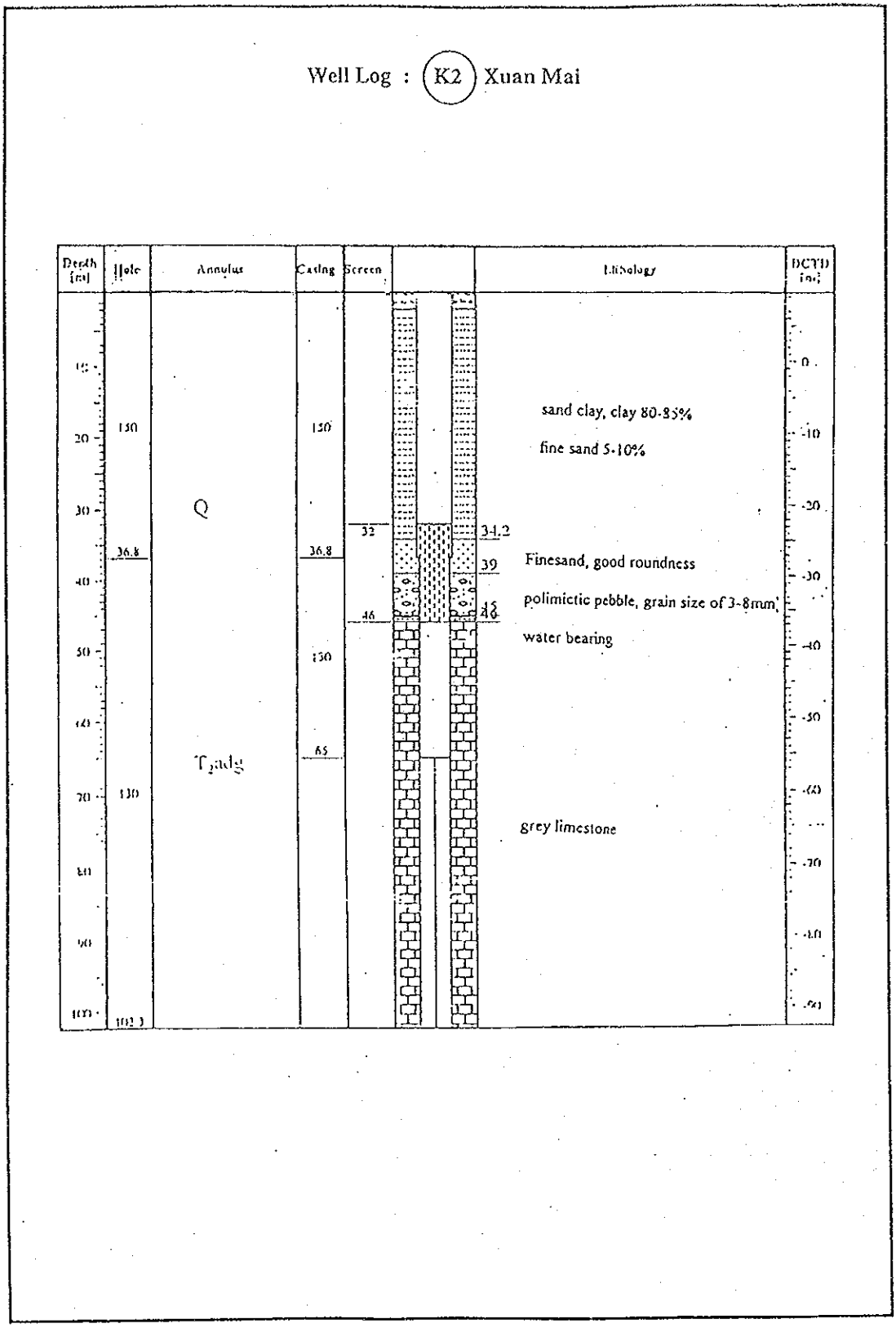


Figure A-1.2.4 Well Log (K2): Xuan Mai

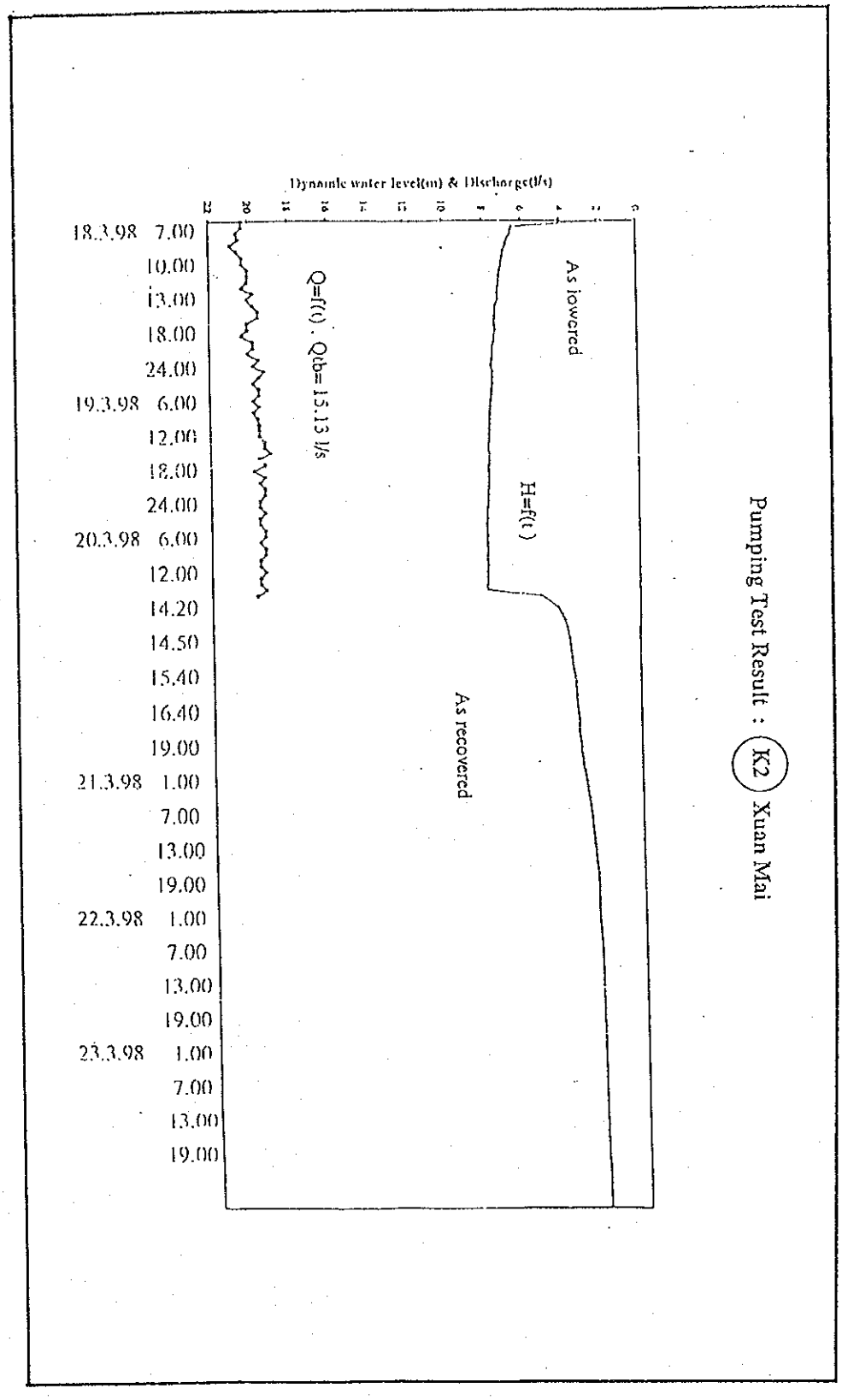


Figure A-1.2.5 Pumping Test Result (K2): Xuan Mai

Table A-1.2.4 Groundwater Quality of Well (K3): Phu Cat 1

No.	Parametres	Unit	Test result	Remark
1	Temperature	℃		
2	pH		8.4	
3	Total iron (Fe)	mg/l	1.40	
4	Manganese (Mn)	mg/l	0.075	
5	Ammonium nitrogen (NH_4-N)	mg/l	0.068-0.051	second is N-content calculated from total NH_4
6	Nitrate nitrogen (NO_3-N)	mg/l	0.088-0.022	second is N-content calculated from total NO_3
7	Nitrite nitrogen (NO_2-N)	mg/l	0.007-0.0035	second is N-content calculated from total NO_2
8	Carbonate (CO_3^-)	mg/l	12	
9	Alkalinity as $CaCO_3$	mg/l	220	
10	Total hardness as $CaCO_3$	mg/l	2.08	
11	Phosphorous (PO_4^{-2})	mg/l	0.36	
12	Sulphate (SO_4^{-2})	mg/l	8.00	
13	Conductivity	microS/cm	474.4	calculated from TDS
14	Coliform group	MPN/100ml	3-7	
15	TDS	mg/l	298.88	
16	COD	mg/l		
17	Turidity		0	
18	Heavy metal			
	-Arsenic	mg/l	0.000560	
	-Cadmium	mg/l	0.000269	
	-Fluorine	mg/l	0.000105	
	-Chromium	mg/l	0.000610	
	-Lead	mg/l	0.000560	
	-Mercury	mg/l	0.000560	
	-Zinc	mg/l	0.001400	
	-Copper	mg/l	0.000239	
	-Selenium	mg/l	0.004020	
19	Odor		0	

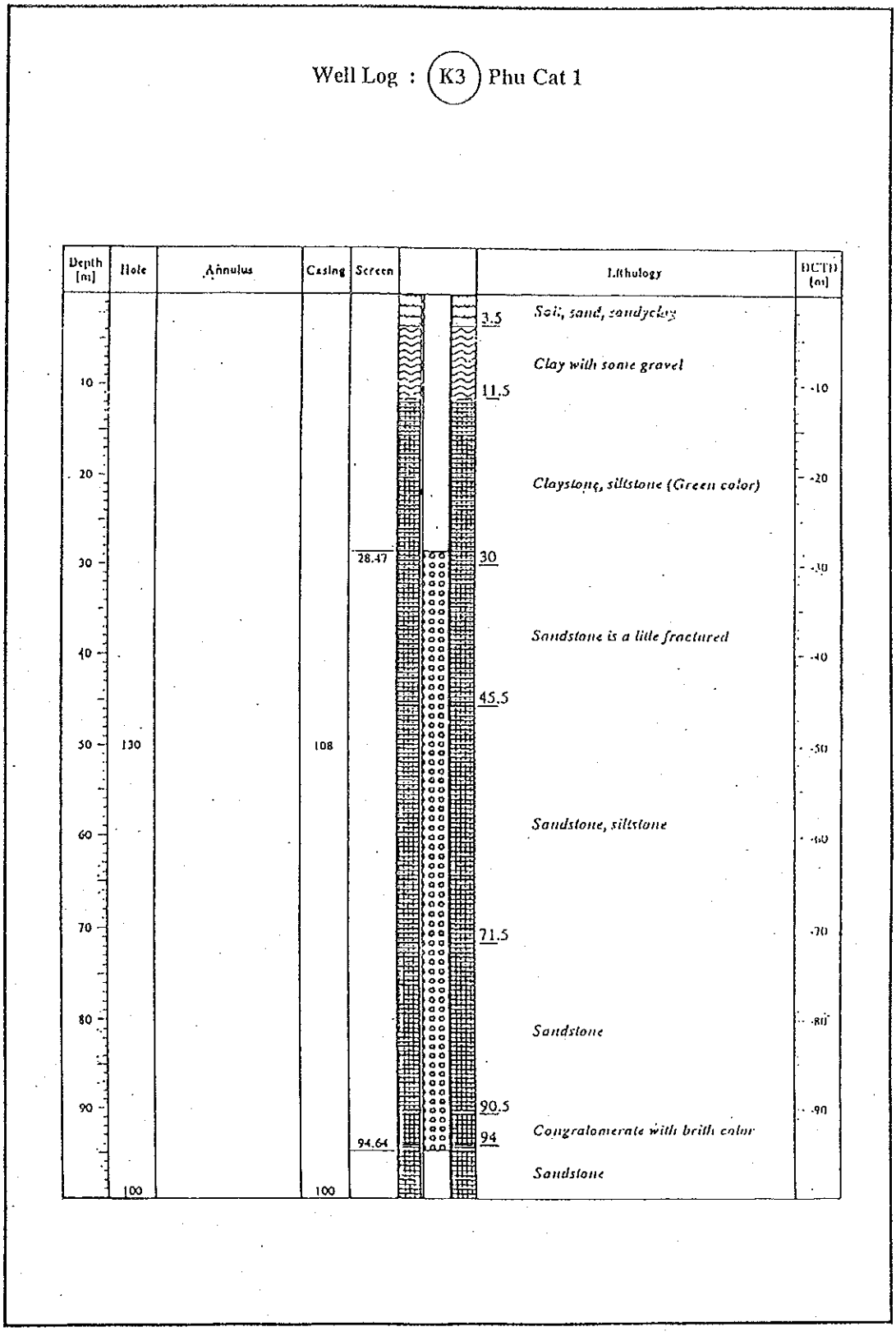


Figure A-1.2.6 Well Log (K3): Phu Cat 1

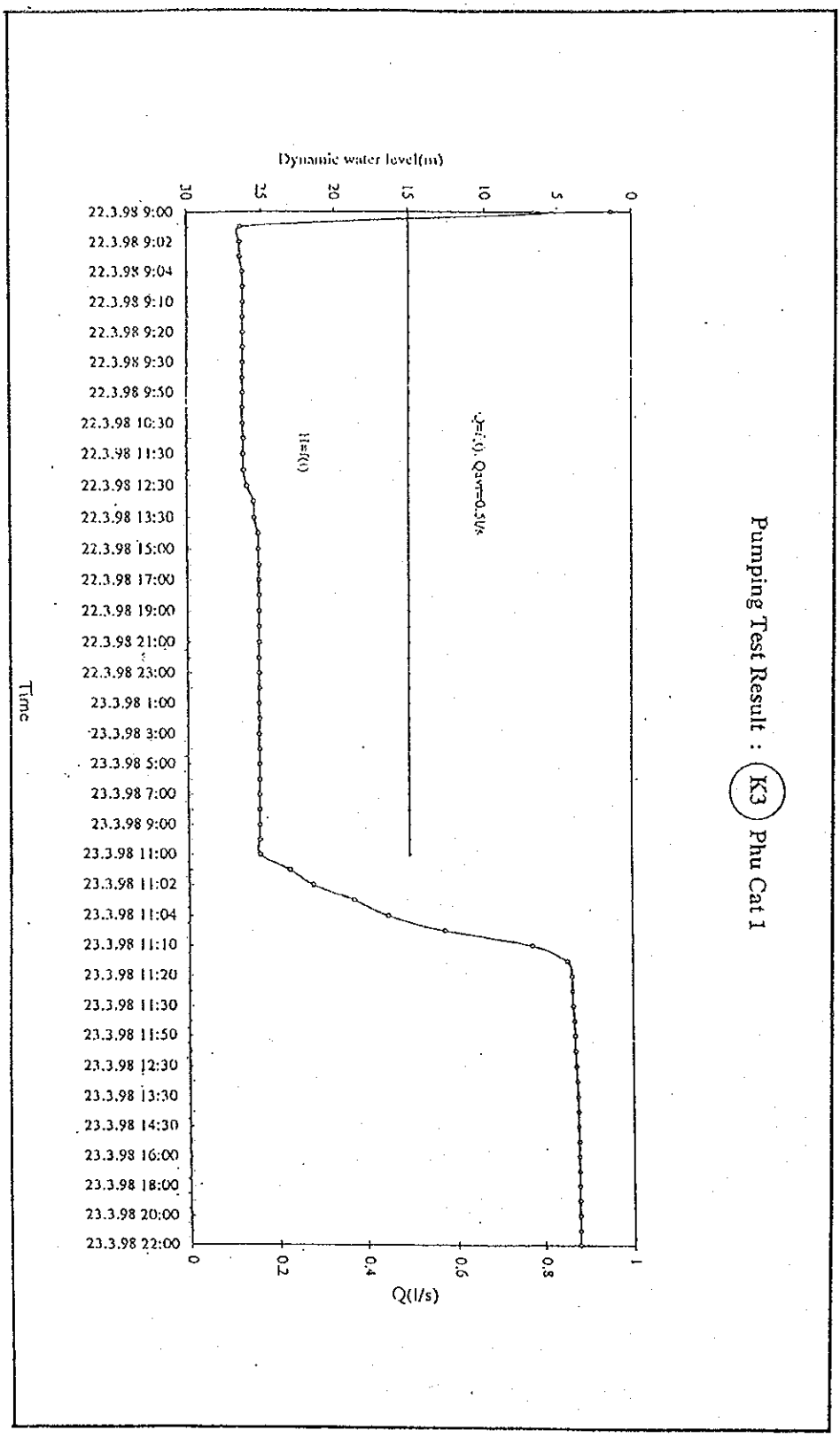


Figure A-1.2.7 Pumping Test Result (K3): Phu Cat 1

Table A-1.2.5 Groundwater Quality of Well (K4): Phu Cat 2

No.	Parametres	Unit	Test result	Remark
1	Temperature	℃		
2	pH		8.4	
3	Total iron (Fe)	mg/l	1.20	
4	Manganese (Mn)	mg/l	0.079	
5	Ammonium nitrogen (NH_4-N)	mg/l	0.065-0.049	second is N-content calculated from total NH_4
6	Nitrate nitrogen (NO_3-N)	mg/l	0.092-0.024	second is N-content calculated from total NO_3
7	Nitrite nitrogen (NO_2-N)	mg/l	0.007-0.030	second is N-content calculated from total NO_2
8	Carbonate (CO_3^-)	mg/l	10	
9	Alkalinity as $CaCO_3$	mg/l	210	
10	Total hardness as $CaCO_3$	mg/l	1.94	
11	Phosphorous (PO_4^{-2})	mg/l	0.34	
12	Sulphate (SO_4^{-2})	mg/l	8.00	
13	Conductivity	microS/cm	470	calculated from TDS
14	Coliform group	MPN/100ml	4-8	
15	TDS	mg/l	295.72	
16	COD	mg/l		
17	Turidity		0	
18	Heavy metal			
	-Arsenic	mg/l	0.000762	
	-Cadmium	mg/l	0.000250	
	-Fluorine	mg/l	0.000115	
	-Chromium	mg/l	0.000605	
	-Lead	mg/l	0.000590	
	-Mercury	mg/l	0.001266	
	-Zinc	mg/l	0.001262	
	-Copper	mg/l	0.000342	
	-Selenium	mg/l	0.003985	
19	Odor		0	

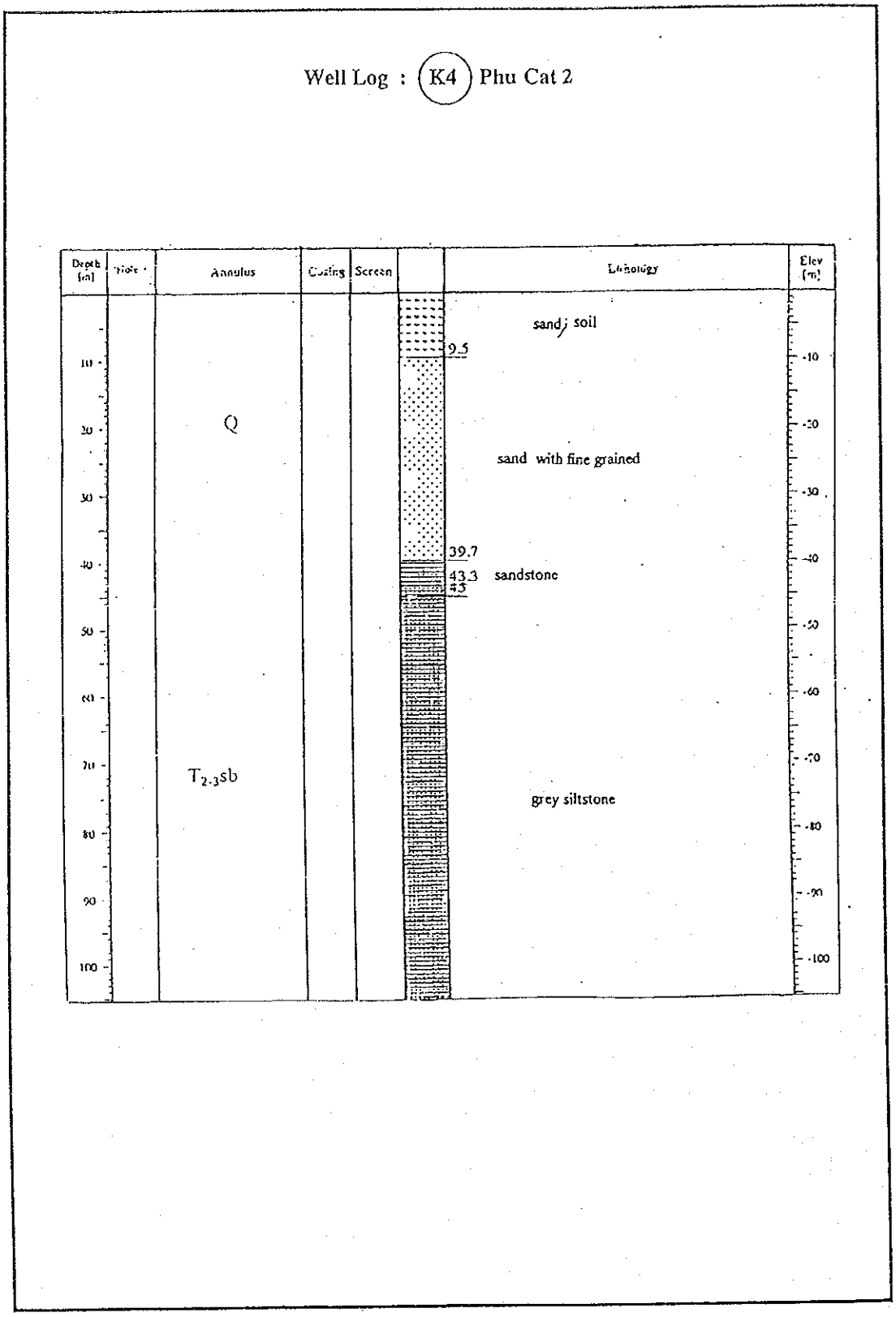


Figure A-1.2.8 Well Log (K4): K4 Phu Cat 2

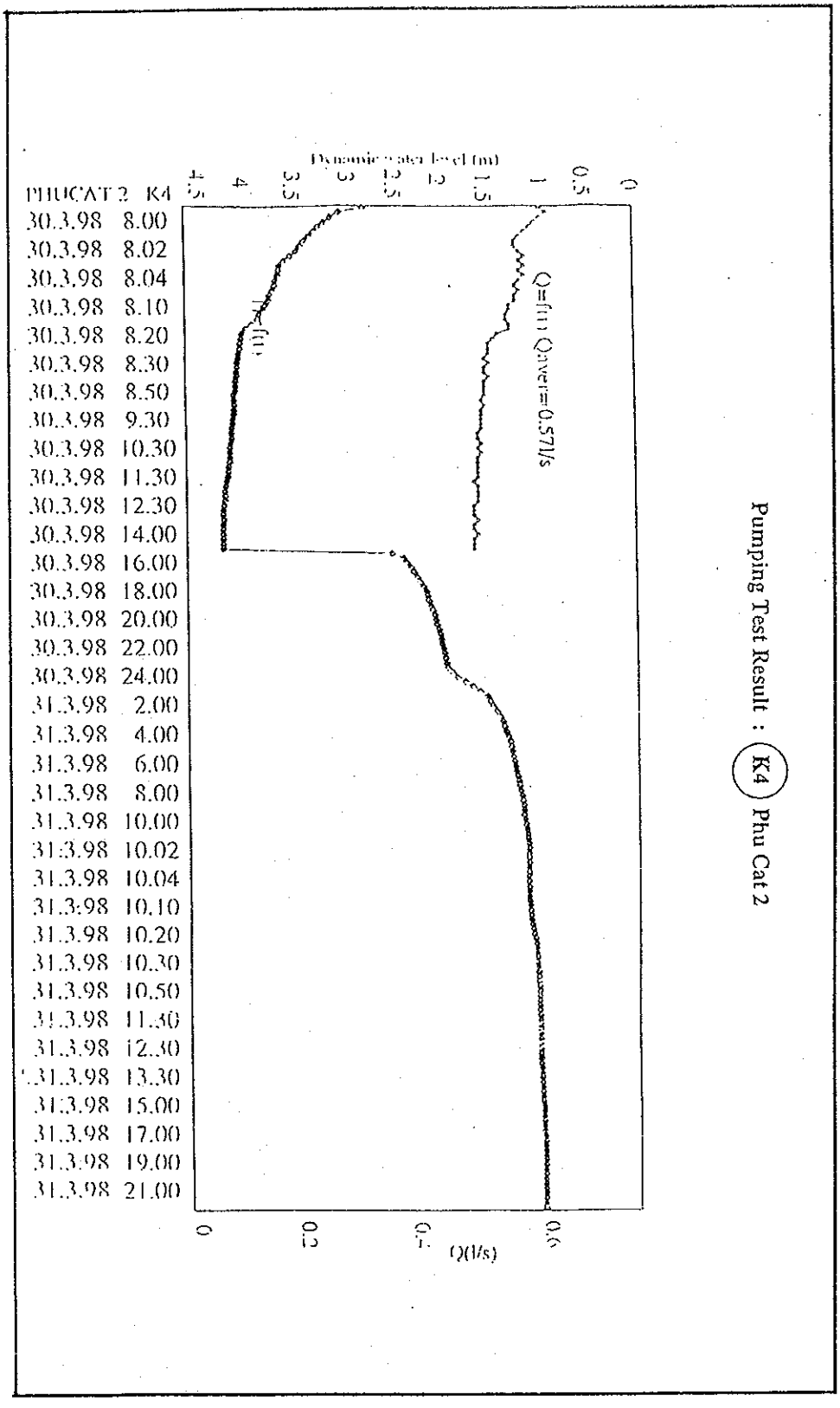


Figure A-1.2.9 Pumping Test Result (K4): Phu Cat 2

Table A-1.2.6 Groundwater Quality of Well (K5): Son Tay

No.	Parametres	Unit	Test result	Remark
1	Temperature	℃		
2	pH		7.50	
3	Total iron (Fe)	mg/l	2.05	
4	Manganese (Mn)	mg/l	0.235	
5	Ammonium nitrogen (NH_4-N)	mg/l	0.050-0.042	second is N-content calculated from total NH_4
6	Nitrate nitrogen (NO_3-N)	mg/l	0.072-0.011	second is N-content calculated from total NO_3
7	Nitrite nitrogen (NO_2-N)	mg/l	0.005-0.0037	second is N-content calculated from total NO_2
8	Carbonate (CO_3^-)	mg/l	14	
9	Alkalinity as $CaCO_3$	mg/l	250	
10	Total hardness as $CaCO_3$	mg/l	2.208	
11	Phosphorous (PO_4^{-2})	mg/l	0.28	
12	Sulphate (SO_4^{-2})	mg/l	8.25	
13	Conductivity	microS/cm	484.5	calculated from TDS
14	Coliform group	MPN/100ml	4-9	
15	TDS	mg/l	295.75	
16	COD	mg/l	2.8	
17	Turidity		0.000	
18	Heavy metal			
	-Arsenic	mg/l	0.000620	
	-Cadmium	mg/l	0.000355	
	-Fluorine	mg/l	0.000121	
	-Chromium	mg/l	0.000705	
	-Lead	mg/l	0.000614	
	-Mercury	mg/l	0.001550	
	-Zinc	mg/l	0.000321	
	-Copper	mg/l	0.004152	
	-Selenium	mg/l	0.000630	
19	Odor		0.00	

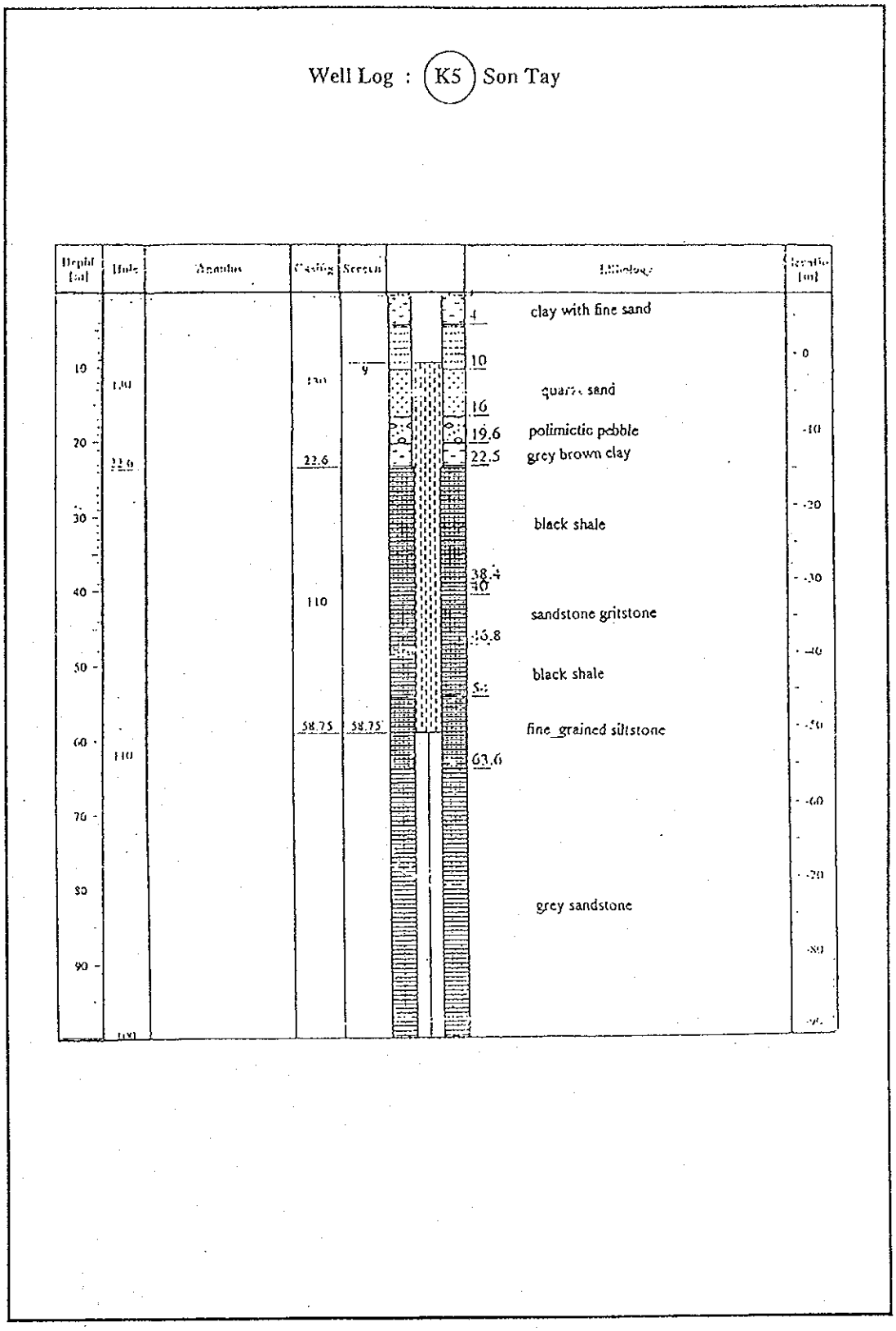


Figure A-1.2.10 Well Log (K5): Son Tay

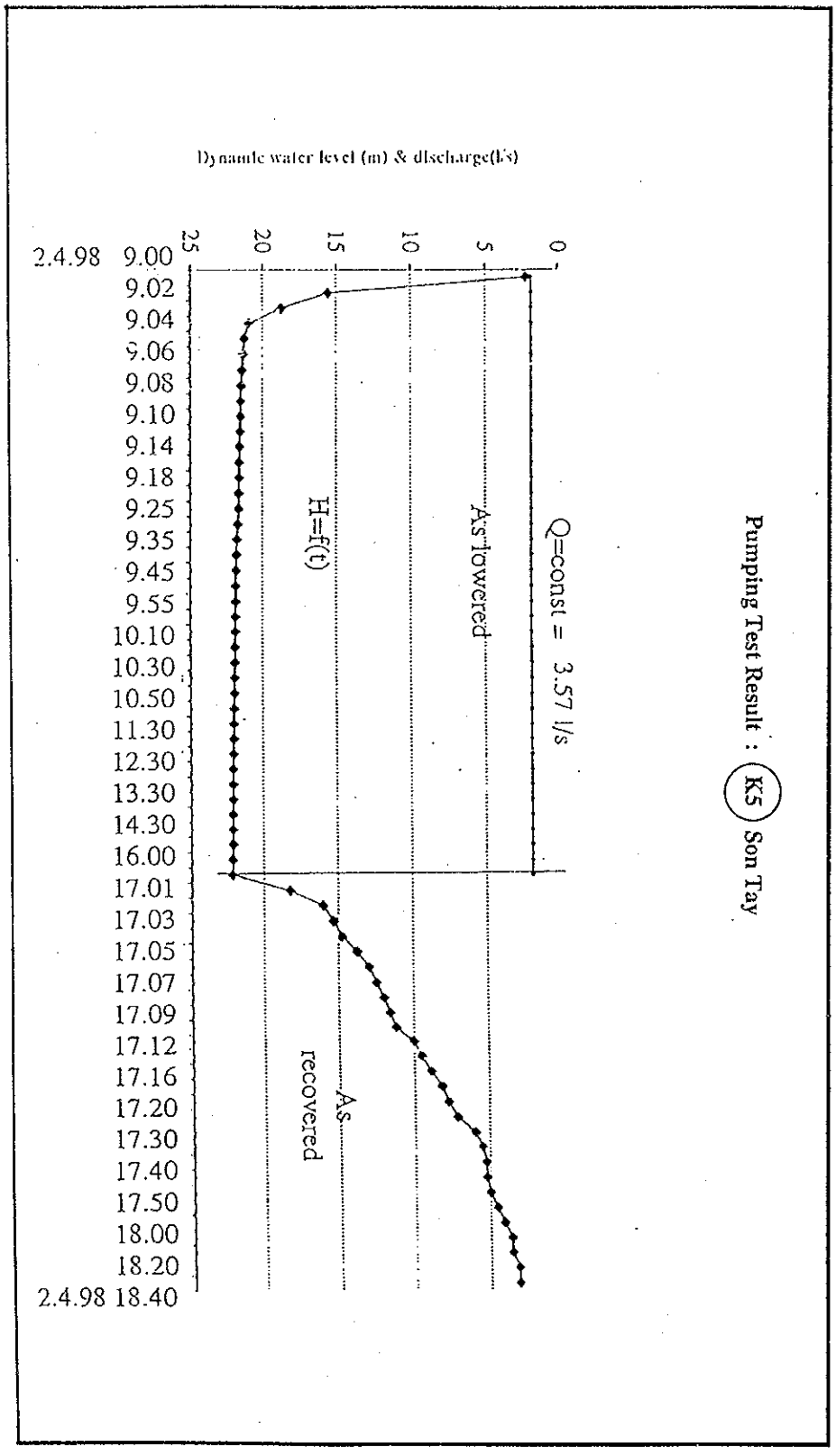
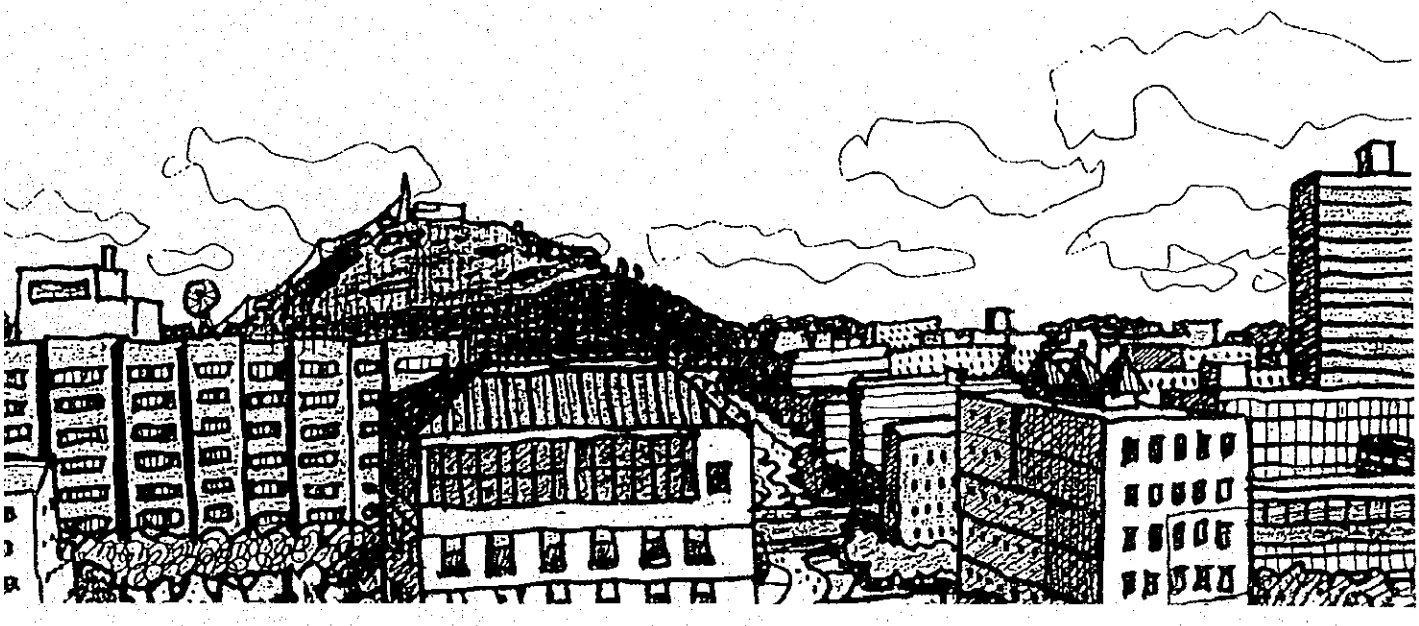


Figure A-1.2.11 Pumping Test Result K5): Son Tay

APPENDIX 2

Major Findings of The Sub-Contracted Survey (Water Quality Survey)



APPENDIX 2 Major Findings of the Sub-Contracted Survey (Water Quality Survey)

Water quality of the Development area was studied by the Institute of Science Information under the National Center for Natural Science and Technology.

The Red River usually contains high concentration of suspended solid or turbidity, which leads to technical difficulty of water treatment and higher costs for operation and maintenance as well as construction cost. On the other hand, the Da River has better water quality than the Red River. Particularly concentration of suspended solids of the Da River is about one-third (1/3) of the Red River, which surely contributes to low construction cost and easy operation of a treatment plant. It is concluded that the Da River shall be the water source of public water supply for the Development area.

2.1 Water Quality Analysis of the Da River

During the JICA study period, the Da River water quality was analyzed on two sampling places, Da Chong and Ky Son. The result of analysis indicated that all parameters and substances of the Da River water samples were lower than the limitation value applied to the surface water quality standard of Vietnam (TCVN-5996-1995). The results are given in Table A-2.1.1, and a summary is given below.

(1) Date of water sampling: 14th February 1998

(2) The samples were collected at Da Chong and Ky Son by plastic-made water sampler; and sub-samples for particular items, such as heavy metals and nutrients, were by stoppered glass or special plastic bottles.

(3) Temperature, conductivity and turbidity were measured immediately after sampling at the sampling sites by a water quality checker.

(4) Potential of hydrogen (pH) was determined electrometrically by means of ion specific electrodes at the sites.

(5) DO was analyzed based on winkler method at the sites.

(6) Dissolved silicon compounds were based on the formulation of a heteropoly acid.

(7) PO_4^{3-}, NO_3^-, NO_2^- and NH_4^+ were by the molecular absorption spectro-photometry and ion-chromatography.

(8) Concentrations of Cu, Pb, Cd, Zn, As, Hg, Cr, Fe, Mn, K and Na were analyzed by using atomic absorption spectrophotometry, comparing with results of the anodic stripping voltammetric and ionic chromatographic methods.

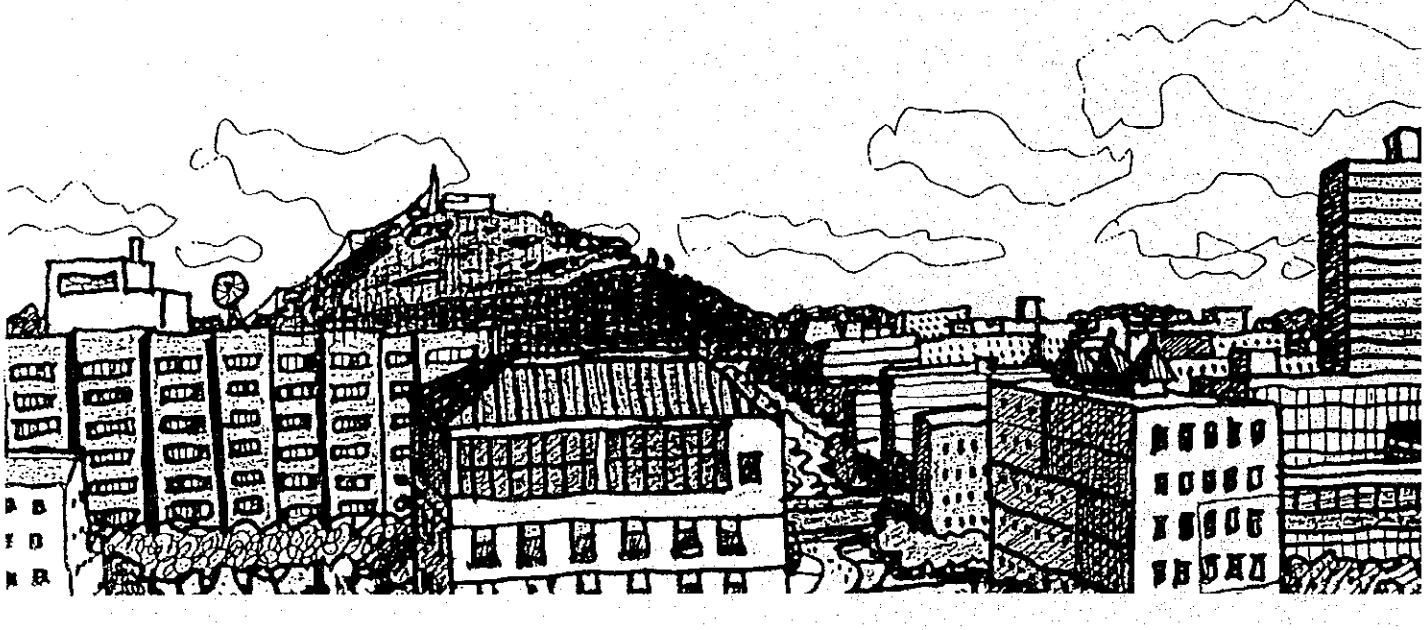
(9) Titration methods and ion chromatography were used for the concentrations of HCO_3^-, CO_3^{2-}, Cl^-, SO_4^{2-}, Ca^{2+}, Mg^{2+}, total iron and total manganese.

Table A-2.1.1 Da River Water Quality

No.	Water Quality	Da River Water		Standards		
		Ky Son	Da Chong	Vietnam's Environmental Standards Class-A (Raw water for drinking)	Vietnam's Drinking Water Standards (for Urban)	WHO's Guidelines
1	Temperature (℃)	20.8	21.4	-	-	-
2	pH	8.15	7.95	6 - 8.5	6.5 - 8.5	7.0 - 8.5
3	Iron Fe^{2+} (mg/l)	0.019	0.023			
4	Total Iron (T-Fe) (mg/l)	0.125	0.140	1	0.3	0.3
5	Manganese Mn^{2+}	0.0054	0.0050			
6	Total Manganese (T-Mn) (mg/l)	0.045	0.045	0.1	0.1	0.1
7	Ammonium nitrogen (NH_4-N) (mg/l)	0.035	0.035	0.05 as N	0	1.5 as N
8	Nitrate nitrogen (NO_3-N) (mg/l)	0.0069	0.0074	10 as N	10	50 as N
9	Nitrite nitrogen (NO_2-N) (mg/l)	0.0016	0.0016	0.01 as N	0	3 as N
10	Calcium as $CaCO_3$ (mg/l)	61.50	60.50			75
11	Carbonate CO_3^{2} (mg/l)	0	0			
12	Alkalinity K-Na (mg/l)	1.62-4.20	1.38-4.06	-	-	-
13	Chlorine (mg/l)	20.08	20.08	-	-	200
14	Total Hardness as $CaCO_3$ (mg/l)	44.0	47.0	-	500	-
15	Phosphorous PO_4^{3} (mg/l)	0.21	0.18			-
16	Sulfate SO_4^{2-} (mg/l)	6.73	5.78	-	400	250
17	Conductivity (m/s)	0.01	0.01	-	-	-
18	Coliform (MPN/100ml)	60	1200		5,000	Negative
19	Total Disolved Solid-TDS (mg/l)	3.7	3.8	-	500	1,000
20	COD ($KMnO_4$) (mg/l)	2.20	2.15			
21	DO (mg/l)	5.50	6.00			
22	Turbidity (mg/l)	1.03	1.04			5 NTU
23	Mg^{2+} (mg/l)	6.62	7.69			50
24	HCO_3^{2-} (mg/l)	112.9	115.8			
25	Cu (mg/l)	0.00330	0.00351	0.1	1	1
26	Pb (mg/l)	0.00178	0.00176	0.05	0.05	0.01
27	Cd (mg/l)	0.00018	0.00020	0.01	0.005	0.003
28	Zn (mg/l)	0.00701	0.00584	1	5	3
29	As (mg/l)	0.00253	0.00271	0.05	0.05	0.01
30	Hg (mg/l)	0.00041	0.00030	0.001	0.001	0.001
31	Cr (mg/l)	0.00146	0.00136	0.15	0.05	0.05
32	F (mg/l)	0.00640	0.00660	1	1.5	1.5
33	CN (mg/l)	0.00720	0.00800	0.01	0.1	0.07

APPENDIX 3

Major Findings of The Sub-Contracted Survey (Social Survey)



APPENDIX 3 Major Findings of the Sub-Contracted Survey (Social Survey)

3.1 Scope of Surveys

This study assumes that the majority of new town residents will move to Hoa Lac and Xuan Mai Area from Hanoi and other surrounding areas. It is expected that there will be some sociological and psychological obstacles that people face when an influx of new residents occurs from Hanoi with affluent and prosperous urban amenity to the Hoa Lac and Xuan Mai Urban Areas of new town. In order to clarify those problems and to make good use of the findings to implement the plan smoothly, the JICA Study Team conducted an interview survey entitled "Interview Survey on Family, Behavioral Pattern and Human Resources."

This direct interview survey was carried out to Hanoi residents. And responses from the present inhabitants in Hoa Lac and Xuan Mai Urban Areas, who were also interviewed, were compiled into the major findings. Major items of the questionnaire include the following:

(1) Social Survey

(a) income sources

(b) commuting time, means, and cost

(c) major activities after 5 p.m.

(d) merits and demerits for present Hanoi residents

(e) merits and demerits for present Hoa Lac and Xuan Mai residents

(f) conditions of dwelling

(2) Major Findings

Average family size of 750 households in Hanoi is calculated to be 4.2 persons: one couple and 2 children. One-fourth of the whole family is living together with their parents.

Five major findings of this social survey relate with:

First: income sources,
Second: commuting time, means, and cost,

Third: major activities after 5 p.m.,
Fourth: merits and demerits for present Hanoi residents,
Fifth: merits and demerits for present Hoa Lac - Xuan Mai residents, and
Sixth: dwelling conditions.

3.2 First Finding: Income Sources

Average family income per month of the potential new inhabitants is calculated to be 2,970,000 Dong for 4.2 persons per family.

Figure A-3.2.1 shows that 72 % of the family income is attributable to main jobs. This share is followed by the part-time job of 19 %, and others at 9 %. This is an important finding for further analysis, since various sources have indicated that more than 60 % or 70 % of the family monthly income in Hanoi urban area normally comes from the part-time jobs.

On the other hand, the interviewees might not have answered correct figures about part-time incomes. This suspicion is justified by the fact that one of the three major disadvantages to move from Hanoi to Hoa Lac is to lose the opportunity of part-time jobs as revealed in the interview survey. But if this figure is correct, it is suggested that there would be no need to pay so much compensation and/or incentives for the loss of part-time income.

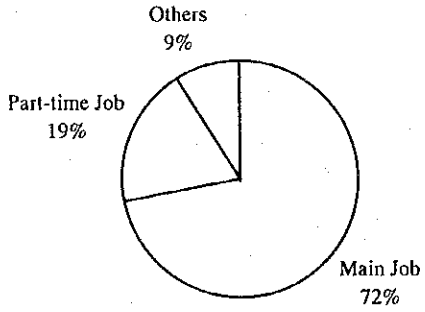


Figure A-3.2.1 Income Sources

3.3 Second Finding: Commuting Means and Time

The second finding is concerned with "commuting means and time at present" and "acceptable maximum level of commuting time and expenditure." These question items are aimed at clarifying the possibility for people to commute to the Hoa Lac and Xuan Mai Urban Areas every day as they do now in Hanoi, and also at testing the necessity of "mass rapid transit mode" between Hanoi and the new town.

As shown in Figure A-3.3.1, about 55 % of the people use motorbikes at present, and 34 % use bicycles. While about 10 % of the people walk to working places. Share of the passenger cars and buses are limited to 0.2 % and 0.9 % respectively.

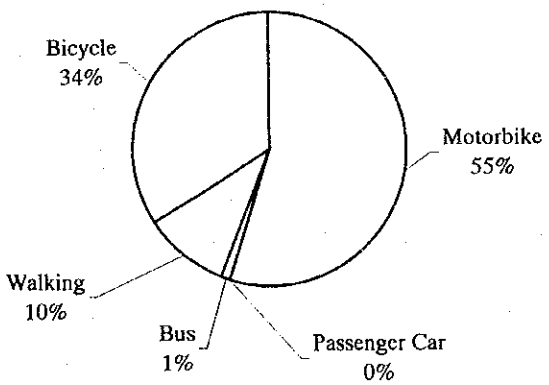


Figure A-3.3.1 Present Commuting Modes

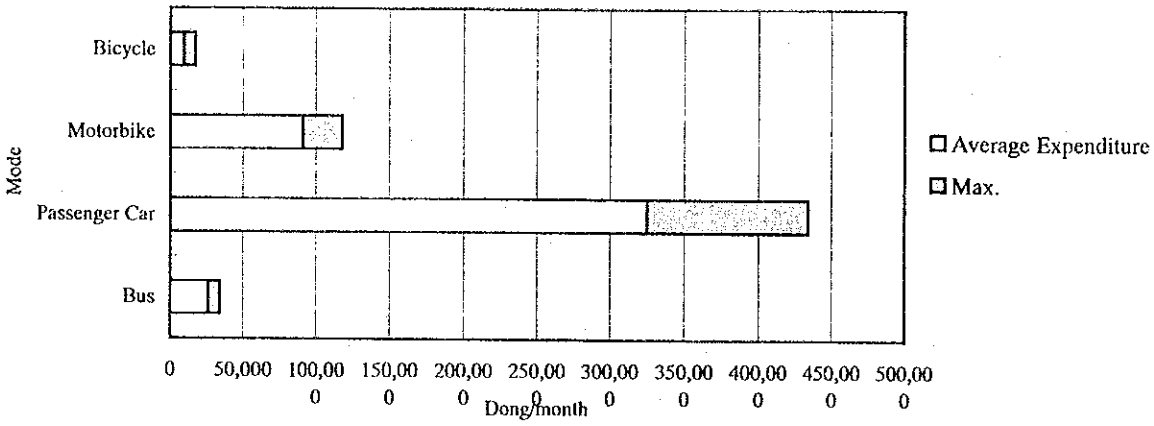


Figure A-3.3.2 Average Maintenance Cost

Monthly maintenance cost for passenger car is presented in Figure A-3.3.2, and it reaches 325,000 VND, and this is followed by motorbike of 91,000 VND. Average bus expenditure is 26,000 VND/month. In the case of motorbike, the operation cost of one motorbike is estimated to be 3% of the total average family income.

It can be judged that this amount is not so large since the respondents answered that they could afford paying a higher maintenance cost by 30 % compared with the present level. All the users of other 3 commuting modes answered that they could also pay 30 % more for daily commuting.

This figure suggest how much people can pay for the commuting means when they will commute to Hoa Lac and Xuan Mai at present and in the future. The suggested figure is 118,000 VND/month/motorbike, equivalent to about 4 % of the total family income. This share can be applied proportionally to the future salary.

Table A-3.3.1 shows findings about the commuting time. About 45 % of the total commuters are at present consuming less than 15 minutes from houses to working places, and the same share of commuters takes only 16-30 minutes. Those are really short times, especially for Malaysian, Bangkok inhabitants, and Japanese because they consume about one hour or more for commuting everyday.

Table A-3.3.1 Commuting Time (Actual, Ideal and Maximum)

Unit: %

Time Category	Present	Ideal Time	Maximum
Less than 15 min.	44.9	75.6	44.7
16 - 30 min.	47.0	23.3	46.4
31 - 45 min.	7.3	0.7	7.7
46 - 60 min.	0.6	0.2	0.9
60 - 90 min.	0.1	0.0	0.1
More than 91 min.	0.1	0.1	0.2

As far as ideal commuting time is concerned, 75.5 % of people answered that it is less than 15 minutes. However, when they are questioned about the acceptable maximum commuting time, their answers are similar to the present situation.

3.4 Third Finding: Life Style

The third finding concerns social activities or community activities after office hours. This question is designed to clarify the most important activities of the present private lives of the residents. In new Hoa Lac and Xuan Mai Urban Areas, it has been determined that similar social circumstance should be maintained to keep the quality of life. Therefore, the findings are fed back to the town planning procedure to guarantee that those activities would be available to the residents when they move to the Hoa Lac and Xuan Mai Urban Areas.

Figure A-3.4.1 shows that the highest share falls on the "Hobbies at Home" and "Relax at Home," which account for 23.9 % and 19.6 % respectively. In aggregating all the "Staying-at-Home" items, it reaches almost 56 %, showing a significant role of the home in Vietnam.

Other significant items are 15.1 % of "Other job," 11.9 % of "Going out for entertainment," 6.2 % of "To meet friends, parents etc.," and 4.8 % of "Care of children and parents." These items account for small shares; however, their impacts are overwhelming other items, and it is suggested that the town planning be designed to guarantee these small, but significant, activities. This result provides a basic principle for the town planning in the Hoa Lac and Xuan Mai Urban Areas.

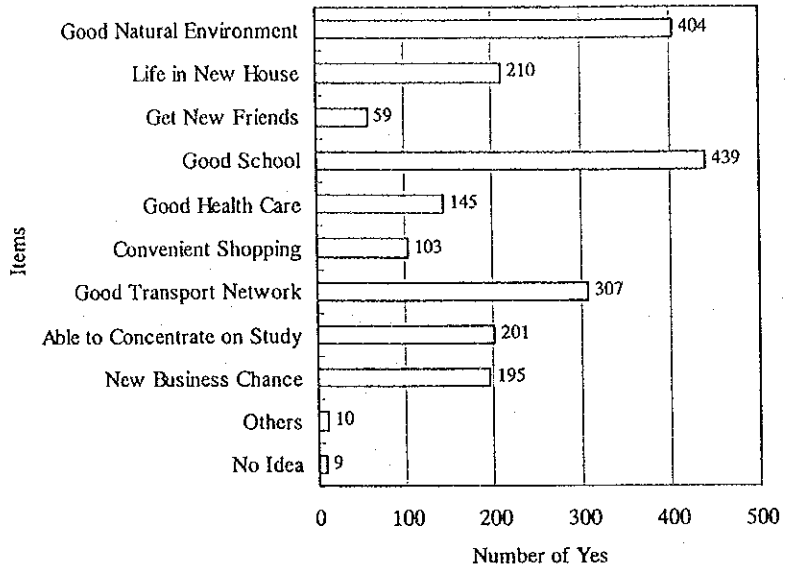


Figure A-3.4.1 Important Social Activities

3.5 Fourth Finding: Attractiveness for Hanoi Residents

The fourth finding measures the awareness of Hanoi residents of this new academic and science city, and what their expectations are.

As shown in Figure A-3.5.1, about 30 % of the people answered that they are well informed about this new town, and that the scientific character of the town and its well-facilitated infrastructure can attract so much people and scientists. And 47 % basically confirm high expectations of the new town.

This is a very important piece of information, since it suggests that the new town is welcomed and expected to be an ideal town to live in by 78 % of the total.

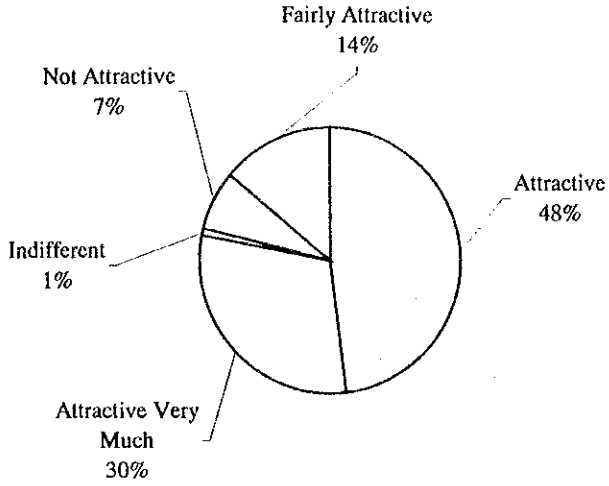


Figure A-3.5.1 Attractiveness of Hoa Lac and Xuan Mai Area

The residents were also asked questions on what they perceive to be merits and demerits of moving from Hanoi to Hoa Lac and Xuan Mai. For this purpose, nine items that were perceived to be attractions of the new town were listed, as follows:

(1) Natural circumstance,
(2) Expectation to new house,
(3) Expectation to new fiends,
(4) High quality school,
(5) High quality health care,
(6) Convenient shopping,
(7) Convenient transportation,
(8) Can devote time for study or research, and
(9) Business opportunities.

The results reveal very interesting facts as shown in Figure A-3.5.2.

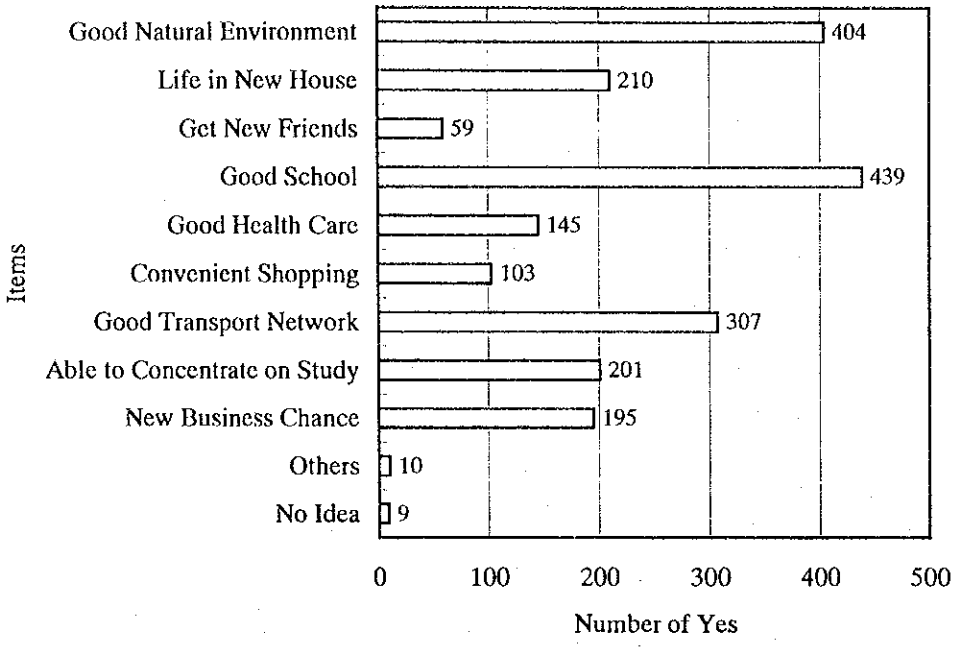


Figure A-3.5.2 Merits for Hanoi Residents

The figure above presents the kind of town that people expect in Hoa Lac and Xuan Mai. It can be said that an ideal image of the town can be described as follows: "High qualified school in good natural circumstance supported with well developed transport infrastructure." This is a result of combining three major items.

However, three other items are also very important because they are expected to bring about significant impact on the life style of the residents. These are the following:

- Able to concentrate on their own study or research,
- New life in new house, and
- New business opportunities.

Expected inhabitants such as researchers and students can live in new houses and be able to devote time for their studies and research. The surrounding areas are very active because of enormous new business opportunities. Those are the images of the new town that the people have in their minds.

Ironically, the worries in the minds of the residents pertain to the opposite of almost all that they consider positive about the development.

Results of interview survey is shown in Figure A-3.5.3, and its major findings are summarized below:

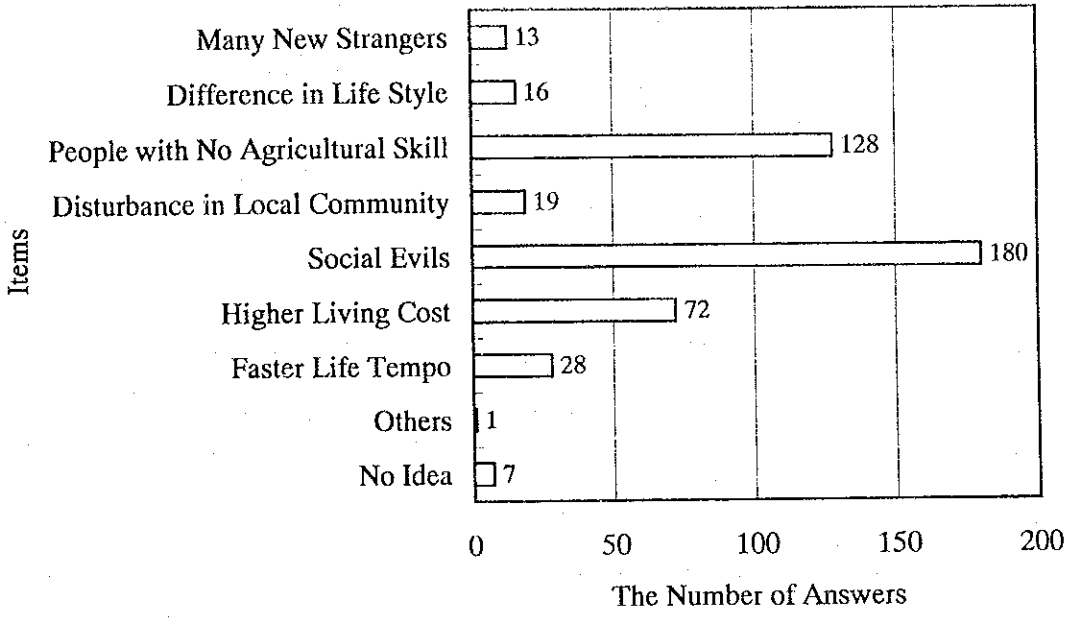


Figure A-3.5.3 Demerits of New Town for Hanoi Residents

(a) It is apparent that people are most worried about "poor schooling facilities for their children" in a new town. This can be solved by an adequate number of schools and well-trained teachers. In the case of Japan, public schools in this kind of academic town marked highest academic performance over the nation since the students have well-educated parents who are mostly researchers and scientists. The JICA Study Team does not see any problem in this regard.

(b) High point falls on "worrying about inability to keep friends." This is a natural feeling when moving to a new residence, and presents an unavoidable psychological conflict. The Team regards this a minor problem.

(c) "Loss of part-time job" causes crucial issues to arise in new town plan formulation. However, kinds of side jobs were not asked in this survey, although supplementary information compiled by related organizations suggest that the majority of university faculties are engaged in side jobs either as night school teacher/tutor or researcher in joint research with private company, and others in various individual companies and shops.

It is suggested that some incentives be taken into consideration to compensate for the loss of income from the part-time job.

3.6 Fifth Finding: Attractiveness for Present Hoa Lac Residents

The last finding deals with how the present residents will react to new residents who will come from a traditional urban city, Hanoi. In the past experience, it is reported that there were so many conflicts between present and new residents because of differences in culture, life style, income and so on. Results of this survey will be utilized to create a new device or system to minimize such kinds of social conflicts in the course of Hoa Lac and Xuan Mai new town development.

Question items include the following:

(a) Better infrastructure,

(b) High land price,

(c) Good water supply, electricity etc.,

(d) Good health care,

(e) Good school,

(f) Job opportunity, and

(g) Access to modern technology.

The results shown in Figure A-3.6.1 demonstrate that "Good schooling" received the highest rating. Other items are rather equally marked, and there seems no significant difference in the seven items except for high land price.

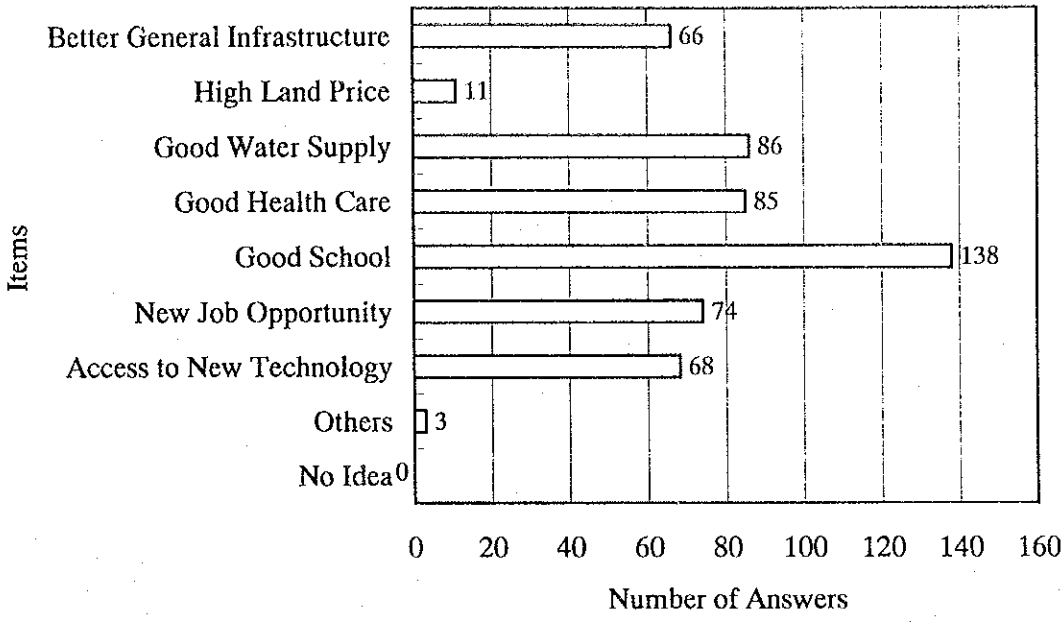


Figure A-3.6.1 Merits for Present Inhabitants

However, when we look at the perceived demerits of the new town development, as presented in Figure A-3.6.2, it may be stated that these effects can be avoided or reversed.

(a) The most serious problem the Hoa Lac and Xuan Mai residents worry about at present is "social evils." This shows overwhelming impact among the seven potential demerits.

(b) Present inhabitants worry that so many non-skilled agricultural laborers will come to the planned area. But this implies that the present major migrants are engaged in agriculture, and they cannot imagine what kind of people will come to Hoa Lac and Xuan Mai. There is no need to worry about this point.

(c) Faster tempo of life style might be one of the most difficult to get accustomed with for the agricultural people. But this is also a necessary evil that people have to experience in the development process.

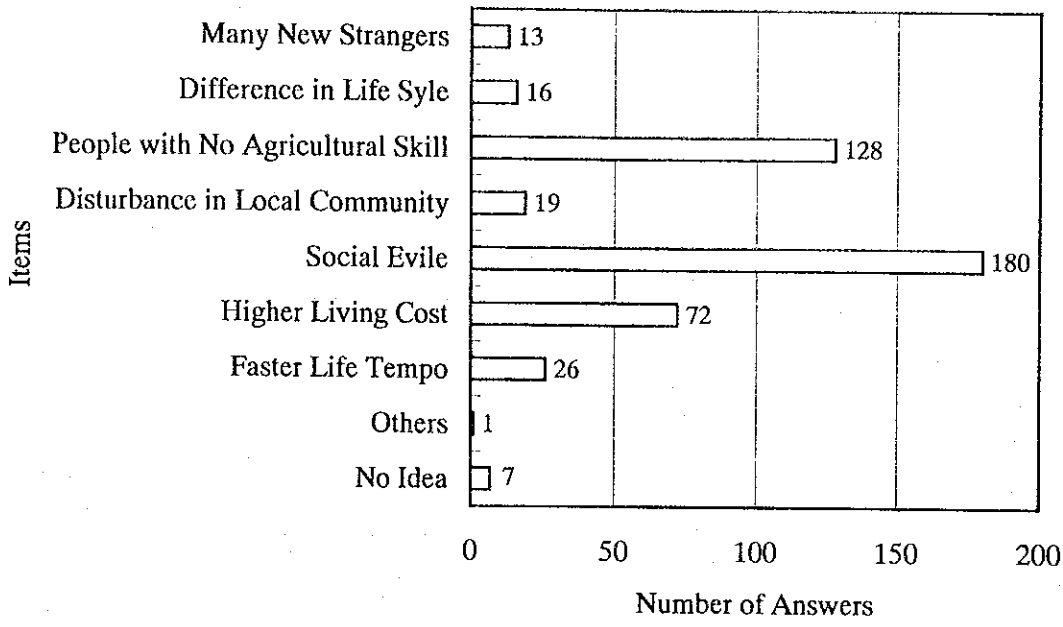


Figure A-3.6.2 Demerits for Present Inhabitants

3.7 Sixth Finding: Dwelling Conditions

Conditions of present dwellings are also clarified as follows:

Kinds of Dwelling:	Own house=7.7 %, Public Apartment house=61.1 %, Private Apartment house=30.9 %, Others=0.3 %
Average Expenditure for Apartment house:	56,968 VND/month
Average Area:	56.9 sq. meter/dwelling

Implications of this survey are as follows:

(a) A big portion of the monthly income is dependent on the part-time jobs, and some compensation should be guaranteed when people have to move to Hoa Lac.

(b) Fast transportation means should be introduce to minimize commuting time from Hanoi. Improvement of sufficient public transportation in Hanoi urban area can contribute to shorten total commuting time.

(c) Major advantages and disadvantages for both the Hanoi residents and Hoa Lac residents are summarized below, and careful attention should be paid them in the planning stage. However, all these findings are subject to change as the town development progresses. This phenomenon can be observed in Japan. Continuous monitoring of the residents' opinion is suggested at all the development stages.

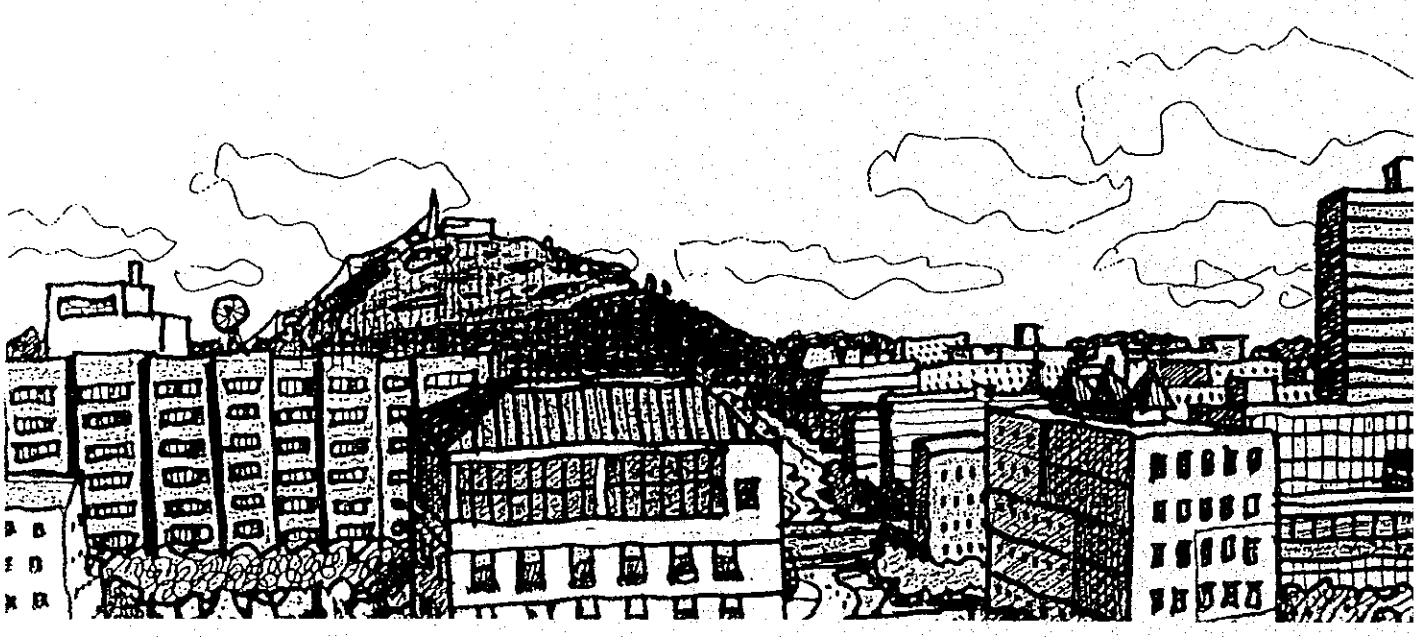
All these results are reflected in town planning in the course of the study as much as possible.

Table A-3.7.1 Advantages and Disadvantage for Hanoi and Hoa Lac Residents

	Hanoi residents	Hoa Lac residents
Advantage (Expectation)	Good school Good natural environment Good transportation network	Good school
Disadvantage (Worrying Points)	Poor school Difficulty to keep friends Loss of part-time jobs	Social evils People with no agri-techonology Higher cost of living

APPENDIX 4

Major Findings of
The Sub-Contracted Survey
(Human Resource Development)



APPENDIX 4 Major Findings of the Sub-Contracted Survey (Human Resource Development)

4.1 The Outline of the Survey

The JICA Study Team conducted a questionnaire survey of 34 universities, 55 institutes, and 90 enterprises located in Hanoi from February 15 to 20, 1998. The questionnaire includes the following items:

- Outline of organization
- The number of employees by type
- Average monthly income by type of employees
- Problems concerning human resource development (HRD)
- Demand for education and training
- Future plan

Table A-4.1.1 shows the response rate of the survey. The questionnaire was distributed to 179 organizations, and JICA Study Team received 149 replies, which were 83.2% of the total.

Table A-4.1.1 Response Rate of the Questionnaire

	No. of distribution	No. of reply	Ratio (%)
University	34	29	85.3
Institute	55	50	90.9
Enterprise	90	70	77.8
Total	179	149	83.2

4.2 Results of Survey

(1) The Number of Employees by Type

The average number of employees by organization and their average age are shown in Table A-4.2.1. According to the survey, professors' account for only 2 % of the total employees engaged in universities. Their average age is 60, which indicates that many professors will retire soon, and many new professors will be needed. Researchers account for 58.5 % of the total employees of institutes. This figure is slightly smaller than that of Japan, 64.5 %. In enterprises, engineers account for only 8.2 % of the total employees.

Table A-4.2.1 The Average Number of Employees by Organization and Their Average Age

	Average No. of Employees	Ratio (%)	Average Age
University			
Professors	9.2	2.1	60
Assistant Professors	26.5	6.1	55
Lecturers	205.3	47.2	43
Assistants	41.1	9.5	31
Administration	85.5	19.6	43
Servants	67.4	15.5	43
Total	435.1	100.0	43
Institute			
Leadership	6.0	3.6	51
Researchers	96.8	58.5	43
Researcher Assistants	33.0	19.9	36
Administration Staff	29.9	18.0	39
Total	165.6	100.0	41
Enterprises			
Administrative Staff	48.2	11.4	34
Engineers	34.4	8.2	38
Technicians	20.1	4.8	34
Skilled workers	248.5	58.7	31
Unskilled workers	56.1	13.3	28
Staff of services	15.1	3.6	32
Total	422.4	100.0	32

(2) Employees by Qualification

The ratio of employees by qualification is shown in the following table. Employees with a doctorate degree account for only 1.2% in university and 2.3% in institute. The figures of master's degree are not so high, either.

Table A-4.2.2 Ratio of Employees by Qualification

Unit: %

	University	Institute
Doctors	1.2	2.3
Masters of science	17.3	12.0
Masters	11.9	4.0
Bachelors	54.3	63.7
Others	15.3	18.0

(3) Average Monthly Income

Average monthly income of employees in universities, institutes and enterprises are shown in the following figures. Employees working for enterprises earn a higher salary than those for other organizations. On the one hand, some engineers earn more than 3 million VND a

month. On the other hand, most employees of universities and institutes earn fewer than half of that amount.

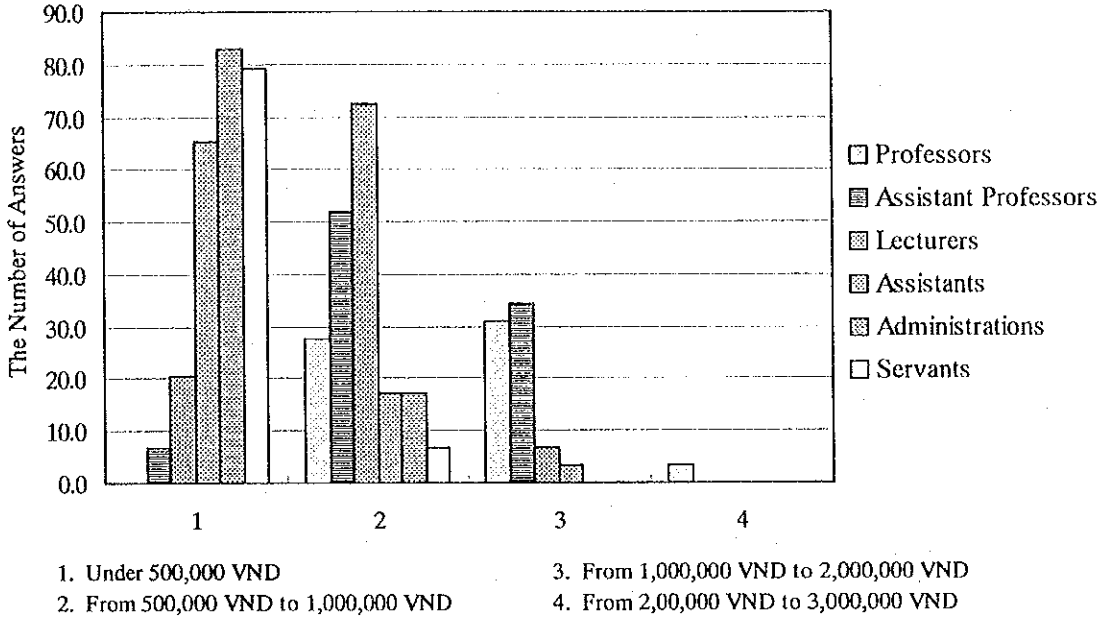


Figure A-4.2.1 Average Monthly Income (Universities)

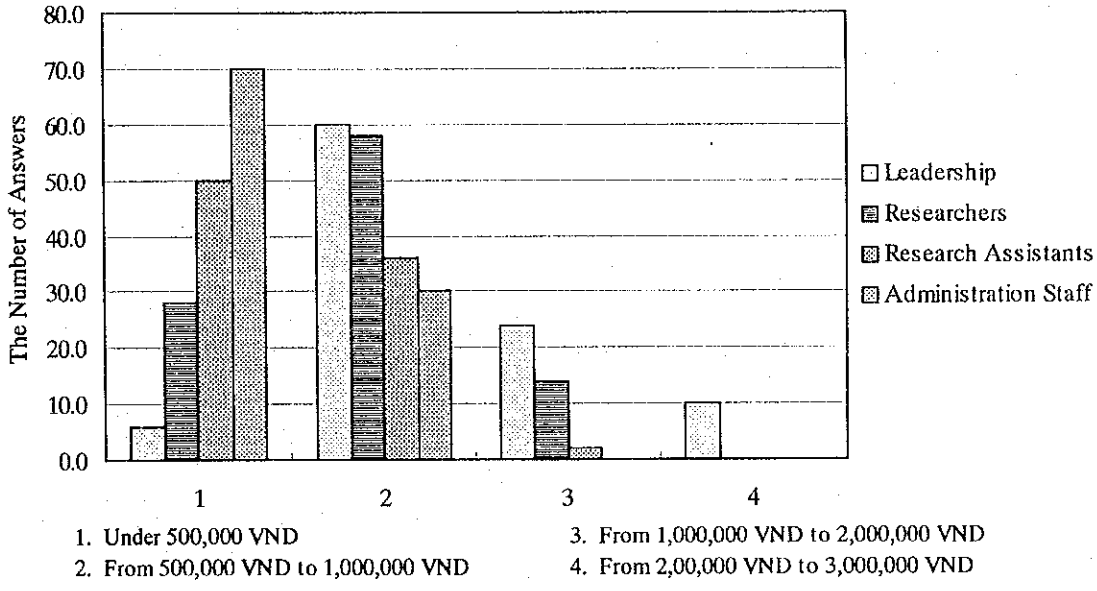


Figure A-4.2.2 Average Monthly Income (Institutes)

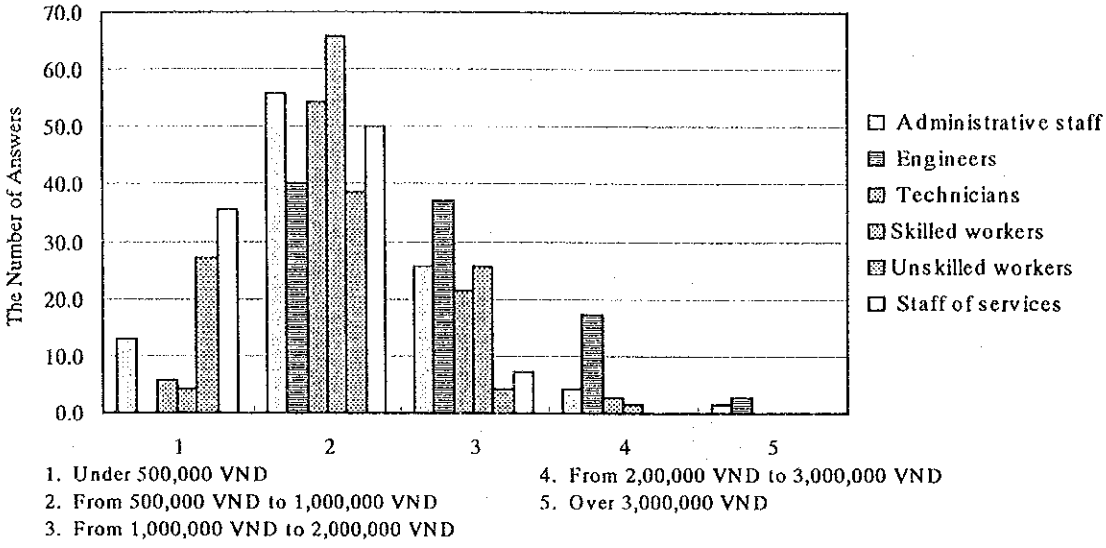
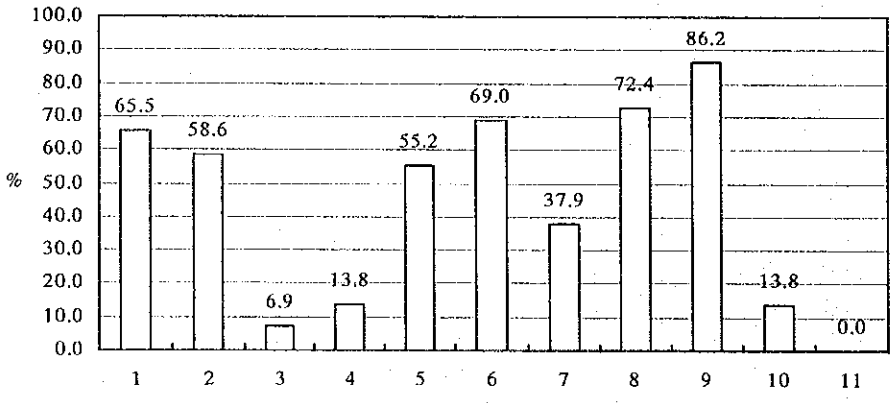


Figure A-4.2.3 Average Monthly Income (Enterprises)

(4) Problems

1) University

According to Figure A-4.2.4, a budget shortage is the problem, which 86.2 % of the surveyed universities encounter. This problem significantly affects other problems that universities face, such as a lack of teaching materials and poor facilities as shown in the figure.



5. Lack of professors
6. Lack of assistant professors
7. Lack of capability of professors
8. Lack of capability of assistant professors
1. Aging of professors
2. Poor facilities
3. Insufficient campus
4. Lack of teaching materials
9. Lack of budget
10.Others
11.None

Figure A-4.2.4 Problems (Universities)

2) Institute

Institutes lack the number of researchers, said 90 % of the surveyed institutes. Furthermore, 80% have difficulty in recruiting new researchers because of low salary. They are resigned due to the poor facilities for research activities. Institutes are also suffering from insufficient budget.

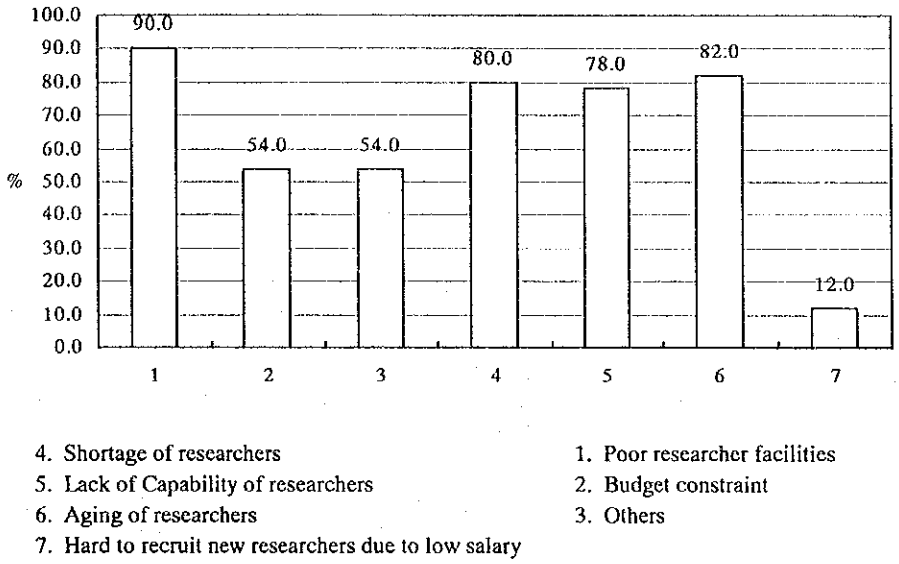


Figure A-4.2.5 Problems (Institute)

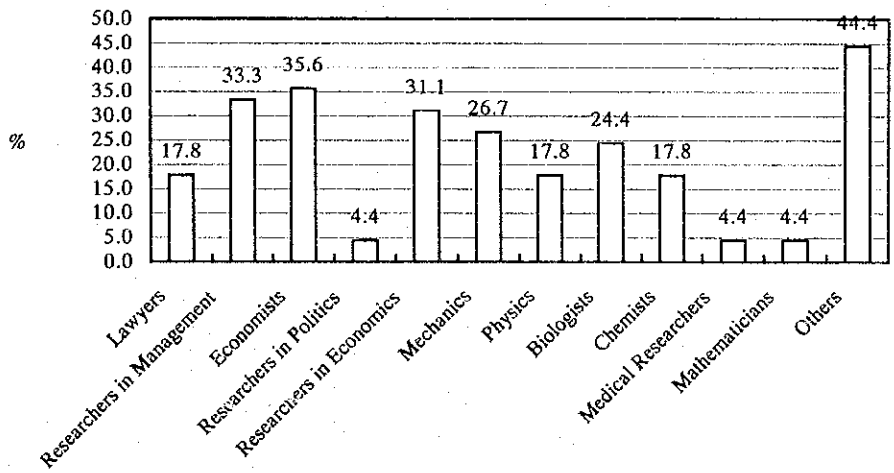


Figure 4.2.6 Researchers in Shortage

The surveyed institutes lack economists, researchers in management, researchers in economics, mechanics, and biologists. Those with a doctorate degree account for 77.8%, followed by 66.7% with a master of science degree. A doctorate or master's degree is a required qualification for researchers, but there are not so many researchers who have such degrees.

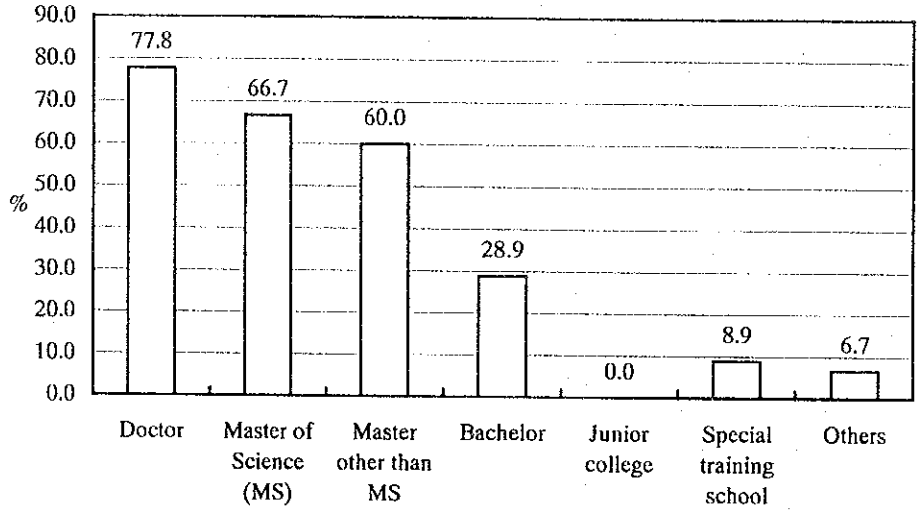
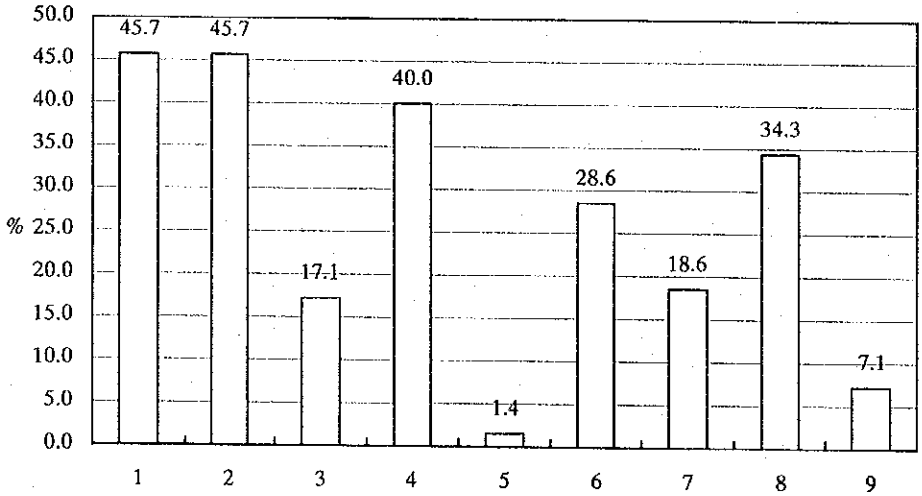


Figure A-4.2.7 Kinds of Highly-Educated Personnel Shortage (by qualification)

3) Enterprises

Enterprises have the similar problem to the universities and institutes: a shortage of highly qualified personnel such as engineers and manager class of personnel.



1. Shortage of engineers
2. Shortage of manager class of personnel
3. Shortage of technicians
4. Shortage of skilled workers
5. Shortage of service staff
6. Lack of capability of engineers
7. Lack of capability of technicians
8. Lack of capability of skilled workers
9. High wage

Figure A-4.2.8 Problems (Enterprises)

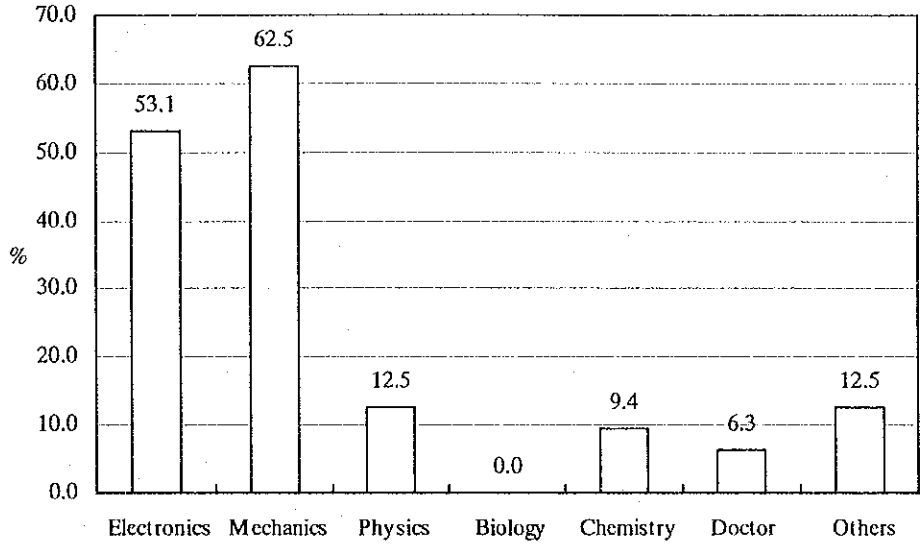


Figure A-4.2.9 Types of Engineers in Shortage (Enterprises)

Figure A-4.2.9 illustrates the types of engineers which enterprises answered that they do not have enough. More than half of all surveyed enterprises, 62.5 % and 53.1 %, answered that they lack mechanical engineers and electrical engineers, respectively.

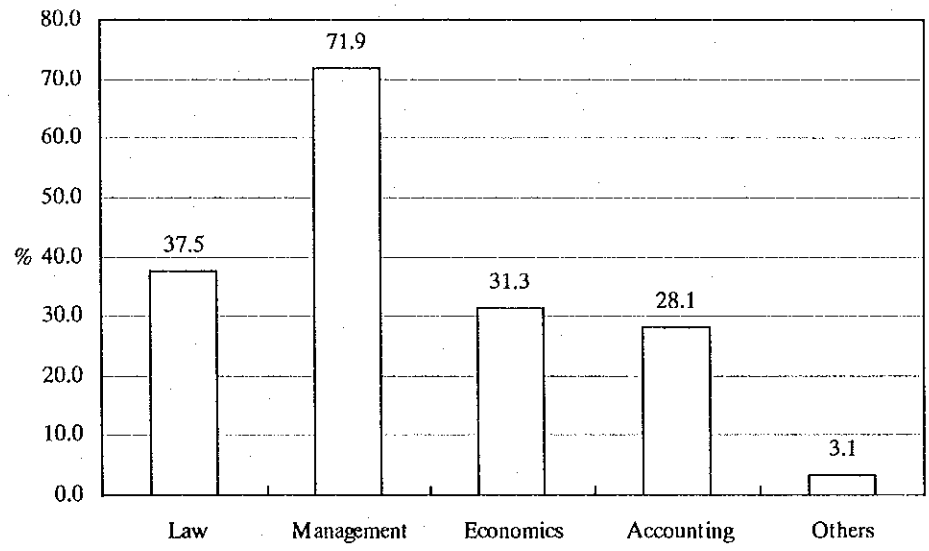


Figure A-4.2.10 Types of Manager Class of Personnel in Shortage (Enterprises)

According to Figure A-4.2.11, about 25 % of the surveyed enterprises lack those who have a bachelor's degree. Enterprises do not seem to need persons who have doctorate or master's degrees.

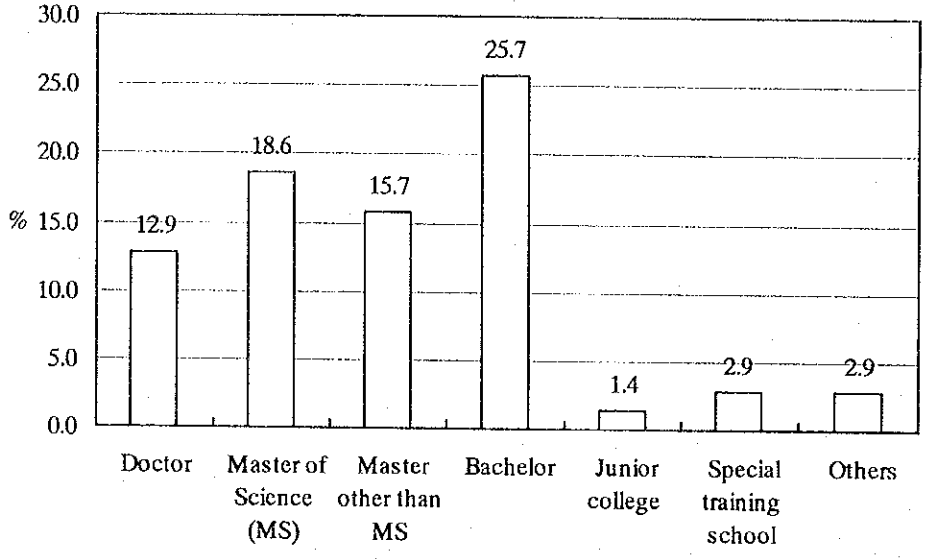
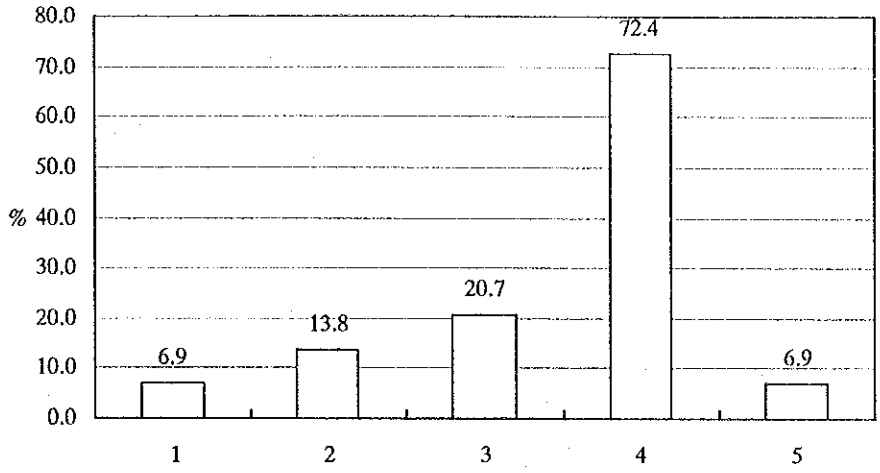


Figure A-4.2.11 Types of Highly Educated Personnel in Shortage (Enterprises)

(5) New Urban Project

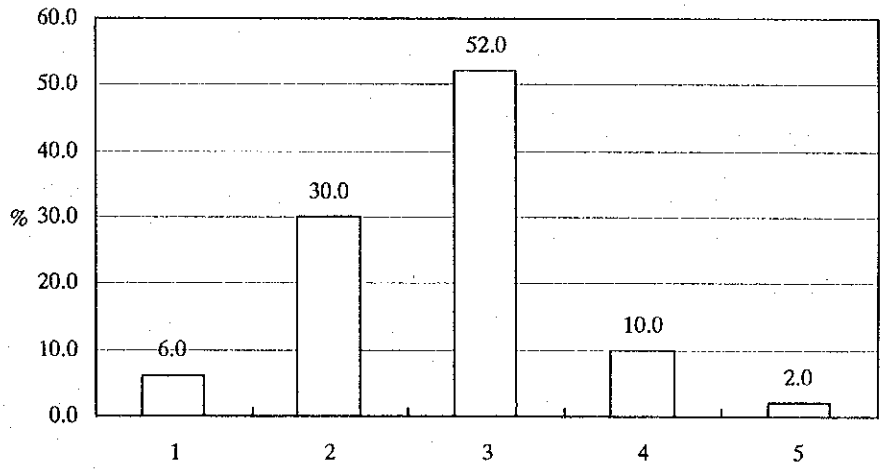
1) Interest in Hoa Lac and Xuan Mai development project

The surveyed universities did not show much interest in the Hoa Lac and Xuan Mai Areas Urban Development Project. Despite that, 30% of the surveyed institutes answered that they might move to the new urban area. Some enterprises showed their interest in the project.



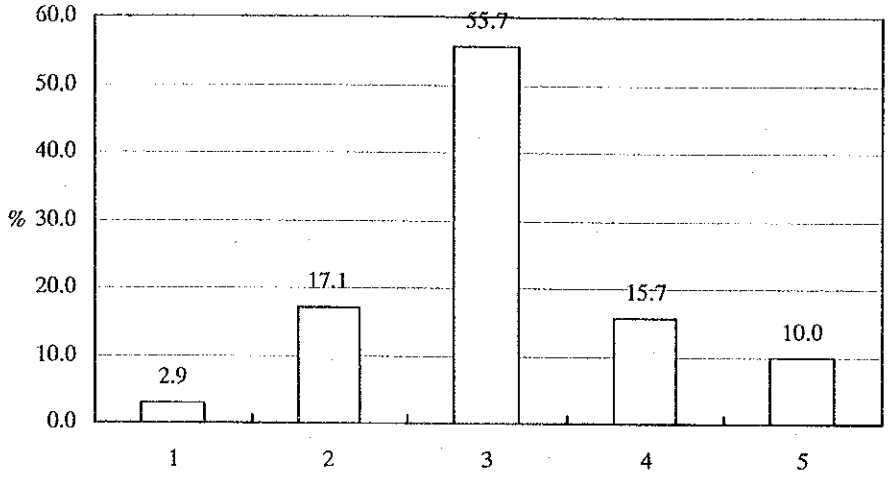
1. Good chance to relocate the entire university to Hoa Lac and Xuan Mai Area
2. Good chance to relocate some appropriate faculties to Hoa Lac and Xuan Mai Area
3. Good chance to establish new faculties of the university in Hoa Lac and Xuan Mai Area
4. No Impact of Hoa Lac and Xuan Mai Area on Our University
5. Others

Figure A-4.2.12 Interest in Hoa Lac and Xuan Mai University Development



1. We will move to Hoa Lac and Xuan Mai Area to take advantage of liking our institution with high-tech areas.
2. We may move part of our institution to Hoa Lac and Xuan Mai Area.
3. We have not decided yet, but we will pay special attention to its development.
4. We are not concerned much about Hoa Lac and Xuan Mai Area.
5. Others

Figure A-4.2.13 Interest in Hoa Lac and Xuan Mai Development Project (Institutes)

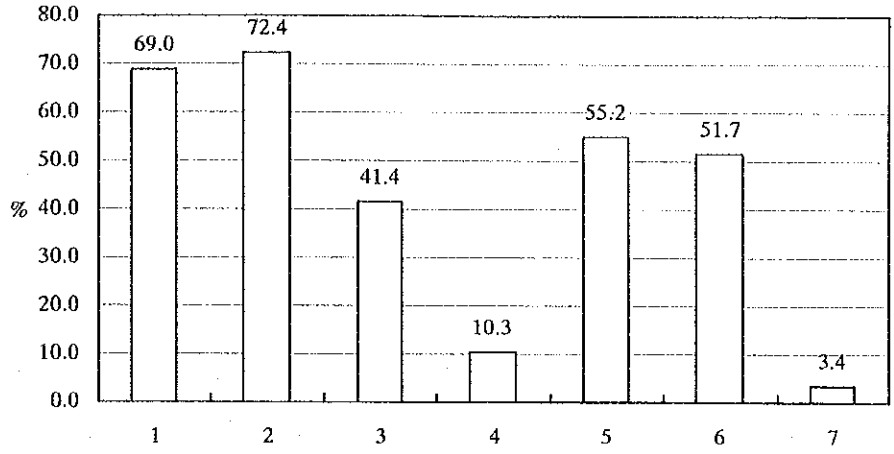


1. We will explore the advantage of Hoa Lac and Xuan Mai Area by relocating our business.
2. In the first step, we try to relocate part of our business.
3. We are interested in Hoa Lac and Xuan Mai Area.
4. We are not interested in the establishment of Hoa Lac and Xuan Mai Area.
5. Others.

Figure A-4.2.14 Interest in Hoa Lac and Xuan Mai Development Project (Enterprises)

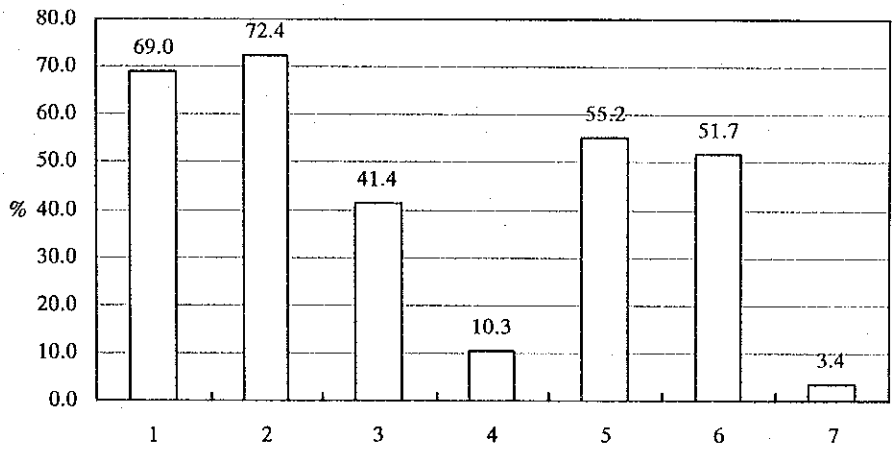
2) Difficulty in Moving to Hoa Lac and Xuan Mai

The surveyed universities consider the accommodation for teachers and students in the new urban area as a problem. Institutes also answered that the new living condition of researchers is a problem. Moreover, they are worried about 'the high cost of new construction and moving,' which accounts for 96%. Another problem raised by the surveyed institutes is difficulty in recruiting researchers in Hoa Lac and Xuan Mai Area. Enterprises are worried about 'additional expenditure on new facilities and moving fees,' which accounts for 82.9%. The figure for 'difficulty about transport to Hanoi' was smaller than what had been expected before the survey for any organizations.



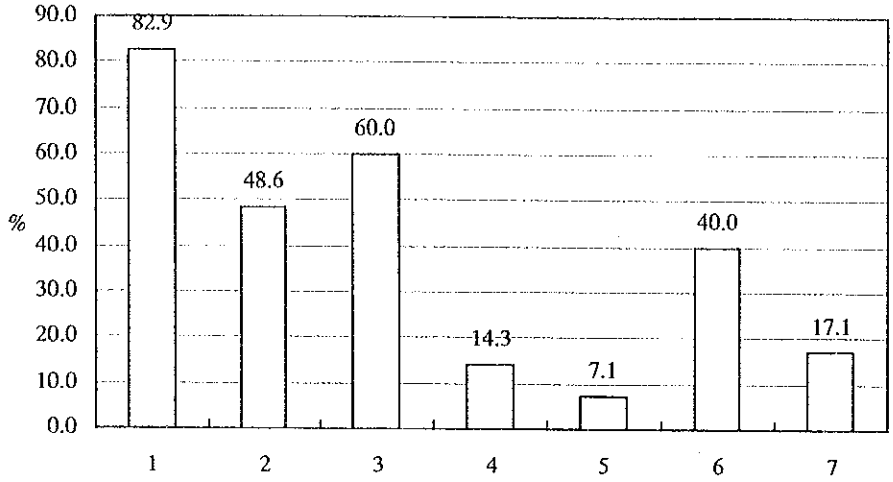
1. Difficulty in student accommodation upon enrolling.
2. Difficulty in housing for professors, staff, and their family.
3. Difficulty in transportation system to Hanoi.
4. Difficulty in relations between newcomers and local residents.
5. Difficulty to access to urban amenity in Hanoi (cultural centers, libraries, museum, etc.)
6. Difficulty in managing universities that partly moved to Hoa Lac and Xuan Mai Area.
7. Others.

Figure A-4.2.15 Difficulty in Moving to Hoa Lac and Xuan Mai (University)



1. Difficulty in student accommodation upon enrolling.
2. Difficulty in housing for professors, staff, and their families.
3. Difficulty in transportation system to Hanoi.
4. Difficulty in relations between newcomers and local residents.
5. Difficult to access to urban amenity in Hanoi (Cultural centers, libraries, museum, etc.)
6. Difficulty in managing universities that partly moved to Hoa Lac and Xuan Mai Area.
7. Others.

Figure A-4.2.16 Difficulty in Moving to Hoa Lac and Xuan Mai (Institute)

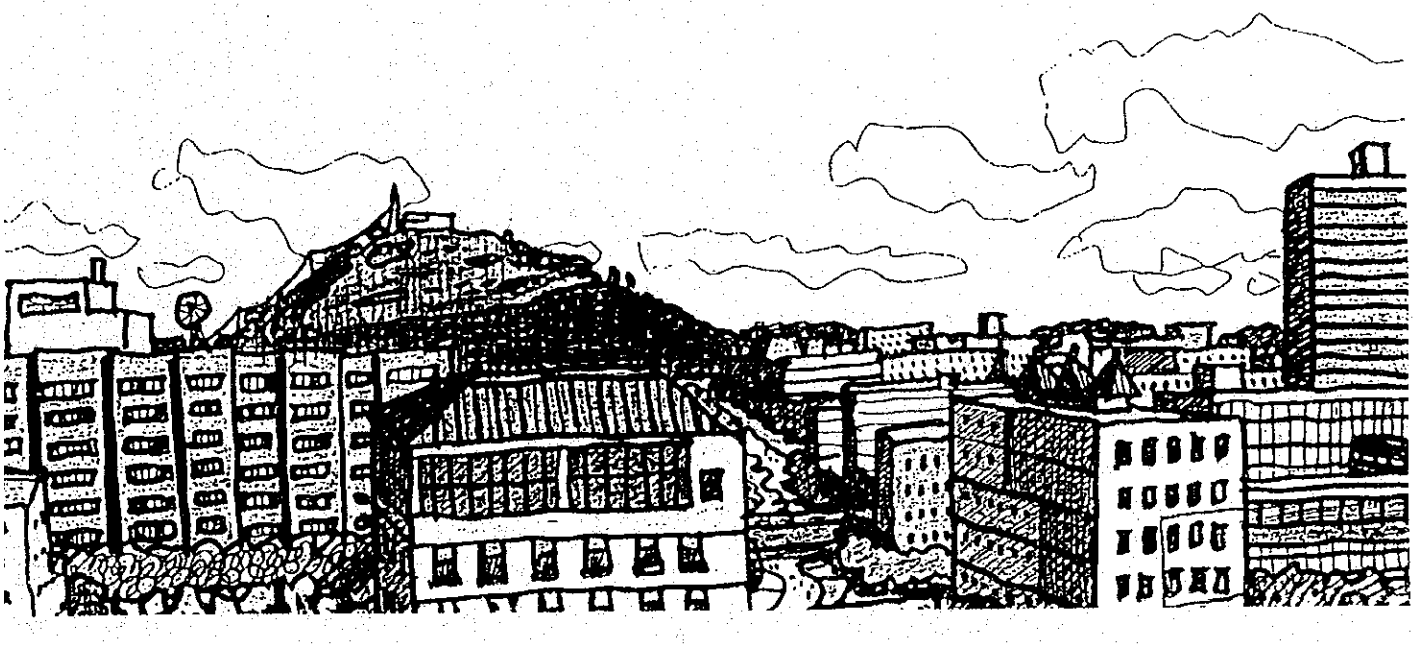


1. Additional expenditure or new facilities and moving fees.
2. Difficulty in recruiting new workers because some traditional workers may not follow.
3. Difficulty in accommodation for officers and workers.
4. Difficulty in transport to Hanoi.
5. Difficulty in relationship between newcomers and local people.
6. Risks of new market.
7. Others.

Figure A-4.2.17 Difficulty in Moving to Hoa Lac and Xuan Mai (Enterprises)

APPENDIX 5

Major Findings of The Sub-Contracted Survey (Environmental Survey)



Appendix 5 Major Findings of the Sub-Contracted Survey (Environmental Survey)

5.1 Location and General Issues

In general, Vietnam is zoned into eight agro-ecological regions, according to the natural environmental characteristics. Among these eight regions, the Red River Delta is located in the coastal region of northern Vietnam and covers the area enclosed with the northernmost and southernmost tributaries of the Red River and all the intermediate complex river system. This region embraces seven provinces and cities in their entirety such as Hanoi, Hai Phong, Hai Hung, Thai Binh, Nam Ha, Ninh Binh and Ha Tay, and 21 districts of three other provinces, namely, Ha Bac, Quang Ninh, and Vinh Phu, having total area of about 16,600 km^2. It has the highest population density in Vietnam, and in some rural districts, the population density is over 1,500 persons/km^2. Also, the educational and cultural development of the region is the highest in Vietnam.

The planned area of Hoa Lac and Xuan Mai Urban Development Project mainly covers the half-mountainous areas of Ha Tay Province. Ha Tay Province lies between Vinh Phu, Hanoi, and Hai Hung to the east and Hoa Binh to the west. It falls under two district units as defined by their topography: the low lying plains (0.08 m to 10 m above sea level) which occupy the eastern and central areas, and a small band of hills lying along its western boundary adjacent to Hoa Binh Province. The western areas are partly forested and, being at a higher elevation, such as Ba Vi district, which is visited by tourists, its importance will be enhanced as the project develops in the future.

More than 80 % of the people in the area are engaged in agricultural activities (including fishery and forestry), and rice is the domestic crop. The limestone hills provide a useful source of construction materials as well as raw materials for a cement factory. However, at present, there is little industry in the area apart from small agro-processing plant, textile-processing factories, small-sized handicraft industry, and so on. Therefore, no serious environmental pollution and/or environmental deterioration are currently reported in the area. However, some environmental resources, particularly water, are being threatened or under increasing risks of degradation because environmental infrastructures, such as water supply, solid waste disposal, and sewage treatment, are insufficient to meet the needs of the current population.

The proposed project area is situated at approximate coordinates of north latitude 20°40' to 21°20' and east longitude 105°30' to 106°.

The Corridor 21 Development

The project covers urban areas that include four towns linked by National Road 21A running about 40 km from Mieu Mon through Xuan Mai, Hoa Lac to Son Tay and is about 30 to 60 km west from the Capital Hanoi. It embraces a total area of 17,500 ha, consisting of 12,500 ha in Hoa Lac, 2,500ha in Xuan Mai, 900 ha in Son Tay, and 600 ha in Mieu Mon. It borders Tich River to the east, Ba Vi mountainous area to the west.

The borders are:

- to the north : with Hong river,
- to the south : with Tuy Lai lake – My Duc – Ha Tay,
- to the east : with Tich River, and
- to the west : with Ba Vi mountains and Hoa Binh province.

Administrative boundaries and constituents of the study area consist of 5 quarters and 9 communes of Son Tay town, 1 townlet and 31 communes of 5 districts in the provinces of Ha Tay and Hoa Binh, which are shown as follows:

(1) Ha Tay Province

- Son Tay town, including 5 quarters (inner town) and 9 communes (external town).
- Thach That district, including 6 communes: Dong Truc, Binh Yen, Kim Quan, Tan Xa, Ha Bang and Thach Hoa.
- Quoc Oai district, including 4 communes: Phu Cat, Hoa Thach, Dong Yen and Phu Man.
- Chuong My district including Xuan Mai town and 6 communes: Thuy Xuan Tien, Tan Tien, Nam Phuong Tien, Thanh Lap, Tran Phu and Dong Lac.
- My Duc district: 1 commune – Dong Tam.

(2) Hoa Binh Province

Luong Son district, including 5 communes: Nhuan Trach, Hoai Son, Dong Xuan, Tien Son and Truong Son.

5.2 Climate

(1) General

The study area lies in the zone of tropical climate and is under the influence of the northeast monsoon. The climate area is classified into two seasons: hot and humid summer, and cold and dry winter. Characteristics of the climatic conditions in the study area are outlined below.

(2) Radiation and Sunshine

Annual quantity of total radiation is about 122 – 125 kcal/cm^2 a year. In the summer, from May to September, total monthly radiation level, at a maximum, is about 13 – 15 kcal/cm^2 a month. In other months of the year, total radiation is lower than in the summer. Particularly, in the last half of the winter (from January to March) total radiation reaches the smallest level during the year, about 5.2 – 6.2 kcal/cm^2 a month.

Sunshine in the study area is not much, as well as in other northern areas of Vietnam. The annual average number of sunshine-hours is about 1,500 – 1,600hr/year.

(3) Wind Speed and Direction

In the first half of the winter (from September to December), the main wind directions (prevailing wind) are N (NW, NE and N) with total frequency: 35 – 40%, and then SE with frequency about 12 – 15%. In the last half of the winter (from January to March), main wind directions are SE and NE, with frequencies of 22 – 45% and 20 – 25% respectively. In the summer (from April to August), main wind directions are SE and the E, each one with a similar frequency of about 15 – 46%.

Because of the situation of the area, which lies relatively far from the sea, the frequency of clam wind reaches rather large values, about 20 – 50%.

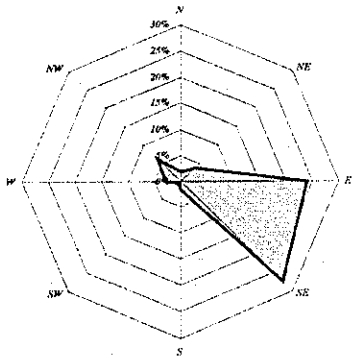
Wind speed in the area is moderate. Annual average wind speed varies between 1.5 and 1.8m/s. The values change in the year, but it is higher in transition period from winter to summer (from February to April). However, the main wind directions usually have higher average speeds of about 2 – 3 m/s. Figure 5.2.1 shows the wind rose in Son Tay and Ha Dong.

(Last half of Winter, Jan. to Mar.)

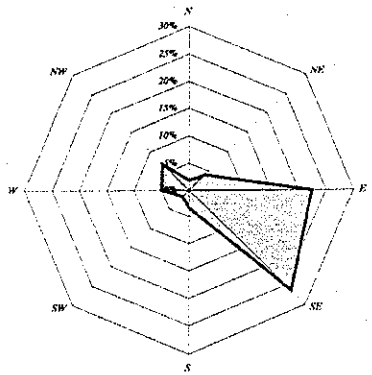
(Summer, Apr. to Aug.)

(First half of Winter, Sept. to Dec.)

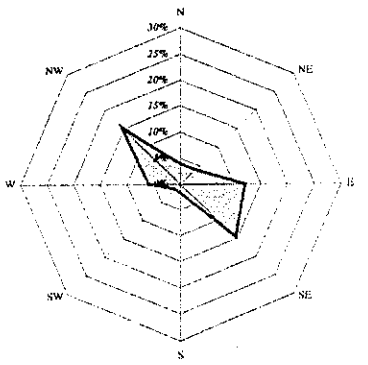
Son Tay



Average wind speed: 1.73 m/s
Calm: 31.3 %



Average wind speed: 1.70 m/s
Calm: 28.3 %



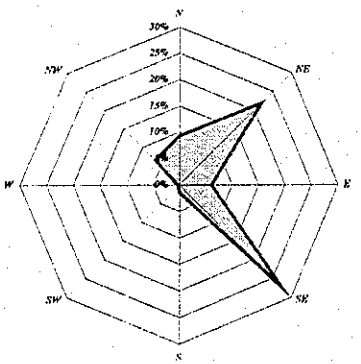
Average wind speed: 1.18 m/s
Calm: 40.8 %

(Last half of Winter, Jan. to Mar.)

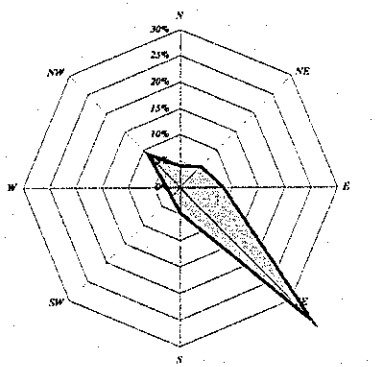
(Summer, Apr. to Aug.)

(First half of Winter, Sept. to Dec.)

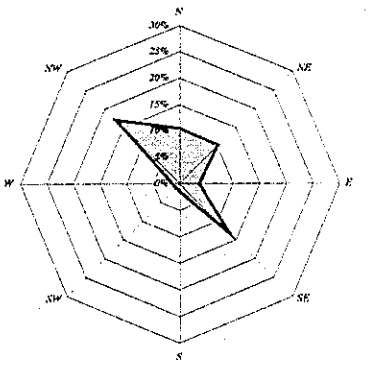
Ha Dong



Average wind speed: 1.93 m/s
Calm: 26.4 %



Average wind speed: 1.90 m/s
Calm: 27.8 %



Average wind speed: 1.28 m/s
Calm: 41.0 %

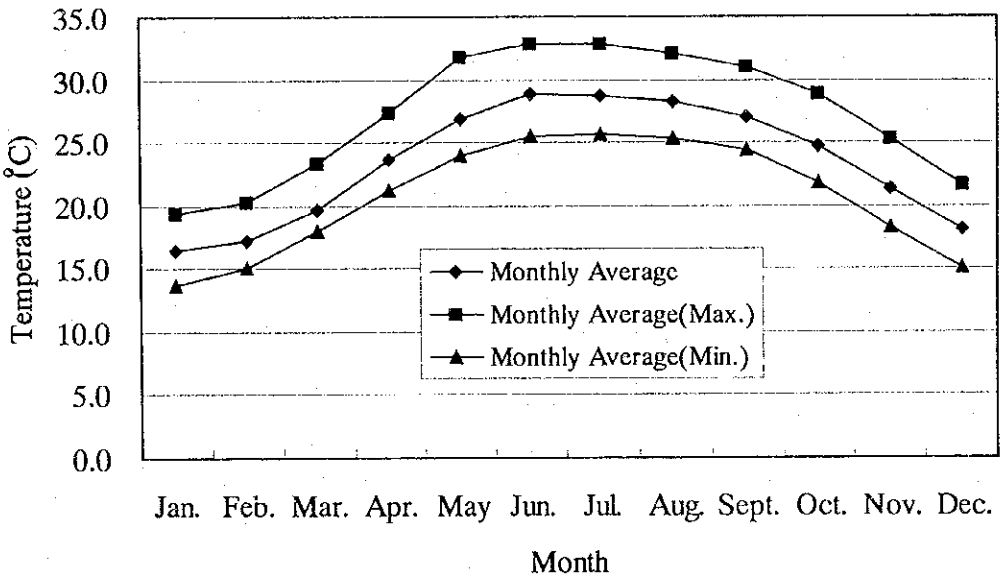
Figure A-5.2.1 Wind Rose in the Study Area

(4) Temperature

Due to low and rather flat relief topography of the study area, it has a rather high temperature. The annual average temperature is about 23°C to 24°C. However, in this area there are two seasons as to temperature: hot and cold. The hot season, which has a monthly average temperature higher than 25°C, lasts for 5 months, from May to September. The period with a monthly average temperature lower than 20°C lasts for four months, from December to March. Between these periods, there are about two to three cold months (January and February or from December to February) with an average temperature lower than 18°C.

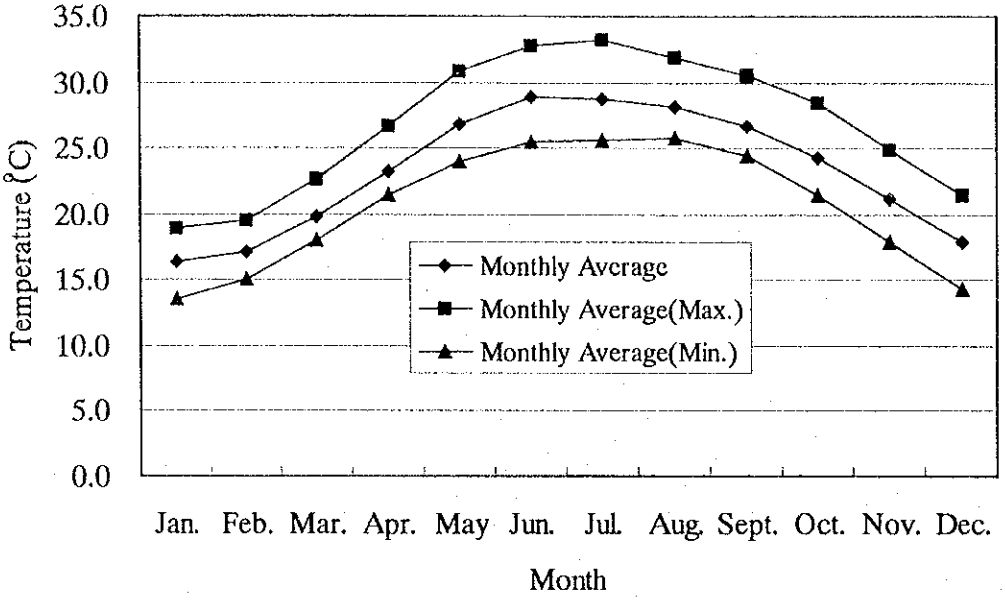
Annual average maximum temperature in the study area varies from 26.5°C to 27.5°C. In the summer (from May to December) this value is usually higher than 30°C, and reaches the maximum of about 33°C in June and July. Annual average minimum temperature is always higher than 20°C, about 20.5° – 20°C.

Following figures (Figures A-5.2.2 and A-5.2.3) show the monthly average temperature in Son Tay and Ha Dong.



Source: NCST.

Figure A-5.2.2 Monthly Average Temperature in Son Tay

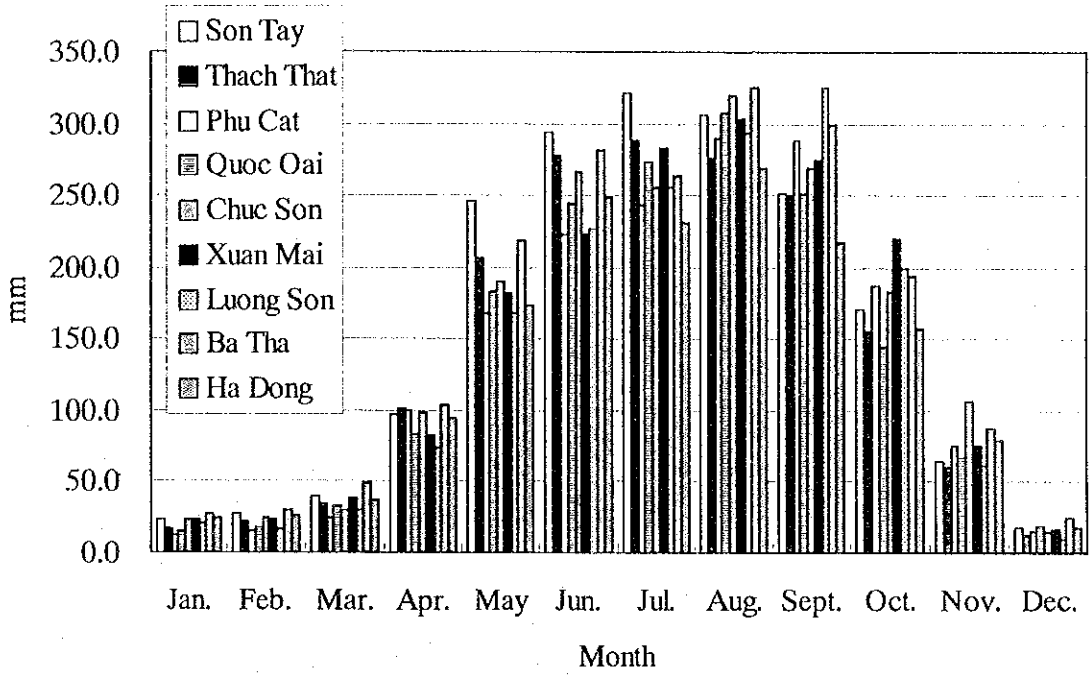


Source: NCST.

Figure A-5.2.3 Monthly Average Temperature in Ha Dong

(5) Rainfall

In the study area, there is moderate rainfall. The annual total rainfall distributes rather evenly on the territory, and varies from 1,600 to 1,950 mm/year. The rainy season usually lasts for six to seven months (from April or May to October). The quantity of rainfall for rainy season takes about 85 – 91 % of annual total rainfall. Annual distribution of rainfall has one maximum and one minimum. The maximum is observed in August or July with rainfall of 270 – 350 mm/month, the minimum, in December or January with rainfall varying from 10 to 25 mm/month. The following figure shows the monthly rainfall recorded in some places in the study area.

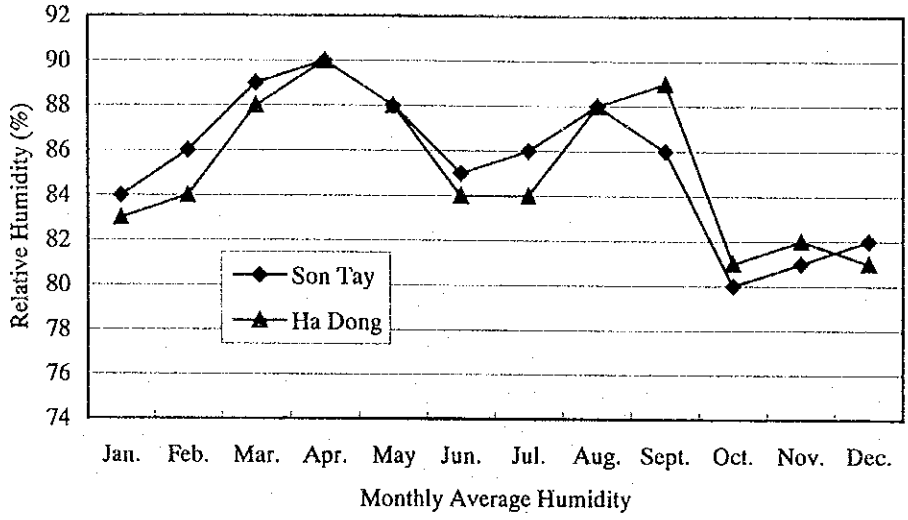


Source: NCST.

Figure A-5.2.4 Monthly Rainfall

(6) Humidity

The study area has high humidity. The annual average relative humidity reaches 84 – 85 %. All through the year, average relative humidity is always higher than 80 %. The annual distribution of humidity has two maximums and two minimums. The maximums have values of about 88 – 90 % and are observed in two periods (March – May and August – September). In the period from October to December, humidity has the smallest value of the year and varies from 80 to 82 %. Figure A-5.2.5 shows the monthly average humidity in Son Tay and Ha Dong.



Source: NCST.

Figure A-5.2.5 Monthly Average Humidity

(7) Others

In the study area, there are some special weather phenomena such as fog, hoarfrost, storm, hail, drizzle, hot and dry wind days and typhoon. However, the frequency of occurrence for most of them is not so high.

Table A-5.2.1 shows the average values of typical climate indicators in the area.

Table A-5.2.1 Typical Climate Indicators in the Study Area

Average Annual Temperature	Average Max. Annual Temp.	Average Min. Annual Temp.	Average Annual Humidity	Average Annual Rainfall
23.4°C	28.7°C	16.6°C	84%	1,839 mm

Source: Report on M/P of Mieu Mon – Xuan Mai – Hoa Lac – Son Tay Urban Areas, MOC

5.3 Geography

(1) Topographical Conditions

Generally speaking, the study area is flat, gradually sloping down from the northwest to the southeast. However, it exhibits great topographic diversity. There are high mountain, sloping hill, paddy field, lake, pond, river, reservoir and so on. The height of the ground varies from 9 to about 1,200 meters, stretching along the north-south axis from Son Tay to

Mieu Mon along NR21A to the southwest of Hoa Binh Province. The area is formed by the last geological movement, which had raised alluvial soil up to the level of 15 – 20 meters. Near Ba Vi Mountain, it is 40 – 50 meter high. The area can be divided into the following three main categories from a topographical viewpoint.

1) Topography of the Tich Riverside:

The Tich River flows through the area from the northwest to the southeast parallel to NR21A. Area of the Tich riverside is mostly flat plain with 5 % slope or less (≤ 5 %). Paddy fields interpose with low hills, streams, swamps, lakes and irrigation channels with elevations ranging from 5 – 12 meters. This area is also dotted with some relatively large lakes such as Suoi Hai Lake and Dong Mo Lake.

2) Topography of Rampant Hills

There are green trees and fruit trees forest alternating with populated areas and some fallow hills, with elevation ranging up to 50 meters. The slope is under 10% (≤ 10 %).

3) Topography of Hilly Area:

This area has elevation ranging from 50 to 100 meters, slope from 10 % to 20 %, including Ba Vi National Park, Vien Nam Mountain, some limestone mountain of Xuan Mai and Mieu Mon.

(2) Hydrological Conditions

There are a number of rivers, lakes, and hydrological facilities, which runs through the area. The following show the major hydrological bodies in the area:

1) River

(a) Da River

Some small rivers flow into and/or out of Da River, which runs from Che to Trung Ha with the length of 42 km.

(b) Red River

Red River flows through Son Tay area with the length of 30 km.

(c) Tich River

Tich River originates in the Tan Vien Mountain range and flows into Bui River at Thuy Xuan Tien commune of Chuong My District. It is 15 to 150 meter wide with a vertical slope of 1 to 8 %. It is the main drainage channel for the entire study area from north to south.

(d) Hang River

Hang River originates from Tan Vien Mountain and runs through Son Tay and Ba Vi Districts with the length of 10 km, and width of 50 m merging into the Tich River.

(e) Bui River

Bui River runs through Xuan Mai area and merges with the Tich River; originated from Bui Mountain in Luong Son District of Hoa Binh Province.

2) Lakes and Other Hydrological Bodies

Apart from the rivers above mentioned, there are relatively some large lakes, water utilization facilities and dykes in the area.

(a) Lake

Major lakes are: Suoi Hai Lake (960 ha), Xuan Khanh Lake (90 ha), Dong Mo Lake (1,250 ha), Tan Xa Lake (167 ha) and the lake of Mieu Mon, Dong Xuong and Van Son. All of them play important roles in the creation of a better climate, landscaped environment as well as the provision of water supply and drainage.

(b) Water Utilization Facility

In relation with the water utilization facilities, there are 62 pumping stations for drainage and/or irrigation in the area. These pumping stations can be also divided into two types by scale: the small scale hydro-agricultural pumping station, which has a drainage and/or irrigation area of less than 200 ha, and the medium scale hydro-agricultural pumping station, which has a capacity of 200 to 10,000 ha. Tables A-5.3.1 and A-5.3.2 show the breakdown of the number of pumping stations in the area.

Table A-5.3.1 Number of Pumping Stations

District	For Drainage	For Irrigation	For Drainage & Irrigation	Total
Son Tay	2	17	0	19
Thach That	2	13	0	15
Quoc Oai	2	7	1	10
Chuong My	4	12	2	18
Total	10	49	3	62

Source: ISI, Report on Hydrological Map, March 1998

Table A-5.3.2 Number of Pumping Stations by Scale

Scale	Son Tay	Thach That	Quoc Oai	Chuong My	Total
Small Scale	18	13	7	12	50
Medium Scale	1	2	3	6	12
Total	19	15	10	18	62

Source: ISI, Report on Hydrological Map, March 1998

(c) Dike

Dike network, which has existed for more than a thousand years, now becomes a relatively integrated hydraulic system for the prevention of flood, for irrigation and drainage together with other hydrological systems in the area such as rivers, lakes and pumping stations. At present, the total length of dike in the area reaches some hundreds of kilometers. However, the present condition of the dikes is poor due to structural damage, lack of adequate management, lack of funds for maintenance, and other reasons. Locations of dikes in the area are shown on the hydrological map.

(d) Soils

The study area consists primarily of alluvial soil, along with smaller amount of red-yellowish soil and degraded soil. According to the Vietnam soil classification, the study area has 12 soil types. Soil types by area are shown in Table A-5.3.3.

Table A-5.3.3 shows that the soil group of hilly sub-zone composed of Fs, Fp and FL, and that of plain, low and valley composed of Pb, P, Pg, Pf, Pj, Py, J, B and Bg occupies an area of 21,480 ha, or 39%, and 25,598 ha, or 46.5%, of total area respectively. The following describe the characteristics of some typical soils: Brown-yellowish soil on old alluvium (Fp), which covers the largest area in the study area and concentrates in Son Tay, Chuong My and Thach That, is cultivated with tea, fruit trees and subsidiary crops, such as cassava, and sweet potato, by the local farmers.

Table A-5.3.3 Types of Soil in the Study Area

No.	Soil Type	Symbol	Son Tay (ha)	Thach That (ha)	Quoc Oai (ha)	Chuong My (ha)	Area (ha)	Rate (%)
1	Deposited alluvium	Pb	93	0	967	671	1,731	3.14
2	Old alluvium	P	588	2,771	1,209	6,198	10,766	19.55
3	Gley alluvium	Pg	598	704	3,618	4,334	9,254	16.80
4	Alluvium spotted with red-yellowish layer	Pf	0	40	0	0	40	0.07
5	Waterlogged alluvium	Pj	374	473	134	298	1,279	2.32
6	Alluvium of streams	Py	0	0	0	177	177	0.32
7	Marshy soil	J	0	0	582	47	629	1.14
8	Degraded soil on old alluvium	B	588	46	90	923	1,647	2.99
9	Gley degraded soil on old alluvium	Bg	0	75	0	0	75	0.14
10	Red-yellowish soil in clay crystal rock	Fs	570	87	1,139	1,100	2,896	5.26
11	Brown-yellowish soil on old alluvium	Fp	6,218	2,582	510	3,635	12,945	23.50
12	Red-yellowish changed by growing rice	FL	1,811	937	1,334	1,557	5,639	10.24
		Sub Total	10,840	7,715	9,583	18,940	47,078	85.47
13	Residential land	RSDT	1,886	1,121	987	732	4,726	8.58
14	Rock mountain	RM	0	0	34	185	219	0.40
15	River and Pond	RP	938	583	208	1,327	3,056	5.55
Total			13,664	9,419	10,814	21,184	55,079	100.00

Source: ISI, Report on Soil Source in Hilly Districts Along 21A Highway of Ha Tay Province, March 1998

Old alluvium soil (P) with an area of 10,766 ha, or 19.6 % of the total area, is distributed in all districts of the area. This soil is suitable for rice and subsidiary crops. At present, most of this soil has been exploited for double rice crops and partly grow one more winter crops. Gley alluvium soil (Pg) covers an area of 9,254 ha, or 16.80 % of the total area, and distributes in all districts. The widest distributed areas are Chuong My and Quoc Oai. At present, double rice crops and one more winter crops are cultivated on this soil. Figures A-5.3.1 and A-5.3.2 show the types of soil by area and the structural composition of soil in the whole study area.

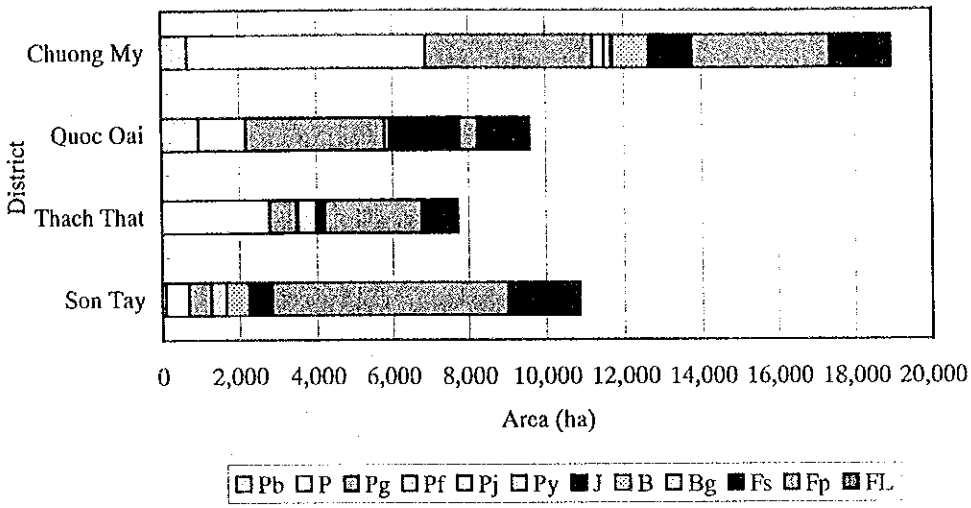


Figure A-5.3.1 Types of Soil in the Study Area

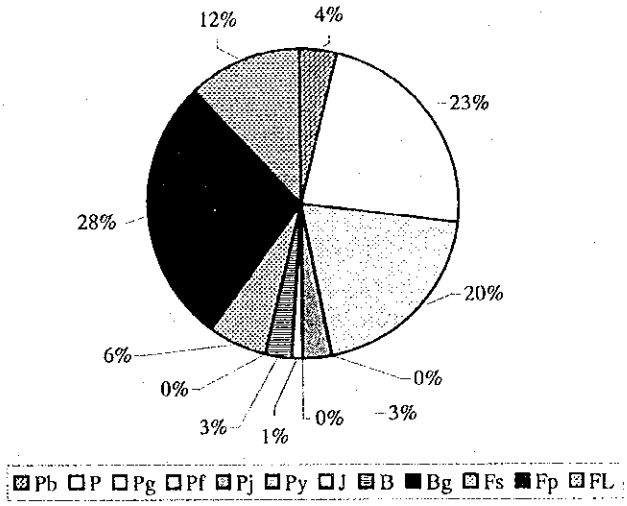


Figure A-5.3.2 Structural Composition of Soil Type

5.4 Biological Resources

(1) Ecological Conditions

The study area has the following five different ecological areas:

1) Ecological Area of Evergreen Tropical and Broad-leaved Forest

The plant community of this ecological area has main characteristics of primary forest. The forest has stratum separation and high canopy. However, this area remains and is distributed only in mountain ranges at elevation above 400 meters at present.

2) Ecological Area of Secondary-scrub Forest

The forest of this area is regenerated scrub forest after cutting the trees for making up the fields. The scrub community is dominant in elevation from 30 to 400 meters. At present, this area is managed by local people for planting trees such as pine, eucalyptus, and so forth.

3) Ecological Area of Hills and Hillocks Fields

The plant community of this ecological area covers regenerated scrub and reestablished plants after making up the fields and/or grass fields.

4) Ecological Area of Settlement

This area includes the part of the settlements of minor people, namely Muong, Kinh, Dao, and Tay people. Crop plants in this area include pineapple, corn, and eucalyptus. Furthermore, fruits and other plants such as Longan, lychee, orange, bamboo, and tea are included.

5) Ecological Area of Rivers, Lakes, Paddy Fields and Gardens

This ecological area includes the region from the east side of NR21A to the Day River area.

(2) Vegetation

Vegetation in the study area can be classified into the following 10 communities.

1) Evergreen Broad-leaved Forest

This type of forest consists of a variety of broad-leaved trees, which form several strata. The highest stratum, which includes Sapindus mukorossi, Pometia pinnate, and Choerospondias axillaris, reaches the height of more than 30 meters. Other major species of this forest are Diospyros dsyphylla.

Formerly, a great part of the study area was covered with this type of forest. However, this forest is limited and distributed only in the area of Ba Vi National Park at present because of the exploitation in the study area. Soil types of this forest are mainly fertile soil which are created from limestone and other stones. The species of this forest also include that of epiphytes such as Asplenium nidus, Pothos repens, Rhapidophora sp, and so forth.

2) Secondary Evergreen Scrub Land

This type of vegetation is distributed on ancient alluvial soils in the western mountainous area of the study area. This land is formed from the primary forest or evergreen broad-leaved forest mentioned above. The most general species in the scrub forest are Rhodomyrtus tomentosa, Melastoma candidum, Psychoria rubra, Maesa acuminata, and Dillenia heterocephala. The height of species is lower than 8 m. In addition, there are other gramineous species such as Gartotia patula, Miscanthus japonicus, Narenga fallax, and so on.

3) Secondary Grass Land

All grasslands in the study area are the secondary growth. The conditions of bio-climate and soil in the area do not agree with the existence of the primary grasslands. The grasslands are now utilized for agricultural cultivation and permanent grazing area. Common species, which have the height from 0.5 to 1.5 meter, are Imperata cylindrica, Miscanthus japonicus, Panicum montanum, Panicum paludosum, and Cynodon dactylon.

4) Communities of Annual Food and Industrial Crops

The types of annual crops observed in the area are Manihot esculenta, Zea mays, and Ipomoea batatas. Manihot esculenta is planted on the hilly area as well as Zea mays and Ipomoea batatas on the river alluvial plains. However, the farmers have a tendency to change the cultivation of Manihot esculenta because of the economical value reduction of that species. In recent years, they have given priority to planting the fruit trees on the hilly area.

5) Cultivated Forest of Eucalyptus species, Accasia species

There are many plantations of Eucalyptus that are 5 – 7 year old or older in the hilly area. The majority of hilly areas are ancient alluvial areas with poor soil, thin humus story. In recent years, in order to improve the fertile degree of soils, local people have a tendency to

plant Accasia species., which grows well in the ancient alluvial areas, instead of Eucalyptus species.

6) Communities of Cultivated Tree near Village

There are many kinds of cultivated trees, which are utilized for various ways such as fruit-tree, ornamental plants, plants for shade, and logs for construction. The kinds of trees for each use are as follows:

(a) Fruit-tree: Citrus nobilis, Citrus sinensis, Citrusgrandis, Citrus limonia, Dimocarpus longan, Litchi chinensis, etc.

(b) Plants for shade: Terminalia catappa, Ficus elastica, etc.

(c) Logs for construction: Melia azedarach, Bambusa species.

(d) Ornamental plants: Ficus benjamica, Cycas species.

7) Bamboo Plantation

Bambusa species. and Dendrocalamus species. are planted near villages and on riverbanks. Bamboo plantation is useful not only to provide materials for construction but also protect soils from erosion, especially in the places near dikes.

8) Tea Estates

Formerly, a tea garden covers a relatively wide portion in the study area, however, the areas for a tea garden have been reduced in recent years. Tea plants are mainly planted in the ancient alluvial hills and supply materials for the local tea factory in the way line from Xuan Mai to Mieu Mon.

9) Paddy Fields

Rice is a staple food in the study area. Species of paddy fields include fifth-month crop and tenth-month crop. The soils are alluvial plains outside dikes and alluvial deltas inside dikes.

10) Communities of Hydrophytic Herbaceous Species

These communities include the species growing in the waterside or underwater, such as Sagetta sagittaefolia, Cyperus species., Eleocharis species., Nymphoides hydrophyllacea, Ceratophyllum demersum, and Vallisneria spiralis.

(3) Fauna

A large number of animal species, such as mammilla and aves are observed in the above mentioned area. The fauna in the area is as follows.

1) Mammalia

The species composition in the study area is shown in Table A-5.4.1.

Most of the 51 species distribute not only in one ecological area; in fact, they may be found in two, three or four ecological areas. The table shows that the dominant mammal species in the area are that of small species such as Rodentia, Carnivora, Chiroptera, and the number of species of Peimates, Artiodactyla is rather small.

Table A-5.4.1 Composition of Species: Mammilla

No. of Species	Order
2	Insectivora
1	Scandenta
7	Chiroptera
3	Primates
17	Carnivora
3	Artiodactyla
1	Rholidona
17	Rodentia
51	Total

Source: Report on Ecological-Animal Map of New Xuan Mai- Hoa Lac Area, ISI, 1998

2) Aves

At present 105 bird species that belong to 41 families and 15 orders are confirmed in the study area. Table A-5.4.2 shows the species composition.

Table A-5.4.2 Composition of Species: Aves

Order	No. of families	No. of species
Podicipediformes	1	1
Pelecaniformes	1	1
Ciconiiformes	1	11
Anseriformes	1	3
Falconiformes	2	5
Gruiformes	2	4
Charadriformes	3	6
Columbiformes	1	3
Psittaciformes	1	1
Cuculiformes	1	4
Strigiformes	1	1
Caprimulgiformes	1	2
Apodiformes	1	1
Coraciiformes	2	6
Passeriformes	22	56
Total	41	105

Source: Report on Ecological-Animal Map of New Xuan Mai- Hoa Lac Area, ISI 1998

The above 105 species can be classified into four-type accordance to their habitat as shown in the table below.

Table A-5.4.3 Habitat

Habitat	A[1)]	B[2)]	C[3)]	D[4)]
No. of species	44	82	52	33
(%)	42	78	49.5	31

[1)] Habitat of lakes, rice paddy fields, wetland
[2)] Habitat of hills, hillocks, man-made forests
[3)] Habitat of secondary scrub forest
[4)] Habitat of settlement, gardens

3) Reptilia-Amphibia

With regard to reptile and amphibian, there are 55 species belonging to 14 families and 4 orders in the study area, namely: 44 species of reptile which belong to 10 families and 3 orders, and 11 species of amphibian which belong to 4 families and 1 order. A number of species of reptile and amphibian in the area are relatively small, and they are about 17 % and 13 % of total species of the country respectively. Ba Vi mountain range has the highest species population with about 36 out of the 44 species. Representative species for each ecological area include the following.

(a) Gecko gecko, Drako maculatus, Rhynchohis bonlengeri, Trimeresurus alblabri, Trimeresurus monticola, etc. (evergreen broad-leaved forest)

(b) Calotes fruhstorferi, Mabyua longicaudata, Mabuya multifasciata, Elaphe radiata, Ptyas korros, etc. (secondary scrub forest)

(c) Mabuya multifasciata, Rana limnocharis, etc. (hills and hillocks)

(d) Hemidactylus frevatus, Mabuya longgicaudata, Mabuya multifasciata, Elaphe radiata, Amphiesma stolata, etc. (settlement)

(e) Bufo mellanostitus, Xenochrophis piscator, Euhydris phumbea, Oeidozyga uma, Rana guentheri, Rana limnocharis, etc. (lakes, ponds, paddy fields)

Aside from the above species, some rare, valuable species are distributed in the study area, for example, Gecko gecko, Acanthosaura lepidogaster, Pytias koros, and Pytas mucosus.

4) Hydro-biological Fauna

(a) Phytoplankton

According to the survey conducted by ISI in February, 1998, 62 species of Phytoplankton belonging to 6 phylum were confirmed. Among these species, Bacillariophyte is dominant in rivers, and Chlorophyte is dominant in stagnant waters such as lake and pond.

(b) Zooplanktons

The ISI's survey conducted in March confirmed 37 species of zooplankton. Tropical species is dominant over the study area. However, the composition structure and concentration of zooplankton are quite different by type of water body. The concentrations in rivers are low, while those in ponds for aquaculture are high in general.

(c) Zoobenthos

As for zoobenthos, 19 species including shrimp, crab, oyster, shellfish were confirmed by the survey of ISI. Dominant species are Oligochaete and Chironomid, but mollusk and crustacean were not confirmed in Suoi Hai reservoir.

(d) Fish fauna

Analysis of samples, interviews with fishermen and local people, and publications ascertain that there exist 37 species of fish in the study area. Among these, four main

species are cultivated in reservoirs and ponds. Some natural fish such as bagarius catfish, drawt catfish, which are caught in Da River, are restricted as commercial species.

5.5 Environmental Quality

(1) Water quality

There are no readily available regular monitoring data on surface water quality to be used as reference in the Red River Delta including the study area. However, some governmental agencies or institutions have conducted specific water surveys targeting particular issues, such as pesticides, in cities or specific projects. Tables A-5.5.1 and A-5.5.2 show the water quality of typical water bodies in the study area.

Table A-5.5.1 Water Quality of Suoi Hai and Dong Mo Reservoirs

Parameter	Suoi Hai Reservoir	Dong Mo Reservoir
Temperature (°C)	16 –31	19 – 31
Transparency [1] (cm)	80 – 150	70 – 155
pH	6.9 – 7.3	6.9 – 8.0
Dissolved oxygen (mg/l)	5.01 – 8.92	5.2 – 8.9
Dissolved CO_2 (mg/l)	0.88 – 21.12	0.88 – 7.92
COD_{Mn} (mg/l)	7.0 – 18.7	5.04 – 11.2
NH_4^+ (mg/l)	0.1 – 0.25	0.05 – 0.15
PO_4^{3-} (mg/l)	0.03 – 0.26	0.03 – 0.17
SiO_2 (mg/l)	1.2 – 3.8	8.0
Ca^{2+} (mg/l)	3.0 – 3.5	5.2
Mg^{2+} (mg/l)	1.4	2.6
Hardness (Germany level)	0.86 – 0.98	0.9 – 1.9
HCO_3^- (mg/l)	28 – 35.6	42.7
Total Iron (mg/l)	0.1 – 1.48	0.17
Cl^- (mg/l)	10.0	10.65

Source: Dang Ngoc Thanh, 1980; Nguyen Van Hao, 1994

(2) Measured by Secchi disk.

Table A-5.5.2 Water Quality of Some Water Bodies in the Study Area

Location	Temperature (°C)	DO (mg/l)	pH	Conductivity (s/m)	Turbidity (mg/l)
Da river [1]					
Surface (0.2m)	21.4	11.1	7.43	0.02	5
Layer(0.5m)	21.3	10.6	7.39	0.02	7
Ky Son					
Surface(0.2m)	21.4	10.1	7.85	0.02	3
Layer(0.5m)	21.4	9.8	7.52	0.02	4
Reservoir[2]					
Surface(0.2m)	24.8 – 24.9	10.5	7.16 – 7.17	0.01	17 – 18
Layer(0.5m)	24.6	8.2	7.02	0.01	18 –22
Stream[3]	27.8	6.6	7.73	0.02	56 – 58
Tributary of Da river[4]	25.7				
Surface(0.2m)		6.6	7.58	0.01	105 – 110
Layer(0.5m)	26.4 – 26.7	6.2	7.04	0.01	104 – 120
Pond for aquaculture	31.3	12.7	8.5	0.03	101 - 102

Source: Measured by ISI in March 1998
1) Da Chong, 2) Da Chong, 3) Xuan Mai, 4) Near Xuan Mai

Figures in above tables indicate that the water quality of water bodies in the study area is slightly polluted by organic substances, but generally good and in stable condition

1) Air quality

There are no regular monitoring data on air quality in the study area. There exist only short-term air quality survey data on particular urban areas. However, some monitoring data indicate that the air quality in the area is relatively good, and most of air quality parameters are below the permissible levels. Table A-5.5.3 shows the air quality in some places of northern Vietnam.

Table A-5.5.3 Air Quality in Northern Part of Vietnam

Location	SPM[1]		SO_2		NH_3	
	Max	Min	Max	Min	Max	Min
Hanoi	45.8	2.1	0.098	0.001	0.005	0.002
Viet Tri	1.9	0.4	0.100	0.003	0.034	0.001
Bac Giang	19.0	1.0	0.0001	-	0.0017	-
Permissible value	0.3 (1-Hr average value)		0.5 (1-Hr average value)		0.2 (24-Hr average value)	

Source: Proceeding of the National Seminar on Environmental Protection and Sustainable Development Research, Hanoi, 1993, p65 – 66
Note: 1) suspended particulate matter