Hoa Lac Hi-Tech Park Management Board,
Ministry of Science and Technology

Japan International Cooperation Agency (JICA)

THE STUDY FOR HOA LAC HIGH -TECH PARK FEASIBILITY STUDY IN THE SOCIALIST REPUBLIC OF VIETNAM

FINAL REPORT

APPENDIX: PROPOSED EIA REPORT

MARCH 2009

NIPPON KOEI CO., LTD.

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INTRODUCTION

1. ORIGIN OF THE PROJECT

Vietnam has been moving in developing orientation and toward an industrial nation by 2020. In industrialization and moderation term, development of science and technology has been a major policy to promote high – tech innovations in manufacturing technologies, business, and others. In Vietnam, the aim of policy is to establish a national high-tech park in order to make a attractive environment for foreign investment in high-tech industries, to build up a national high-tech core for key economic area's promotion, to make a open room for linking scientific and technological activities, to train high tech qualified human resources appropriate for the national eco-social, scientific and technological context.

The Prime Minister of Vietnam approved Decision No 198/QD-TTg dated 12th October 1998 to establish a Hoa Lac High-Tech Park (HHTP) with total areas of 1,650 ha. This was considered as a crucial factor for speeding up the industrialization and modernization process in the region and the entire country. It will also play a cross-section's link for receiving exchanges and approaching the advanced technologies and will be the major pilot for drawing practical lessons.

As a result, a national large-scale project for establishment of high-tech industry, and Research & Development, education and training zone is defined in Hoa Lac. The location is evaluated and was found to have many advantages in term of construction land fund, natural landscape with half-mountain half-plain geography, and forest and large lakes, where many cultural and tourist projects at national and international scale are implemented. The location is 30 km far away from Hanoi to the direction of Lang-Hoa Lac highway. The company to implement the construction of Hoa Lac High-tech Park (HHTP) is the Management Board (HHTP-MB).

The HHTP acts as the centre of national high-tech development network, focusing on high-tech research and development; production and trading of high-tech products, and nursery garden for high-tech enterprises. This all will lead towards a development of National Scientific and Technological City. Emphasis is to provide a technology-intensive environment with full equipment and infrastructure that can facilitate education- research- and application activities. In addition, to promote investment with a wide range of partners, emphasis will also be on to provide a well legal status with the intensified management in high-tech industry.

Together with the fast development of science and technology regionally and worldwide, HHTP plays an essential role in nation's development. It has potential to be a typical model of high-tech zone in Vietnam. In order to strengthen the development of HHTP, the following missions need to be fulfilled:

- Timely development of high-tech industry to enable Vietnam to keep up with other countries in region or all over the world
- Direct high-tech and financial resources to the key areas. This will promote development and create attractive environment for other industries that are concentrating on research and technology development..
- Keep the balance and establish the link between high-tech industries, research institutes, universities, and manufacturers. This will facilitate the speedy growth rate among competitive high-tech industries.

The shorter distance between the first high-tech zone in Vietnam and Hanoi can be considered as an advantage for this area. The capital, Hanoi is a political, administrative, cultural and technological centre of the country, where three quarters of national research institutes are located. In addition it is also a favorable place from regional and international connectivity in terms of existence of good road, railway, airline, and waterway system.

The Prime Minister had approved the mission of general planning on the construction of HHTP in Decision No. 274/QD-TTg on 31st October 2005. In addition, another joint statement between Vietnam and Japan government signed on October 2006 that declares that JICA (Japan International Cooperation agency) shall support the study to justify general planning of HHTP in Vietnam. As a result, since April 2007, the specialist team as selected by JICA conducted the study to update master plan of HHTP. In order to carry out the project of updated master plan of HHTP smoothly in line with Vietnamese legal procedures, Prime Minister's office recommended a Vietnamese consultancy unit to cooperate with JICA study team through official letter No. 4430/VPCP dated 09 August 2007. Management board of HHTP chose Urban-Rural Planning Institute to participate in Decision No.129/QD- CNCHL dated 17 August 2007.

2. LEGAL BASIS TO IMPLEMENT ENVIRONMENTAL IMPACT ASSESSMENT

The legal documents to assess environmental quality that has been issued by Government, Ministry of Science, Technology and Environment (Ministry of Natural Resources and Environment at present) and other functional organizations are as follows:

Law on Environmental Protection of The Socialist Republic of Viet Nam, No 52/2005/QH11, dated November, 29, 2005, revised and dated on December 12, 2005.

Decree No 80/2006/NĐ-CP dated August, 9, 2006 of the Government on detailed regulation and instruction in implementation of environmental protection law.

Regulation on hazardous waste management for business enterprises to minimize and reuse solid waste issued on July, 1999 by the Prime Minister .

National Environmental Protection 2001-2010 and National Environmental Action 2001 – 2005, enhance the environmental protection, living standard, public health and sustainable development.

National Cleaner production Program issued on May, 06th, 2002, MONRE to encourage the application of cleaner production in industrial enterprises.

Instruction No 23/2005/CT-TTg issued on June 21th, 2005 about the promoting the solid waste management in Urban and Industrial area.

Circular No 08/2006/TT-BTNMT dated 08/09/2006 of the Ministry of Natural Resources and Environment on guiding for evaluation of strategic environment, environmental impact assessment and environmental protection commitment.

National Environment Standards TCVN 1995/ 2005, TCVN 1998/2000/2001 issued by The Minister of Science, Technology and Environment.

Decision 155/QD-TTg issued on 07/16/1999 about the regulation for hazardous waste collection, transportation and treatment.

Decree No 81/2005/NĐ-CP dated 9/8/2006 of the Government on administrative fines and charges on violations of environmental protection.

Legal documents of Government on approving the establishment of the HHTP project.

Decision No 22/2006/QD-BTNMT dated 18/12/2006 of MONRE on the requirement of implementation of Vietnam Standard.

3733/2002/QD-BYT of Ministry of Health issued on 10/10/2002: Detailing and guiding

the implementation of 21 sanitation standards. .

Decree 36/CP dated 24/04/1997 of Government: Promulgating the regulation for industrial zone, high-tech park…

Decree 16/2005/ND-CP dated 07/02/2005 of Government on Project management.

Circular No 05/2008/TT-BTNMT dated 08/12/2008 issued by the Ministry of Natural Resources and Environment provides guidelines for evaluation of strategic environment, environmental impact assessment and environmental protection commitment.

Environmental Vietnamese Standard (TCVN)

TCVN 5937 - 2005: Ambient air quality standard

TCVN 5942 - 2005: Surface water quality standard

TCVN 5944 - 2005: Ground water quality standard

TCVN 5945 - 2005: Wastewater discharge standard

TCVN 5949 - 2005: Noise quality standard

3. APPLIED MEASURES IN EIA REPORT

Statistical method: collecting and analyzing meteorological and social-economic information to estimate possible influences of the project on the environment. In other word, using the high accuracy data, this method was also used to forecast the possible impacts of project activities on the current and proposed components.

On site Sampling and lab analyzing method: used to define the current state of environment in project area. The method of taking air, water and soil samples from the various location of the project area was applied. Thereafter, all the samples were stored and analyzed in lab by the standard methods promulgated by Vietnamese environmental management agency. Finally, all of the analyzed results were used to assess the environmental status at the various location of the project area. Based on this assessment, impact levels to surrounding areas of project activity area were estimated.

The advantage of this method is that all the supplied data can reflect the current and background status of the environmental conditions during construction and operation stage. This will help the managers to evaluate all current impacts of the project to environment in project area and its vicinities.

Environmental matrix method is a comprehensive assessment approach which enumerates progress activities in accordance with the affected resource and environment factors. Matrices are good tools for organizing and presenting the large amount of information that will be processed in EIAs. Matrices also help to represent the interactions between project activities and environmental components.

Comparative method is a reasoning method originated from homogeneous comparison of the project with other activities which had been studied and researched.

4. EIA IMPLEMENTING ORGANIZATION

EIA Report of the “Hoa Lac High Tech Park” was conducted jointly by consultative organization: Institute for Environmental Science and Technology (INEST) and Vietnam Consultant Corporation for Industrial and Urban Construction JSC (VCC)

Consultative Organization Information:

Name: Institute for Environmental Science & Technology (INEST) - Hanoi University of Technology.

Address: 3rd Floor, C10 Building - Hanoi University of Technology, 1 Dai Co Viet Street – Hai Ba Trung District, Ha noi.

Tel: (04).868.1686 Fax: (04).869.3551.

Representative: Prof. Dr.Nguyen Ngoc Lan – Deputy Director of INEST.

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CHAPTER 1 BRIEF DESCRIPTION OF HOA LAC HIGH TECH PARK PROJECT

1.1 NAME OF PROJECT

Name of Project: Hoa Lac High-tech Park

Location: Km 29 – Lang Hoa Lac Highway.

1.2 INVESTOR

Investor: HHTP Management Board

1.3 POSITION AND THE MASTER PLAN OF THE PROJECT

1.3.1 Feature, position and boundary of the project area

HHTP has a total land area of 1,586 ha and is located in the area of 6 communes that includes Tan Xa, Ha Bang, Thach Hoa, Binh Yen, Dong Truc in Thach That district and Phu cat commune in Quoc Oai district, Hanoi City (former Ha Tay Province).

For the first phase of project, the project area (1,036 ha) includes 3 communes: Thach Hoa, Tan Xa and Ha Bang. The Study area is located about 30km west of the center of Hanoi City. The location details are as follows:

- Bordering the current inhabitants of the south of the road 84 (provincial road) in the north.
- Bordering the Agriculture and Forestry area (the resettlement zone of Quoc Oai district) in the south.
- Bordering the belt of the urban center Hoa Lac in the east.
- Bordering the national road No. 21 in the west.

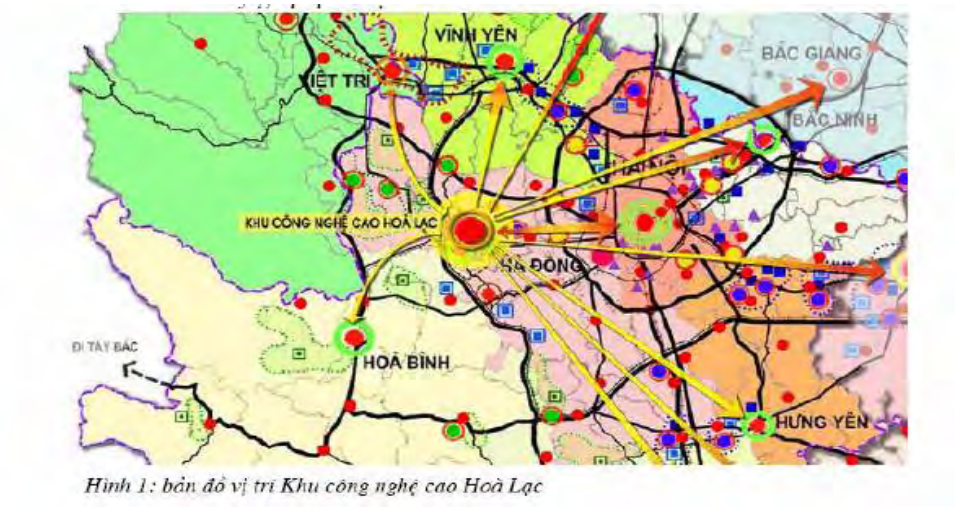


Figure 1-1: Position of Hoa Lac High tech Park

Out of the total 1,586 ha that was decided for urgent improvement by the approved Master Plan (priority area in the north of Lang-Hoa Lac Highway), the current study corresponds to an area of 1,036 ha.

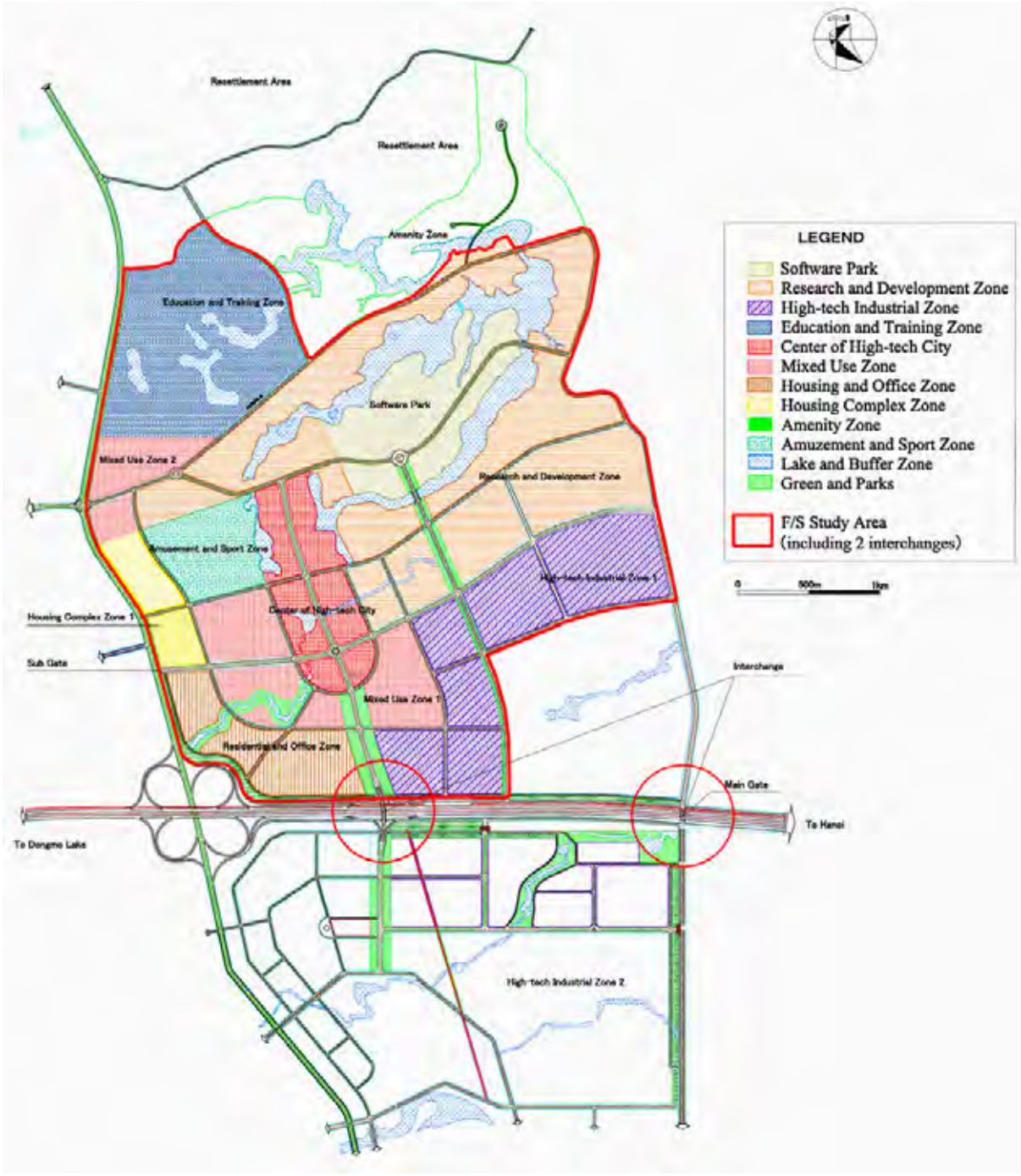


Figure 1-2: Study area for Feasibility Study (1,036 ha)

1.3.2 Master plan for Hoa Lac High Tech Park

(1) Current land usage

The HHTP has a total area of 1,586.51 ha and is divided by the Lang-Hoa Lac Highway (LHLH) into two areas: Hoa Lac Area (north of the LHLH) and the Northern Phu Cat Area (south of the LHLH). The present land use pattern in the HHTP is summarized in Table1-1.

The Hoa Lac Area, with total land area of 1,268.51 ha, is located to the north of LHLH. The present land use pattern in the Hoa Lac Area consists of a waterfront area of 11%, an agricultural of 50%, a developed area of 34% and an undeveloped of 5%. There are 6 relics in the cultural assets area which consists of: (i) Tran communal house, (ii) Vong communal house in the Tan Xa commune; (iii) Van Loi communal house, Van Loi pagoda, Ba Thanh temple, and (vi) Thai Binh church in the Binh Yen commune. However, none of these relics are located within the study area. The total area of the HHTP project in the Hoa Lac Area (north of the LHLH), excluding the cultural assets area, is therefore estimated to about 1,268 ha.

Table 1-1: Current land usage in HHTP

Land use type	Hoa Lac Area		Northern Phu Cat		Total Area of the HHTP	
	Area (ha)	Proportion	Area (ha)	Proportion	Area (ha)	Proportion
I. Developed Area	435.61	34.34	65.81	20.69	501.42	31.61
1. Residential Area	236.22	18.62	44.55	14.01	280.77	17.70
2. New Industrial Area	11.50	0.91	4.15	1.31	15.65	0.99
3. Specialized Use Area	187.89	14.81	9.55	3.00	197.44	12.44
Public Utility	20.68	1.63			20.68	1.3
Transportation	80.73	2.36	9.55	3.00	90.28	5.69
Irrigation	12.15	0.96			12.15	0.77
Cultural Assets	0.28	0.02			0.28	0.02
Security & Defense	68.13	5.37			68.13	4.29
Cemetery	5.92	0.47			5.92	0.37
4. Existing Industrial Area			7.56	2.38	7.56	0.48
II. Agricultural Area	636.0	50.14	200.77	63.14	836.77	52.74
III. Surface Water	139.0	10.96	34.5	10.85	173.5	10.94
IV. Undeveloped Area	57.9	4.56	16.92	5.32	74.82	4.72
1. Forestry Area	51.51	4.06	16.92	5.32	68.43	4.31
2. Open Space	6.39	0.5			6.39	0.4
Total	1268.51	100	318.0	100	1586.51	100

Source: VN Revised M/P

(2) Proposed land usage

Table 1-2: Land usage plan which already approved by Government

No	Type of land	Area (ha)	%
1	Software park	76	4.8
2	Research & Development zone	229	14.4
3	Hi-tech Industrial zone	549.5	34.7
4	Education and Training zone	108	6.8
5	Center of Hi-tech city	50	3.2
6	Service zone	87.5	5.5
7	Residential zone	42	2.6
8	Apartment complex	26	1.6
9	Amenity zone	110	6.9
10	Recreational zone	33.5	2.1
11	Infrastructure and road	115.5	7.3
12	Lake and buffer	117	7.4
13	Tree area	42	2.7
Total		1,586	100

Source: VN Revised M/P

(3) Arrangement of functional zones of HHTP

Table 1-3: Main functional zones in HHTP

Arrangement of functional zones		Planned works
Software park		Software companies
Research & Development zone		State Research Institutes, hi-tech business laboratories and talent incubation.
Hi-tech Industrial zone		Technological product manufactures, factories and plants
Education and Training zone		Universities, Vocational training schools, and academies.
Center of Hi-tech city		Hi-tech transfer and services.
Residential zone	Housing	High-quality living environment and luxurious works.
	Apartment complex	Apartments with necessary living works.
Mixed use zone		Trading facilities and houses.
Amusement zone		Recreational, sport and health facilities.
Amenity zone		Social and recreational works including luxurious housing and golf courses.
Infrastructure		Roads, waste treatment plant and services.
Lakes and Buffer		Eco-friendly area including green trees and water surface

Source: VN Revised M/P

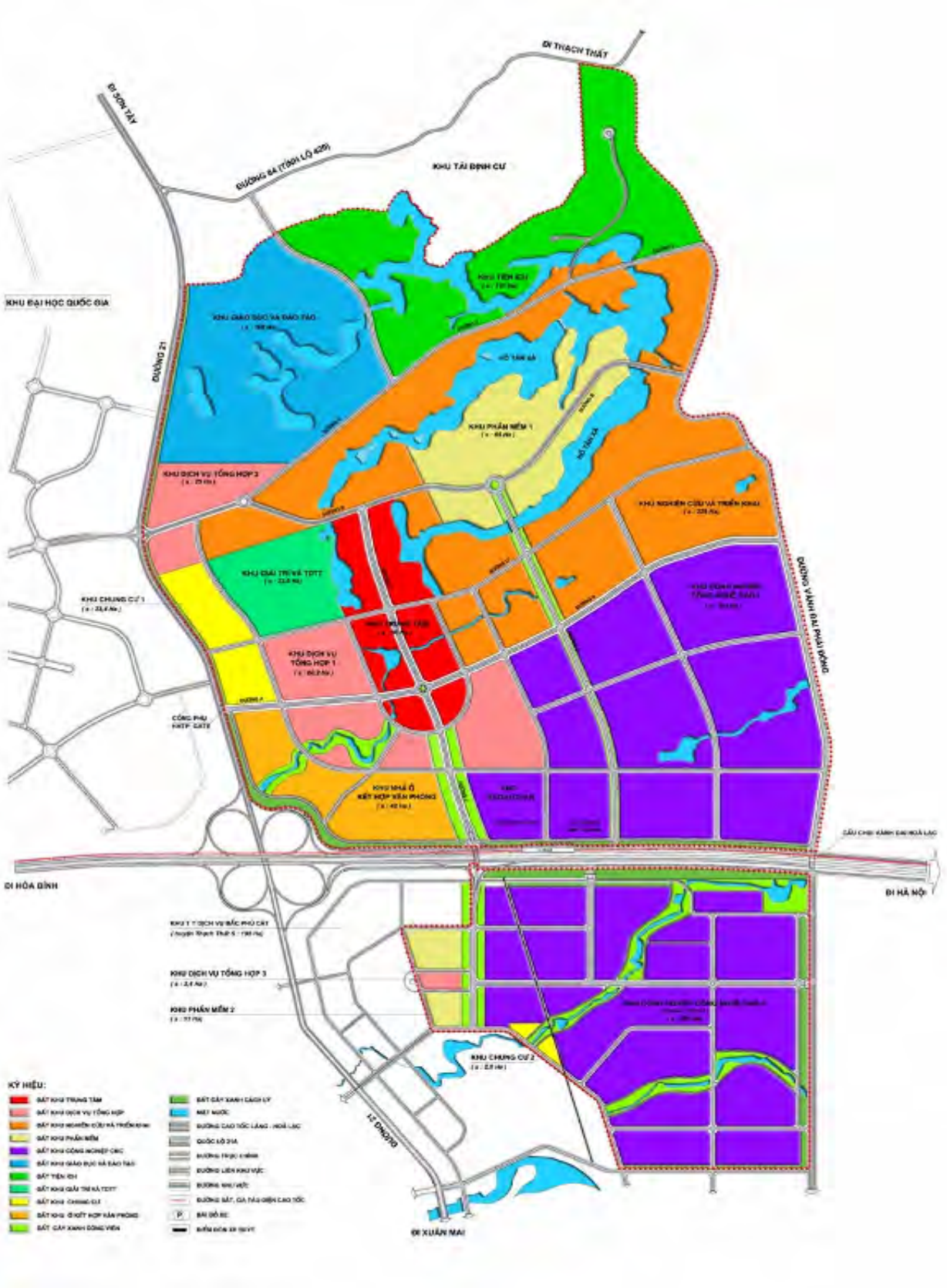


Figure 1-3: Land usage in VN-Revised M/P approved

1) The research and development zone

Research and development are two of the most important functions of HHTP to accomplish the set goals. In principle, national research institutes will be established to attract experts and excellent researchers.

The R&D zone is located in the center of HHTP surrounding the software park. The area faces the Tan Xa lake.

The total area of R&D zone is 229ha, accounting for 14.4% of the HHTP area. Some research institutes located in this zone are planned for development in an average area of 5 ha per institute. The R&D zone, Software Park and the central zone are placed next to each other. This will provide flexibility in use and can also support land in future.

2) Software park

In this research, the Institute of urban and agriculture planning suggests that the area for software zone should be separated from the R&D zone by Tan Xa Lake as these two zones have different functions. In addition, the R&D zone will be implemented by the project management unit and the software zone will be implemented by the company of zone development. The total area for software zone is 76ha, equal to 4.8% of the total area of HHTP.

3) The hi-tech industrial zone

According to the planning, the hi-tech industrial zone is located on the southeast of HHTP, far away from Tan Xa Lake, near the belt Hoa Lac.

The total area for the hi-tech industrial zone is 550 ha, accounting for 34.7% of the area of HHTP. An area of 140 ha for the development of hi-tech industrial zone will be implemented during the stage one.

4) Education and training zone

At first, in the general planning there is no area for education and training zone. However, Hanoi national university has a planned to move to Hoa Lac. With this, HHTP will able to provide education and training in major fields so as to incubate technology talents. In order to meet with the social requirements, FPT University opened in Hanoi has a plan to move to HHTP and start a new academic year in 2008. In additions, training agencies including the centre of technical training and vocational training will be arranged in this zone to educate and train engineers, technicians, and professional workers.

Figure 1-4: Illustration of the education and training zone

The education and training zone is located along the national road No. 21, near the R&D zone. The total area of this zone is 108 ha, accounting for 6.8% of the total area of HHTP.

5) The center of hi-tech city

The center of hi-tech city in this project is located near the R&D zone and the comprehensive service zone. In addition, this zone has a view of trees and water surface. This zone will establish complex services that can facilitate activities of the whole HHTP such as ceremonies, inauguration of plants or research institutes etc. Works recommended for construction in the center of hi-tech city consists of the information center, the center of conferences, the exhibition,

post offices, police stations, laboratories, and science museums.

The total area of this zone is 50ha, accounting for 3.2% of the total area of HHTP.

Figure 1-5: Illustration of the center of hi-tech industrial park

6) The mixed use zone

This zone is located in close connection to Lang Hoa Lac highway and the national road No. 21 and act as a multi-functional zone in terms of commerce, business, and houses. This zone will be divided into two sub-zones. One is located near the gateway to the center of HHTP, and the other is located in the road 21. As this is near to the offices and agencies it makes easy for people to commute for work to R&D zone, the software zone and other zones. This will also be good for the people who are living outside the park. The total area of this zone is 88 ha, accounting for 5.5% of the total area of HHTP.

Figure 1-6: Illustration of the mixed use zone

7) Office zone

This zone is located near to the lakes and it creates a natural landscape. Houses in this zone are very luxurious with many infrastructure and service such as: super markets, hospitals, schools etc. which are also comfortable for foreigners. Moreover, this zone has house complex for workers and officers with satisfactory price and other essential facilities.

This zone is located on the northwest of HHTP with the total area of 42ha, accounting for 2.7% of the total area of HHTP.

Figure 7: Illustration of the office zone

8) The amusement and sport zone

This zone is located near to the center hi-tech city, the R&D zone and the education and training zone. This zone's area is 34 ha accounting for 2.1% of the total area of HHTP. This zone closely connects to the other functional zones of HHTP.

9) The amenity zone

This zone consists of facilities for entertainment and social works as well as living houses for manager. It is located on the northeast of the end of HHTP with the total area of 110ha which accounts for 6.9% of the total area of HHTP. As suggested, this zone will build a golf field and luxurious villas to serve businessmen and high income people.

Figure 1-8: Illustration of the amenity zone

10) Technical infrastructure

In the initial project, the total area of this was 116 ha accounting for 7.3% of the total area of HHTP. However, now this area has been decreased as this project now does not account for the detail planning of areas for walking, cycling and the traffic area in Phu Cat hi-tech industrial park as required by Ministry of Science and Technology.

11) Lake and buffer zone

Some small lakes and a small hill are located in the functional zones. This creates an open space, the most favorable condition for the landscape. One part of Tan Xa lake touches the golf field, the R&D zone, and the software zone. The total area of this zone is 117 ha accounting for 7.4% of the total area of HHTP.

12) Tenement houses and villa

The hi-tech industrial park will be able to produce goods with intelligent brain and quality man power. In other words, requirements or demand for intelligent and talented workforce will be very high. With the area of 26 ha for tenement house and villa and 42 ha for apartments and offices, the workforce and researchers will have a comfortable living environment. The stay model for workers in hi-tech industrial parks will provide them safe and civilized living environment and assist them in working effectively. It has been calculated that the permanent population living in this zone will be about 75,000 with an average requirement of 150m2/flat.

Figure 1-9: Houses and villas

The zone then will be subdivided into different zones such as: the multistoried tenements with an area of 2000m2 per tenement block and about 60 tenement blocks wil be used for teachers, students, engineers, service officers. The luxurious villas will have an area if 300m2/lot and about 120 villas will be used for experts and senior professors. Especially, the numbers of luxurious villas in the golf field for experts, professionals will be about 40 with the area of 250 m^2 per villa.

By 2020, the HHTP will operate with highest capacity attracting about 30 investors with the total hi-tech work force of more than 32 millions. It is estimated that the immigrants will account for 80%. The hi-tech industrial park in Ho Chi Minh City with the current area of 913 ha will attract about 20,000 workers.

According to the planning of Hanoi, some universities and vocational schools will be moved outside Hanoi: The University of Natural Science, The University of Technology, The University of Economics, The International University in 2010; The University of social science, The University of Law, The University of pedagogy, The University of foreign languages. According to survey, the University of Technology will have about 6,000 students – 5 courses in 2010. After moving, the old campus of universities will be transferred to Hanoi city. The education and training zone with the area of 108 ha will be the place to educate and train more than 43 millions of students, vocational students and teachers. This zone will save a spare area to build hostels for 30% of students, equal to 7,000 people.

Other zones such as the software zone, the R&D, the office zone, the center zone, the service zone, the golf field, the gymnastics zone etc. will have space for about 111 millions people including service staffs, workers and visitors.

So in the survey area of 1,586 ha, it is estimated that about 229 millions of people will live, work, learn and visit HHTP as against the permanent inhabitants of 99,330 people.

1.4 PLAN OF INFRASTRUCTURES DEVELOPMENT OF HHTP

1.4.1 Plan of Projects considered in the EIA

The projects to be considered in the EIA are summarized below:

1. Land reclamation works to meet 100 years of return period
2. Tan Xa Lake environmental conservation with protection bank of 29km in length
3. Road development of 21km in length and road widening of 16km in length
4. Drainage system with sewer line of 37km length and retention reservoirs with a capacity of 386,000m^3
5. Water supply system with pipeline of 64km
6. Sewerage system with sewer line of 54km and wastewater treatment plant with a capacity of 36,000 m^3
7. Power supply system with cables of 75km and sub station No.1 with 110/22kV, and the relocation of 5km of overhead transmission line as underground cable
8. Telecommunication system with telecommunication conduit of 61km, 536 hand holes, 7 base station houses, 7 antenna towers with a height of 50m,and 64km optic fiber cable
9. Area development with area of 399 ha in total for 3 zones of R&D, E&T and High-Tech City Center

1.4.2 Land Use Plan

The land use plan is prepared based on the concept summarized below:

- As the VN Revised M/P has been approved by the Prime Minister of Vietnam, Land use plan of the VN Revised M/P is applied as a base. The land use classification and layout is adopted,
- The proposed land use plan covers 1,036 ha in the Hoa Lac area, a part of the industrial zone has been excluded,
- Idea of detailed plan prepared by developer has been referred in the land use plan, and
- Infrastructure development plan proposed in the Study has been integrated in the land use plan, particularly for the calculation of areas.

The Proposed land use plan of the Study area is shown in Figure 1-10 and the allocated areas are summarized in Table 1-4.

Arrangement of land use plan has not been changed. However, the re-examination of width of road has been carried out in the road plan. For this reason, infrastructure area increases and the area of each development zone decreases.

Source: JICA feasibility study, 2008-2009

Figure 1-10: Proposed Land Use Plan

Table 1-4: Proposed Land Use Plan and Predicted Population (Hoa Lac Area)

Development Zone		Study Area (ha)	Area (ha) Total	Population Projection (persons)		Classification of Population	
				Total	Density (p/ha)	Daytime Population	Nighttime Population
1	Software park (PM)	64.4	64.4	12,880	200.0	12,880	0
2	R&D (RD)	227.9	227.9	13,674	60.0	13,674	0
3	High-tech Industrial (CN1)	114.7	231.6	23,160	100.0	23,160	0
4	Education & Training (DT)	108.0	108.0	43,200	400.0	25,920	17,280
5	Center of high-tech City (TT)	49.0	49.0	12,250	250.0	7,350	4,900
6	Mixed Use (VP)	84.5	84.5	12,675	150.0	5,070	7,605
7	Houses & Offices (HH)	41.9	41.9	34,149	815.0	0	34,149
8	Housing Complex CC)	22.6	22.6	34,691	1,535.0	0	34,691
9	Amenity (GF)	0.0	110.0	220	2.0	220	0
10	Amusement (TD)	33.2	33.2	1,660	50.0	1,660	0
11	Traffic & Infrastructure	146.6	147.1	0		0	0
12	Lake & Buffer	112.4	117.0	0		0	0
13	Greeneries/Trees	30.8	30.8	0		0	0
Sub-total		1,036.0	1,268.0	188,559		89,934	98,625

Note: Study area is excluding Amenity and a part of High-tech industrial zone from the Hoa Lac Area.
Source: JICA feasibility study, 2008-2009

1.4.3 Land Reclamation and Landscape Plan

(1) Land Reclamation Plan

In the Study area, the estimated volume of soil required for reclamation is a slightly larger than the volume given in the VN Revised M/P. Thus, it is necessary to secure the acquisition and disposal place of soil as soon as possible.

Table 1-5: Total Cut and Fill Volume

(1,000m^3)

	Filling	Excavation	Sub-Total	Disposal	Supplement	Total
Site total (excluding roads)	18,010	3,117	21,127	2,246	2,246	25,618
3 zone	10,031	961	10,992	1,039	1,039	13,069
Other zones	7,979	2,156	10,135	1,207	1,207	12,549
Roads	1,745	574	2,319	126	-	2,445
Grand Total	19,755	3,691	23,446	2,372	2,246	28,063

Note: All the high-tech industrial zones are included. A supplement is necessary when it settles.
3 zones: Research & Development, Education & Training, Center of High- tech City
Source: JICA feasibility study, 2008-2009

(2) Landscape Plan

For preservation of the Tan Xa Lake and to protect the construction, the shore of a lake is prepared. As a buffer green zone, a green tract of land is prepared along a symbol road, an expressway, and a river.

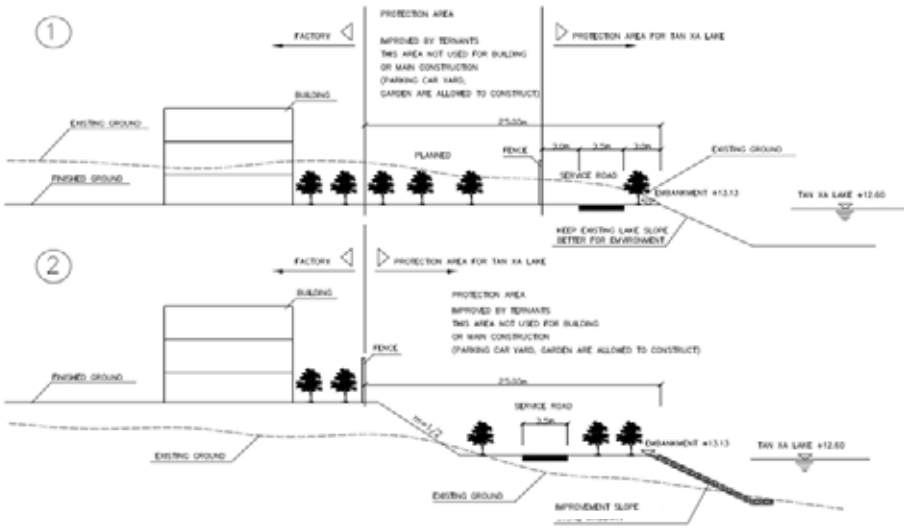


Figure 1-11: Proposed Shoreline Protection Area

Design for protection of revetment of Tan Xa Lake has been studied during the JICA feasibility study to find the best way for the project from the view point of technic as well as environment.

Table 1-6: Comparison of Designs for Revetment of Tan Xa Lake

	VN Revised M/P	With Protection Area
Environmental Protection Measures	Provision of revetment for all periphery of lake, Non consideration of protection area for lake.	Keep the existing slope of dyke as far as possible, Minimization of revetment construction, Provision of protection area according to Vietnamese regulation.
Landscape	Less nature and more artificial then current condition.	Environmentally friendly.
Greenery	Less green.	Much green.
Rain Water Retaining Function	Less than current condition.	Keep retaining capacity as regulated.
Land Use	More use for development.	Less development.
Conclusion	Not Recommended, considering environmental impact and Tan Xa lake disaster (flood) prevention function.	Recommended, to provide sufficient atmospheres for environmental and technologies/economics growths are necessary.

1.4.4 Road and Transport System

(1) Traffic Demand Projection

Traffic demand in the HHTP was projected by using population forecast value in the HHTP based on revised land use plan as proposed in this study. Projected traffic demand in the Stage-1 and Stage-2 are 27,358 pcu/day and 49,123 pcu/day respectively. Capacity analysis of the HHTP gates and planning of public transport system facilities are examined based on the projected traffic demand.

(2) Planning Concept

Following principles and planning concepts were set to examine the appropriate road functions of the HHTP internal roads:

- Traffic Functions (Trafficability, Accessibility, Storagebility)
- Space Functions (Environmental space, Disaster Prevention, Utility space, Urban formation)

(3) Proposed Road and Transport System Development Plan

HHTP Internal Roads Development

The HHTP internal road consists of 18 roads, 11 bridges, and 6 culverts. About 43 % of roads, 5 bridges, and 2 culverts have been executed for construction or detailed design. Rest of the other roads, bridges, and culverts are subject to planning of the development plan.

Table 1-7: Status of HHTP Internal Roads Development (Roads)

Routes	Type	Length (m)	Road Right of Way (m)	No. of lanes	Road Implementation Status									
					Completion	Step Completion		Incompletion						
								New			Widening			
					(m)	length (m)	width (m)	Under Construction (m)	D/D Complete (m)	No Design (m)	Under Construction (m)	D/D Complete (m)	No Design (m)
Route A	1	3,306	50	6		3,036	33.5		270				3,306
Route B	2	2,931	38	4		2,091	27.0	840					2,931
Route C	1	2,125	50	6		2,125	25.0						2,125
Route C*	3	3,430	34	4		280	26.0	2,810		340			3,090
Route D	2	2,289	38	4		1,133	26.0			1,156			1,133
Route E	3	3,940	34	4		730	23.0		2,337	873			3,067
Route 01	3	1,193	34	4						1,193			
Route 02	5	96	16	2						96			
Route 03	1	632	50	6						632			
Route 04	3	1,353	34	4						1,353			
Route 05	3	3,366	34	4						3,366			
Route 06	4	1,875	31	2						1,875			
Route 07	4	1,611	31	2						1,611			
Route 08	3	1,034	34	4						1,034			
Route 09	2	1,928	38	4						1,928			
Route 10	4	2,700	31	2						2,700			
Route 11	3	732	34	4						732			
Route 12	4	1,628	31	2						1,628			
Total		36,169			0	9,395		3,650	2,607	20,517	0	0	15,652

Note: 'Under Construction' and 'D/D Complete' are designed/constructed as same width of 'Step Completion'.

Source: JICA feasibility study, 2008-2009

Table 1-8: Status of HHTP Internal Roads Development (Bridges and Culverts)

Code	Plan	Route	Station			DHWL	Clearance	Minimum Height	Structure Type	Width	Length
			Beginning	Center	End	(m)	(m)	(Girder/Top Slab Bottom)		(m)	(m)
B01	Completed	Route B									
B02	Completed	Route B									
B03	Under Construction	Route B									
B04	Plan (Widening)	Route C	Followed the existing condition						PC Hollow Girder	33.5	0.05+15.0+0.05=15.1
B05	Plan (New Construction)	Route D	0+241.110	0+267.160	0+293.210	12.63	0.5	13.13	Concrete Arch	26	0.05+52+0.05=52.1
B06	Completed	Route D									
B07	Under Construction	Route E									
B10	Plan (New Construction)	Route 07	0+169.950	0+176.000	0+182.050	12.63	0.5	13.13	PC Hollow Girder	22	0.05+12.0+0.05=12.1
B11	Plan (New Construction)	Route 09	0+867.950	0+880.000	0+892.050	9.6	0.5	10.1	PC Hollow Girder	26	0.05+24.0+0.05=24.1
C01	Completed	Route A									
C02	Completed	Route C*									
B08	Plan (New Construction)	Route 01	0+454.347	0+475.422	0+496.497	12.63	0.5	13.13	PC Hollow Girder	29	0.05+21+0.05+21+0.05=42.15
C03	Plan (New Construction)	Route 04	0+743.625	0+747.000	0+750.375	12.63	0.5	13.13	Box Culvert(2@3.0*2.0	29	0.25+3.0+0.25+3.0+0.25=6.75
C04	Plan (New Construction)	Route 05	1+617.750	1+619.000	1+620.250	12.63	0.5	13.13	Box Culvert(1@2.0*2.0	29	0.25+2.0+0.25=2.5
C05	Plan (New Construction)	Route 06	0+661.750	0+663.000	0+664.250	12.63	0.5	13.13	Box Culvert(1@2.0*2.0	22	0.25+2.0+0.25=2.5
B09	Plan (New Construction)	Route 06	1+738.450	1+746.000	1+753.550	12.63	0.5	13.13	PC Hollow Girder	22	0.05+15.0+0.05=15.1
C06	Plan (New Construction)	Route 10	0+526.750	0+528.000	0+529.250	12.63	0.5	13.13	Box Culvert(1@2.0*2.0	22	0.25+2.0+0.25=2.5

Source: JICA feasibility study, 2008-2009

Five types of typical cross sections were designed as shown in Figure 1-12. As a result of utilities accommodation examination, buffer zones on road type 2, 3 and 4 were revised from the VN Revised M/P.

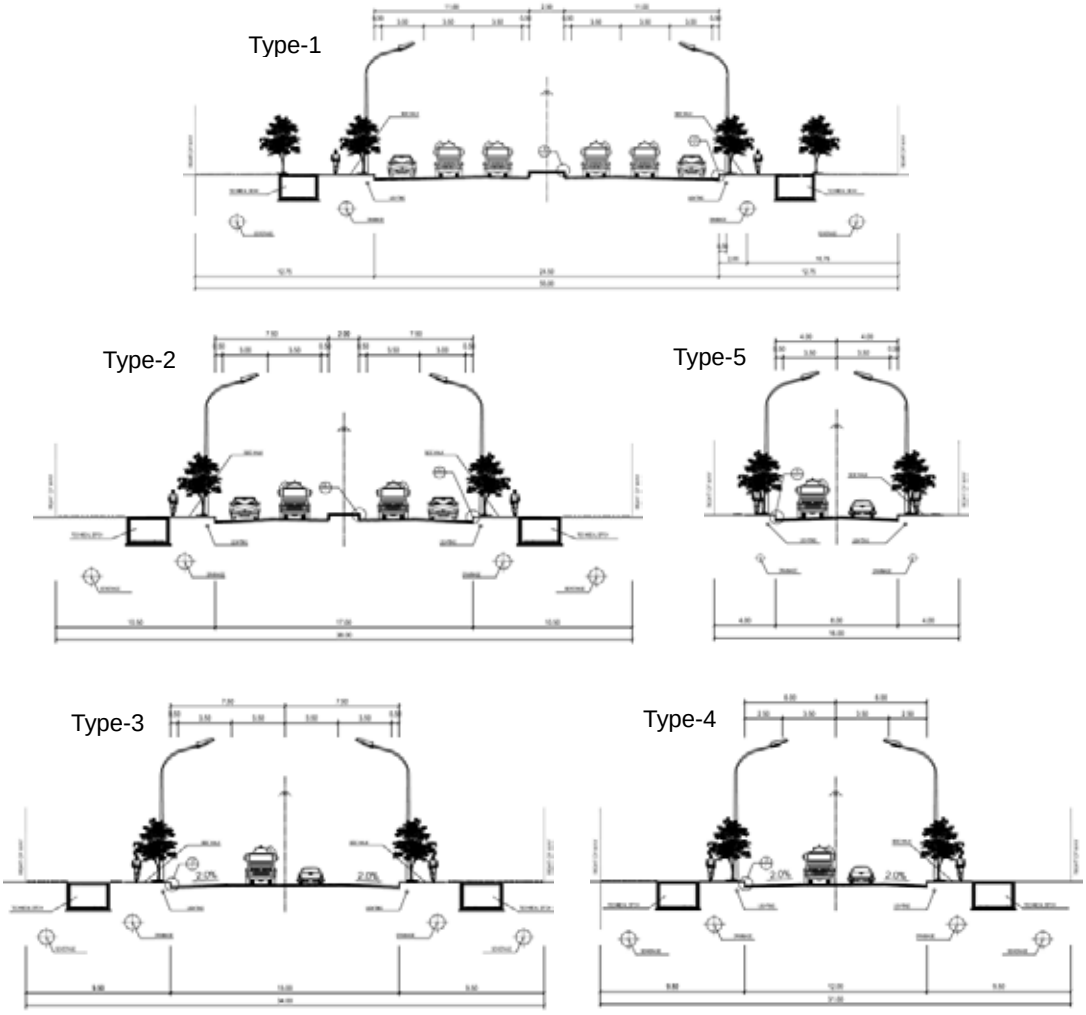


Figure 1-12: Typical Cross Section

HHTP Internal Transport System

A circulating bus is proposed as internal transport system of the HHTP. Based on the revised

traffic demand, in case three circulation bus route are introduced then the requirement of necessary number of bus in 2015 and 2020 are estimated 9 (2 large bus, 7 middle bus) and 30 (6 large bus, 24 middle bus) respectively. Necessary bus terminal area in 2015 and 2020 are also estimated 1,537m^2 and 5,398m^2 respectively.

(4) Proposed Interchange, Fly-over bridge, and Underpass crossing LHLE

The JICA feasibility study, 2008-2009 proposed to add additional on and off ramps connecting the frontage roads and the express ways to ensure efficiency of traffic flow as shown in Figure 1-13 to Figure 5.3.3.

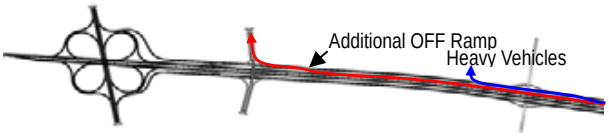


Figure 1-13: Recommended Modification of the LHLE Connection Plan (Inflow)

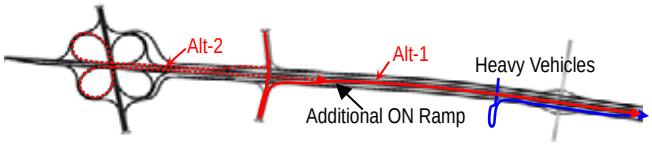


Figure 1-14: Recommended Modification of the LHLE Connection Plan (Outflow)

Fly-over bridge, Underpass

1) Fly-over Bridge

The MOT proposed typical cross section for the fly-over bridge, which specifies a total road width of 17m that includes vehicle lanes (8.0m×2) and median (1m). The JICA study team proposed total 18m road width (lane 3.75m*4, shoulder 0.5m*2, median 2.0m) in accordance with applied road geometric standards to ensure smooth trafficability.

2) Underpass

The MOT proposed typical cross section for the underpass, which specifies a total road width of 6m and height clearance of 4.925m. The JICA study team proposed total 10m road width based on road geometric standards and connecting road plan. Considering the practical experience in Vietnam, the clearance height of 5.925m was proposed to maintain adequate space for the passage of over-loaded heavy vehicle.

1.4.5 Drainage Plan

(1) Design Concept

The design concept and criteria for the stormwater drainage system in the Hoa Lac Area (north of LHLE) are summarized below:

1) Design period	: The year of 2020
2) Planning area	: 1268 ha of Hoa Lac area (north of LHLE)
3) Design population	: 193,326
4) Drainage basin	: Four basins of Tan Xa Lake, Dua Gai Stream, Vuc Giang Newly Built Reservoir and Vuc Giang Stream
5) Collection system	: Separate system
6) Design stormwater flow (DSF)	: 5 years of return period for sewer
7) Stormwater reservoir for flood control	: Tan Xa Lake & Vuc Giang stream (10 years of return period)

8) Receiving water bodies	: Tich River through Vuc Giang stream and Tich Gang River
9) Allowable discharge of Tich River	: 10 years of return period for Tich River (assumed)
10) Rainfall intensity	: Intensity formulation of MOC $q = 0.36 \cdot [5416 \cdot (1+0.25 \cdot \log P \cdot t^{0.13})]/(t+19)^{0.82}$ where, q: Rainfall intensity (mm/hour) P: Return period (year) t: Concentration time (minute)
11) Design return period	: 10 years for retention functions
12) Type of retention functions	: Natural pond with environmental conservation bank for Tan Xa Lake, and Multiple type with orifice for Vuc Giang Newly Built Reservoir
13) Capacity of retention function	: $Q = [Q_{10} - Q_a/2] \cdot T \cdot 60$ Where, Q: Design capacity of retention pond (m^3) Q_{10}: Design storm water flow (m^3/second) Q_a: Allowable discharge flow (m^3/second) T: Concentration time (minute)

(2) Proposed Project

The proposed stormwater drainage plan should cope well with the variety of public facilities and services, functional zones and environmental requirements particular to HHTP. The overall stormwater drainage plan in the Hoa Lac Area is presented as shown in Figure 1-15. The proposed stormwater drainage project is summarized in Table 1-8.

Table 1-9: Proposed Stormwater Drainage Project

	Work Item	Quantity
1	Storm water Collection Sewer	
a)	New Installation	27.0 km
b)	Replacement	12.0 km
c)	Manholes	536 units
d)	Connection Pipes: D1500mm & D2000mm	465 m
2	Tan Xa Lake Regulating Facilities	1 unit
3	Dua Gai Stream Diversion & Improvement with Diversion Box Cuvert 3000mmx2000mm x 180m	3.2 km
4	Vuc Gaing Stream Retention Functions (Capacity of Multipurpose Type Reservoir: 52000m3, Length of Stream: 500m)	1 unit

Source: JICA feasibility study, 2008-2009

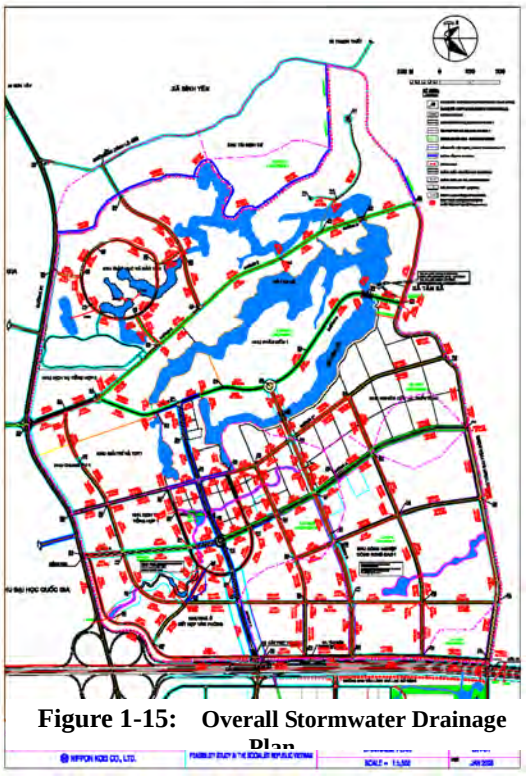


Figure 1-15: Overall Stormwater Drainage Plan

1.4.6 Water Supply Plan

(1) Water Supply Demand Projection

The water demand projection for the HHTP was estimated as shown below.

Table 1-10: Estimated Water Demand in the HHTP

ZONE	Stage 1 (m^3/d)	Stage 2 (m^3/d)	Total (m^3/d)
Software Park	660	310	970
R&D	2,920	2,090	5,010
High-Tech Industrial	8,890	1,540	10,430
Education & Training	710	3,020	3,730
Center of High-Tech City	1,440	0	1,440
Mixed Use	940	820	1,760
Houses & Offices	6,150	0	6,150
Housing Complex	3,380	2,870	6,250
Amenity	10	0	10
Amusement	4,100	450	4,550
TOTAL	**29,200**	**11,100**	**40,300**

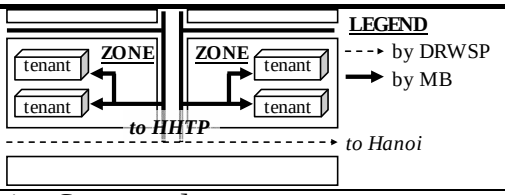
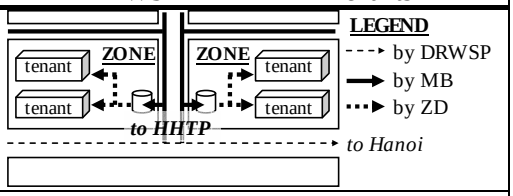
Source: JICA feasibility study, 2008-2009

(2) Plan Concept

The following plan concept is applied for water supply to HHTP.

- High reliability water supply system both for external (supply from Da River Water Supply Project, hereinafter called as DRWSP) and internal systems.
- Simple operation and management in terms of technical and organization aspects.
- Secure water supply plan for JICA Feasibility Study.

Table 1-11: Operation and Management (O&M) System

<table>
<tr><th>DRWSP – MB – Tenants</th><th>DRWSP – MB – ZD - Tenants</th></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td colspan="2">[Project Component]
1. Transmission Pipeline (from DRWSP connection point to each zone entrance).
2. Distribution Pipeline (from zone entrance to each tenant).
3. Necessary distribution system by ZD, such as reservoir and pump facilities.</td></tr>
<tr><td>[Project Component for MB]
- Both Transmission and Distribution Pipelines, starting from HHTP entrance (connection point from DRWSP) to every tenant.
- Water Meter for every tenant (connection point to tenants).</td><td>[Project Component for MB]
- Transmission Pipeline, starting from HHTP entrance (connection point from DRWSP) to Zone entrance.
- Water Meter for every Zone (connection point to ZDs).</td></tr>
<tr><td>[Technical Consideration]
- Necessary temporary water supply system to supply water continuously to the current tenants.</td><td>[Technical Consideration]
- Necessary to adjust the water supply system based on the detailed plan of every zone immediately.
- Necessary temporary water supply system to supply water continuously to the current tenants.</td></tr>
<tr><td>[Operation & Maintenance Consideration]
- Clear responsibility.
- Currently no organization as well as staff of MB can operate and maintain water supply system.</td><td>[Operation & Maintenance Consideration]
- Sequenced operation with zone development and sales strategy can be achieved.
- Not all ZD was determined; therefore water supply system and its O&M structure can not be fixed.
- Commonly, the contract for water supply was done between Supplier and Tenant, however in this case, it should involve MB and ZD which requires more over-head cost for O&M.</td></tr>
</table>

[General Evaluation] More Sufficient - Considering the capability of MB, it is suggested to out-source the O&M works to private or public water supply company.	[General Evaluation] Not Sufficient - The Project can not proceed as the detailed plan and sales strategy of every zone is not yet decided.

Source: JICA feasibility study, 2008-2009

(3) Water Supply Plan

Outline of the water supply system is shown in the Table 1-11 and Figure 1-16 below.

Table 1-12: Outline of Water Supply System

pipeline	unit	quantity	accessories	unit	quantity
1. DN100	km	39.25	1. air valve	set	13
2. DN150	km	6.00	2. drain valve	set	8
3. DN200	km	8.74	3. gate valve	set	126
4. DN250	km	1.41	4. T-branch	set	521
5. DN300	km	3.19	5. fire hydrant	set	328
6. DN350	km	2.17	note:		
7. DN400	km	3.86	All accessories including handhole and necessary civil works.		
8. DN500	km	0.41			
9. DN600	km	1.33			

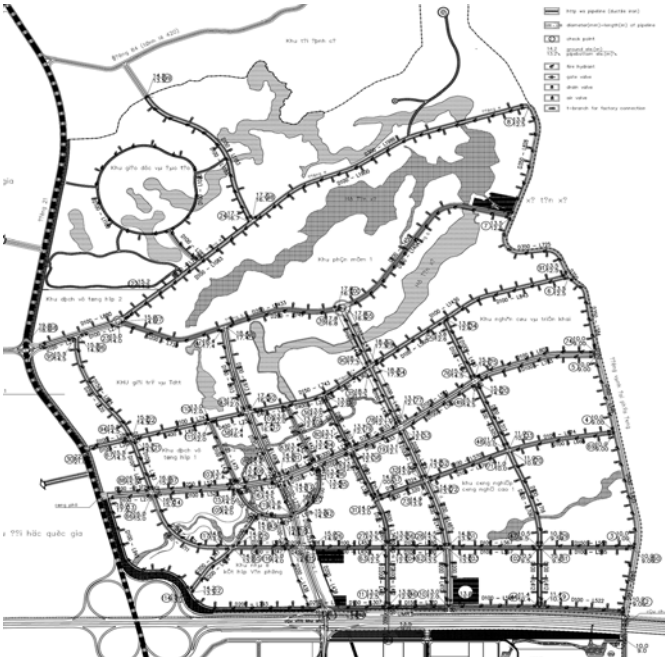


Figure 1-16: Layout Plan of Water Supply System

1.4.7 Wastewater Sewerage Plan

(1) Wastewater Yield Projection

Design wastewater yield is identified as 90 % of water supply amount and will be the daily average wastewater generation. The 10 % of the supplied amount will infiltrate to the ground . Sewerage facilities are to be designed based on daily maximum wastewater flow (DMWF) for wastewater treatment plant and hourly maximum wastewater flow (HMWF) for sewer pipes and

intermediate pumping stations. The designed daily average wastewater flow (DAMF), DMWF and HMWF are 34,000 m3/day, 40,200 m3/day, 51,400 m3/day respectively.

Table 1-13: Design Wastewater Volume

Unit: m3/day

Item	Stage 1 (2015)			Stage 2 (2020)			Total		
	DAWF	DMWF	HMWF	DAWF	DMWF	HMWF	DAWF	DMWF	HMWF
Design Wastewater Yield	24,000	28,300	36,200	10,100	11,900	15,200	34,000	40,200	51,400

DAWF: Daily Average Wastewater Flow, DMWF: Daily Maximum Wastewater Flow, HMWF: Hourly Maximum Wastewater Flow
Source: JICA feasibility study, 2008-2009

(2) Wastewater Quality and Target Effluent Quality

Design wastewater quality has been identified by setting unit pollutant loads for domestic residents and commercial (workers and visitors) population in HHTP. In addition, for wastewater from industrial facilities, allowable wastewater quality is applied following the regulation of discharge standard in Vietnam. Referring the design wastewater quality, daily pollutant loads and wastewater yield, the BOD (Biochemical Oxygen Demand) and SS (Suspended Solid) are estimated as 274 mg/L and 342 mg/L respectively. Target effluent quality follows the Vietnamese discharge criteria in public water body, which are 50 mg/L for BOD and 100 mg/L for SS.

(3) Facilities for Wastewater Sewerage Plan

For sewer network, in total 53.7 km of sewer lines are planned. The 50 km of sewers can be installed by gravity sewer system and 4 km of sewers will be applied pressure sewer system with 10 intermediate pumping stations. Separated sewer system is planned following the M/P. The RC (Reinforced Concrete) pipe will be used for gravity sewers and DCIP (Ductile Cast Iron Pipe) are planned for pressure sewers.

Pumping stations will be constructed underground and will be equipped with submersible pump. They will be located on the sidewalk or green area beside roads. The submersible pump units are to be equipped.

With reference to wastewater treatment plant, six additional series of units as expansion units with the capacity of 36,000 m3/day has been identified for construction purpose. This excludes the existing unit as constructed by HHTP having a capacity of 6,000 m3/day. Method of treatment process is planned as conventional activated sludge process with gravity sludge thickener and mechanical dewatering process.

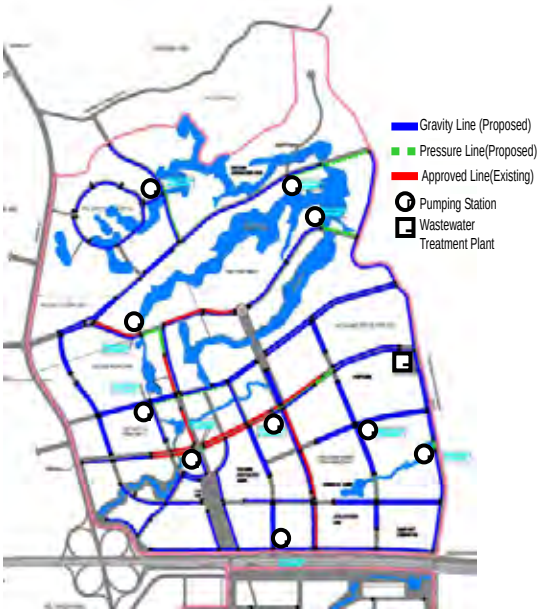


Figure 1-17: Layout Plan of Sewerage Network

Table 1-14: Summary of Sewerage Facilities

Item	Total	Existing	Plan	Remarks
Sewer Pipe Lines (Gravity, RC Pipes)	50 km	0 km*	50 km	250~1350 mm
Sewer Pipe Lines (Pressure, DCIP)	4 km	0 km*	4 km	150~600 mm
Subtotal	54 km	0 km*	54 km	
Intermediate Pumping Station (Small)	7 nos	0 nos*	7 nos	
Intermediate Pumping Station (Middle)	3 nos	0 nos*	3 nos	
Subtotal	10 nos	0 nos*	10 nos	
Wastewater Treatment Plant (Capacity)	42,000 m3/d	6,000 m3/d	36,000m3/d	Activated Sludge Process

*For part of sewer pipes and pumping stations, there are some facilities which were partly constructed during the previous project, however those facilities are not to be considered to be used due to the unreliability to the project so far.

1.4.8 Power Supply Plan

(1) Power Demand Projection

Demand for an area of 1,268 ha of Hoa Lac area is projected, which includes an area of 1,036 ha of JICA F/S. In addition, power demand of Northern Phu Cat area of 318 ha is projected as follows:

Table 1-15: Total Demand Projection

Stage	Area	Projected Demand (MVA)
Hoa Lac Are a(including1036ha of F/S)	1,268 ha	147 MVA
Northern Phu Cat Area	318 ha	117 MVA
Total	1586 ha	264 MVA

It is planned that the following capacity and unit of the transformers should be installed for the area of 1,268 given that some of the power for an area except in 1,036 ha can be supplied by a substation that is planned in northern Phu Cat area by Vietnamese Revised M/P.

Table 1-16: Necessary capacity of substation for Hoa Lac Area(1,268 ha)

Stage	Assumed Demand (MVA)	Recommended Capacity
Hoa Lac Area (1,268 ha)	134MVA(147MVA divided by 1.1 of diversity factor)	63MVA×3 units(one unite for standby)

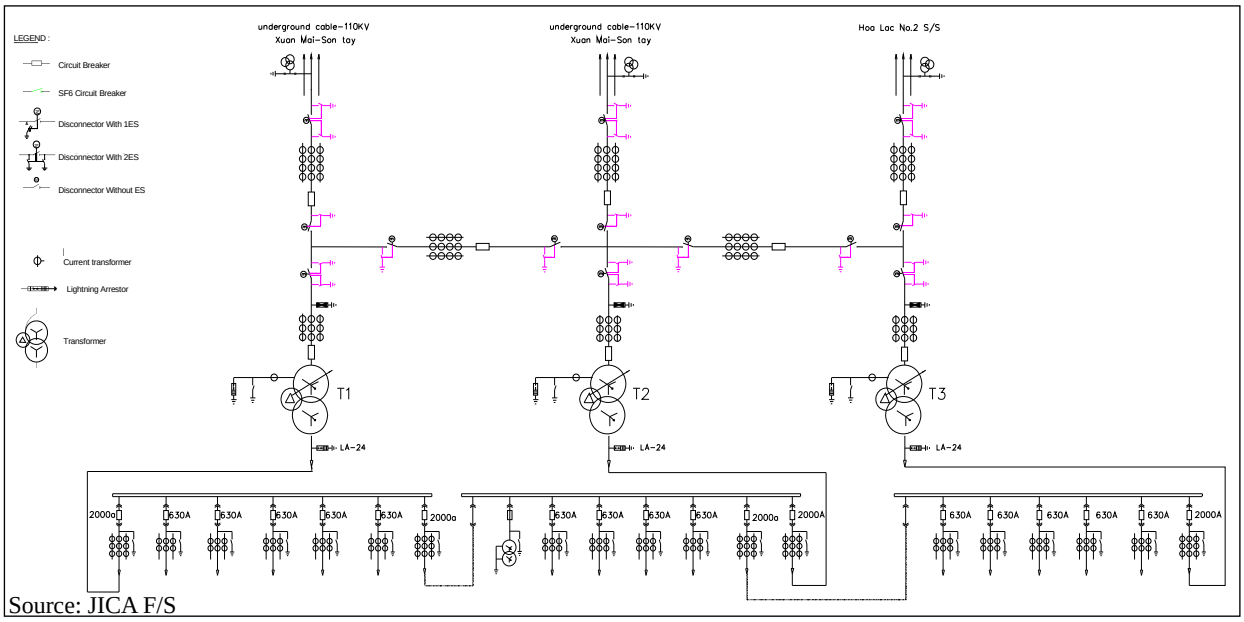
(2) Plan Concept and Design Criteria

HHTP is a high tech park, which requires more reliable supply networks than existing electrical facilities in Vietnam, which are expected to be constituted by some of the state of the art facilities. Therefore, as a concept, it is prerequisite to have power entities like EVN and power companies have a different mind from the one toward existing facilities owned by the EVN and the power companies. Design criteria are shown below.

Criteria
a)To follow N-1 conditions that are used as an index to measure electrical supply reliability
b)To follow recommendation mentioned in PDP 6th made by Vietnam
c)To achieve easy maintenance

(3) Power Supply Network Plan

The Hoa Lac 110/22kV No.1 S/S planned to be constructed is shown in Figure 1-18.



Source: JICA F/S

Figure 1-18: Configuration of Electrical Equipment for Hoa Lac No. 1 S/S

(4) Design for Power Supply Facilities

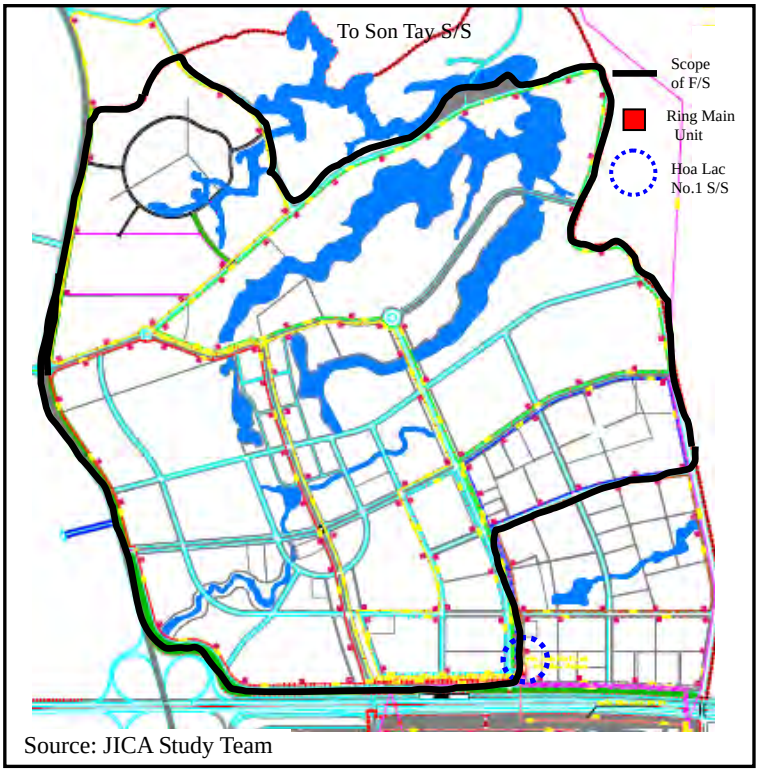
The following projects should be implemented to supply power to Hoa Lac Area.

<u>Relocation of over head transmission line to underground cable</u>

Relocation of 110kV overhead transmission line to underground cables should be implemented because existing transmission line will disturb the development of adjacent area to the lines and also there is a regulation in Vietnam that all of transmission lines less than 220kV in new development has to be laid underground. The location of the relocation and the specification is shown in Figure1-19 and Table1-16.

<u>Construction of Hoa Lac 110 /22kV No.1 S/S</u>

Three units of 63MVA transformers should be installed adjacent to the existing Thach That S/S. The location of the construction and the specification is shown in Figure1-19 and Table1-16. Necessary dimension for Hoa Lac No.1 is approx. 3,025m2(55m×55m).



Source: JICA Study Team

Figure 1-19: The Location of Ring Main Unit

<u>Installation of feeders and Ring Main Unit (RMU)</u>

From Hoa Lac No.1 S/S, 14 distribution lines of 22kV are planned to be installed underground

together with other infrastructure in buffer zone along the roads. The location of Ring Main Unit and the specification are shown Figure1-19 and Table1-16.

Table 1-17: Specification and Quantity of Equipment

Facilities to be installed	Specification	Q'ty
(1) Relocation of over head transmission line to underground cable		
Dismantlement of existing transmission line	110kV 2cct.	Approx.5km
Underground cable	110kV, XLPE 300×3×2cct.	Approx.5km
Cable accessory	For overhead line and transformer	1 lot
Pipe	HDPE φ200	30 km
Manholes		1 lot
(2) Construction of Hoa Lac 110 /22kV No.1 S/S		
Power Transformer	110/22kV, 63MVA	3 units
Disconnecting switch	123kV, 3-pole	13 units
Circuit Breaker	123kV, 3-phase,Ourdoor-use	8 units
22kV distribution cubicle	Incoming and Outgoing feeder	20 units
Control house and miscellaneous		1 lot
(3) Installation of feeders and Ring Main Unit (RMU)		
Distribution cable	24kV-Cu/XLPE/DSTA/PVC	Approx. 75km
Cable accessory	24kV-Cu/XLPE/DSTA/PVC	1 lot
Pipe	Steel pipe	Approx. 75km
Ring Main Unit	Compartment and switchgear	119 units
Miscellaneous		1 lot

1.4.9 Telecommunication Plan

(1) Final Goal of Telecommunication System

End-user Telecommunication Services

In recent years, telecommunication services and applications requested by end-users have become more multifaceted and are required such as data communication and multimedia services represented by internet, video conference, IPTV, and conventional voice/fax communication. The end-user services to be provided within the HHTP and their expected beneficiaries are summarized in Table 1-17 below.

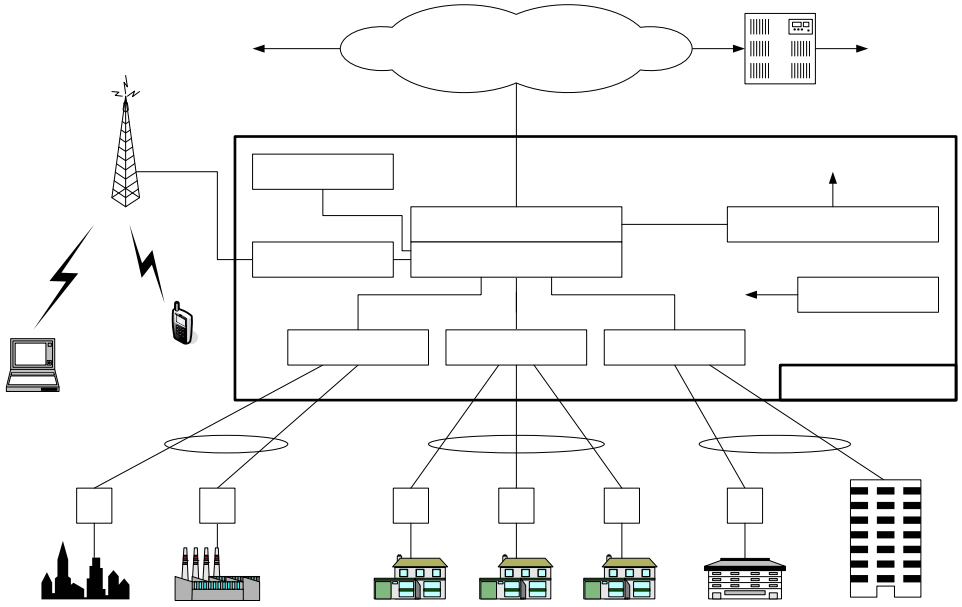
Table 1-18: End-User Services and Expected Beneficiaries

End-User Services		Expected End-Users		
		Home User	Office User	Institution, Others
Audio/Data Communications	Voice Communication/FAX	O	O	O
	Internet Access Service	O	O	O
	Office Network System (WAN)	-	O	O
	Large File Transfer/Sharing Service	-	O	O
Multimedia Communications	Videoconference	-	O	O
	IPTV	O	-	-
	Triple/Quattro Play Services	O	O	O
Others	Security Service	O	O	O
	E-education	-	-	O
	Telemedicine	-	-	O
	Satellite Image Dissemination Service	-	-	O
Mobile Access	GSM Mobile Communication Services	O	O	O
	Wireless Access Service	O	O	O

Source: JICA feasibility study, 2008-2009

Telecommunication System Configuration

The expected overall telecommunication system configurations in the HHTP are shown in Figure 1-20.



Source: JICA feasibility study, 2008-2009

Figure 1-20: Overall Telecommunication System Configuration

(2) Realistic Telecommunication Plan

As the final goal, the telecommunication services and systems that comply with NGN standards, as described above, shall be provided to all end-users in the HHTP. However, it is considered that construction and operation of the telecommunication system by HHTP-MB is not a realistic approach.

Local Line
(Hanoi City or Oth

(3) Design of Telecommunication Infrastructures

Estimated quantities of the telecommunication conduits, optic fiber cable the antenna tower components are summarized as follows:

Table 1-19: Estimated Quantities of the Telecommunication Conduit

Item	Description	Unit	Quantity
1. Conduit	Steel pipe D=100mm x 4 x 4	km	61
2. Optic Fiber Cable	SM-100C	km	64
3. Optic Fiber Splicing Box		unit	500

Table 1-20: Summary of the Antenna Tower Components

Item	Description	Unit	Quantity
1.Antenna Tower	4-legged self supporting steel tower, H=50m	Unit	7
2.Base Station House	4m x 4m	Unit	7

Mobile Base Stations

Figure 1-21 below shows the planned telecommunication conduit and antenna tower layout.

2.5G/3G
GSM

Wi-MAX

Mobile Phone

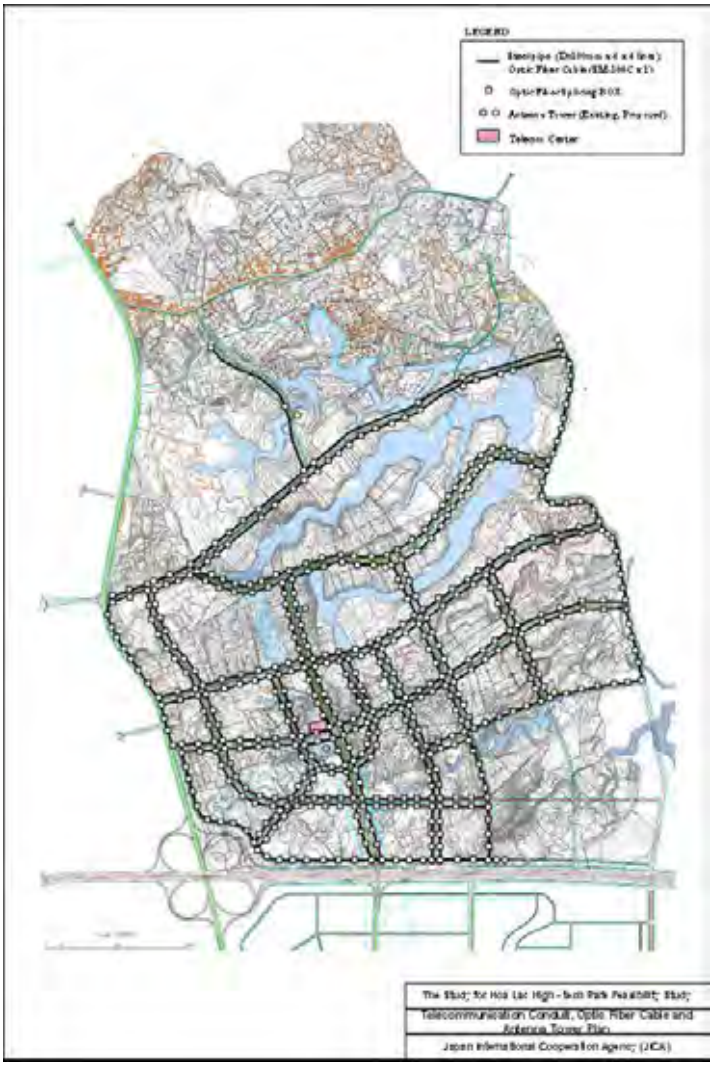


Figure 1-21: Telecommunication Conduit and Antenna Tower Plan

1.4.10 Solid Waste Management Plan

The projected amount of waste generated in HHTP is 152.6 t/day in Stage 1 and 215.1 t/day in Stage 2. The estimated kinds of solid waste generated are; ordinary waste mainly from households and offices, hazardous waste mainly from manufacturing factories in High-tech industrial zone, infectious waste from NIHE and sewage sludge from the waste water treatment plant.

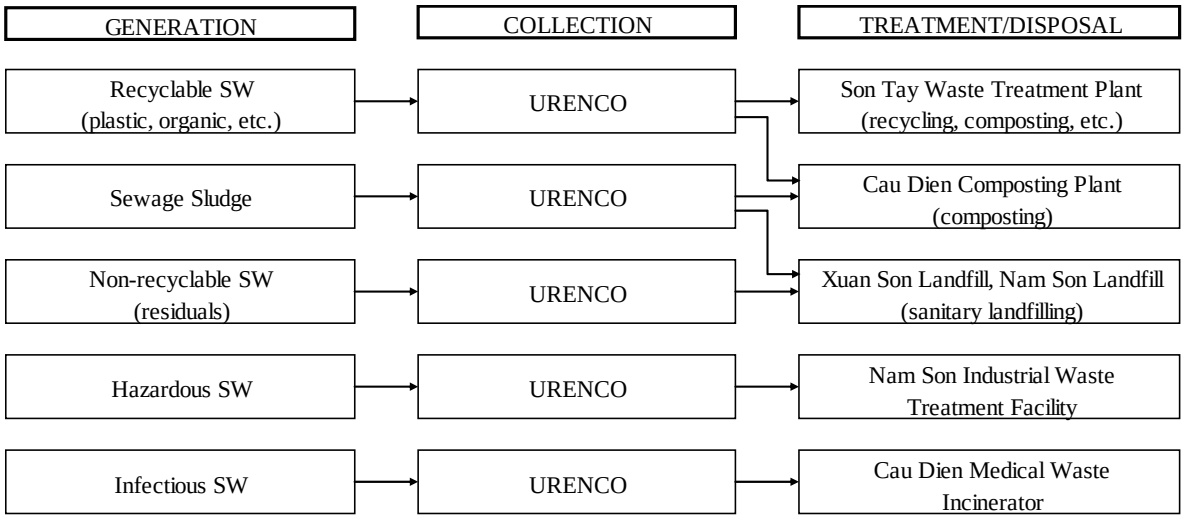
The solid waste generated from HHTP should be transported and treated in existing facilities outside HHTP, according to Vietnam Building Code (QCVN:01/2008/BXD). The candidate for solid waste management is the existing company URENCO, which is responsible for solid waste collection, transportation, treatment, and disposal service in Hanoi City.

Ordinary waste collection service fee is regulated by the government, and hazardous waste collection service fee shall be decided by contracts between hazardous waste generators and hazardous waste collector/transporter and treater/disposer. URENCO will visit their customers in HHTP to collect corresponding fees for their services periodically.

All solid waste generators in HHTP have to make effort to reduce the amount of waste

generation through their activities, and are encouraged to segregate generated waste at source into categories suitable for recycling and other treatment. Hazardous waste must be packed and stored safely at source in compliance with the Regulation on Management of Hazardous Waste (Decision No.155/1999-QD-TTg), before transferring entrusted hazardous waste to collector/transporter and treater/disposer. Infectious waste and sewage sludge should be handled separately as these waste needs careful consideration for transportation and treatment.

The solid waste management system for HHTP is summarized in Figure 1-22. However, it should be reviewed and revised in accordance with the revision on solid waste management plan in Hanoi City.



Note: SW: Solid waste
Source: JICA feasibility study, 2008-2009

Figure 1-22: Flow chart of solid waste management system for HHTP

1.4.11 Zone Development Plan

(1) General

The area development plan is planned based on the following manner.

- The plan was made so as not to influence areas where operation and planning have already been carried out within the HHTP.
- Size of the lot already operated and planned will be referred to.
- In order to ensure that each lot can accommodate as many tenants as possible, the roads within each lot section will not be constructed by the HHTP-MB. It is considered that each lot will be accessed from the existing road plan, and each tenant following the existing plan road will be connected to infrastructure, such as power, water and drainage.
- The shore of the Tan Xa Lake will improve to the new shore considering the present shape.
- Construction adjacent to the shoreline of lakes and rivers will be restricted in order to preserve the Tan Xa Lake. The setback distance from the front road in each zone has been established from the viewpoint of environmental protection, landscape and disaster prevention.

It will be possible to aggregate the planned lots according to the needs of the tenants, and to consider the aggregation as a single large lot.

Table 1-21: Land Use

	R&D zone	E&T zone	Center of High-tech City
Development area	227.9ha	99.6ha	49.0ha
(Protection area)	(17.6ha)	—	(1.53ha)
Road	—	8.4ha	—
Lake & Buffer	—	14.2ha	—
Total	227.9ha	122.2ha	49.0ha

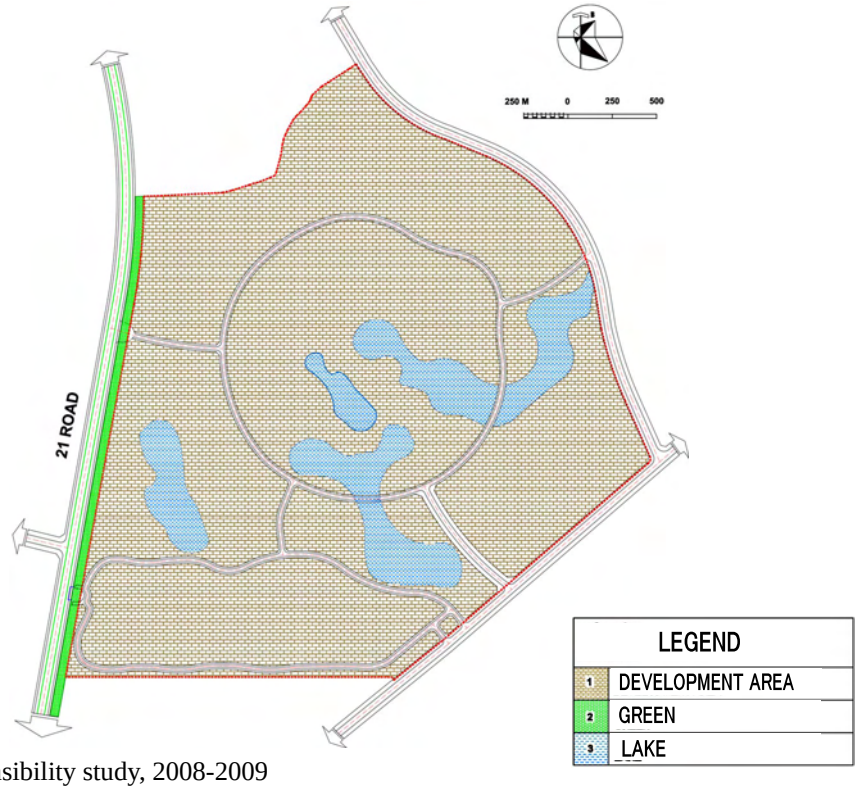
Note: Protection area is a boundary by which construction is regulated for shore protection preservation. It contains in development area.
Source: JICA feasibility study, 2008-2009

(2) Zone Development Plan

The layout plans of the R&D zone, the Education and Training zone, and the Center of High-tech City are prepared by JICA Study Team are as follow.

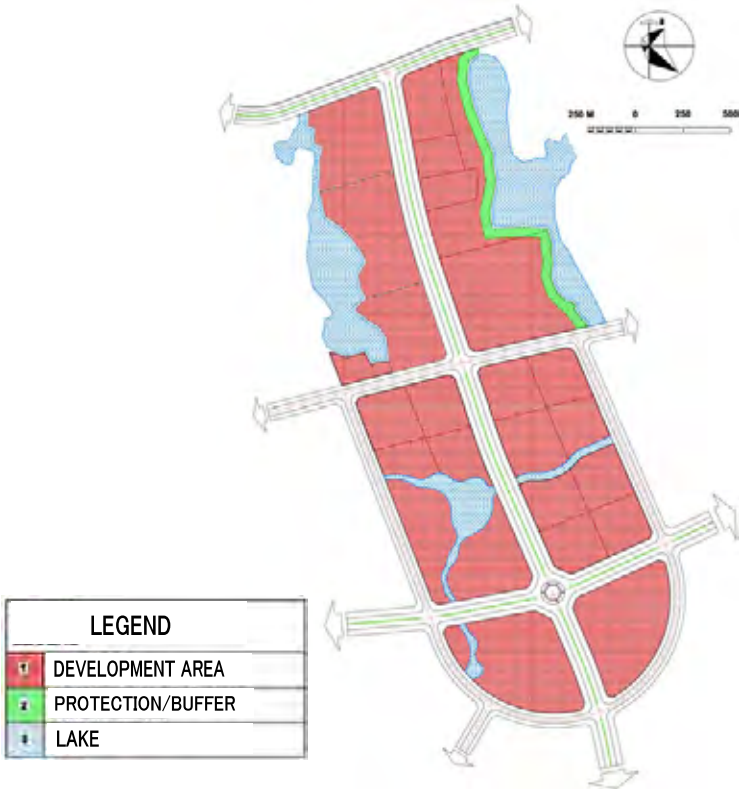
Source: JICA feasibility study, 2008-2009

Figure 1-23: Land Use for the Research and Development Zone



Source: JICA feasibility study, 2008-2009

Figure 1-24: Land Use for the Education and Training Zone



Source: JICA feasibility study, 2008-2009

Figure 1-25: Land Use in the Center of the High-tech City Zone

1.4.12 Development Guidelines and Rules for Land Lease Contracts

A guideline has been prepared so that the HHTP-MB could guide various developers' work in order to achieve the harmonious development as well as environment conservation of HHTP.

Besides, a draft of the land lease agreement has been prepared. In the implementation stage, it shall be developed ensuring fairness and consistency in the assessment of tenants.

Issues quoted relating to environmental management mentioned in the development guidelines proposed by the JICA study are shown in the following table.

Table 1-22: Requirements for Environmental Management in Development Guideline

CONNECTION TO THE HHTP COMMON INFRASTRUCTURE
(1)Roads - The road section design shall follow the typical design set out by HHTP-MB. - Road marking, street lighting, sidewalks and pedestrian crossings shall be planned and consider both safety and the landscape of the Park. - Intersections with street signals shall be designed with minimum length of one (1) kilometer (km).
(2)Drainage - The DC shall provide a sufficient retention pond volume to maintain the rain water run-off capacity at the original level. The total pump capacity shall not exceed the original run-off capacity. - Connection of the Zone drainage system to the HHTP common drain system shall be carried out by the DC under the instruction and attendance of HHTP-MB. - The DC shall properly maintain and clean all drains in the Zone in order to prevent any deleterious affect on the HHTP common drain system. - The DC shall take responsibility for all claims and cost incurred due to damage or obstruction of the HHTP common drain system that are caused by the Zone's drain system.
(3)Water Supply - The DC shall not establish any new water wells. All water demand shall be supplied by HHTP-MB or the Water Supply Company from the common water supply pipeline. - The DC shall inform HHTP-MB of any required water supply capacity in not less than thirty (30) calendar days before its required utilization. - HHTP-MB has the right to shut down the water supply during periodical or emergency maintenance of the water supply facilities. - The DC shall provide a water reservoir with a minimum capacity of one (1) day. - Connection of the Zone water supply pipes to the HHTP common water supply pipeline shall be carried out at the DC's expense by a contractor approved by HHTP-MB and under the instruction and attendance of HHTP-MB.
(4)Power Supply - The DC shall inform HHTP-MB of any required power supply capacity before the DC makes a submission to and/or enters into any negotiation with EVN or a Power Company. - Power supply is the responsibility of EVN or a Power Company. - The DC shall make arrangements for their internal power distribution system with EVN or a Power Company. All internal power distribution systems shall be underground systems.
(5)Telecommunication - The DC shall inform HHTP-MB of any required telecommunication system capacity before the DC makes a submission to and/or enters into any negotiation with the telecommunication agency/company appointed by the Government. - The telecommunication system is the responsibility of the appointed telecommunication agency/company. - The DC shall make arrangements for their internal telecommunication system with the telecommunication agency/company. All telecommunication cable lines shall be underground system.
ENVIRONMENTAL PRESERVATION
(1)Sewerage - The DC shall utilize the HHTP common sewerage system. - Connection of the Zone sewer pipes to the HHTP common sewer pipeline shall be carried out at the DC's expense by a contractor approved by HHTP-MB and under the instruction and attendance of HHTP-MB. - The DC shall provide a facility to remove garbage before connecting the sewer pipes from the Zone to the HHTP common sewer pipeline and ensure that no any garbage or solid waste enters the HHTP common sewer pipeline. - The DC shall accept all responsibility for claims and costs incurred due to damage or obstacles entering the HHTP common sewer system from the Zone's sewer system.

- The DC shall monitor the Zone effluent water quality before the connection point to the HHTP common sewer pipeline and report the monitoring results to HHTP-MB each month. The water sampling shall be done weekly and the samples shall be analyzed by an institute approved by HHTP-MB.

Where the effluent water quality exceeds the standards listed below the DC shall pre-treat the effluent.

  - Biochemical Oxygen Demand (BOD_5) > 300 mg/l
  - Suspended Solids (SS) > 300 mg/l
  - Any radioactive substances
  - Any petroleum sprits
  - Any non-biodegradable pigments
  - Any colored water
  - Any liquid that may damage the sewer pipeline

- When a violation of Article 4.1 (f) above is founded HHTP-MB shall send a notification to the DC. The DC shall be fully responsible for improvement of the effluent quality within fourteen (14) calendar days of receiving notification.
- Where the DC fails to meet the requirement of Article 4.1 (g) above, HHTP-MB shall have a right to terminate the utilization or lease agreement between the DC and to stop the supply of water to the Zone. The DC of the negligent Zone shall compensate any costs incurred by the Tenants for the DCs of other Zones.

(2)Air Pollution

- The DC shall install air pollution measurement devices at major points agreed by HHTP-MB.
- The air quality shall be in accordance with the requirements of Vietnamese Standard issued by the Ministry of Construction (MOC) and the Ministry of Natural Resources and Environment (MONRE).

(3)Noise Pollution

- The DC shall install noise measurement devices at major points agreed by HHTP-MB.
- The noise level shall be in accordance with the requirements of Vietnamese Standard issued by the Ministry of Construction (MOC).

(4)Solid Waste

- The DC shall make their own arrangement with a company duly authorized by HHTP-MB to treat and dispose of solid waste in an approved way.
- Solid waste storage shall be strictly controlled to ensure the environmental status of the Park, especially in relation to sanitation, scenery and odors.
- The DC shall have all responsibility for claims and costs incurred by others due to damage or obstructions cause by the Zone's solid waste treatment system.

(5)Others

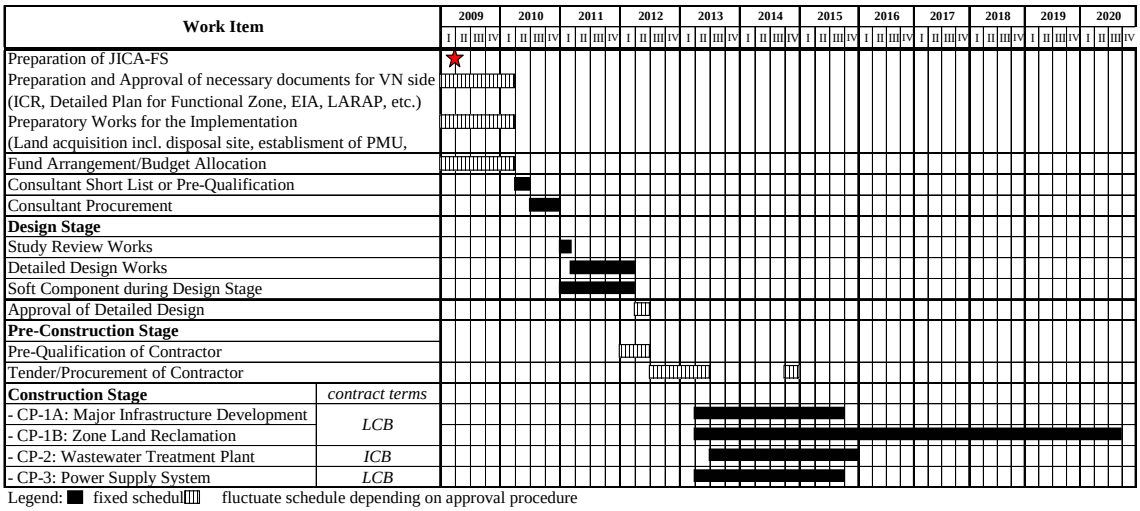
Utilization, production, storage, disposal and handling of any dangerous or hazardous material inside the Park are prohibited.

SAFETY AND SECURITY MEASURES

- The DC shall ensure the security and safety inside the Zone for all activities and properties.
- The DC shall install a fire fighting system, an emergency alarm and an emergency communication system inside the Zone.

1.4.13 Implementation Schedule

Implementation schedule is assumed as shown in Figure 1-26 below.



Legend: ■ fixed schedul▥ fluctuate schedule depending on approval procedure
sources: JICA Study Team

Figure 1-26 Implementation Schedule

Considering the scramble works on the CP-1A and CP-1B which both are civil works and utilize same limited number of the access roads, one package contract is strongly recommended from safety and efficiency view points of the construction works.

For smooth handing-over, power supply work package should be followed EVN customs and instructions, which commonly done by Local Competitive Bidding (LCB).

1.4.14 Cost Estimate

(1) Terms of Estimation

The Project cost was estimated based on the following conditions and assumptions.

(a) Price level: at the end of December 2008
(b) Exchange rate: 1 US$ = 104.91 JPY = 16,392 VND
(c) Unit costs: Most of unit costs were estimated at the local currency and 10% of the portion is allocated to foreign currency and 90 % to local currency. Unit costs of estimated imported material and equipment/plant were allocated into portion of 80 % and 20% for foreign currency and local currency respectively.
(d) Import duties: 5 % of CIF Hai Phong port prices of the costs for foreign procurement
(e) Tax for contract: 10 % of the contract amount
(f) Administration cost for the Vietnamese Government: assumed to be 2 % of construction cost and engineering service
(g) Engineering service expenses: about 12 % of the direct construction cost
(h) Price escalations are assumed to be 1.7 % for foreign currency and 7.4 % for local currency
(i) Physical contingency is assumed to be 10 %.
(j) Value Added Tax (VAT) is 10 % of the expenditure in local currency of the infrastructure portion

(2) Construction Cost

The Project work scope was divided into ODA scheme portion and Vietnam government portion.

ODA Scheme Portion

CP-1A Major infrastructures, including roads, drainage facilities, water supply, sewerage and telecommunication
CP-1B Zone land reclamation
CP-2 Wastewater treatment plant
CP-3 Power supply

Vietnam Government Scheme Portion

CP-4 Internal transport system
Land acquisition and compensation

The construction costs of the contract packages above were prepared with reference to prevailed market prices of construction resources, standard criteria and actual project cost of similar project and is estimated to be Japanese Yen 31.0 billion for ODA scheme portion and Yen 4.8 billion for the Vietnam government portion.

Table 1-23: Construction Cost

Contract Package	Infrastructure	Cost (JPY)
I. Infrastructure scheme portion		
CP-1A	**Major infrastructure development**	
	1) Preparatory works	745,751,000
	2) Tan Xa Lake protection and green areas	109,266,000
	3) Road and transportation system	6,819,567,000
	4) Drainage system	2,307,005,000
	5) Water supply	884,045,000
	6) Sewerage	420,242,000
	7) Telecommunication	2,804,880,000
	8) Technical Ditch	1,570,020,000
	9) Soil Disposal	58,737,000
	Sub-total CP-1A	**15,719,513,000**
CP-1B	**Zone land embankment**	
	1) Preparatory works	330,743,000
	2) Land reclamation	6,614,845,000
	3) Soil Disposal	484,193,000
	Sub-total CP-1B	**7,429,781,000**
CP-2	**Wastewater treatment plant**	
	1) Preparatory works	181,244,000
	2) Sewerage treatment plant	3,624,872,000
	Sub-total CP-2	**3,806,116,000**
CP-3	**Power supply**	
	1) Preparatory works	194,597,000
	2) Power supply	3,891,934,000
	Sub-total CP-3	**4,086,531,000**
	Total (CP-1A, 1B, 2 and3)	**31,041,941,000**
II. Other scheme portion		
CP-4	**Internal transport system**	
	1) Procurement of middle bus	36,960,000
	2) Procurement of large bus	311,040,000
	Sub-total CP-4	**348,000,000**
Land Acquisition and compensation		**4,480,000,000**

Source: JICA feasibility study, 2008-2009

(3) Engineering Service Cost

Based on the construction works, necessary engineering services as planned are shown below.

Table 1-24: Assumed Required of Engineer's Inputs

Engineering Stage	Foreign Engineer (Man-Month)	Local Engineer (Man-Month)
1. Design Stage	206	352
2. Pre-Construction Stage	15	27
3. Construction Supervision	350	2,074
4. Soft-Component Services	39	-
5. Project Manager/Project Implementation Adviser	117	-
Total	**727**	**2,453**

Source: JICA feasibility study, 2008-2009

The total of Japanese Yen 3.54 billion has been estimated as professional charges for the engineering service, design works, pre-construction, construction and supervision work. This will consist of Japanese Yen 2.36 billion as foreign engineering fees and Japanese Yen 1.18 billion as local engineering fees.

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CHAPTER 2 CONDITIONS OF NATURE, ENVIRONMENT, ECONOMY AND SOCIETY

2.1 CONDITION OF NATURE AND ENVIRONMENT

2.1.1 Geographical position of the study area

HHTP has total natural land area of 1586 ha and is located in the area of 6 communes that includes Tan Xa, Ha Bang, Thach Hoa, Binh Yen, Dong Truc in Thach That district and Phu cat commune in Quoc Oai district, former Ha Tay Province. The location details are as follows:

- Bordering current resident area of the Southern Road 84 (provincial road No. 420) to the North
- Bordering Agricultural and Forestry area to the South (resettlement area, Quoc Oai district)
- Bordering Hoa Lac belt route to the East.
- Bordering the National Road No. 21 to the West

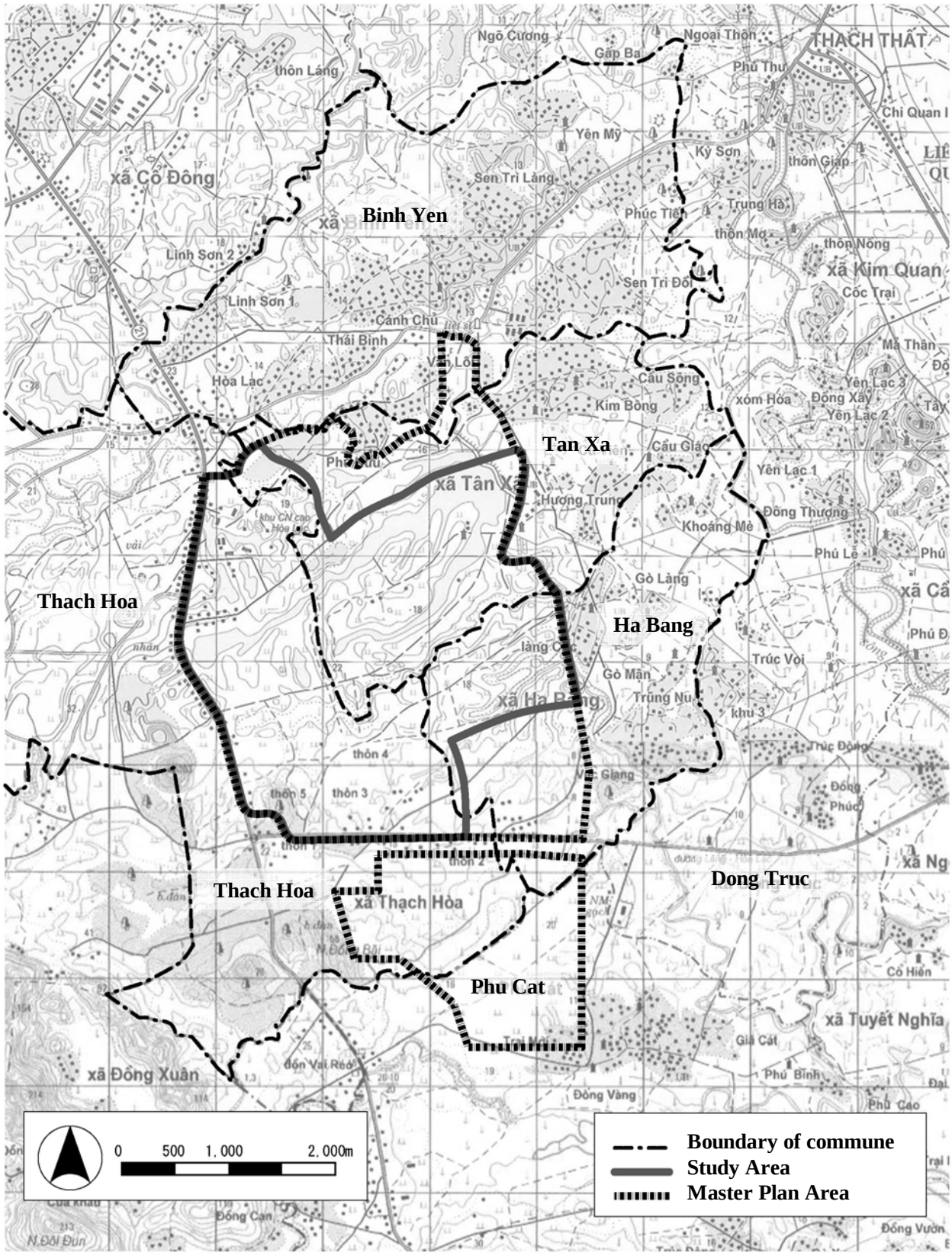
Out of the total 1,586 ha that was decided for urgent improvement by the approved Master Plan (priority area in the north of Lang Hoa Lac Highway), the current study corresponds to an area of 1,036 ha. As a result, the Tan Xa, Thach Hoa and Ha Bang commune and their land will be affected by the implementation of the project. In which:

Thach Hoa commune: All the area of this commune (approximately 490.84 ha) will be acquired.

Tan Xa commune: The area of acquired land is 295.16 ha.

Ha Bang commune: The area of acquired land is 250 ha.

Border and range of the study area is reflected in the following figure.



Proposed EIA Report for HHTP	**Figure 2-1: Location map of the Study Area**

2.1.2 Terrain characteristic

To the north of Lang Hoa Lac highway, the topography is valley shaped with low and small hills and divided into many small areas by springs and Tan Xa Lake. The land in this area mostly used to grow rice. The lowest area is mainly in the southeast region with height level varying from 3.8m to 10 m. Direct slope of the terrain from northwest to southeast has gradient of 5%. The hills in this area are not too high and rather flat with the average slope ranges from 10 to 20%. The highest hill is 22m high, average hills are about 17 m high and the average slope of hills varies from 3 to 7%. The Northern area has an area of high hills with a height varying from 41 to 55m, with an average slope of 7% gradually declining from the Northwest to the Southeast. The average height in the remaining field land varies from 8 m to 11m. There are two small springs in the Southeast area.

General assessment of terrain: This area is a favourable area for construction. However, topography need to be thoroughly studied in order to avoid any lose in the diversity of terrain and beautiful landscape of the study area.

2.1.3 Meteorological and hydrographical conditions

(1) Climate condition

Located in the Northern area of Vietnam, the climate feature of HHTP area has typical specific characteristics of a tropical, monsoon and wet area. It is hot in the summer and cold in winter. The tropical monsoon climate normally leads to four specific seasons in a year. This includes two main seasons i.e. summer and winter and two transition seasons i.e. spring and autumn.

Summer: from May to August; hot and heavy rain sometimes.

Autumn: from September to November; dry and at ease.

Winter: from November to January of the next year; cold and dry

Spring: from February to April; cold, drizzling with high humidity

(2) Air temperature:

The air temperature has a deep impact on the spread and metabolism of pollutants in the air, land surface and water source. The higher the air temperature, the higher is the impact of spreading toxins and metabolizing the environment. The result of follow up developments of air temperature of past years has shown that there is a clear change in the regional climate characteristic in the winter and the summer.

Table 2-1: Average temperature

Annual average	Month (°C)											
	1	2	3	4	5	6	7	8	9	10	11	12
23.3	16.1	16.9	19.9	23.5	27.1	28.6	29.1	28.3	27.0	24.5	21.2	17.8

Source: Statistic yearbook of Ha Tay province in 2006

(3) Radiation regime

The study area is located in the area, which has the average level of sunny hours as prevails in Vietnam. Total annually average sunny hours observed are 1595 hours. The longest sunny period is during rainy months; the average amount of sunny hours is about 168~205 hours. The least sunny month has about 43.3 hours.

The yearly average total hours of sunshine: 1464 hours

The yearly average total amount of radiation: 122 kcal/cm^2

(4) Rainfall

This area has the high average volume of rain each year.

Average rainfall: from 1,676mm to 1,839mm.

Average rainy days/year: 144 days.

The average evaporation: 989mm.

The numbers of days have drizzle rain/ year: 38.7 days.

Rainy regime of the area fluctuates immensely from year to another.

(5) Humidity

Annually average air humidity is 84%. The highest humidity period in the year is from June to November. The driest periods in the year are February, March and April with the monthly average humidity below 77%.

Table 2-2: Average relative humidity (%) of the air

Annual average	Month (%)											
	1	2	3	4	5	6	7	8	9	10	11	12
84	80	79	78	77	84	86	87	88	89	90	87	83

Source: Statistic yearbook of Ha Tay province in 2006

(6) Vapour degree

In the study area, the total amount of annually average vapour during the period of 2002- 2006 fluctuated from 864.4- 1122.2 mm, with a highest in 2003 and lowest in 2002.

The highest and lowest vapour degree in the year often happens during the period of May – July, and December-March, respectively.

The dates on which highest and lowest vapour amount were recorded are 2 October, 2004 (7.9 mm), and 9 April, 2003 (0.1 mm), respectively.

(7) Wind

In summer: The average wind speed: 2.2m/s.

The main wind direction: Southeast.

In the winter: The average wind speed: 2.8m/s.

The main wind direction: Northeast.

The average wind speed in all directions: 2.4m/s.

(8) Storm

The storm often affects this area every year. The average speed of wind is low.

According to statistics of recent years as received from Lang stations hydrometeorology, the natural phenomena occurred between 100 to 200 days with drizzling rain, fog, thunder storm, mist. Fog and sleet took place with a low frequency.

Table 2-3: **Statistic of special natural phenomena in the study area**

Year	Phenomena	Month												Day/yr
		1	2	3	4	5	6	7	8	9	10	11	12	
2002	Drizzling rain			1	2	13	18	8	7	8	3		1	61
	Thunderstorm				4	11	20	8	9	7	5			64
2003	Drizzling rain				5	10	7	10	15	6	3			56
	Thunderstorm		2		5	11	11	9	11	6	2			57
2004	Drizzling rain			5	6	10	5	6	12	8	1	2	1	56
	Fog	1												1
	Thunderstorm			4	10	9	5	6	15	7	1		1	58
2005	Drizzling rain		2	2	3	12	11	16	13	5	3	1		68
	Hail				1									1
	Thunderstorm		2	1										3
	Mist		2	3	2	14	15	15	17	7		1		76
2006	Drizzling rain			2		8	10	11	14	7	2	3		57
	Thunderstorm			2	3	11	18	11	15	6	3	2		71

Source: National Institute hydrometeorology, 2007

2.1.4 Hydrographical condition

(1) Ground water condition

The ground water in the study area has close relation of hydraulic power with big rivers in the area (Red River, Day River, Nhue River and Tich River). High level of ground water changes as per the seasons. Ground water level has pressure in the rainy season (from March to September, the high level is often -9m to -11m). In the dry season (from September to next March), the high level of ground water with pressure is often -10m to -11m. Ground water of swallet without pressure is often far from land surface 1- 1.5m.

The survey and assessment of ground water at the construction area of step 1, phase I (5 bores with depth of 90- 101m/bore) have shown that the area is located in the complex development region with diversified ground water source. Of five bores, three bores were capable to exploit from 2,500 - 2,700m3/day and night. Such ground water source mainly is at the depth of 40 - 100m; water column is high and stable on water flow; water level is recovered quickly; pure water; content of extraneous matters below permitted level.

The study area, a part of Red River delta, has characteristic of plain river valley. However, it also suffered influences due to the process of sea penetration and continent erosion. Sediment is often classified into layers with gradual raw degree under depth. In the area, there are certain layers, which contain water and are as follows:

1) Vuggularw water containing layer without pressure Halocen (qh)

This layer has wide distribution area on the study area and is covered by upper clay layer. Lithologic component of pH water containing layer includes clay sand, loam, lay, organic and botanical mud sand. On the top of the layer, there is clay layer and weak waterproofing loam, which being discontinuously distributed; it is mainly distributed in the right of Red River. The distribution depth of this waterproofing layer also changes in the large scale, 0- 0.5m in this position but 20m in other position. In the below clay and loam layer, there are layers of mud, clay mud, sand and clay sand containing water. The depth of qh layer changes from 0.0 to 15.5m, averagely 14.0m.

Ground water of qh layer is mainly ground water in the right of Red River, with partial pressure somewhere. Total small mineralization degree of the water fluctuates from 0.1g/l to 0.5g/l. Main water containing layer of qh layer is distributed mainly at a depth of 15- 25m, resulting in good

quality of water. Type of main chemical is Bio Carbonate- Clorua Canxi

Water supply source for qh water containing layer mainly is rainwater, surface water and part of water used for agricultural activities. Areas of supply and distribution are coincided. Drainage areas are river, lake, and pond in the dry season; and partially being pervious to below water containing layer (qp layer), and the rest being vapor.

Ground water behavior in qh layer has close relation with river water such as Red River, Duong River.

Ground water deposit in qh water containing layer is not much but it can supply water at small scale mainly for ingestion and daily domestic activities. Many wells as used by households are exploiting this layer.

2) Vuggular water containing layer with pressure Pleitocen (qp)

The vuggular water-containing layer with pressure Pleitocen is divided into sub-layers: superior sub-layer (qh2) that includes different types of sand, and inferior sub-layer (qh1) that includes pebble sediment, pebble, grit and sand.

(a) Superior sub-layer (qp^2)

This sub-layer is distributed in almost entire area of district. The main lithologic components are sand, clay sand, and pebble sand (in some areas). The depth of sub-layer in the roofing position varies from 25 to 18m. The depth of sub-layer positioned in the bottom varies from 39.7 to 50m. This sub-layer thickness changes from 8 to 18m, with an average of 11.67m. This sub-layer has close hydraulic relation with next water layers.

Main water supply source is rainwater, surface water, superior water and the source discharged into river and lake, and water absorbed by layers below..

(b) Inferior sub-layer (qp^1)

This sub-layer is distributed in almost entire area of the project. This water containing sub-layer plays a substantial role in water supply for urban resident. The thickness of this sub-layer varies from 6.5 to 20m. Components include sand, and pebble. The depth of sub-layer in the roofing position varies from 45.5 to 56m. The depth of sub-layer positioned in the bottom varies from 58 to 65m. Water of this sub-layer is very rich.

The main water supply source for this sub-layer is rainwater, irrigation water, water from Red River, Day River, pond and discharge of water from the superior layer. The water partially is used for daily domestic activities, and partially is discharged into Red River and Day River and rest gets evaporated.

(2) Surface water condition

Tich River is originated from Tan Vien Mountain (Ba Vi). After passing through Son Tay, it merges with Bui River at Tan Thuong Bridge- Xuan Mai. Tich River has many branches with an average width of 45m. The river is sinuous. In the dry season, it almost has no flow; in the rainy season, it often causes flood situation in the surrounding areas. The highest water level of the Tich River, which was measured in Thach That district and Quoc Oai district in 1971, was 9.35m and 8.19mm, respectively; and the lowest water level was 2.89m in 1969.

HHTP area is affected by the hydrography of the Tich River, which flows for more than 2km of length in the eastern area of the Project.. The total area of basin is 1330 km2. The width and flow of Tich river depends on the topography and the width varies from 15 to 150 m. According to a recent hydrography report, water levels in Tich river in Tan Xa commune area has a

maximum and minimum height of 8.5m and 4.5 m respectively. (Hmax = 8.5 m and Hmin = 4.5 m).

Table 2-4: **Water level in Tich River at different frequency rate (P%)**

P (%)	1	2	10	20
Hmax	10	9.5	8.5	8

Tan Xa Lake is located in the northern part of the Project area. This lake is used for irrigation and agricultural production by many communes such as Ha Bang, Thach Hoa, Co Dong, Binh Yen and some communes in Thach That District too.

Area basin of the lake: 472 ha; Area lake: 139 ha; Useful land space: 2x106 m^3; Water level Hmax = 13.5 m; Water level at rainy season :Htb = 11.0 m; Water level at Dry season: Htb = 9.5 m; Lowest water level : Hmin = 7.5 m
In the southern part of Tan Xa lake, there are some small streams and springs. Average depth of water levels in streams varies from 1.2m to 1.5 m. However, the highest water level can reach upto 2m and during dry season, water levels remains low with a variation of 0.2 to 0.5 m.

2.1.5 Geological condition

The HHTP has some geological forms:

- Newly sediment and slope sediments are distributed on all hills. These hills are mainly occupied by block stone, and criss-crossed by literate with a high pressure capacity i.e. on average ≥ 2.5Kg/cm2.
- Slope sediment consist mainly of grit and clay. In addition, sand is distributed almost in all low hill slopes.
- Swamp sediment distributed in swamp and lakes consist of mixed mud with dark clay. This sediment has the low loading capacity i.e. ≤ 1.5Kg/cm2 on average.
- The alluvium composition of the Tich Delta comprises of alluvium, sand, grit, gravel and mixing clay. The loading capacity is 1.5 < R < 2.5 Kg/cm2.

According to surveyed data of geologic union 3, this land area was originated due to the sedimention process of Tich River. As a result, it consists of stone with clay slate power and building materials. The cultivation level is thin (from 30- 50cm). Stale geology, good supporting land, and average compression ratio (Ro) of 2.5kg to 3kg/cm2 are very favorable for the constructions, which ensures construction steadiness.

Based on the construction geology documents, results of surveyed bore, and experiment result of land sample, the area stratums is divided into land layers and are described below in the order of upper to lower level:

Layer 1 - Sub-layer: This layer has complex component including field land, land for growing cassava, secondary crop, mud with the main components of loam, and clay mud containing botanic, waste and extraneous matters.

Layer 2: Yellow grey, yellow brown loam in the soft plastic to hard-plastic states. This layer is located below layer 1 and presented in almost scale of survey. The bottom depth of the layer varies from 1.5m- 3.5m. The thickness of the layer varies from 1.2m to 3m. The main component of this layer is loam. The standard supporting capacity is as follows:

Rtc = 0.8-1.2 KG/cm^2. Modular of total variation: E0 = 50-80 KG/cm^2

Layer 3 : black grey loam in the state of plastic to soft plastic. This layer exists below layer 2. The depth of layer bottom varies from 2.5m to 5.5m. The thickness of the layer varies from 1.2m to 3m. The main component of this layer is loam. Standard supporting capacity is as follows:

Rtc = 0.5-0.7 KG/cm^2. Modular of total variation: E0 = 30-50 KG/cm^2

Layer 4: black grey fine and small grain sand layer. This layer is located below the layer 3. The depth has not been defined. The main component of this layer is small and fine grain sand. Standard supporting capacity is: Rtc = 1.2 – 1.8 KG/cm2. Modular of total variation: E0 = 80-120 KG/cm2

In the studied area, there is no dynamic geologic phenomenon found that may cause any disadvantage to the construction steadiness. Based on the procedure "Transport construction in the earthquake area 22 TCN - 221 - 95", the surveyed area was found in line with earthquake level-8.

Assessment on natural condition

This area has many favourable conditions for the construction of the project facilities:

- Favourable terrain; most of the high terrain will not have any negative impact due to Tich River flood; and favourable slope for drainage. Only a small area in the Southeast must be heaved to ground bed.

- Good geology for construction

2.1.6 Pedological characteristics

Diversified condition for land establishment of Thach That district has formed 2 land groups with 6 land types (Table 2-6).

Table 2-5: Land classification of Thach That district

No	Name of land	Sign	Area	% in comparison with natural area
I	*Alluvial land*	*P*	*5633.38*	*42.73*
1	Acid alluvial land not being raised	Pe	4757.01	36.08
2	Gray alluvial land	Pg	804.57	6.10
3	Water flooded alluvial land	Pj	71.79	0.55
II	*Yellow red land*	*F*	*614.64*	*46.62*
4	Yellow red land changed due to rice growing	Fl	970.61	7.36
5	Yellow red land on ancient alluvial land	Fp	5036.94	38.21
6	Yellow red land on clay schist	Fs	139.08	1.05
	Dwelling-land		*1105.97*	*8.39*
	River, spring		*297.68*	*2.26*

Source: Land environment and use status in Thach That, Ha Tay- Institute of Geography- Vietnam Institute of Science and Technology, 2008

(1) Group of alluvial land

The alluvial land group of Thach That district has an area of 5633.38ha, making up 42.73% of the total natural area of the district. This land group is distributed in all communes of the district. Types of land under alluvial land group were established on sediment of rivers. A process of pedology is weak. The current land due to the consolidation of different grain levels still has a characteristics of layer arrangement of alluvial material. The alluvial land group of Thach That district includes 3 types of land as follows:

1) Alluvial land not being consolidated neutral, little acid: Pe

Area of 4747.01ha, makes up 36.08% of the natural area. This is distributed mainly in the Eastern communes of the district such as: Phu Kim, Huong Ngai, Di Nau, Dai Dong. The land was established by the alluvial consolidation of river system.

The land has mechanical component of average to heavy; little acid (pH KCL =5.57 - 6.02); bazo saturated degree of land layer over 60%. Concentration of organic substances in the surface layer is fair (2.20%) and gradually reduces as per the depth; Total average nitrogen is 0.022 - 0.220%; total phosphorus and potassium is 0.053 - 0.156% and 1.34 - 1.58%, respectively; integration level of phosphorus is good and of potassium is medium (9.4 – 14.3mg/100g land); Medium exchanged Cation and CEC.

2) Gray alluvial land: Pg

Area of 804.57ha, makes up 6.10% of the total natural area. This land is mainly distributed in communes of Binh Phu, Huu Bang, Binh Yen (Thach That district). The land was established on alluvial product of river system, mainly on the low terrain. The land is always in the neutral condition of strong and regular water, creating the state of an-aerobic in the land. Iron, manganese, after getting deoxidized in the water saturated environment, moves and gathers in fixed layers. Thus, creating a gray layer.

Acid land; concentration of surface layer is very high (3.87%); tonge potassium in the surface layer is fair (0.257%) and reduces gradually as per the depth; Total phosphorus in the surface layer is fair (0.212%); fair total potassium (1.69 – 1.88%); easy integration level of surface level phosphorus is fair (16.3 mg/100g land); and easy integration level of potassium is low. Absorb liquid (CEC) in layers is low. The mechanical component of land is medium.

3) Waterlogged alluvial land in the summer: Pj

Having the smallest area in the alluvial land group (71.9ha), making up 0.55% of the total natural area. This land is mainly distributed in Cam Kiem commune, Thach and That district. As land is located in the low terrain, it makes the land difficult for drainage. The waterlogged situation for a long time has caused strong gray land. The surface land layer is often brown grey; the below layers is often blue or black grey.

Acid land with high organic concentration; rich total nitrogen; fair concentration of total phosphorus; poor concentration of total potassium; easy integration level of phosphorus is poor; easy integration level of potassium is high; absorb liquid CEC is high; and Mechanical component of land is medium. In general, this is acid land but is rich in nutrient.

(2) Yellow red land group

The district has 616.64 ha of yellow red land, which makes it 46.62% of the total natural area. This land group was established by the process of being weathered of parent stones under the impact of natural factors and human activities. The physical and chemical characteristics of this land group are depended on the parent stones. From the weathered products of parent stone of different types such as clay stone, macma acid stone and sandy stone, the ancient alluvial established many different types of land. The land is established at the height of < 900m. The main process of land establishment of this group is the feralite process which resulted in formation of layer of yellow red land. In addition, there are processes of erosion, oxidization, mud forming and integration. The yellow red land group of Thach That district is classified into 3 types as follows:

1) Degraded yellow red land on the foundation of clay stone (Fs)

The smallest area in the yellow red land group with an area of 139.08ha makes up 1.05% of the total district natural area. This is mainly distributed in Ha Bang commune. The land was established due to weathered and degenerated products of clay stone such as philite, miv ca schist, clay schist, etc. In the land, the process of feralite is the main one that forms a layer of yellow red fine land. In addition, there are other processes such as erosion, acidization, mud forming and integration…

Acid land: medium concentration of organic substances and total nitrogen; phosphorus and potassium from medium to fair level; easy integration level of phosphorus and potassium is low; absorb liquid Cec is from low to medium.

2) Yellow brown land on the foundation of ancient alluvial (Fp)

Having the largest area in the yellow red land group with an area of 5036.94ha, making up 38,21% of the total district land area. This land is mainly distributed in the Western communes of Thach That district such as: Thach Hoa, Ha Bang and Binh Yen.

The land was established on the foundation of ancient alluvial land; the main establishment process is the process of feralite. In addition, there are processes of erosion, mud forming and integration.

Acid land; low total amount of substances and easy integration level; absorb liquid CEC is very low; mechanical component is from light to medium.

3) Yellow red land changed due to grow water rice (Fl)

The smallest area in the yellow red land group with an area of 139.08 ha, making up 1.05% of the total district land area. This land is mainly distributed in the communes of Kim Quang, Lai Thuong, Ha Bang, Thach That district. The land was established on the foundation of yellow red land types that was used for growing water rice once or twice per season in a year. The main process of land establishment is the process of graying layer of surface land which is often waterlogged during the time of cultivation. Besides, there are processes of erosion, oxidization, mud forming and integration…

The surface land layer is the cultivation layer being grayed, brown grey or blue gray color, depending on level of gray; the deep layer has the main color of yellow red; and being changed in color and structure due to be removed under the depth of alkaline metals, N, dissolved organic substances and glue element.

Acid land; concentration of organic substances and total nitrogen is very high; other substances concentration and easy integration level are low; absorb liquid CEC is high; the mechanical component of land is medium.

2.1.7 Land use

The condition of land use in Thach That district is shown in table 2-7.

Table 2-6: **Situation of land use in Thach That district in 2005**

No	Purpose	Code	Area	Rate
Total natural area			13,183.67	100%
1	*Agricultural area*	NNP	6,159.76	46.72
1.1	Land used for agricultural production	SXN	5,570.99	42.26
1.1.1	Land used for growing annual trees	CHN	5,281.17	40.06
	Land used for growing rice	LUA	5,003.06	37.95
	Grass land for breeding	COC	4.1	0.03

	Land used for growing other annual trees	HNK	274.01	2.08
1.1.2	Land used for growing long-standing trees	CLN	289.82	2.2
1.2	*Forestry land*	LNP	301.72	2.29
1.2.1	Forestry land used for production	RSX	301.72	2.29
1.2.2	Forestry land used for protection	RPH		0.00
1.2.3	Forestry land for special use	RĐ		0.00
1.3	Land used for aquacultural activities	NTS	208.22	1.58
1.4	Land used for salt production	LMU		0.00
1.5	Other agricultural land	NKH	78.83	0.6
2	*Non-agricultural land*	PNN	6,913.41	52.44
2.1	Land for accommodation	OTC	1,317.65	9.99
2.1.1	*Accommodation land in the rural*	ONT	1,284.35	9.74
2.1.2	*Accommodation land in the urban*	ODT	33.3	0.25
2.2	Land used for special purposes	CDG	5.082,74	38,55
2.2.1	*Head offices, administrative construction*	CTS	43,47	0,33
2.2.2	*National defence, security*	CQA	1.292,42	9,8
2.2.3	*Non-agricultural production and business*	CSK	1.820,21	18,81
2.2.4	*Public purposes*	CCC	1,926.64	14.61
2.3	Land used for religion, belief	TTN	16.5	0.13
2.4	Cemetery land	NTD	88.73	0.67
2.5	Land of river, spring, and specialized water surface	SMN	378.53	2.87
2.6	Other non-agricultural land	PNK	29.26	0.22
3	*Unused land*	CSD	110.50	0.84
3.1	Unused plain land	BCS	85.23	0.65
3.2	Unused mountainous land	DCS	25.27	0.19
3.3	Mountain without forest	NCS	-	-

Source: Data from total inventory of national land in 2005- Ministry of Natural resources and Environment, 2007

(1) Agricultural land use

Land for agricultural production:

In 2005, Thach That district had 5,570.99 ha of land for agricultural production (making up 42.26% of the total natural area of the district). Out of this land used for growing annual trees is 5,281.17 ha; and land used for growing long-standing trees is 2,289.82.

Area for growing annual trees:

Distributed mainly in the plain area. It consist of the large land area for rice cultivation (5,003.06 ha), land for other long-standing trees is 274.01ha; and grass land for breeding is 4.1 ha

Land for forestry:

Thach That district has the forest area of 301.72ha, making up 2.29% of total natural area of the district. It is mainly consist of forest land and used for production.

Land used for aquaculture activities:

Has the area of 208.22ha making up 1.58% of total natural area. It consists mainly of ponds, lakes, and rivers.

Other agricultural land:

Has an inconsiderable area of about 78.83ha (making up 0.6% of the total natural

area of the district).

(2) Non-agricultural land

Accommodation land:

Has an area of 1,317 ha (making up 9.99% of the total natural area of the district). Of this, the land area for accommodation in the urban is 33.3ha, and the land area for accommodation in rural is 1,284.35 ha.

Specialized land:

Has a total area of 5,082.74ha in 2005 (making up 38.55% of total natural area). Of this, the land area for head offices and administrative construction is 43.47 ha; the land area for national defense and security is 1,292.42 ha; the land area for non-agricultural production and business is 1,820.21 ha; and the land area for public purpose use is 1,926.64 ha

Land for religion and belief purposes:

Has a total area of 17.5 ha, making up 0.13% of the total natural area of the district

Cemetery land:

Has a toal area of 88.73ha, making up 0.67% of the natural area of the district

Land of river, spring, and specialized water surface:

Has a total area of 378.53 ha, making up 2.87% of the natural area of the district.

(3) Exploitation of unused land

The unused land of Thach That district in 2005 is 110.5 ha (making up 0.84% of natural area of the district). Of this, the unused plain land area is 85.23 ha, the unused mountain area is 25.27 ha.

2.2 PRESENT SITUATION OF NATURAL ENVIRONMENTAL FACTORS

In order to assess current state of natural environmental components in the study area as well as in the surrounding area, Institute for Environmental Science and Technology - Ha Noi University of Technology had carried out surveys during dry as well as in rainy seasons. The environmental samples were measured and analyzed technically in the Laboratory.

2.2.1 Air quality

(1) Methodology

1) Sampling date:

A network of air quality sampling stations was set up to measure and assess the air quality in the surrounding area. Information and data collected for measuring the air quality were analyzed.

The samples were taken during two seasons: the rainy season and the dry season.

In rainy season: From 23 September, 2008 to 5 October, 2008

In dry season: From 17 December, 2008 to 24 December, 2008

2) Sampling location

The geographical coordinates for the sample locations were determined based on characteristics of study area and meteorological characteristics (wind and wind direction). The locations for air quality measurement were determined accurately by global position equipment GPS-America. Geographic coordinates of observed places in the study area are shown in Table 7. Position of observed places is stated in Figure 2-2.

Table 2-7: Location of sampling station

Symbol	Sampling location	Geographical coordinate	
		East	North
AN1	Km28, Lang-Hoa Lac high way-Hamlet 2,Thach Hoa commune	$105^0$32’24.2’’	$20^0$59’25.8’’
AN2	Km 29+500-Lang Hoa Lac Highway, Hamlet 5-Thach Hoacommune	$105^0$32’16.6’’	$20^0$59’11.6’’
AN3	National No 21 (to Xuan Mai)	$105^0$32’12.6’’	$20^0$59’23.1’’
AN4	National No 21 (to Son Tay). Hamlet 8, Thach Hoa commune	$105^0$31’12.7’’	$20^0$00’12.5’’
AN5	Residential area of HHTP	$105^0$31’21.9’’	$20^0$59’53.9’’
AN6	Education zone of HHTP	$105^0$31’04.9’’	$21^0$01’18.6’’
AN7	Resetlement area	$105^0$32’19.2’’	$21^0$01’56.9’’
AN8	Opposite HHTP area, Hamet 9-Thach Hoa commune.	$105^0$31’05.0’’	$21^0$01’18.8’’
AN9	Start-up center building	$105^0$31’22.3’’	$20^0$59’50.5’’

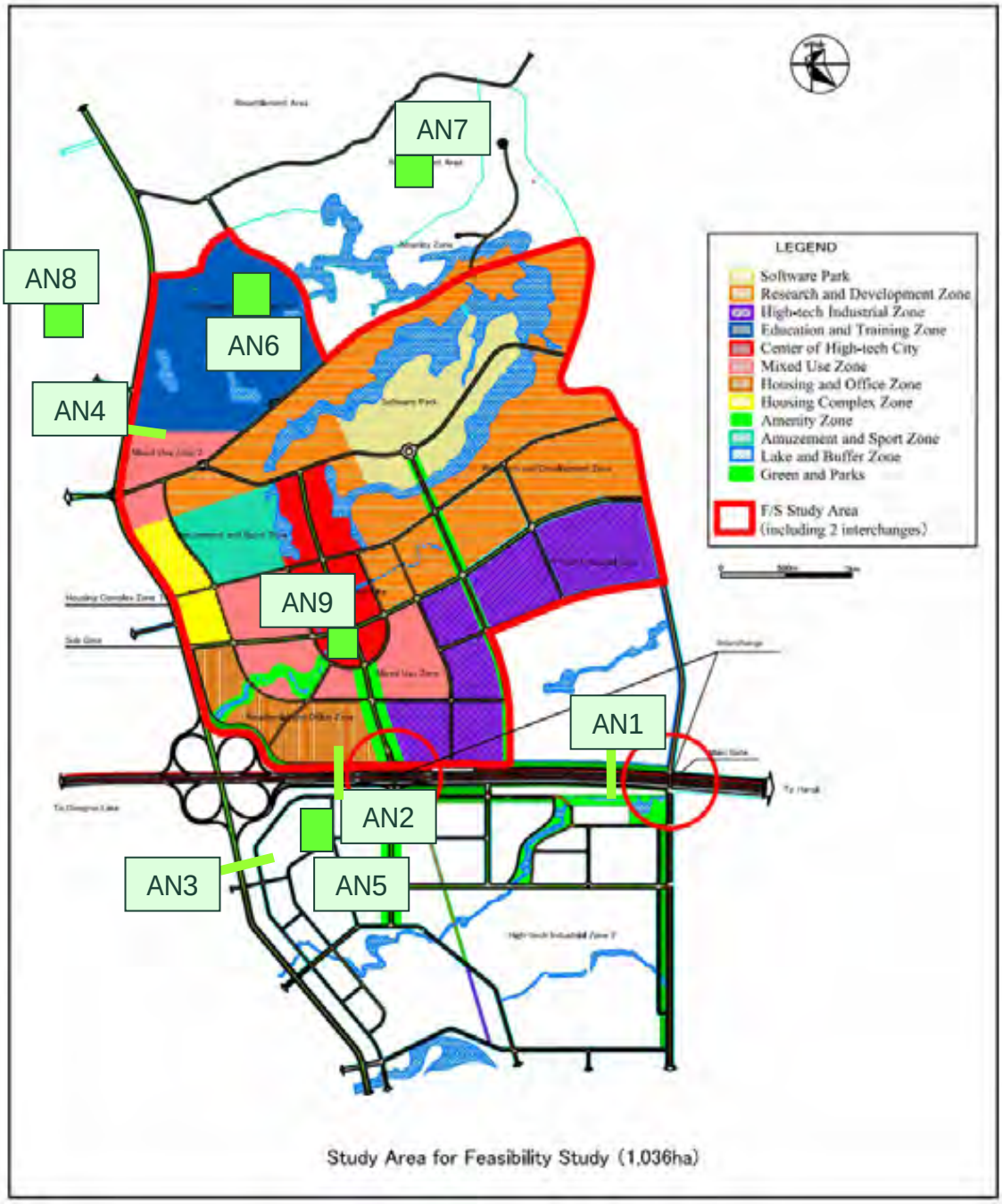


Figure 2-2: Location of sampling stations of air quality and noise


Photograph 1: Scenery of air quality survey

3) Sampling method

Meteorological data (t, humidity, v, wind direction), concentration of suspended dust and harmful exhausted fumes are recorded for 7 days (sample being taken for 24 hours). The way of sampling was as per Vietnamese Standard on Environment TCVN - 1995 (dust as per TCVN 5067-1995, SO2 as per TCVN 5971-1995, CO as per TCVN 5972-1995, NO2 as per TCVN 6137-1995). The method of analysis is also carried out as per regulation of TCVN 1995.

Parameters of microclimate such as temperature, humidity, wind speed, and noise were measured by fast measurement equipments on site.

Equipments used for recording and analysis of sample are:

- Dust sampler Sibata Model SL-15P
- Air check Sampler Model 224 - PCXR8
- Air sampler Kimoto
- Microclimate measurement machine
- Ecotech (PM 10 sampling) low volume
- UV/Vis Spectrophotometer Lambda EZ 210 Perkin Elmer

4) Methods of sample analysis

Vietnamese Standards

5) Evaluation

The assessment of surrounding air environment condition was analyzed by comparing the collected information with Vietnamese Standards on environment.

Table 2-8: **Ambient air quality standard (TCVN 5937-2005)**

Unit: µg/m3

Parameter	Mean value in 1 hour	Mean value in 8 hours	Mean value in 24 hours	Mean value in 1 year	Methods
SO2	350	-	125	50	Pararosalin of ultraviolet fluorescence
CO	30000	10000	-	-	Non dispersive Infrared spectromètre (NDIR)
NO2	200	-	-	40	Air chemical fluorescence
TSP	300	-	200	140	Sampling big volume for quantity analysis
PM10	-	-	150	50	Analyzing or separating quantity inertial

Note: PM10: Suspended dust has size of aerodynamics smaller than or equivalent to 10µm.
Dash (-): Not defined.

The SO2, TSP, NO2 and CO was compared with ambient air standard applied for 1 hour.

PM10 has been compared with an average standard of 24 hours. The major reason for this is that substant' content is very low, silky and in order to assess pollution level and get reliable data, it is necessary to use the average standard of 24 hours.

(2) Results

1) Microclimate

Results of microclimate condition measured during rainy and dry seasons in the study area are shown as in Table 2-9Table 2-10.

Table 2-9: Mean value of air quality results for 7 days at 9 sampling points at rainy season

Sampling points	Temperature (^{0}C)	Moisture (%)	Wind velocity (m/s)	Direction
AN1	27.5	64.7	1.47	Northeast
AN2	27.8	65.1	1.64	Northeast
AN3	27.7	64.8	1.67	Northeast
AN4	27.4	65.0	1.47	Northeast
AN5	27.3	64.8	1.36	Northeast
AN6	27.6	65.4	1.37	Northeast
AN7	27.5	64.7	1.33	Northeast
AN8	27.3	65.1	1.44	Northeast
AN9	27.5	66.0	0.90	Northeast

Table 2-10: Mean value of air quality results for 7 days at 9 sampling points at dry season

Sampling points	Temperature (^{0}C)	Moisture (%)	Wind velocity (m/s)	Direction
AN1	20.0	55.7	1.30	Northeast
AN2	20.3	56.0	1.35	Northeast
AN3	20.7	54.0	1.30	Northeast
AN4	20.4	54.0	1.23	Northeast
AN5	20.7	53.8	1.37	Northeast
AN6	20.6	52.9	1.26	Northeast
AN7	20.5	53.3	1.50	Northeast
AN8	20.9	53.2	1.22	Northeast
AN9	20.9	52.9	0.81	Northeast

2) Air quality

Analyzed results about the presence of pollutants in the air during rainy and dry season in the

project area and it surrounding environment are presented in Table 2-11 and Table 2-12.

Table 2-11: Air quality result in the study area in rainy season
(Samples time from 23/ 9/2008 to 5/10/2008)

Unit: mg/m^3

Parameter	AN1	AN2	AN3	AN4	AN5	AN6	AN7	AN8	AN9	TCVN 5937-2005
SO_2	0.0030	0.0035	0.0029	0.0022	0.0050	0.0044	0.0053	0.0060	0.0052	0.35
CO	3.771	3.785	4.585	3.771	4.442	3.914	3.342	4.714	2.842	30
NO_2	0.0022	0.0028	0.0026	0.0030	0.0028	0.0026	0.0037	0.0040	0.0016	0.2
TSP	5.194	0.544	2.515	3.889	12.537	0.308	0.751	0.312	0.103	0.3
PM10	0.160	0.164	0.149	0.162	0.179	0.0618	0.099	0.053	0.100	0.15

Note: 1. Value of TCVN in the tables gives limit mean value in 1hour for SO2, CO, NO2, TSP, and limit mean value in 24 hours for PM10 respectively
2. Shaded column means value do not satisfy TCVN

Table 2-12: Air quality result in study area in dry season
(Samples time from 17/12/2008 to 24/12/2008)

Unit: mg/m^3

Parameter	AN1	AN2	AN3	AN4	AN5	AN6	AN7	AN8	AN9	TCVN 5937-2005
SO_2	0.0082	0.0123	0.0084	0.0138	0.0102	0.0099	0.0105	0.0097	0.0061	0.35
CO	5.43	6.70	7.1	5.64	8.011	5.119	5.339	5.213	3.617	30
NO_2	0.023	0.0183	0.0226	0.0171	0.0209	0.0077	0.0085	0.0067	0.0028	0.2
TSP	7.128	3.83	4.73	6.38	16.32	1.247	2.321	1.036	0.160	0.3
PM10	0.230	0.336	0.267	0.412	0.368	0.109	0.117	0.047	0.112	0.15

Note: 1. Value of TCVN in the tables gives limit mean value in 1hour for SO2, CO, NO2, TSP, and limit mean value in 24 hours for PM10 respectively
2. Shaded column means value do not satisfy TCVN

(3) Examination/Comments

1) Microclimate

In the rainy season;

The climate is unstable and the same was observed during sampling time too. Sometimes it rains and sometimes does not. This is also the normal climate phenomenon of Thach That district.

The air temperature fluctuates from 27.3 – 27.8 ^oC.

The humidity fluctuates from 64.7- 66.0%.

The main wind direction is the Northeast.

The wind speed fluctuates from 0.90 – 1.67 m/s.

In the dry season;

The climate is relatively stable and characterizes typical climate of the area.

The air temperature fluctuates from 20.0 – 20.9 ^oC.

The humidity fluctuates from 52.9- 56.0 %.

The main wind direction is the Northeast.

The wind speed fluctuates from 0.81- 1.50 m/s.

2) Air environment quality

By comparing the results of the analysis of dry and rainy season with TCVN 5937-2005 has revealed:

Content of SO_2: The concentration of SO_2 in the surveyed positions fluctuates from 2.2 µg/m^3 - 6 µg/m^3, with an average of 4.16 µg/m^3 in the rainy season. In the dry season, the concentration of SO_2 fluctuates from 6.1 µg/m^3 – 13.8 µg/m^3, with an average of 9.9 µg/m^3. On comparing with Vietnamese Standard, the content of SO_2 is found much lesser than permitted standard limit (TCVN 5937-2005 is 350 µg/m^3).

Content of CO: The concentration of CO fluctuates from 2842 to 4585 µg/m^3 (average of 3393 µg/m^3) in the rainy season; and from 3617 to 8011 µg/m^3 (average of 5799 µg/m^3) in the dry season. Both of the results are under the permitted limit (TCVN 5937-2005 is 30000µg/m^3). This proves that the concentration of CO in the study area has not been polluted.

Content of NO_2: The concentration of NO_2 in the surveyed positions fluctuates from 1.6 µg/m^3 – 4.0 µg/m^3, with an average of 2.81 µg/m^3 in the rainy season. In the dry season, the concentration of NO_2 fluctuates from 2.8 µg/m^3 - 23 µg/m^3, with an average of 14.7 µg/m^3. The comparison with Vietnamese Standard has shown that the content of NO_2 is much lesser than permitted standard limit (TCVN 5937-2005 is 200 µg/m^3).

Concentration of TSP dust: In the rainy season, observations at all location except at AN9 – center area of general service, exceeded the standard by 1.56 to 62.68 times, fluctuating from 0.312 to 12.537 mg/m^3. Particularly, at sampling three areas on Lang- Hoa Lac Highway and the national road No. 21, the concentration of dust is very high: AN1: 5.194 mg/m^3, AN4: 3.889 mg/m^3, AN5: 12.537mg/m^3. In the dry season, the concentration of suspended dust (TSP) fluctuates from 0.16 mg/m^3 to 16.32 mg/m^3; the average dust concentration in observed positions is 4.795mg/m^3 (exceeding permitted standard 159.8 times). Especially, at Km 29+500- Lang- Hoa Lac Highway, hamlet 5, Thach Hoa (AN5) the highest concentration of dust was observed with a value of 16.32 mg/m3 (exceeding permitted standard by 544 times).

Concentration of PM10 dust (kinetics size of suspended dust is smaller or equivalent to 10µm) in the rainy season exceeds permitted standard in almost all of the observed positions, such as: AN1:0.16 mg/m^3 (exceeding 1.06 times), AN2: 0.164 mg/m^3 (exceeding 1.1 times). Especially, in AN5 (Lang- Hoa Lac Highway) the concentration of PM10 dust exceeded the permitted standard by 1.9 times. In the dry season, the concentration of PM10 dust fluctuates from 0.047 mg/m^3 to 0.412mg/m^3. Most of observed positions exceed or are equivalent to the permitted limit. Positions of AN1, AN2, AN3, AN5 exceed the standard by 1.53 to 2.45 times. Especially, in the position of AN4 (the National Road No. 21 (to Sơn Tây), hamlet 8, Thach Hoa, Thach That), the highest concentration of dust was observed with a value of 0.412mg/m^3, exceeding permitted standard by 2.74 times.

In summary, the data as analyzed above has shown that the situation of the air environment in project and its surrounding construction site is polluted by dust. The concentration of dust was observed high along the national road. It may be due to nearness to the transport road and the daily volume of traffic on the road. In addition, as the project is in the construction period, the construction activities might have also caused high concentration of dust at number of other positions. The air environment in the area has not had any sign of SO_2, CO and NO_2 pollution.

2.2.2 Noise

(1) Methodology

1) Sampling date

Measurement time of noise coincided with the time of air sampling.

In rainy season: From 23 September, 2008 to 5 October, 2008

In dry season: From 17 December, 2008 to 24 December, 2008

2) Sampling location

The selected sampling locations are as follows:

Table 2-13: Sampling location

Symbol	Sampling location
AN1	Km28, Lang-Hoa Lac high way-Hamlet 2,Thach Hoa commune
AN2	Km 29+500-Lang Hoa Lac Highway, Hamlet 5-Thach Hoacommune
AN3	National No 21 (to Xuan Mai)
AN4	National No 21 (to Son Tay). Hamlet 8, Thach Hoa commune
AN5	Residential area
AN6	Education zone
AN7	Resetlement area
AN8	Opposite HHTP area, Hamet 9-Thach Hoa commune.
AN9	Start-up center building

3) Sampling method

Noise measurement as described in TCVN 5965-1995 was used.

Devices used for taking sample and analysis are:

- Noise measurement equipment D-1422C
- Noise measurement Quest (USA)
- Wind velocity measurement TESTO – USA
- Global Positioning System GPS
- Noise measurement equipment Quest 2800

Photograph 2: Scenery of noise survey

4) Evaluation

The noise assessment was done by collecting information and comparing it with the Vietnamese Standard on environment.

Table 2-14: Noise in public and resident places- maximum permitted level TCVN 5949 - 1998

Unit: dB(A)

No	Area	Duration		
		6:00~18:00	18:00~22:00	22:00~6:00
1	Especially quiet areas (Hospitals, libraries, schools…)	50	45	40
2	Resident areas, hotels, accommodations, administrative agencies.	60	55	45
3	Commercial and service areas	70	70	50
4	Manufacturing areas located in the resident areas	75	70	50

Monitoring points except the point along National Road and LHLH were compared with the standard applicable to residential areas, hotel areas and administrative areas.

(2) Results

Results of the noise measurement in the surrounding area of sampling locations are shown in Table 2-15Table 2-16.

Table 2-15: **Noise measurement and microclimate at different sampling points at rainy season (From 23/ 9/2008 to 5/10/2008)**

No			Noise level Leq (dB(A))		
			6:00- 18:00	18:00- 22:00	22:00- 6:00
1	AN1	Km28, Lang-Hoa Lac high way - Hamlet 2,Thach Hoa commune	74	68	57
2	AN2	Km 29+500-Lang Hoa Lac Highway, Hamlet 5-Thach Hoa commune	70	62	54
3	AN3	National No 21 (to Xuan Mai)	76	70	58
4	AN4	National No 21 (to Son Tay). Hamlet 8, Thach Hoa commune	72	60	51
	TCVN: Manufacturing area		75	70	50
5	AN5	Residential area of HHTP	72	59	47
6	AN6	Education zone of HHTP	56	44	35
7	AN7	Resettlement area	58	48	41
8	AN8	Opposite HHTP area, Hamlet 9- Thach Hoa commune.	62	56	46
9	AN9	Start-up center	52	49	38
	TCVN: Resident areas, hotels, accommodations, administrative agencies		60	55	45

Note: Shaded column means value do not satisfy TCVN

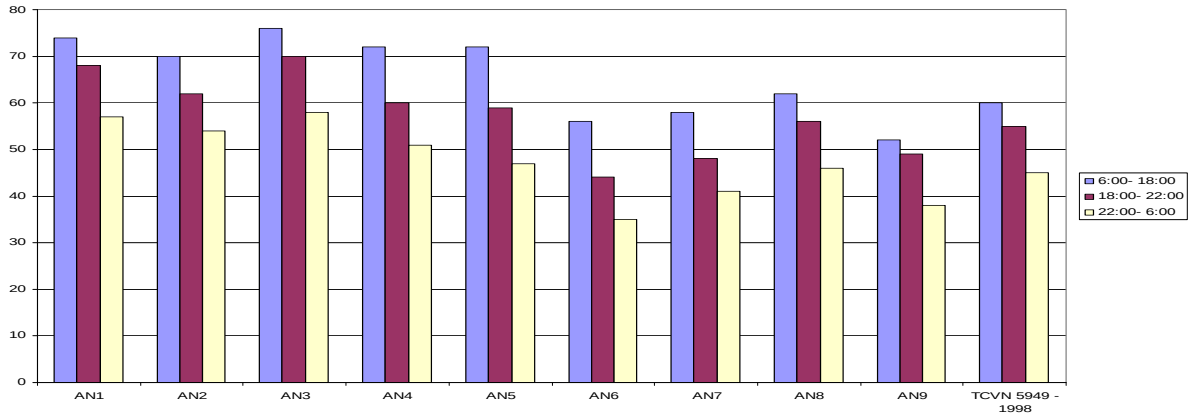


Figure 2-3: Noise measurement and microclimate at different sampling points at rainy season (From 23/ 9/2008 to 5/10/2008)

Table 2-16: Noise measurement and microclimate at different sampling points at dry season (From 17/ 12/2008 to 23/12/2008)

No			Noise level Leq (dB(A))		
			6:00- 18:00	18:00- 22:00	22:00- 6:00
1	AN1	Km28, Lang-Hoa Lac high way - Hamlet 2,Thach Hoa commune	78	72	61
2	AN2	Km 29+500-Lang Hoa Lac Highway, Hamlet 5-Thach Hoa commune	74	71	62
3	AN3	National No 21 (to Xuan Mai)	77	72	57
4	AN4	National No 21 (to Son Tay). Hamlet 8, Thach Hoa commune	74	61	52
	TCVN: Manufacturing area		75	70	50
5	AN5	Residential area of HHTP	72	59	47
6	AN6	Education zone of HHTP	56	44	35
7	AN7	Resettlement area	58	48	41
8	AN8	Opposite HHTP area, Hamlet 9- Thach Hoa commune.	62	56	46
9	AN9	Start-up center	58	47	40
	TCVN: Resident areas, hotels, accommodations, administrative agencies		60	55	45

Note: Shaded column means value do not satisfy TCVN

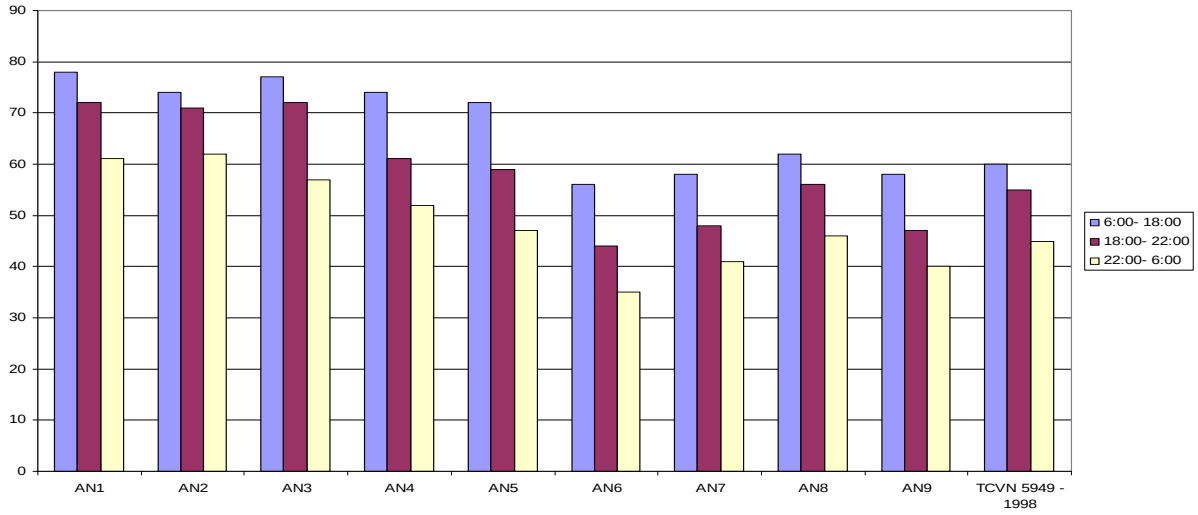


Figure 2-4: Noise measurement and microclimate at different sampling points at dry season (From 17/ 12/2008 to 23/12/2008)

(3) Examination/Comments

The survey results showed that the noise level, quantified by $L_A$eq (noise level equivalent, "A" weighted), at AN1, AN2, AN3 and AN4 is almost as high as the standard for manufacturing areas such as 75dB(A) during 6:00-18:00, 70dB(A) during 18:00-22:00, and 50dB(A) during 22:00-6:00) as defined by TCVN5949-1998. The result at AN5 indicated that this location was subject to the affect of traffic, similar to the four points along National Road 21 and LHLE. At other points, namely AN6, AN7, AN8 and AN9, the noise level was low and can be recognized as residential areas in accordance with TCVN standards.

2.2.3 Surface water quality

(1) Methodology

1) Sampling date

In rainy season: Duration of 3 days: September 25, 26 and October 1st, 2008

In dry season: Duration of 2 days: December 19, 20; 2008

Water quality assessment based on data analysis.

2) Sampling location

The surface water source that has a considerable impact on hydrologic regime in the area is Tich River. Tich River is the affluent level 1 of Red river with the width changing as per the flow and terrain, fluctuating from 15 - 150m, steepness of river red from 0.1– 0.8%. The water quality of the lake is relatively good as still the area and its environment are not yet been influenced or approached by industrial production and social life. It is to noted that the surface water source plays an important role in production of water supply in Tan Xa Lake. In addition, there's a number of small springs such as Trung Lu, and spring passing over Da Moc field to the Southern lake

Sampling stations are shown in Figure 2-5.

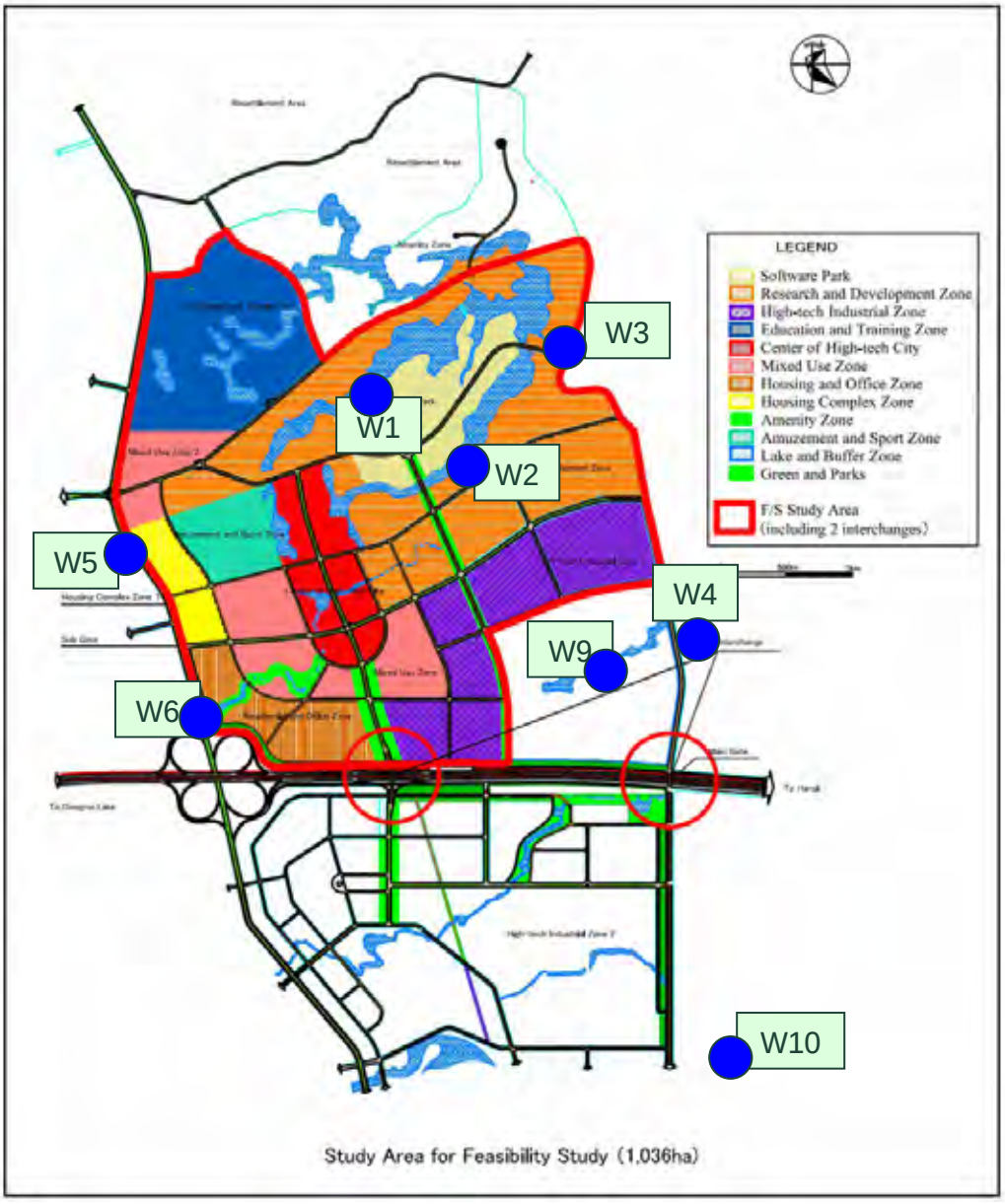


Figure 2-5: Location of sampling stations of surface water

Position coordinates of sampling places under the rainy and dry seasons are given in Table 2-17 as follows

Table 2-17: Geographical coordinate of surface water sampling points

Symbol	Sampling location	Geographical coordinate	
		North	East
W1	Tân Xã Lake	$20^0$01’08.9”	$105^0$32’09.2”
W2	Tân Xã Lake	$20^0$01’01.3”	$105^0$32’52.9”
W3	Tân Xã Lake	$20^0$00’36.2”	$105^0$32’33.0”
W4	Trung Lu Lake (outlet of HHTP)	$20^0$59’57.8”	$105^0$33’18.8”
W5	Stream inlet to HHTP	$20^0$59’53.9”	$105^0$00’19.7”
W6	Stream inlet to HHTP- Km 16 + 500, Son Tay - Xuan Mai	$20^0$59’53.9”	$105^0$31’12.0”
W9	Trung Lu lake	$21^0$00’13.5”	$105^0$33’17.2”
W10	Tích River	$21^0$58’13.5”	$105^0$34’34.5”

Sampling at Trung Lu Lake

Sampling at Trung Lu Lake

Sampling at Tich River

Sampling at Tich River

Sampling at Tan Xa Lake

Sampling at Tan Xa Lake

Photograph 3: Scenery of surface water survey

3) Sampling method

Parameters of water quality selected for measurement are based on the following principles:

Collected data of water quality must clearly indicate the present condition of water quality of surface water sources in the area.

Collected data must allow the water quality assessment of water source surveyed as per current environmental standards.

Devices used for taking sample and analysis are:

- Water quality control equipment (WQC-TOA, Japane)
- BOD determination equipment WTW Model 602 (Germany)
- COD analysis equipment Palintest (England)
- Atomic absorption spectrophotography (AAS) Perkin Elmer (USA)
- Inductively coupled plasma mass spectroscopy (ICP-MS) (USA)
- Lambda EZ 210 Spectrometer Perkin Elmer (USA)
- VA 646 Profession (Switzerland)
- GC-2010 Shimazhu – Japan using GC-EDC

4) Methods of sample analysis

Analyzing and summarizing water sources in the study area. The parameters of observation and assessment of water quality in this report are based on water quality parameters as specified in "Vietnamese Standards" on environment with characteristics of the study area. Applied norms of water quality, and method of measurement and analysis are presented briefly in the table below. .

Table 2-18: **Parameters to assess water quality and analyse method**

No	Parameter	Analysis methods
Physical criteria		
1	pH	Measure on site
2	Water temperature	Measure on site
3	TSS	APHA 2540 D
Oxygen criteria		
4	BOD_5 (20^0C)	APHA 5210 B
5	COD	APHA 5220 C
Chemical criteria		
6	Organic Phosphorus	APHA 4500-P
7	PO_4^{3-}	APHA 4500-P
8	Total Phosphorus	TCVN 6499:1999
9	Fe	APHA 3500-Fe
10	Total N	TCVN 6498:1999
11	Amoniac (NH_4^+)	ISO 7150/1
12	Nitrite (NO_2^-)	APHA 4500-NO_2^- B
13	Nitrate (NO_3^-)	APHA 4500-NO_3^- E
14	Sulphate (SO_4^{2-})	TCVN 6656-2000
15	Coliform	APHA 9221
16	Hg	EPA 6020A
17	Sulphide (S^{2-})	APHA 4500-S^{2-} D
18	Sn	APHA 3500-Sn
19	As	APHA 3500-As D

No	Parameter	Analysis methods
20	Total oil and grease	Gravity method
21	Cd	APHA 3500-Cd B,C
22	Pb	APHA 3500-Pb B,C
23	Clo dư	APHA 4500-Cl B
24	Cl^-	TCVN 6194:1996
25	Cr (VI)	APHA 3500-Cr D
26	Cu	APHA 3500-Cu B,C
27	Zn	APHA 3500-Zn B,C
27	Mn	APHA 3500-Mn B,C
28	Ni	APHA 3500-Ni B,C
29	PCBs	APHA 6431 C
30	Total organo-chlorinated pesticides	APHA 6630 D
31	Total alpha ray, total beta ray strength	APHA 7110 B

5) Evaluation

Assessment method of water quality is done by measurement and inspection of water quality. For this necessary information on the amount and quality of the selected water was collected and analyzed. Information of the collected water quality were compared with Vietnamese Standard on Environment. The Standard TCVN 5942-1995 is used to assess water quality.

Table 2-19: Regulation of parameter limits and concentration of pollutants in surface water

No	Parameter	Unit	Value limit	
			A	B
1	pH	-	6 – 8.5	5.5 - 9
2	BOD5 (20^oC)	mg/l	< 4	< 25
3	COD	mg/l	>10	>35
4	DO	mg/l	$\geq$ 6	$\geq$ 2
5	SS	mg/l	20	80
6	As	mg/l	0.05	0.1
7	Ba	mg/l	1	4
8	Cd	mg/l	0.01	0.02
9	Pb	mg/l	0.05	0.1
10	Cr (VI)	mg/l	0.05	0.05
11	Cr (III)	mg/l	0.1	1
12	Cu	mg/l	0.1	1
13	Zn	mg/l	1	2
14	Mn	mg/l	0.1	0.8
15	Ni	mg/l	0.1	1
16	Fe	mg/l	1	2
17	Hg	mg/l	0.001	0.002
18	Sn	mg/l	1	2
19	NH_4-N	mg/l	0.05	1
20	F	mg/l	1	1.5
21	NO_3-N	mg/l	10	15
22	NO_2-N	mg/l	0.01	0.05
23	CN	mg/l	0.01	0.05
24	Phenol	mg/l	0.001	0.02
25	Oil and grease	mg/l	None	0.3
26	Detergent	mg/l	0.5	0.5
27	Coli form	MPN/100ml	5000	10000
28	Total chemical plant protection (except DDT)	mg/l	0.15	0.15
29	DDT	mg/l	0.01	0.01
30	Total α	Bq/l	0.1	0.1
31	Total β	Bq/l	1.0	1.0

Analysis results of surface water in the study area are compared with TCVN 5942-1995 (B column) because Tich river, Trung Lu and Tan Xa lakes are used for irrigation, aquatic culture and serve the living humans in the study area.

(2) Result

The analyzed survey results of surface water quality are shown in Table 2-20 andTable 2-21.

Table 2-20: Analysis result of surface water quality on rainy season

No	Parameter	Unit	Results								TCVN 5942-1995 (Column B)
			W1	W2	W3	W4	W5	W6	W9	W10	
1.	pH	-	6.8	7.1	6.9	7.2	6.2	6.4	6.6	7.2	5.5-9
2.	BOD_5	mg/l	8	16	18	12	7	6	9	16	< 25
3.	COD	mg/l	19	22	29	24	14	9	23	29	< 35
4.	SS	mg/l	9	12	23	7	29	11	14	23	80
5.	As	mg/l	0.004	0.007	0.010	0.002	<0.001	<0.001	<0.001	0.006	0.1
6.	Cd	mg/l	0.003	0.008	0.003	<0.001	0.0002	0.0002	0.0002	0.004	0.02
7.	Pb	mg/l	0.013	0.017	0.023	0.001	0.004	0.005	0.007	0.024	0.1
8.	Cr(VI)	mg/l	0.0008	0.0012	0.0014	0.0009	0.0032	0.0024	0.0029	0.0031	0.05
9.	Cr(III)	mg/l	0.0003	<0.0001	<0.0001	<0.0001	0.0018	0.0021	0.0027	<0.0001	1
10.	Cu	mg/l	0.116	0.123	0.097	0.098	0.029	0.121	0.066	0.097	1
11.	Zn	mg/l	0.289	0.321	0.272	0.002	0.077	0.004	0.003	0.166	2
12.	Ni	mg/l	0.017	0.021	0.113	0.224	0.231	0.352	0.117	0.160	1
13.	Fe	mg/l	0.600	0.621	0.577	0.680	2.170	1.770	1.121	1.150	2
14.	Hg	mg/l	<0.0001	<0.0001	<0.0001	0.0003	<0.0001	<0.0001	<0.0001	0.0002	0.002
15.	Sn	mg/l	0.0001	0.0007	0.0002	0.0031	0.0013	0.0009	0.0026	0.0008	2
16.	NH_4^+-N	mg/l	1.527	1.648	1.712	1.396	0.266	0.553	0.611	1.383	1
17.	NO_3^--N	mg/l	0.035	0.038	0.037	0.451	0.111	0.485	0.442	0.897	15
18.	NO_2^-- N	mg/l	0.007	0.012	0.014	0.016	0.004	0.025	0.036	0.051	0.05
19.	CN^-	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.05
20.	Phenol	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.02
21.	Oil and Grease	mg/l	0.11	0.12	0.11	0.07	0.06	0.09	0.010	0.06	0.3
22.	Coliform	MPN /100ml	2,400	2,400	2,400	13,000	2.4×10^4	9,000	10,000	90,000	10,000
23.	Total chemical plant protection (except DDT)	mg/l	0.000006	0.000006	0.000006	0.000017	0.000022	0.000019	0.000015	0.000038	0.15
24.	DDT	mg/l	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.01
25.	Total Alpha	Bq/l	0.01	0.02	0.01	0.01	0.03	0.02	0.03	0.03	0.1
26.	Total Beta	Bq/l	0.02	0.02	0.02	0.02	0.01	0.03	0.02	0.04	1.0
27.	Total P	mg/l	0.31	0.29	0.33	0.65	0.72	0.51	0.42	0.59	-
28.	Total N	mg/l	3.1	3.6	4.2	3.8	5.0	3.2	3.8	3.5	-
29.	Cl^-	mg/l	8	9	12	7	4	3	5	6	
30.	Mn	mg/l	0.074	0.023	0.044	0.003	0.054	0.176	0.103	0.097	0.8
31.	PCBs	mg/l	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-

Note: Shaded column means value do not satisfy TCVN

Note: TCVN 5942 - 1995 This standard specifies parameter limits and maximum allowable concentration of pollutants in surface water. This standard is applicable to control of quality of surface water source

Table 2-21: Analysis result of surface water quality on dry season

No	Parameters	Unit	Result								TCVN 5942-1995 (Column B)
			W1	W2	W3	W4	W5	W6	W9	W10	
1.	pH	-	7.6	7.4	7.7	7.8	6.4	6.8	7.6	6.9	5.5-9
2.	BOD_5	mg/l	11	13	19	6	3	11	9	15	< 25
3.	COD	mg/l	17	20	25	12	7	16	17	29	< 35
4.	SS	mg/l	18	16	20	9	35	14	23	17	80
5.	As	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.012	0.1
6.	Cd	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.02
7.	Pb	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.1
8.	Cr(VI)	mg/l	0.0003	0.0009	0.0022	0.0009	0.0017	0.0028	0.0032	0.0029	0.05
9.	Cr(III)	mg/l	<0.0001	<0.0001	<0.0001	<0.0001	0.006	0.011	0.0012	0.0014	1
10.	Cu	mg/l	0.123	0.117	0.102	0.029	0.072	0.029	0.065	0.058	1
11.	Zn	mg/l	0.023	0.014	0.117	0.006	0.032	0.018	0.012	0.138	2
12.	Ni	mg/l	0.009	0.013	0.007	0.009	0.112	0.231	0.065	0.036	1
13.	Fe	mg/l	0.193	0.177	0.273	1.17	1.78	1.32	1.326	1.236	2
14.	Hg	mg/l	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.002
15.	Sn	mg/l	0.0002	0.0003	0.0002	0.0026	0.0017	0.0011	0.0032	0.0009	2
16.	NH_4^+-N	mg/l	0.439	0.512	0.447	0.155	0.332	0.277	0.515	0.612	1
17.	NO_3^--N	mg/l	0.015	0.027	0.011	0.035	0.214	0.113	0.347	0.689	15
18.	NO_2^-- N	mg/l	<0.001	0.009	0.008	<0.001	0.002	0.013	0.022	0.016	0.05
19.	CN^-	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.05
20.	Phenol	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.02
21.	Oil and grease	mg/l	0.08	0.18	0.17	0.14	0.09	0.13	0.08	0.16	0.3
22.	Coliform	MPN /100ml	2200	2400	3600	3000	12000	7000	6200	4200	10,000
23.	Total chemical plant protection (except DDT)	mg/l	0.000005	0.000003	0.000007	0.000021	0.000017	0.000023	0.000024	0.000033	0.15
24.	Total Alpha	Bq/l	0.02	0.02	0.01	0.01	0.04	0.02	0.02	0.04	0.1
25.	Total Beta	Bq/l	0.02	0.02	0.02	0.02	0.01	0.03	0.02	0.04	1.0
26.	DDT	mg/l	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.01
27.	Total P	mg/l	0.61	0.33	0.57	0.53	0.46	0.64	0.48	0.73	-
28.	Organic Phosphorus	mg/l	0.29	0.32	0.41	0.27	0.32	0.39	0.23	0.42	-
29.	Total N	mg/l	1.7	2.2	1.9	2.0	2.4	2.9	3.2	3.4	-
30.	Cl^-	mg/l	6	8	7	12	17	8	7	11	-
31.	Mn	mg/l	<0.001	0.008	0.011	0.009	0.017	0.065	0.087	0.114	0.8
32.	Animal oil	mg/l	0.32	0.26	0.13	0.35	0.22	0.28	0.14	0.41	-
33.	Vegetable	mg/l	0.11	0.23	0.17	0.12	0.18	0.21	0.17	0.26	-
34.	PCBs	mg/l	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-

Note: Shaded column means value do not satisfy TCVN

*Note: * TCVN 5942 - 1995: This standard specifies parameter limits and maximum allowable concentration of pollutants in surface water. This standard is applicable to control of quality of surface water source.*

(3) Examination/Comments

Value of pH and other parameter such as COD, BOD_5, TSS, $N\text{-}NO_3^-$ are lower than

Vietnamese Standard 5942 - 1995 (column B) in both the seasons (rainy season and dry season)

The concentration of parameter NH_4^+ in rainy season was higher than standard at W1, W2, W3, W4, W10. The concentration of this parameter at monitoring point was lower than the standard in dry season.

The concentrations of contaminants in surface water such as Pb, Cd, Cr, Zn, As, Mn, Cu, Sn, Ni are lower than the standard.

The parameters such as DDT, Oil and grease, total alpha and total beta are also lower than the permitted standard.

In rainy season, total Coli form index in some positions exceeded in comparison to the permissible standard from 1 to 24 times (from 10,000 MPN/100ml to 24.10^4 MPN/100ml). However in dry season, most of the samples analyzed were within the permissible limit, except the sample W5 (Stream inlet to HHTP) where Coli form exceeded 1.2 times of the standard. The reason might be due to the domestic wastewater discharge from surrounding residential areas.

In conclusion, the surface water of the study area is slightly polluted by the presence of high concentration of $NH4^+$-N and biological index (Total Coliform). Many factors can cause these pollutions such as untreated domestic wastewater, the wastewater from handicrafts from nearby households, untreated direct discharge to the water bodies by existing companies (all river flowed through study area and irrigation system of Thach That).

2.2.4 Ground water quality

(1) Methodology

1) Sampling date

In rainy season: Duration of 3 days: September 25, 26 and October 1st, 2008
In dry season: Duration of 2 days: December 19, 20; 2008
Water quality assessment based on the data analysis.

2) Sampling location

Table 2-22: Geographical coordinate of ground water sampling points in rainy and dry season

Symbol	Location	Geographical Coordinate	
		North	East
W0	Supply water taken at office zone	$20^0$59',50,5"	$105^0$31',22,3"
W7	Underground water taken at bore well with depth 40m	$21^0$00'12,5''	$105^0$32'12,7''
W8	Dug well water sample with depth less than 15 m	$20^0$59'26,2''	$105^0$32'01,8''
W11	Dug well water sample with depth less than 15 m at the Eastern of project	$21^0$00'35,8''	$105^0$31'17,3''
W12	Underground water taken at bore well with depth 40m m at the Eastern of project	$21^0$00'56,8''	$105^0$32'52,2''

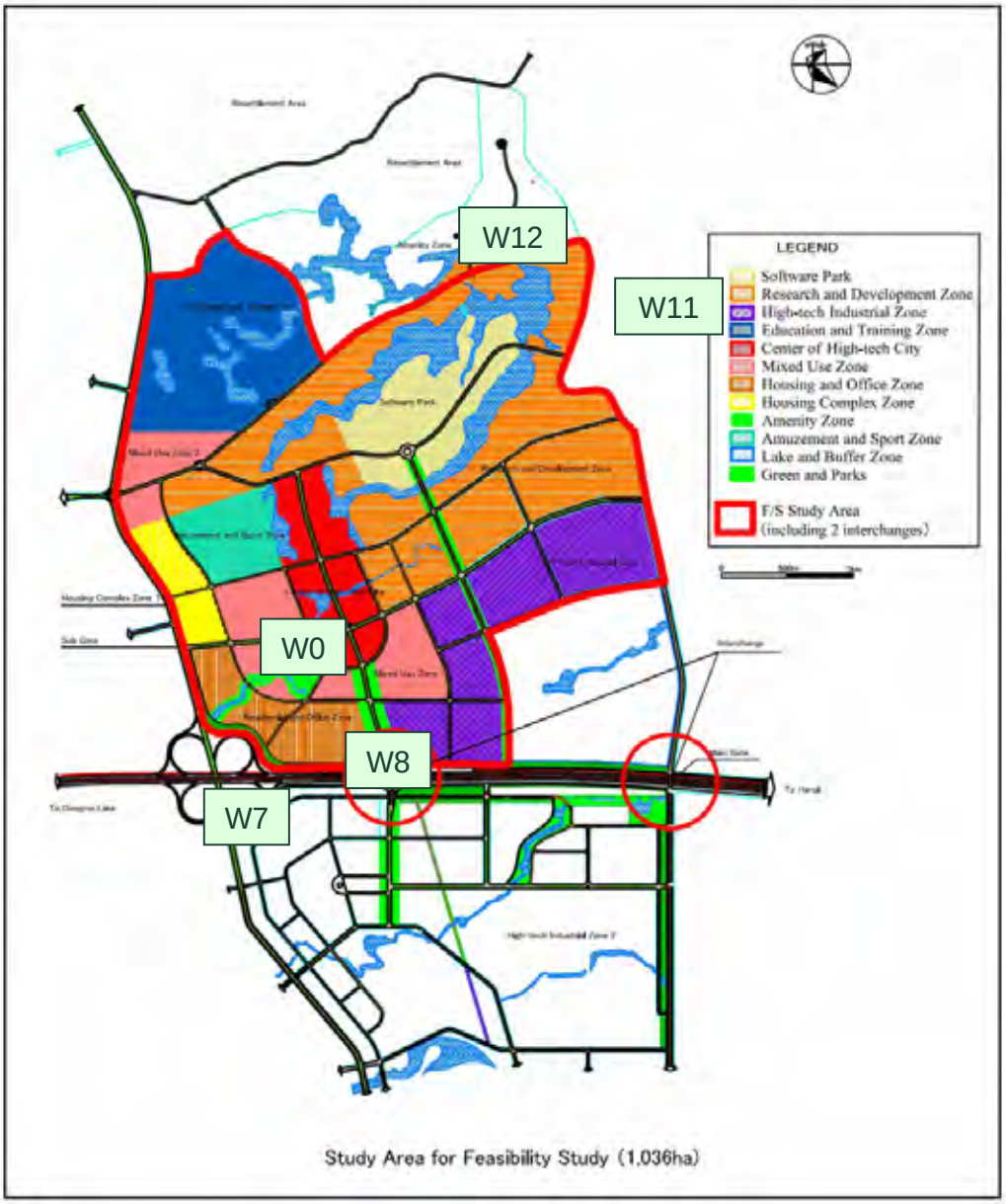


Figure 2-6: Sampling locations of ground water samples

3) Sampling method

The parameters selected for water quality measurement are based on the following principles:

Collected data of water quality must clearly indicate the present condition of water quality of ground water sources in the area.

Collected data must allow the water quality assessment of water source surveyed as per current environmental standards.

Devices used for taking sample and analysis are:

Water quality control equipment (WQC-TOA, Japan)
Atomic absorption spectrophotography (AAS) Perkin Elmer (USA)
Inductively coupled plasma mass spectroscopy (ICP-MS) (USA)

Lambda EZ 210 Spectrometer Perkin Elmer (USA)
VA 646 Profession (Switzerland)
GC-2010 Shimazhu – Japan using GC-EDC

4) Methods of sample analysis

Applied norms of water quality, and method of measurement and analysis are presented briefly in the table below .

Table 2-23: **Parameters to assess water quality and analyse method**

No	Parameter	Analysis methods
Physical criteria		
1	pH	Measure on site
2	Total solid	APHA 2540 B
Chemical criteria		
3	Fe	APHA 3500-Fe
4	Amoniac (NH_4^+)	ISO 7150/1
5	Nitrite (NO_2^-)	APHA 4500-NO_2^- B
6	Nitrate (NO_3^-)	APHA 4500-NO_3^- E
7	Sulfate (SO_4^{2-})	TCVN 6656-2000
8	Coliform	APHA 9221
9	Hg	EPA 6020A
10	Sn	APHA 3500-Sn
11	As	APHA 3500-As D
12	Hardness	APHA 2340 C
13	Color	TCVN 6185:1996
14	Cd	APHA 3500-Cd B,C
15	Pb	APHA 3500-Pb B,C
16	Cl^-	TCVN 6194:1996
17	Total Cr	APHA 3500-Cr B,C
18	Cu	APHA 3500-Cu B,C
19	Zn	APHA 3500-Zn B,C
20	Mn	APHA 3500-Mn B,C
21	Ni	APHA 3500-Ni B,C

5) Evaluation

Table 2-24: Limited value of polluted parameters in ground water

No	Parameter	Unit	TCVN 5944:2005
1	pH	-	6.5 - 8.5
2	Color	Pt - Co	5 – 50
3	Hardness ($CaCO_3$)	mg/l	300 – 500
4	TS	mg/l	750 – 1500
5	Arsenic	mg/l	0.05
6	Cd	mg/l	0.01
7	Cl^-	mg/l	200 – 600
8	Pb	Mg/l	0.05
9	Cr (VI)	Mg/l	0.05
10	CN^-	mg/l	0.01
11	Cu	mg/l	1.0
12	F^-	mg/l	1.0
13	Zn	mg/l	5.0
14	Mn	mg/l	0.1 - 0.5
15	NO_3^-	mg/l	45
16	Phenol	mg/l	0.001
17	Fe	mg/l	1 – 5
18	SO_4^-	mg/l	200 – 400
19	Hg	mg/l	0.001

No	Parameter	Unit	TCVN 5944:2005
20	Se	mg/l	0.01
21	Fecal coli	MPN/100 ml	Negative
22	Coliform	MPN/100 ml	3

(2) Result

Table 2-25: Analysis results of ground water quality in study area on rainy season.

No	Parameter	Unit	Results			TCVN 5944-2005
			W0	W7	W8	
1.	pH	-	7.4	6.5	4.9	6.5-8.5
2.	Color	Pt/Co	9.9	18.1	137.2	5-50
3.	Turbility	NTU	0	0.70	0.25	-
4.	Hardness	$mgCaCO_3/l$	109.6	89.2	107.2	300-500
5.	TS	mg/l	180	110	162	750-1500
6.	As	mg/l	0.002	<0.001	<0.001	0.05
7.	Cd	mg/l	< 0.001	< 0.001	< 0.001	0.01
8.	Cl^-	mg/l	4	4	48	200-600
9.	Pb	mg/l	< 0.001	< 0.001	< 0.001	0.05
10.	Cr	mg/l	0.004	0.008	0.006	0.05
11.	CN^-	mg/l	<0.001	<0.001	<0.001	0.01
12.	F^-	mg/l	0.12	0.14	0.13	1
13.	Zn	mg/l	0.027	0.024	0.028	5
14.	NO_3^--N	mg/l	0.358	0.373	8.671	45
15.	Phenol	mg/l	< 0.001	< 0.001	< 0.001	0.001
16.	Fe	mg/l	0.743	0.370	0.213	1-5
17.	NO_2^--N	mg/l	<0.001	<0.001	0.014	-
18.	SO_4^{2-}	mg/l	1.7	<1	8.9	200-400
19.	Hg	mg/l	0.0004	<0.0001	<0.0001	0.001
20.	E.Coli	MPN/100ml	-	-	300	-
21.	Coliform	MPN/100ml	2	4	2,400	3
22.	NH_4^+-N	mg/l	<0.020	0.198	0.392	-
23.	S^{2-}	mg/l	0.0016	0.0254	0.0027	-
24.	Mn	mg/l	0.003	0.005	0.033	0.1-0.5

Note: Shaded column means value do not satisfy TCVN

TCVN 5944-2005: This standard specifies parameter limits and allowable concentration of pollutants in ground water.

Table 2-26: Analysis results of ground water in the study area in dry season.

No	Parameter	Unit	Results					TCVN 5944-2005
			W0	W7	W8	W11	W12	
1.	pH	-	7.1	6.8	6.4	6.8	6.6	6.5-8.5
2.	Odor	-	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless
3.	Color	Pt/Co	6	12	36	21	13	5-50
4.	Turbility	NTU	0	0.3	0.2	0	0	-
5.	Hardness	$mgCaCO_3/l$	103	96	124	23	12	300-500
6.	TS	mg/l	228	132	156	178	216	750-1500
7.	As	mg/l	< 0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.05
8.	Cd	mg/l	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.01
9.	Cl^-	mg/l	5	6	24	5	8	200 - 400
10.	Pb	mg/l	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.05
11.	Cr(VI)	mg/l	< 0.001	< 0.001	0.006	0.002	0.002	0.05
12.	CN^-	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	0.01
13.	Cu	mg/l	0.015	0.033	0.011	0.023	0.008	1.0
14.	F^-	mg/l	0.13	0.11	0.17	0.23	0.13	1
15.	Zn	mg/l	0.032	0.026	0.029	0.006	0.006	5

No	Parameter	Unit	Results					TCVN 5944-2005
			W0	W7	W8	W11	W12	
16.	NO_3^--N	mg/l	0.235	0.218	5.478	0.575	0.423	45
17.	Phenol	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
18.	Fe	mg/l	0.921	0.547	0.415	0.081	0.093	1-5
19.	NO_2^--N	mg/l	<0.001	0.003	0.021	< 0.001	< 0.001	-
20.	SO_4^{2-}	mg/l	2	<1	4.8	<1	<1	200 - 400
21.	Hg	mg/l	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001
22.	E.Coli	MPN/100ml	-	-	300	-	-	-
23.	Coliform	MPN/100ml	2	0	12	20	12	3
24.	NH_4^+-N	mg/l	0.034	0.107	0.226	0.043	0.056	-
25.	S^{2-}	mg/l	0.0021	0.032	0.0012	0.0032	0.0016	-
26.	Cr(III)	mg/l	0.002	0.003	0.005	0.003	0.003	
27.	Mn	mg/l	0.011	0.009	0.028	<0.001	0.004	0.1-0.5

Note: Shaded column means value do not satisfy TCVN

Note: - TCVN 5944-2005: This standard specifies parameter limits allowable concentration of pollutants in ground water.

(3) Examination/Comments

Monitoring results of water in the study area show that most concentrations of contaminants in ground water has not exceeded the permissible standard limit as defined by TCVN 5944- 1995 for ground water. Only the Coli form index in W8 was found 800 times higher than standard. However on dry season this value is lower. Coli form index at W8, W11, W12 are 4 to 6.6 times higher than standard. This sample was taken from the shallow well and it may be contaminated due to its location near to the castle area. In general the underground water in the area is quite pure and can be use for domestic usage.

2.2.5 Soil and Sediment quality

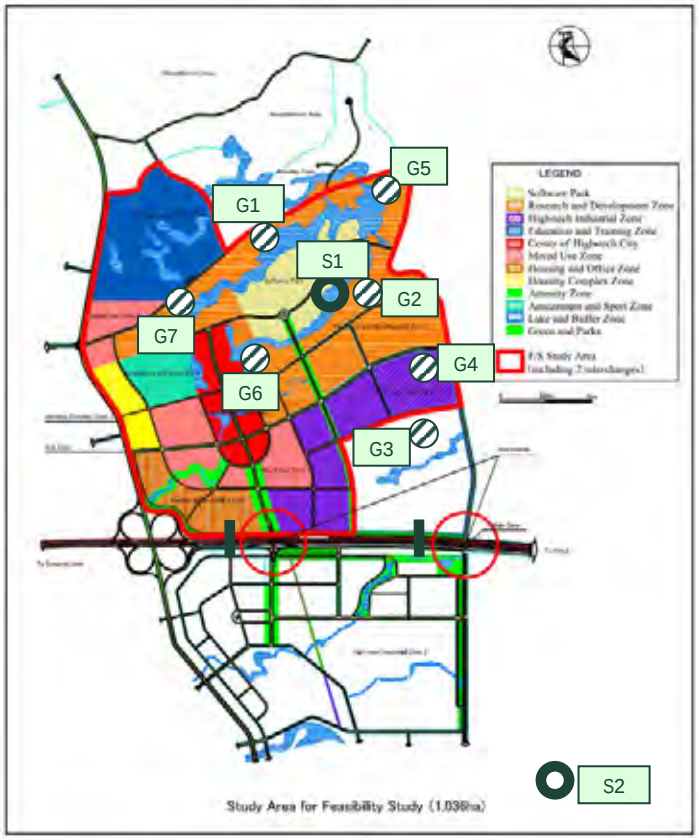
(1) Methodology

1) Sampling date

- In rainy season: 30 September 2008.
- In dry season: 20 December 2008

2) Sampling location

Location of monitoring point is shown in Figure 2-7.



Sediment:
S1: Tan Xa lake
S2: Tich river

Soil:
G1: Near Tan Xa lake
G2: Near Tan Xa lake
G3: Near Trung Lu Lake
G4: Near Pump station
G5: Near Pump station
G6: Near Trung Lu Lake
G7: Hamlet 8, Thach Hoa Commune

Figure 2-7: Location of sampling stations of soil samples

Table 2-27: Geographical coordinate of samples points

Symbol	Location	Geographical coordinate	
		North	East
Sediment			
S2	Tich Rive	$21^0$58'16.6''	$105^0$34'34.5''
S1	Tan Xa Lake	$21^0$01'01.3''	$105^0$32'52.9''
Soil			
G1	Near Tan Xa Lake	$21^0$01'09.1''	$105^0$32''11''
G2	Near Tan Xa Lake	$20^0$01'17.6''	$105^0$32'21.5''
G3	Near Trung Lu Lake	$21^0$00'13.5''	$105^0$33'17.2''
G4	Near Pump station	$21^0$00'13.5''	$105^0$33'17.2''
G5	Near Pump station	$21^0$01'01.1''	$105^0$32'51.2''
G6	Near Trung Lu Lake	$21^0$00'52.9''	$105^0$31'50.5''
G7	Hamlet 8, Thach Hoa Commune	$21^0$00'35.4''	$105^0$31'11.5''

3) Sampling method

Monitoring and samples soil was done under regulation of Vietnamese Standard.

The equipments used for analysis are:

UV-Vis 1201 (Shimadzu – Japan)

Inductively coupled plasma mass spectroscopy (ICP-MS) (USA)

Lambda EZ 210 Spectrometer Perkin Elmer (USA)

4) Evaluation

Table 2-28: Maximum allowable total concentration of As, Cd, Cu, Pb, Zn in soil (mg/kg dry soil, surface soil)

Parameter	Agriculture land	Forestry land	Relic land	Commercial land	Industrial land
As	12	12	12	12	12
Cd	2	2	5	5	10
Cu	50	70	70	100	100
Pb	70	100	120	200	300
Zn	200	200	200	300	300

The analyzed data were compared with TCVN 7209-2002 that is applicable for agricultural land. This was done because at present all the sampling locations are used for growing agriculture trees.

(2) Result

1) Soil quality

Table 2-29: Analysis results of soil samples in the study area in rainy season

Parameter	Unit	Results			TCVN 7209-2002
		G1	G2	G3	Agricultural land
pH_{KCl}	-	3.9	4.0	3.9	-
Cu	mg/kg	120	149	163	50
Pb	mg/kg	123	110	143	70
Cd	mg/kg	0.03	0.06	0.12	2
Zn	mg/kg	177	198	139	200
Fe	mg/kg	66,900	59,320	67,102	-
As	mg/kg	18	12	11	12

Note: Shaded column means value do not satisfy TCVN

Note: TCVN 7209: 2002: This standard specifies parameter limits and maximum allowable concentration of heavy metal in soil depending on the purpose of land usage.

Table 2-30: Analysis results of soil samples in the study area in dry season

Parameter	Unit	Results							TCVN 7902-2002
		G1	G2	G3	G4	G5	G6	G7	
pH_{KCl}	-	3.7	3.9	3.9	3.6	3.6	3.8	4.1	-
Cu	mg/kg	58.9	68.7	54.2	43.4	56.8	66.0	57.3	50
Pb	mg/kg	42	54	14.6	10.6	13.8	17.3	14.7	70
Cd	mg/kg	0.02	0.18	0.75	0.34	0.34	0.40	0.36	2
Zn	mg/kg	56.7	92.6	83.8	72.4	94.0	118	49.3	200
Fe	mg/kg	66900	59320	44600	60920	37200	51600	42156	-
As	mg/kg	18	12	9.8	11.2	7.2	9.3	7	12

Note: Shaded column means value do not satisfy TCVN

TCVN 7209-2005: This standard specifies parameter limits and maximum allowable concentration of heavy metal in soil (soil samples used for agricultural purposes)

2) Sediment quality

Table 2-31: Analysis results of sediment samples in the study area in dry and rainy season

Parameter	Unit	S1		S2	
		Rainy season	Dry season	Rainy season	Dry season
pH_{KCl}	-	7.1	7.2	6.8	7.1
Pb	mg/kg	39	24	150	72

Cd	mg/kg	< 0.03	0.05	0.15	0.13
Zn	mg/kg	183	101	1080	989
Cu	mg/kg	84	27	150	121
Fe	mg/kg	26.040	32.032	12.660	13.760
Mn	mg/kg	285	116	1674	536
As	mg/kg	12	8	60	32
Total organic chlorinated pesticide	mg/kg	0.0184	0.0092	0.0211	0.0036

(3) Examination/Comments

1) Soil quality

The selected land in the phase 1 has a total area of 1,036 hectares and is located in 3 communes: Thach Hoa, Tan Xa and Ha Bang commune. Total area of the agricultural land is 985 hectares which occupies 62.1% and forest land occupies a very small area of 68.4 hectares accounting for 4.3%. As the most of the land area is used for growing rice and vegetable, the pesticides still are in use and are quite popular.

On the rainy season: Parameter As in G1 is 18 mg / kg (higher than standard 1.5 times) and two samples i.e. G2, G3 has approximately allowable standards. The concentration of Cu has exceeded the standard by 2.4 -3.26 times, Pb content is also higher than Vietnamese standard by 1.57 to 2.86 times and Zn concentration was found close to the standard at all monitoring points. The concentration of Fe in all the samples was found very high. This may be due to the typical characteristic of the soil in Thach That district area.
On the dry season:

2) Sediment quality

Currently, there are no standard for sediment. However, based on the analysed results, the concentration of Fe, Mn were found rather high. The reason may be as during rainy season, the concentrations of some heavy metals in the soil were washed away and thus remains in the sediment.

Conclusions:

Air environment quality

Currently, the air quality in the study area is determined by 4 emission sources: transport, construction, production and daily domestic activities. Out of these 4 main sources, currently are transport and construction has a major impact on the air quality in the area. The air pollution caused by industrial production is not considerable because the area of industrial production is still small. The air pollution caused by daily domestic activities is partial and temporarily by pollutant sources.

Ambient air in almost all of the surveyed samples in the study area have polluted by dust and PM10. These are mainly due to the transportation and construction activities. In the dry season, in most of the observation positions the value of the suspected TSP and PM10 dust either exceeded or were close to permissible limit. Other pollution parameters (CO, SO_2, NO_2) are much smaller than permitted standards. Analyzed results have shown the contents of air pollution parameters in the dry season are higher than that in the rainy season.

Noise quality

Position causing noise in the study area is mainly due to the following processes:

- Transport process of raw material, activities of land clearance and construction;

- Means of transport
- Activities of units surrounding the project
- Activities of business and daily domestic activities of households living along the route 420 and the national road no. 21

The major noise pollutant source in the study area is due to the transport activities on Lang- Hoa Lac Highway and the national road 21A. These have been causing considerable impacts on the environment in the area. All sampling points along the the Highway and around residential area in the study area are polluted slightly by noise pollution.

Surface water quality:

Polluted slightly with NH_4^+ and coli form. This is manily due to the discharge of untreated daily domestic waste water into surface water sources by nearby households.

Groundwater quality

The ground water in the commune is exploited by the bore wells at 30- 40m depth; and a sample of well water is at the depth of 15m . The quality of ground water is relatively good; only one observed sample has content of microorganism exceeding permitted standard. This might have been polluted during the process of application. In general, ground water in the studied area is fairly pure due to geological structure. The ground water is being filtered by natural late rite layer and it can be used for daily domestic activities and ingestion.

Soil and sediment quality:

Soil sample in the study area was assessed. In the rainy season: Content of heavy metals such as As, Zn are within the permitted standard. Content of other metals such as Cu, Pb exceeds the standard limit; content of iron is very high both in land sample and sediment in the study area. However, in the dry season, parameters of pollution are under permitted limit.

2.2.6 Ecological survey

(1) Methodology

1) Survey date

From 10 October 2008 to 18 October 2008

From 22 November 2008 to 28 November 2008

2) Survey area

Binh Yen, Tan Xa, Ha Bang, Dong Truc, Thanh Hoa belong to Thach That District and Phu Cat commune of Quoc Oai District

3) Survey method

Two major methods were used for this study.

(a) Field trip:

This is a traditional method in which statistics of animal and plant species are investigated in the ecosystem and the method follows:

- Plantation ecosystem
- Agricultural ecosystem
- Population ecosystem

- Aquatic ecosystem
- Standstill water ecosystem
- Running water ecosystem

Species were observed in all topographic region, and in different ecosystem. The investigation was carried out on defined lines or points during day time, by naked eyes or with binocular, singing, footprint etc, and through interviews with local people. This all investigation was combined the with specific features of species (size, color, biological characteristics etc) and standard color set of species in order to understand about species components, distribution and the number of some species.

(b) In- door method:

For plant survey: we have utilized Indochina's general Flora vol. I – VII (Lecomte, 1907 – 1951); Viet Nam Plants I-III (Pham Hoang Ho, 1991-1993); Flora Viet Nam, Laos, Cambodia (Aubreville, 1960-1980); Checklist of plant species of Viet Nam (Le Trong Cuc, coordinator, Volume I,II,III,2001, 2003 – 2005); Viet Nam Red Data book (Part II- Plants, 2007); Viet Nam Red List (Natural Science and Technology Publishing house, 2007).

For animal survey: Bird of South – East Asia (Craig Robson, 2005); for mammalia: mainly based on Dang Huy Huynh et al., 1994; for Aves: based on Vo Quy, Nguyen Cu, 1995. Further reference to Ben F. king and Edward Dickinson, 1975; for reptiles and amphibians: according to Nguyen Van Sang et al., 2005. Freshwater fisher of Northern Viet Nam (Maurie Kottelat, 2001); Decree No 32/2006/N§-CP dated 30th March 2006 of the Government

(2) Results

1) Plant species components

The checklist of the vascular plants of the HHTP zone is presented in the table below:

1. Ordinal number
2. Scientific name
3. Viet Nam name
4. Plantation ecosystem
5. Agricultural ecosystem
7. Standstill water ecosystem
8. Running water ecosystem
9. Use

The following 9 groups as follows:

1. Timber trees
2. Medicinal plants
3. Man's foods plants
4. Fodder for animals plants
5. Ornamental plants
6. Essential oil, resin, tannin plants
7. Constructional material plants

8. Toxic plants

9. Paper, fiber plants

Table 2-32: The Plants Composition follows ecosystems

No	Scientific name	4	5	6	Aquatic ecosystem		9
					7	8	
	I. Polypodiophyta						
	1. Gleicheniaceae						
1	*Dicranopteris linearis* (Burm.f.) Underw.	+					
	2. Marsileaceae						
2	*Marsilea quadrifolia* L.		+				
	3. Pteridaceae						
3	*Pteris ensiformis* Burm.f.	+					
4	P.vittata L.	+					
	4. Salviniaceae						
5	*Salvinia cucullata* Roxb. ex Bory		+	+	+	+	
6	*S. natans* (L.) All.		+	+	+	+	
	5. Schizaeaceae						
7	*Lygodium flexuosum (L) Sw.*	+					
	II. Gymnospermae						
	1. Araucariaceae						
1	*Araucaria heterophylla* (Salib.) Franco			+			5
2	*Thuja oriientalis* L.			+			5
	2. Cycadaceae						
3	*Cycas revoluta* Thunb.			+			5
4	*C. szechuannensis* Sheng S L. K. Fu			+			5
	3.Pinaceae						
5	*Pinus merkusii* Jungh. T Vriese			+			1,5
	4. Podocarpaceae						
6	*Podocarpus pilgeri Foxw.*						5
	III. Angiospermae						
	A. Dicotyledones						
	1. Amaranthaceae						
1	*Alternanthera sessilis* (L.) A. DC.		+	+			
2	*Amaranthus lividus* L.		+	+			3
3	*Am. spinosus* L.		+	+			4
4	*Am. tricolor* L.			+			3
5	*Celosia argentea* L.			+			2,5
6	*C. argentea* L. var. *cristata* (L.) Kuntze			+			2,5
	2. Anacardiaceae						
7	*Allospondias lakonensis* (Pierre) Stapf			+			1,3
8	*Dracontomelum duperreanum* Pierre			+			1,3
9	*Mangifera indica* L.			+			1,3
	3. Annonaceae						
10	*Annona squamosa* L.			+			1,3
11	*Canaga odorata* (Lamk.) Hook.f. & Thom			+			5,1
	4. Apiaceae						

No	Scientific name	4	5	6	Aquatic ecosystem		9
					7	8	
12	*Anethum graveolens* L.		+	+			3
13	*Apium graveolens* L.		+	+			3
14	*Centella asiatica* (L.) Urb. in Mart.		+	+			3,2
15	*Coriandrum sativum* L.		+	+			3
16	*Eringium foetidum* L.		+	+			2,3
17	*Oenanthe javanica* (Blume) DC.						3
	5. Apocynaceae						
18	*Alstonia scholaris* (L.) R. Br.			+			1,2,5
19	*Catharanthus roseus* (L.) G. Don		+	+			2,5
20	*Nerium oleander* L.			+			2,5
21	*Plumeria rubra* L.			+			2,5
22	*Thevetia peruviana (Pers.) K. Schum.*			+			2,5
	6. Araliaceae						
23	*Polyscias fruticosa (L.) Harms*			+			2,5
24	*Scheflera heptaphylla (L.) Frodin*			+			2
	7. Asclepiadaceae						
25	*Calotropis gigantea* (L.) Dryand. ex Ait.f.			+			2
26	*Telosma cordata* (Burm.f.) Merr.			+			2,3,5
	8. Asteraceae						
27	*Ageratum conyzoides* L.	+	+	+			2
28	*Art. vulgaris L.*			+			2
29	*Bidens pilosa L.*	+	+	+			2
30	*Blumea lanceolaria* (Roxb.) Druce			+			2,3
31	*Chrysanthemum coronarium* L.		+	+			2,3,5
32	*Crassocephalum crepidioides* (Benth.) S Moore	+	+	+			2,3
33	*Dahlia pinnata* Cav.		+	+			2,5
34	*Eclipta prosata* (L.) L.	+	+	+			2
35	*Elephantopus scaber L.*		+	+			2
36	*Enydra fluctuans* Lour.				+	+	2,3,4
37	*Eupatorium odoratum* L.		+	+			2
38	*Gerbera jamesonii* Bolus ex Hook.f.		+	+			2,3
39	*Gnaphalium polycaulon* Pers.		+				2,3
40	*Lactuca raborowski* Maxim.		+				
41	*L.sative L.*		+	+			2,3
42	*Lactuca sativa* L.		+	+			2,3
43	*Pluchea indica* (L.) Less.			+			2
44	*Tagetes erecta* L.		+	+			2,5
45	*Taraxacum offianale*(Weber) Wigg.		+	+			2,3
46	*Xanthium strumarium L.*		+	+			2
	9. Basellaceae						
47	*Basella rubra* L.		+	+			2,3
	10. Bombacaceae						
48	*Bombax malabaricum* DC.			+			1,2
49	*Ceiba pentandra* (L.) Gaertn.			+			2,9
	11. Boraginaceae						
50	*Heliotropium indicum* L.		+	+			2

No	Scientific name	4	5	6	Aquatic ecosystem		9
					7	8	
	12. Brassicaceae						
51	*Brassica campestris* L.		+	+			2,3
52	*Br. juncea* (L.) Czem		+	+			2,3
53	*Br. oleracea* L. var. *botrytis* L.		+	+			3
54	*Br. oleracea* L. var. *capitala* L.		+	+			2,3
55	*Br. oleracea* L. var. *gongylodes* L.		+	+			2,3
	13. Cactaceae						
56	*Cereus peruvianus* (L.) Mill.			+			5
57	*Epiphyllum oxypetalum* (DC.) Haw.			+			2,5
58	*Opuntia dillenii* (Ker - Gawl.) HaW.			+			2
	14. Caesalpiniaceae						
59	*Delonix regia* (Bojer ex Hook.) Raf.			+			2,5
60	*Erythrofleum fordii Oliv.*			+			1,5
61	*Peltophorum dasyrrachis (Miq.) Kurz*			+			1,5
62	*Tamarindus indica L.*			+			1,3,5
	15.Caricaceae						
63	*Carica papaya L.*			+			2,3
	16. Combretaceae						
64	*Terminalia catapapa L.*			+			1,5
	17. Convolvulaceae						
65	*Ipomoea aquatica Forsk.*		+	+	+	+	2,3,4
66	*I. batatas (l.) Poir*		+	+			2,3,4
	18. Crassulaceae						
67	*Kalanchoe pinnata (Lank.)*			+			2,5
	19. Cucurbitaceae						
68	*Benincasa hispida (*Thunb.ex Murr.) Cogn.		+	+			2,3
69	*Cucurbita pepo L.*		+	+			2,3
70	*Lagenaria siceraria (Mol.) Standl.*		+	+			2,3
71	*Luffa cylindrica (L.) M. Roem.*		+	+			2,3
72	*Momordica cochinchinensis (Lour.) Spreng.*			+			2,3,8
	20. Cuscutaceae						
73	*Cuscuta japonica* Choisy			+			2
	21. Ebenaceae						
74	*Diospyros kani* Thumb.			+			2,3,6
	22. Euphorbiaceae						
75	*Alchornea rugosa* (Lour.) Muell. Arg.	+					2,9
76	*Breynia fruticosa* (L.) Hook. f.	+	+	+			2
77	*Euphorbia antiquorum* L.			+			2
78	*E. pulcherima Willd. ex Klotzsch*			+			2,5
79	*E. thymifolia* L.	+	+	+			2
80	*Excoecaria cochinchinensis* Lour.			+			2,5
81	*Manihot esculenta* Crantz.		+	+			2,3,4
82	*Phyllanthus reticulaus Poir.*	+	+	+			2
83	*P. urinaria* L.	+	+	+			2
84	*Ricinus communis* L.		+	+			2,6
85	*Sauropus androgynus* L. Merr.		+	+			2,3

No	Scientific name	4	5	6	Aquatic ecosystem		9
					7	8	
	23. Fabaceae						
86	*Arachis hypogea L.*		+				3,6
87	*Erythrina variegata L.*			+			2,3,5
88	*Lablab purpureus (L.) Sweet*			+			3,2
89	*Pueraria montawa (Lour.) Merr. Var chinensis*			+			2,3,9
	(ohwi) Maesen						
90	*Tephrosia candida (Roxb.) DC.*	+	+				
91	*Uaria crinata (L.) Desv.*	+	+	+			2
92	*Vigna radiantn (L.) Wilczek*		+				2,3
93	*V. unguiculata (L.) Walp. Ssp. Cylindrica (L.)Verd.*		+				2,3
	24. Lamiaceae						
94	*Elsholtzia ciliata* (Thunb.) Hyland.		+	+			2,3,6
95	*Mentha arvensis* L.		+	+			2,6
96	*Ocimum basilicum* L.		+	+			2,3,6
97	*Perilla frutescens* (L.) Britt.		+	+			2,3,6
	25. Lecythidaceae						
98	*Barringtonia acutangula* (L.) Gaertn.			+			1,2,3,5
	26. Lythraceae						
99	*Lagerstroemia speciosa* (L.) Pers.		+	+			2,5
100	*Rotala indica* (Willd.) Koehne		+				
	27.Magnoliaceae						
101	*Michelia champacal* L.			+			1,2,5,6
	28. Malvaceae						
102	*Hibiscus rosa-sinensis* L.			+			2,5
103	*Sida rhombifolia* L.	+	+	+			2,9
104	*Urena lobata* L.	+	+	+			2,9
	29. Melastomataceae						
105	*Melastoma malabathrica L.*	+					2
	30. Meliaceae						
106	*Khaya senegalensis (Ders.) A. Juss*			+			1,5
107	*Melia azedarach L.*			+			1,2,8
	31. Mimosaceae						
108	*Acacia auriculiformis* A. Cunn. ex Benth.	+	+	+			1
109	*Ac. mangium* Willd.	+	+	+			1
110	*Leucaena leucocephala* (Lam.) De Wit			+			1,2,9
111	*Mimosa diplotricha* C. Wright ex Sauvalle	+	+	+			
112	*M. pigra* L.	+	+	+			
113	*M. pudica* L.	+	+	+			2
	32. Moraceae						
114	*Artocarpus heterophyllus* Lamk.			+			1,2,3
115	*B. papyrifera* (L.) L' HĐr ex Vent.			+			2,4,5,9
116	*Ficus benjamina* L.			+			5,2
117	*F. elastica* Roxb. ex Horn.			+			2,5
118	*F. g*laberrima *Blume*			+			5

No	Scientific name	4	5	6	Aquatic ecosystem		9
					7	8	
119	*F. racemosa* L.			+			2,3,4
120	*F. religiosa* L.			+			2,5,6
121	*Morus alba* L.		+	+			2,3,4
122	*Streblus aspera* Lour.			+			2,3,5
	33. Myrcinaceae						
123	*Maesa perlarius* (Lour.) Merr.	+		+			2,3
	34. Myrtaceae						
124	*Callistemon citrinus* (Curt.) Skeels			+			2,5
125	*Cleistocalyx operculatus* (Roxb.) Merr. & Perry			+			2,3
126	*Eucalyptus camaldulenssis Dehnhart.*	+	+	+			1,2,9
127	*E. camphora* R.T. Baker	+	+	+			1,6
128	*Eucalyptus exserta* F. Muell.	+	+	+			1,6
129	*Psidium guajava L.*			+			2,3
130	*Rhodomyrtus tomentosa (Ait.) Hassk.*	+					2,3
131	*Syzygium jambos* (L.) Alston			+			1,3
	35. Nelumbonaceae						
132	*Nelumbo nucifera* Gaertn.		+		+	+	2,3,5
	36. Nyctaginaceae						
133	*Bougainvillea brasilliensis* Rauesch.			+			5
	37. Nymphaeaceae						
134	*Nymphaea pubescens* Willd.		+		+	+	2,5
135	*N. rubra Roxb. ex Salisb*				+	+	2,5
	38. Ochnaceae						
136	*Ochna atropurpurea* DC.			+			5
137	*Ochna integerrima* (Lour.) Merr.			+			5
	39. Oleaceae						
138	*Jasminum sambac* (L.) Ait.			+			5
	40. Onagraceae						
139	*Ludwigia adcendens* (L.) Hara				+	+	2
140	*L. octovalis* (Jacq.) Raven		+		+	+	2
	41. Oxalidaceae						
141	*Averrhoa carambola* L.			+			3
142	*Oxalis corniculata* L.		+	+			2,3
	42. Piperaceae						
143	*Piper belte* L.			+			2,3
144	*P. lolot* C. DC.			+			2,3
	43. Plantaginaceae						
145	*Plantago major* L.	+	+	+			2
	44. Polygonaceae						
146	*Antigonon leptopus* Hook. & Arn.			+			5
147	*Polygonum barbatum* L.		+	+	+		2
148	*P. chinense* L.		+	+	+		2
149	*P. hydropiper* L.		+	+	+		2
150	*P. odoratum* Lour.		+	+			2,3
	45. Portulacaceae						
151	*Portulaca oleracera* L.			+			2,3

No	Scientific name	4	5	6	Aquatic ecosystem		9
					7	8	
	46. Rhamnaceae						
152	*Zizyphus mauritiana* Lamk.		+	+			2,3
	47. Rosaceae						
153	*Prunus persica* (L.) Batsch			+			2,3,5
154	*Pr. salicina* Lindl.			+			2,3,5
155	*Rosa chinenssis* Jacq.			+			2,5
156	*R. cymosa* Tratt.			+			2,5
157	*R. odorata* (Andr.) Sweet			+			2,5
	48. Rubiaceae						
158	*Hedyotis corymbosa*		+				2
159	*Ixora chinensis* Lamk.			+			2,5
160	*Paederia scandens* (Lour.)			+			2,3
	49. Rutaceae						
161	*Citrus aurantifolia* (Christm. & Panzer.) Swingle			+			2,3
162	*C. grandis* (L.) Osb.			+			2,3
163	*C. nobilis* Lour.			+			2,3
164	*C. reticulata* Blanco			+			2,3
165	*Fortunella japonica* (Thunb.) Swingle			+			2,5
	50. Sapindaceae						
166	*Dimocarpus lomgan* Lour.		+	+			2,3,1
167	*Lichi chinensis* Sonn.		+	+			2,3,1
	51. Sapotaceae						
168	*Chrysophyllum cainito* L.			+			3,2
169	*Manillara zapota* (L.) P. Royen			+			2,3
170	*Pouteria sapota* (Jacq.) H. Moore & Dtearn.			+			3
	52. Saururaceae						
171	*Hottuynia cordata* Thunb.		+	+			2,3
	53. Scrophulariaceae						
172	*Paulownia fortunei (Seem.) Hemsl.*			+			1,2,9
	54. Solanaceae						
173	*Capsicum frutescens* L.		+	+			2,3
174	*Lycianthes biflora* (Lour.) Bitter		+	+			2
175	*Lycopersicon esculentum* Mill.		+	+			2,3
176	*Solanum album* Lour.		+	+			2,3
177	*S. nigrum* L.		+	+			2,8
178	*S. tuberosum* L.		+				2,3
	55. Tiliaceae						
179	*Muntingia calabura* L.			+			2,3,5
	56. Verbenaceae						
180	*Clerodendrum chinensis (Osbeck.) Mabb.*		+	+			2,5
181	*Cl. japonicum* (Thunb.) Sweet		+	+			2,5
182	*Stachytarphyta jamaicensis* (L.) Vahl	+	+	+			2
183	*Verbena officinalis* L.	+	+	+			2
	B. Monocotyledones						
	1. Agavaceae						

No	Scientific name	4	5	6	Aquatic ecosystem		9
					7	8	
1	*Polianthes tuberosa* L.		+	+			5,6
	2. Alismataceae						
2	*Sagittaria sagittaefolia*L.		+		+	+	2,4
	3. Alliaceae						
3	*Allium ascalonicum* L.		+	+			2,3
4	*All. fistulosum* L.		+	+			2,3
5	*All. Satirum* L.		+	+			2,3
	4. Amaryllidaceae						
6	*Crinum asaticum* L.		+	+			2,5
7	*Cr. ensifolium* Roxb.		+	+			2,5
8	*Hippeastrum puniceum* (Lamk.) Kuntze		+	+			2,5
	5. Araceae						
9	Aglaonema modestum Schott ex Engl.			+			5
10	*Colocasia esculenta* (L.) Schott		+	+	+	+	2,4
11	*C. esculenta (L.) Schott var. antiquarum*		+	+			2,3
12	*C. gigantea (Blume ex Hassk.) Hook.f.*			+			3,4
13	*Pistia stratiotes L.*			+	+	+	2,4
14	*P. repens (Lour.) Druce*			+			2,5
	6. Arecaceae						
15	*Areca catechu L.*			+			2,3,5
16	*Calamus tetradactylus Hance*			+			7
17	*Caryota mitis Lour.*			+			
18	*Chamaedorea elegans Mart*			+			5
19	*Cocos nucifera L.*			+			1,2,3,7
20	*Licuala fatua Becc.*			+			5
21	*Livistona saribus (Lour.) Merr. ex A. Chev.*			+			1,5,7
22	*Roystonea regia* (H.B.K.) Cook			+			5
	7. Asteliaceae						
23	*Cordyline fruticosa* (L.)			+			2,5
	8. Cannaceae						
24	*Canna edulis* Ker - Gawl.			+			3,4
25	*C. indica l.*			+			5
	9. Commelinaceae						
26	*Aclisia secundiflora (Blume) Bakh.f.*		+	+			
27	*Commelina difusa Burn.f.*		+	+			2
	10. Convallariaceae						
28	*Peliosanthes tete* Andre.			+			2
	11. Cyperaceae						
29	*Cyperus compressus L.*		+				4
30	*C. bifformis* L.		+				4
31	*C. diffusus Vahl*		+				2,4
32	*C. distans* L.		+				7
33	*C. iria L*		+				2,4,7
34	*C. rotundus* L.		+	+			2,4
35	*Fimbrystylis aestivalis (Retz.) Vahl*		+				4
36	*F. miliacea (L.) Vahl*		+				4,7
37	*Eleocharis congesta D.*		+	+			4

No	Scientific name	4	5	6	Aquatic ecosystem		9
					7	8	
38	*Scirpus grossus L.f.*		+				
	12. Dioscoreaceae						
39	*Dioscorea alata L.*			+			3,2
40	*D. esculeta (Lour.)Burk*			+			3,2
	13. Dracaenaceae						
41	*Dracaena angustifolia Roxb.*			+			2,3,5
42	*Dr. fragrans (L.) Ker - Gawl.*			+			5
43	*Sansevieria canaliculata Carr.*			+			5
	14. Eriocaulaceae						
44	*Eriocaulon longgifolium Nees ex Kunth*		+				
	15. Hydrocharitaceae						
45	*Hydrilla verticillata* (L.f.) Royle				+	+	4
46	*Ottelia alismoides* (L.) Pers.				+	+	2,3,4
47	*Vallisneria natans* (Lour.) Hara				+	+	4
	16. Iridaceae						
48	*Gladiolus gandavensis* Van Houte		+	+			5
	17. Lemnaceae						
49	*Lemna minor* L.				+	+	4
	18. Liliaceae						
50	*Lilium longiflorum* Thumb		+	+			2,5,6
	19. Musaceae						
51	*Musa paradisiaca L*			+			3,4
	20. Orchidaceae						
52	*Cymbidium aloifolium* (L.) Sw.			+			5,2
53	*Dendrobium nobile Lindl.*			+			2,5
54	*Renanthera coccinea* Lour.			+			2,5
	21. Pandanaceae						
55	*Pandanus tonkinensis* Mart.	+	+	+			2
	22. Pontederiaceae						
56	*Eichhornia crassipes* (Mart.) Solm.			+	+	+	2,4
57	*Monochoria cyanea* F. muell		+		+	+	4
58	*M. hastata* (L.) Solms.		+		+	+	4
	23. Poaceae						
59	*Apluda mutica L.*	+					2,4
60	*Bambusa spinosa* Roxb.			+			3,4,7
61	*B. vulgaris Card. var.striata Gamb.*			+			3,5,7
62	*Chrysopogon aciculatus* (Retz.) Trin.	+	+	+			2
63	*Cymbopogon caesius* (DC. ex Nees) Stapf		+	+			2,6
64	*Cynodon dactylon (L.) Pers.*	+	+	+			2,4
65	*Dactyloctenium aegiptiacum* (L.) Beauv.		+	+			
66	*D. longiflora* (Retz.) Pers.		+	+			
67	*D. violascens Link*		+	+			
68	*Echinochloa colona (L.) Link*		+	+			4
69	*Eleusine indica* (L.) Gaertn.		+	+			2,4
70	*Eriochloa procara* (Retz.) C.		+	+			4
71	*Imperata cylindrica* (L.) Beauv.	+					2,7
72	*Microstegium vagans* (Nees ex Steud.) A	+					

No	Scientific name	4	5	6	Aquatic ecosystem		9
					7	8	
	Camus						
73	*Miscanthus sinensis Ander. ss*	+					2,7,9
74	*Oryza sativa* L		+				3,4
75	*Panicum sarmentosum* Roxb.		+	+			2,4
76	*Paspalum conjugatum* Berg.	+	+	+			4
77	*P. scrobiculatum* L.		+				4
78	*Pennisetum purpureum* Schum.	+	+	+			4
79	*Polytrias indica* (Houtt.) Veldk.	+	+				4
80	*Saccharum arundinaceum Retz.*	+					7
81	*Saccharum officinarum* L		+	+			2,3,4
82	*S. spontaneum* L.	+					4,7
83	*Thysanolaena maxima* (Roxb.) Kuntze	+					2,7
84	*Zizania caduciflora* (Turcz. ex Trin. Hand.-Maz			+	+	+	2,3,4,9
85	*Zea mays L.*		+				2,3,4
	24. Zingiberaceae						
86	*Alpinia officinarum* Hance			+			2,3
87	*Curcuma. longa* L.			+			2,3
88	*Kaempferia galanga* L.			+			2
89	*Zingiber officinale* Rosc.			+			2,3
90	*Z. zerumbet* (L.) Sosc ex Smith			+			2,3

HHTP flora has 286 species, belonging to 227 genera, 89 families of 3 vascular plants phyla, absent 3 phyla: Equisetophyta, Lycopodiophyta and Psilotophyta of Viet Nam flora.

The species component of HHTP flora contains wild and cultivated species. They are widely disposing species, continuous regeneration. This means that the construction of HHTP will not lessen the biodiversity

HHTP has 242 use species, divided into 9 use groups, among medicinal plants are richest species with 189 species, next is man's foods plants – 99 species, timber -31 species; essential oil, resin, tannin- 15 species; constructional material- 13 species; paper, fiber – 11 species. Two species are toxic species.

2) Vertebrate fauna species composition

Based on the direct observation and interviews in rainy season, a total of 108 vertebrate species has been recorded from HHTP. However, the diversity of migration birds was not recorded as the survey time was not in coincident with migration season, especially the water birds.

In the dry season based on the direct observation and interviews, some new species are found: a total of 112 vertebrate species has been recorded from HHTP comprising 14 species (7 families, 3 orders) of mammals, 72 species (28 families, 9 orders) of birds, 8 species (7 families, 2 orders) of reptiles and 8 species (3 families, 1 order) of amphibians..

Table 2-33: **List of mammals, birds, reptiles and amphibians recorded from HHTP area**

No.	Scientific name	Field survey	Ecosystems distribution	Important species			
				ND32/2006	SDVN 2007	IUCN 2008	CITES 2008
	mammalia						
	I. Insectivora						
	1. Soricidae						
1	*Suncus murinus*	M	1,2,3				
	II. Chiroptera						
	2. Pteropodiade						
2	*Rousettus leschenaulti*	M	1,3				
3	*Cynopterus sphinx*	M	1,3				
	3. Rhinolophidae						
4	*Rhinolophus affinis*	M	1,3				
	4. Hipposideridae						
5	*Hipposideros pomona*	M	1,3				
	5. Vespertilionidae						
6	*Pipistrellus javanicus*	M	1,2,3				
7	*Rhinolophus affinis*	M	1,2,3				
	III. Rodentia						
	6. Sciuridae						
8	*Callosciurus erythraeus*	QS	1				
	7. Muridae						
9	*Bandicota indica*	M	1,2,3				
10	*Mus musculus*	M	3				
11	*Rattus bowersi*	M	1,2,3				II
12	*Rattus flavipectus*	M	3				II
13	*Rattus moniculus*	M	1,2,3				
14	*Rattus norvegicus*	M	3				
	aves						
	I. ANSERIFORMES						
	1. Dendrocygnidae						
1.	*Dendrocygna javanica*	QS	4				
	2. Turnicidae						
2.	*Turnix sp.*	QS	2,4				
	II. PICIFORMES						
	3. Picidae						
3.	*Sasia ochracea*	M, QS	1				
	4. Megalaimidae						
4.	*Megalaima lagrandieri*	QS	1				
5.	*Megalaima faiostricta*	QS	1				
	iii. CORACIIFORMES						
	5. Alcedinidae						
6.	*Alcedo atthis*	QS	2,3,4				
7.	*Ceyx erithacus*	M	2,3,4				
	6. Halcyonidae						
8.	*Halcyon smyrnensis*	QS	4				
	iv. CUCULIFORMES						
	7. Centropodidae						
9.	*Centropus sinensis*	QS, K	1,2				
10.	*Centropus bengalensis*	QS	1,2				
	v. STRIGIFORMES						
	8. Strigidae						
11.	*Otus bakkamoena*	QS	1				
12.	*Glaucidium cuculoides*	QS	1				

				Important species			
	9. Caprimulgidae						
13.	*Caprimulgus macrurus*	QS	1,3				
	vi. COLUMBIFORMES						
	10. Columbidae						
14.	*Streptopelia chinensis*	QS	1,2,3				
15.	*Streptopelia tranquebarica*	M, QS	1,2,3				
16.	*Chalcophaps indica*	QS	1				
17.	*Treron curvirostra*	QS	1				
	vII. GRUIFORMES						
	11. Rallidae						
18.	*Amaurornis phoenicurus*	QS	4				
	vIII. CICONIIFORMES						
	12. Scolopacidae						
19.	*Gallinago sp.*(*)	QS	4				
	13. Charadriidae						
20.	*Charadrius dubius*	QS	2,4				
21.	*Charadrius alexandrinus*(*)	QS	2,4				
	14. Accipitridae						
22.	*Milvus migrans*	QS	1,2,3				II
23.	*Spilornis cheela*	QS	1,2,3	IIB			II
	15. Podicipedidae						
24.	*Tachybaptus ruficollis*	QS	4				
	16. Ardeidae						
25.	*Ardea cinerea*(*)	QS	2,4				
26.	*Egretta garzetta*	QS	2,4				
27.	*Bubulcus ibis*	QS	2,4				
28.	*Ardeola bacchus*	QS	2,4				
29.	*Butorides striatus*	QS	2,4				
30.	*Ixobrychus cinnamomeus*	QS	2,4				
	ix. PASSERIFORMES						
	17. Laniidae						
31.	*Lanius collurioides*	QS	1,2,3				
32.	*Lanius schach*	QS	1,2,3				
	18. Corvidae						
33.	*Oriolus chinensis*	QS	1				
34.	*Rhipidura albicollis*	M, QS	1,2,3				
35.	*Dicrurus macrocercus*	QS	1,2,3				
36.	*Dicrurus annectans*	QS	1,2,3				
	19. Muscicapidae						
37.	*Turdus merula*(*)	QS	1,3				
38.	*Copsychus saularis*	QS	1,2,3				
39.	*Phoenicurus auroreus*(*)	QS	1,2,3				
40.	*Saxicola torquata*(*)	QS	1,2,3				
	20. Sturnidae						
41.	*Sturnus nigricollis*	QS	1,3				
42.	*Acridotheres grandis*	QS	1,2,3				
43.	*Acridotheres cristatellus*	QS	1,2,3				

				Important species			
44.	*Parus major*	QS	1,2,3				
	22. Hirundinidae						
45.	*Hirundo rustica*	QS	2,3,4				
46.	*Hirundo daurica*	QS	2,3,4				
	23. Pycnonotidae						
47.	*Pycnonotus jocosus*	QS	1,3				
48.	*Pycnonotus cafer*	QS	1,3				
49.	*Pycnonotus aurigaster*	QS	1,3				
50.	*Pycnonotus sinensis*	QS	1,3				
51.	*Alophoixus pallidus*	QS	1				
	24. Cisticolidae						
52.	*Cisticola juncidis*	QS	2				
53.	*Prinia rufescens*	QS	1,2				
	25. Zosteropidae						
54.	*Zosterops palpebrosus*	QS	1,2,3				
	26. Sylviidae						
55.	*Orthotomus sutorius*	QS	1,2,3				
56.	*Orthotomus atrogularis*	QS	1,2,3				
57.	*Phylloscopus inornatus*(*)	QS	1,2,3				
58.	*Phylloscopus borealis*(*)	QS	1,2,3				
59.	*Garrulax leucolophus*	QS	1				
60.	*Garrulax chinensis*	QS	1				
61.	*Pellorneum tickelli*	QS	1				
62.	*Macronous gularis*	QS	1,3				
63.	*Yuhina zantholeuca*	QS	1,3				
	27. Nectariniidae						
64.	*Dicaeum concolor*	QS	1,3				
65.	*Aethopiga siparaja*	QS	1,3				
66.	*Arachnothera longirostra*	QS	1,3				
	28. Passeridae						
67.	*Passer montanus*	QS	2,3				
68.	*Motacilla alba*(*)	QS	2,3				
69.	*Motacilla cinerea*(*)	QS	1,2,3				
70.	*Anthus richardi*(*)	QS	1,2,3				
71.	*Anthus hodgsoni*(*)	QS	1,2,3				
72.	*Lonchura punctulata*	QS	2				
	reptilia						
	i. SQUAMATA						
	1. Geckonidae						
1.	*Gecko gecko*	K	1				
2.	*Hemydaclylus frenatus*	M,QS	1,3				
	2. Agamidae						
3.	*Acanthosuura lepidogaster*	QS	1				
4.	*Calotex versicola*	QS	1				
	3. Seincidae						
5.	*Mabuya longicaudata*	QS	1,2,3				
6.	*Mabuya multifasciata*	QS	1,2,3				
	4. Colubridae						
7.	*Ahaetulba prasina*	QS	1,2,3				
8.	*Amphiesma stolata*	QS	1,2,3				
9.	*Elaphe radiata*	QS	1,2,3,4	IIB	VU		
10.	*Ptyas korros*	QS	1,2,3		EN		II

				Important species			
11.	*Ptyas mucosus*	QS	1,2,3	IIB	EN		
12.	*Xemochrophis piscata*	M,QS	2,3,4				
	5. Elapidae						
13.	*Bungarus fasciatus*	PV	1,2,3	IIB	EN		II
14.	*Bungarus multicinctus*	PV	1,2,3	IIB			II
15.	*Naja naja*	QS	1,2,3		EN		II
16.	*Trimeresurus albolabrix*	QS	1				
	ii. testudinata						
	6. Emydidae						
17.	*Pyxidea mouhoti*	Pv	1			VU	II
	7. Triongchidae						
18.	*Pelodiscus sinensis*	QS	4				
	amphibia						
	i. ANURA						
	1. Bufonidae						
1.	*Bofo melanosticus*	QS	1,2,3				
	2. Ranidae						
2.	*Hoplobatrachus rugulosus*	QS	2,4				
3.	*Limnoneates limnocharis*	QS	2,3,4				
4.	*Rana kuhlii*	QS	2,3,4				
5.	*Rana guentheri*	QS	2,3,4				
6.	*Rana macrodactyla*		2,3,4				
	3. Michrohylidae						
7.	*Kaloula pulchra*	QS	2,3,4				
8.	*Michrohyla ornata*	QS	2,3,4				

Notes: *Important species:*

No32/2006: The Governmental Decree No 32/2006/ND-CP: IIB: Limit of exploitation and use

SDVN (2007): Red Data Book of Vietnam 2007: EN: Endangered; VU: Vulnerable.

Ecosystems:

1: Plantation forest

2: Agricultural habitat

3: Residential habitat

4: Aquatic habitat

Fuel survey:

M: sampled; QS: observed; K: singing; DV: trace; PV: Interview to local people

Because of the lack of natural habitats, species composition of the fauna in the HHTP is not diverse and the population abundance is also very low. The main habitat types can be found in this area includes plantation forests of eucalyptus and Acacia or agricultural habitat (e.g. for rice, peanut, sesame). Most of species found in this area are common or having wide range.

Of the 112 recorded species, 78 species are found in the habitat of plantation forests, 73 species are recorded in residential habitat, 68 species are reported in agriculture habitat, and 28 species are recorded in aquatic habitat.

Table 2-34: Species diversity of vertebrate in different habitat types in rainy season

No	The class of Animal	Plantation forest	Agricultural habitat	Residential habitat	Aquatic habitat
1	Mammalia	11	6	13	0
2	Aves	46	39	37	18
3	Reptilia	16	11	12	3
4	Amphibia	1	8	7	7
Total		74	64	69	28

Table 2-35: Species diversity of vertebrate in different habitat types in dry season

No	The class of Animal	Plantation forest	Agricultural habitat	Residential habitat	Aquatic habitat
1	Mammalia	11	6	13	0
2	Aves	50	43	41	18
3	Reptilia	16	11	12	3
4	Amphibia	1	8	7	7
Total		78	68	73	28

Above results showed that plantation forest is the most important habitat for vertebrate animals in the project area. However, the movement of many species is not restricted within this habitat. They may expand to the near habitats depending on conditions and seasons.

3) Fish Fauna

Overview about common fish composition

The reservoirs for irrigations and hydropower system has an area of about 340.000 ha in the Vietnam. It consist of lake such as Thac Ba, lake Hoa Binh, lake Nui Coc etc. There are 123 fishes species only in the reservoirs of Northern Vietnam such as Silver carp, Bighead carp, Mud carp, Grass carp, Common carp, *Megalobrama*, *Squaliobarbus*, *Bagarius*, *Cranoglanis*, *Hemibagrus*, *Monopterus albus*, *Mastacembelus*, *Channa*, *E. bambusa etc (Le Sinh Co, 1990).* As culture people often use the part of the reservoir for aquaculture in the floating cages or grow fish in the small branches of reservoir, for example aquaculture in lake Suoi Hai (Ba Vi) (Pham Nhat Thanh, 1988).

The aquaculture in the lake Suoi Hai and Dong Mo – Ngai Son intensively developed since year 1996. In this year (1996), production of total larvae of economical species reached to 800 millions of larva. It includes valued species as well such as Silver carp (*H. molitrix*), Bighead carp (*A. nobilis*), Mud carp (*C. molitorella*), and another species. The total fisheries in the lake consist of Silver carp (58,88 %), Bighead carp (15,73%), Mud carp (12,35%), and other fishes (13,06%).

Aquaculture in the ponds is also developing such as in the village Ngoc Dong, commune Phuong Tu (Ung Hoa district) with multicultural model (rice culture + aquaculture (fishes culture), chicken culture + fruit tree garden) give fish productivity 1,73 ton/ha and rice productivity 11,5 ton/ha/year (Tran Huy Cuong, 2003). The aquaculture in the commune Thanh Thuy (district Thanh Oai) develops in the mono-culture, grows only Indian carp (Mrigala) or Tilapia in the ponds from 1 Northern rice field unit (1 Sao = 360 m^2) to pond (1,800 m^2) with stock density (1.5 – 5 young fish/m^2), and a productivity of 5 – 6 ton/ha (Ph¹m Van Trang, 2001).

From survey in the lake Dong Mo - Ngai Son by Le Dinh Thuy and Phan Van Mach, and by interviewing fishermen who are catching fishes around lake, 24 species were recorded. Most of the species belongs to Family Carps and Minnow (*Cyprinidae*) with 13 species. Its are economical valued species and often caught. In addition, Common carp (*Cyprinus carpio*),

Silver carp (*Hypophthalmichthys molitrix*), Bighead carp (*Aristichthys nobilis*), Grass carp (*Ctenopharyngodon idella*), Mud carp (*Cirrhina molitorella*), Goldfish (*Carasius auratus*) are other fisheries. Now, one species that has origin from Southern America (*Colosoma brachypomum*) has been introduced in the Northern Vietnam and its culturing has begun in the ponds around lake. Other groups of fishes are little. The lake is managed by Fisheries office, which has aim to use waters rationally for irrigation and fisheries. The fisheries production in the lake supply can only meet the local food demand in the surrounding area. The aquaculture in the lake may supply local demand of fish and service fishing sport game. There are 24 fishes species in lake §ong Mo - Ngai Son (Le §inh Thuy and Phan Van Mach – report). Among them, *Spinibarbus caldwelli* was recorded in Vietnam Red data Book (2000, 2007), with vulnerable threatened specie (V) (table 5).

HHTP has some water-bodies:

Flowing waters: Tich River and some small streams draining to Tan Xa lake

Standing waters: Tan Xa lake, Trung Lu, aquacultural ponds, Rice field with one season Winter- Spring grow rice and another rainy season (flooding season) culture fish

Table 2-36: Fish composition in the water-bodies of HHTP

No	English name	Scientific name	Standing waters			Flowing waters		VNRB	ES
			1	2	3	4	5	6	7
	I. Order Needlefishes	Beloniformes							
	1. Family Ricefishes	Adrianichthyidae							
1.	Ricefish	*Oryzias latipes* (Temminck & Schlegel, 1846)	+	+			+		
	II. Order Characin	Characiformes							
	2. Family Characin	Characidae							
2.	Red piranha	*Colosoma brachypomum* (Cuvier,1818)			+				+
	III. Order Carps and Minnows	Cypriniformes							
	3. Family Carps and Minnows	Cyprinidae							
3.		*Acheilognathus barbatulus* Gunther, 1873	+	+		+			
4.		*Acheilognathus meridianus* (Wu, 1939)	+			+			
5.		*Acheilognathus tonkinensis* (Vaillant, 1892)		+		+			
6.	Bighead carp	*Aristichthys nobilis* (Richardson, 1844)	+						+
7.		*Carassioides acuminatus* (Heincke, 1892)	+						
8.	Goldfish	*Carasius auratus* (Linnaeus, 1758)	+	+	+	+			+
9.	Mrigal	*Cirrhinus mrigala* (Hamilton, 1822)	+		+				+
10.	Grass carp	*Ctenopharyngodon idella* (Cuv et Val, 1844)	+		+				+
11.		*Culter recurvirostris* Sauvage, 1884	+						
12.	Common carp	*Cyprinus carpio* carpio (Linnaeus, 1758)	+		+				+
13.	Carp	*Cyprinus rubrofuscus* Lacepede, 1803	+	+		+			+

14.	Yellowcheek	*Elopichthys bambusa* (Richardson, 1844)	+					VU	
15.		*Hainania serrata* Koller, 1927	+		+	+			+
16.	Sharpbelly	*Hemiculter leucisculus* (Bacilewskii, 1855)	+			+			
17.	Silver carp	*Hypophthalmichthys molitrix* (Cuv et Val, 1844)	+		+				+
18.	Rohu	*Labeo rohita* (Hamilton, 1822)	+		+				+
19.		*Metzia lineate* (Pellegrin, 1907)	+	+					
20.	Black carp	*Mylopharyngodon piceus* (Richardson, 1846)	+						+
21.		*Osteochilus salsburyi* Nichol & Pope, 1927	+	+		+			
22.		*Rhodeus vietnamensis* Yen, 1978	+						
23.		*Sinibrama affinis* (Vaillant, 1891)	+						
24.		*Puntius ocellatus* Yen, 1978		+					
25.	Chinese barb	*Puntius semifasciolatus* (Gunther, 1868)	+	+	+	+			
26.		*Toxabramis houdemeri* Pellegrin, 1932	+	+					
	4. Family Loaches	Cobitidae							
27.		*Acantopsis arenae* (Lin, 1934)	+						
28.	Oriental weather fish	*Misgurnus anguillicaudatus* (Cantor, 1842)	+	+	+				+
	IV. Order perches	Perciformes							
	5. Family Climbing gouramies	Anabantidae							
29.	Climbing perch	*Anabas testudineus* (Bloch, 1792)	+	+	+	+			+
30.	6. Family Cichlids	Cichlidae							
31.	Mozambique tilapia	*Oreochromis mossambicus* (Peters, 1852)	+	+	+				+
32.	Nile tilapia	*Oreochromis niloticus* Linnaeus, 1758	+		+				+
	7. Family nakeheads	Channidae							
33.		*Channa gachua* (Hamilton, 1822)					+		
34.		*Channa maculata* (Lacepede, 1802)	+	+	+				+
35.	Snakehead murrel	*Channa striata* (Bloch, 1797)	+		+				
	8. Family Sleepers	Eleotridae							
36.	Marble goby	*Oxyeleotris marmoratus* (Bleeker, 1852)	+						+
	9. Family Gobies	Gobiidae							
37.		*Rhinogobaus giurinus* (Rutter, 1897)	+	+		+			+
	10. Family Odontobutid	Odontobutidae							
38.		*Neodontobutis tonkinensis* (Yen, 1978)	+	+					
	11. Family Gouramies	Osphronemidae							
39.	Paradise fish	*Macropodus opercularis* Linnaeus, 1758.	+	+	+				
40.	Three spot gourami	*Trichogaster trichopterus*	+						

		(Pallas, 1770)							
	V. Order Catfishes	Siluriformes							
	12. Family Bagrid catfishes	Bagridae							
41.		*Pelteobagrus fulvidraco* (Richardson,1846)	+			+	+		
	13. Family Airbreathing catfishes	Claridae							
42.	Whitespotted clarias	*Clarius fuscus* (Lacepede, 1803)	+	+	+				+
43.	North African catfish	*Clarias gariepinus* (Burchell, 1882)			+				+
	14. Family Sheatfishes	Siluridae							
44.	Amur catfish	*Silurus asotus* Linnaeus,1758	+			+			
	VI. Order	Synbranchiformes							
	15. Family Swamp eels	Synbranchidae							
45.	Swamp eel	*Monopterus albus* (Zuiew, 1793)	+	+	+				+
	16. Family Spiny eels	Mastacembelidae							
46.	Zig-zag eel	*Mastacembelus armatus* (Lacepede, 1800)	+	+		+			
Total			40	20	18	14	2	3	21

Note: (1) Tan Xa lake, (2) wetland -Trung Lu; (3) Aquacultural ponds; (4) Tich river, (5) Dong Dao stream; (6) VNRD = Vietnam Red data Book; (7) ES – Economical fishes species.

The study area have many water – bodies as standing waters (ponds, lake, wetlands, rice field in the lowland with one rice season and grow fish in the rainy flooding season) and flowing waters (Tich River and streams). The stock of young and economical fishes into lake will increase the fish productivity and give abundance of fish composition in the waters. The aquaculture in these waters as Hoa Lac Tourism camp and ponds is semi-extensive aquatic culture. This is because of the use of waste of manihos, waste of brewery industry, and castle fecall to input into waters for increasing tropic base of fish food. In another ponds,lake Tan Xa, and rice field in lowland they stock only young fishes. This aquaculture has extensive property. Wetland Trung Lu is almost natural wild waters. There are natural local fishes living in the wetland Trung Lu. All water- bodies in HHTP has clean rainy waters.

The fishes composition in the water-bodies of HHTP area consist of 45 species which belong to 16 families, 6 orders. Among them only one species as Yellowcheek (E. bambusa) is threatened species with vulnerable range “VU” in the Red Data Book of Vietnam (2007). All fish’s species are used by local people as food. Among them, 21 species are high economical species in the aquaculture and in fisheries. This area has introduced 13 local species for aquaculture.

4) Important species

Thirteen species are listed in the Governmental Decree No 32/2006/ND-CP (2006), the Red Data Book of Vietnam (2007), IUCN Redlist (2008) and CITES Appendices (2008) comprising: six reptilian species, one bird species and one fish species. None of these species of mammals and amphibians was found in the study area.

Table 2-37: Important species recorded in the study area

No	Scientific name	Reference				Remarks
		ND32/2006	SDVN/2007	IUCN 2008	CITES 2008	
Plant						
1.	*Erythrofleum fordii Oliv*	IIA				Observed
Aves						
2.	*Otus bakkamoena*				II	Observed
3.	*Glaucidium cuculoides*				II	Observed
4.	*Milvus migrans*				II	Observ**ed**
5.	*Spilornis cheela*	IIB			II	Observed
Reptilia						
6.	*Elaphe radiata*	IIB	VU			Observed
7.	*Ptyas korros*		EN		II	Observed
8.	*Ptyas mucosus*	IIB	EN			Observed
9.	*Bungarus fasciatus*	IIB	EN		II	Interview
10.	*Bungarus multicinctus*	IIB			II	Interview
11.	*Naja naja*		E**N**		II	Observed
12.	*Pyxidea mouhoti*			VU	II	Interview
Fish						
13.	*Elopichthys bambusa*		VU			Interview
Total		5	6	1	9	

Note: Criteria of threaten species

1. ND32/2006: Governmental Decree No 32/2006/ND-CP:
   IIA/IIB: Limit of exploitation and use
2. SDVN/2007**:** Red Data Book of Vietnam 2007: EN: Endangered; VU: Vulnerable
3. IUCN2008: Red list 2008: VU: Vulnerable
4. CITES2008: the Convention on International Trade in Endangered Species of Wild Fauna and Flora: Appendix II lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled**.**

2.3 CONDITION OF ECONOMY AND SOCIETY

Overview of population and structure of using land: Populations is distributed in villages. The average living land area of each household is rather small. On average, each house has an area of 120-250 m^2, some of them has a garden.

In general, the land budget for developing the grouped residential area is limited. As little area has been allocated supplementary, there still remains a huge need of living land. Along the road axis, the living land is small, thus affecting the architecture space.

The natural condition, especially the geographical location of the commune is convenient for the growth of the economy and society in general, and the infrastructure in particular. Due to the limited land budget, land use planning need to be examined carefully, in order to have high effective use of land, and correspond with the long-term orientation and general view of the district.

Though the non-agricultural production brings major income to people in the commune; yet, the agricultural production is important and can play a big role in social stabilization. The use of some area of sunken-slopping land is not very effective, thus its use is needed to be changed, in order to get high effectiveness in land using, and the stable development in term of ecology.

The requirement for living land is huge. Large number of household is in need of living land but no large land have allocated. The population growth rate (both natural and mechanical) in the forthcoming years is likely to reach level of 1.0 to 1.3% per year. Therefore, while formulating the plans, attention should be paid for the expansion of the residential area.

The infrastructure system, cultural-social works are still limited, especially cultural area/square, sport square, green park, stadium, and leisure cente etc. There is a high need for developing

industrial zones, industry and service-commercial center. Thus during land use planning for the period of 2010 to 2015, sufficient land area that can serve these needs should be taken into consideration.

For the first phase of study, the study area (1,036 ha) consist of 3 communes: Thach Hoa, Tan Xa and Ha Bang in Thach That District.

The population of Thach Hoa is largest (8,714 people) whereas the lowest population is in Tan Xa (4200 people). In general, the household size is in moderate level with 3.89 people/ household. The difference of size is not significant.

Table 2-38: Number of households

	Tan Xa	Ha Bang	Thach Hoa
Population (people)	4,200	5,896	8,714
The number of household (household)	1,119	1,304	2,522
Household (People/house)	3.75	4.52	3.40

Source: Synthesizing the questionnaire about status of social and economic condition in communes (December, 2008)

Populations are distributed in villages. The average living land area of each household is rather small. On average, each house has an area of 120-250 m^2, some of them has a garden.

In the study area, the typical characteristic of land is hilly land. Most of land is being used for agriculture production and forestry. The total area of Thach Hoa commune is largest i.e. 3291.44 ha, followed by Tan Xa with an area of 834.85 ha and the aaea of Ha Bang is 699.99 ha. The proportion of land use in these 3 communes is relatively similar. The land used for agriculture forestry accounted for 70% of the total natural land area in these communes. The economy in these area is less developed with poor infrastructure. Area of land for the office, enterprises, public works such as schools, the culture house etc, occupies a very small percentage of land. The investment for the development of transportation infrastructure in form of road network connecting the villages and land was not properly done. The proportion of road in these communes makes up 65%.

Table 2-39: Proportion of land use

No	Type of land	Unit	Thach Hoa	Tan Xa	Ha Bang	Total
1	Agriculture land	ha	232.49	105.76	247.02	585.27
2	Non-agriculture land (house, specific usage)	ha	3056.55	544.34	423.5	4024.39
3	Forestry land	ha	0	0	0	0
4	Others	ha	2.36	139.75	2.47	142.11
Total			3291.4	789.85	672.99	4751.77
(%)			70	16	14	100

Source: Synthesizing the questionnaire about status of social and economic condition in communes (December, 2008)

Most of the families are involved in agriculture activities such as planting rice, cassava, crops and other fruit trees. However, due to poor soil fertility, the level of cultivation is low, and thus the yield is also low. In addition as geographical location is not convenient, the household in 3 communes finds difficulty in establishing business and trade development.

2.3.1 Tan Xa commune

(1) Population and distribution

Total population of the commune until December 25, 2008 was 4,200 people with 1,119 households. The density was 490 per/km^2. On average, the natural population growth rate in last

5 years is 1.7% per year.

(2) The status of economic development

In the past years, the economy of the commune was growing quite fast with an average per capita income of 3.2 million VND in 2007. In Tan Xa the per capita income is increasing gradually every year. This has attributed to the development of traditional works such as mechanics, civil carpentry, furniture, building materials production, textile, carpet embroidering etc.

During December, 2008, the commune has only 16% poor households (183 households) and 11% policy households (128 households).

(3) Main production sectors

Agricultural and aquaculture production value accounts for 69.87 %

Industrial, home craft industrial production value account for 30.13%

The total food production is 310 kg per capita per year.

(4) Agricultural production

1) Cultivation

In the recent years, agricultural land is narrowing down gradually because of the development of the industrial zones. However, due to good intensive farming and effective application of new rice variety into production, the rice productivity has increased and stable.

Total of farmer households: 932

The production of rice in 2007 reached 119 tons / ha

The production of other crops is 112 tons / ha.

The 100% of land used during spring season. The 213 ha of land used for rice and 103 ha of land used for crops. In 2007, the weather was also suitable for agriculture and as a result the rice yield reached to 5310 kg/ ha.

Plan is to make it 50 million VND/ ha/ yr from the total of 24 ha of agriculture production.

2) Husbandry

According to the statistical data, until November of 2007, the entire commune has 766 buffalos; 3,850 pigs (685 reproduction sow); 33,800 poultry. The area of water surface for aquaculture is 12 ha, with the annual fish productivity of 45.8 tons, estimated 650 million VND.

(5) Home craft industry and service

In recent times, this sector has been growing at rapid pace. The household production is major base for such growth. The local government creates good conditions in bank loan, tax policy to promote the development of craft industry and service. The industrial – home craft industrial production values in 2007 are estimated to be about 4.237 billion VND. At the moment, there are 55 home craft foundations with 135 workers. The commercial, service sector is also been growing fast in the past years.

(6) The status of infrastructure development

The total investment in the commune in 2007 was estimated about 3.6 billion VND. Of the total investment, about 21.7% came from district budget and about 78.3% contributed by the commune people. .

1) Transportation

There is a convenient transport system in the commune. Besides the Lang – Hoa Lac high way, there is a good road network between communes and villages, connecting all the villages to each other, and to other parts. Using the budget from district and as well from the local people, 6.5 km of road was widened and 3.5 km of concrete road was made (road between village 3 and 8; 5 and 6; 4 and 7). The connecting road between village 7 and 9 was maintained and new road for village 4 was laid.

2) Electrical power system

The low-tension line system is connected to all the villages. 100% of households have electricity with good service. Household electrical appliance selling has been carried out.

3) Irrigation

The large surface area of Tan Xa lake helps in regulating and supplying sufficient irrigation water to whole commune. In general, the irrigation system of the commune is quite complete and good and fulfills the requirements for production and living of the people. The arid or water logging has been avoided. In year 2007, People Committee focused on making Khoang Luon, Phu Huu Pump Station and a new Elementary school.

4) Education infrastructure

Level of pre-school includes 7 classes and 252 children. Among the classes, 7 are in good quality. Level of elementary school includes 11 classes, 18 teachers and 313 pupils. The infrastructure has been maintained and upgraded frequently. Level of secondary school includes 9 classes with 306 pupils. There are 22 teachers, 100% are qualified.

The rate of graduation pupils annually is nearly 100%. In year 2007, in Tan Xa commune, there were 9 pupils entered university and 15 entered college. The infrastructure is improved and maintained regularly. The investment for the study equipments was made and all schools have the plans to improve the teaching quality. On the Teacher Day in year 2007, 10 teachers were awarded with Certificate of Merit.

5) Medical care center

Dispensary: area of 1500m^2, sufficient area for use, need of upgrading the equipment, no need of enlarging the land area.

(7) The status of residential area development

In general, populations concentrate in villages; the average area of living land of each household is rather small. On average, each house has an area of 120 to 250 m^2, some of them has garden.

Practically, the land budget for developing the grouped residential area is limited. The little supplementary area has been allocated, and thus there remains a need for living land. Along the road axis, the living land is small, thus affecting the architecture space.

2.3.2 Ha Bang commune

(1) Population and residential distribution

On December 25, 2008, the total population of the commune was 5896 people with 1304 households. The population density was 806 per/m^2. The natural population growth rate in last 5 years has been 0.93%/year. The residents mainly live in villages. At the moment, commune consists of 9 villages.

(2) The economical development situation

In the past years, the economy of the commune has grown rapidly, with the average rate of 9%

annually.

Till December, 2008, the commune has only 11.6% poor households (151 households) and 27% policy households (362 households).

The per capita income of the commune in the year of 2008 is about 8 millions VND/per/y. The per capita income in Ha Bang has been gradually increasing every year, and is higher than the communal average. This is mainly due to the development of traditional works such as mechanics, civil carpentry, furniture, building materials production...

(3) Main production sectors

Agricultural and aquaculture production value accounts for 44.83 %

Industrial, home craft industrial production value account for 55.17%

The total of food production is 382 kg per capital per year.

(4) Agricultural production

1) Cultivation

Recently, agricultural land is shrinking gradually because of the development of the industrial zones. However, due to good intensive farming, effective application of new rice variety into production, the productivity is high and stable. Total of farmer households: 1,299 (account for 99%) thus it can be seen that the main income of this commune comes from agriculture production. The yield of rice in year 2008 reached 2100 kg/ha.

(5) Home craft industry and service

This sector is also growing rapidly, especially in household production. The local government creates good conditions in bank loan, tax policy to promote the development of craft industry and service.

(6) The status of infrastructure development

1) Transportation

There is a convenient transport system in the commune. Besides the Lang – Hoa Lac high way, there are a road network between communes and villages connecting all the villages to each other and other parts. Currently, some of road connecting communes such as Cam Yen- Dong Truc, Tay Phuong –Ha Bang are under construction. However the length of the road still remain 11 km. The authority is trying to make the concrete road in the commune area.

2) Electrical power system

The low-tension line system is connected to all the villages. 100% of households have electricity with good service. Household electrical appliance selling has been carried out.

3) Irrigation

In general, the irrigation system of the commune is quite good and fulfills the requirements for production and living of the people. As a result flood and water logging have been avoided. At the moment, about 3 km of canals have been concreted, serving the irrigation of the entire commune.

4) Educational infrastructure

Level of pre-school includes 16 classes and 281 children. Among the classes, 13 are in good quality. Level of elementary school includes 17 classes, 22 teachers and 558 pupils. The infrastructure has been maintained and upgraded frequently. Level of secondary school includes 14 classes with 574 pupils. There are 38 teachers, 100% are qualified.

The rate of annually graduation pupils is nearly 100%. However, the rate of drop-out pupils is still rather high, about 1.3% in 2005.

5) Medical care center

Dispensary: area of 1500m^2, is sufficient and currently no need of expansion of the land area. However, it is necessary to upgrade the equipment. In year 2008, some of programmes such as lung pneumonia prevention, endemia prevention were taken into consideration and carried out in the commune area. During the end of 2007 and early 2008, diarrhea was reported in Ha Tay province. To deal with the problem, Tan Xa's People Committee has created a team of qualified personnel to handle with this problem. Doctors with medicine were ready in case of any emergency. With this good preparation, no case of diarrhea was reported in Tan Xa commune.

2.3.3 Thach Hoa commune

(1) Population and residential distribution

The total number of households in Thach Hoa commune is 2,240 with a total population of 8,829. The total of KT2 is 221 households with 663 people. The number of temporary residence are 537 people, which consist of 116 students, 310 freedom labors and others as labors who already have the contracts with restaurants, companies and enterprises. The natural population growth rate in last 5 years has been 0.84 %/year

(2) The economical development situation

Land for agricultural production: In 2005, Thach Hoa commune has a total land area of 207.68 hectares for agricultural production (accounting for 6.24% of natural area of entire commune). In this area, rice was planted in 62.33 ha; long-term fruit trees were planted in 95.23 hectares and the remaining area was hill and used for plantation of rice. The area for fresh water aquatic product is about 0.09 ha.

The land for forestry is about 62.52 ha, account for 1.85% of the total land area.

The current status of non-agriculture land:

Land for housing: the total land for housing purpose is about 236.71ha (accounting to 7.12% of the total area of Thach Hoa commune).

Specific land use: Total area for specific land use in 2005 was 1937.41 ha, accounting to 58.27 % of the total natural area).

No	Purpose	Square(m2)	Percentage
Total nature area		1802.79	100%
1	*Agriculture land*	269.29	8.09
1.1	Agriculture production	207.68	6.24
1.1.1	*Rice*	62.33	1.87
1.1.2	*Rice*	50.12	1.51
1.1.3	*Fruits tree*	95.23	2.86
1.2	Fresh water aquatic product	0.09	0.00
1.3	Forestry	61.52	1.85
1.3.1	*Defence forestry*	61.52	1.85
2	*Non-agriculture land*	6,913.41	52.44
2.1.1	Rural area	236.71	7.12
2.2	Specific land usage	1,937.41	58.27
2.2.1	Office house	0.81	0.02
2.2.2	Security	0.03	0.00
2.2.3	Business	1.84	0.06
2.2.4	Utilities	10.68	0.32
2.2.5	Industry zone	619.45	18.63

2.2.6	Culture	5.27	0.16
2.2.7	Education	1126.24	33.87
2.2.8	Streams channel, springs…	173.09	5.21

(3) Main production sectors

Agricultural and aquaculture production value accounts for 19.2%

Industrial, home craft industrial production value account for 80.8 %

The total food production is 366 kg per capita per year.

(4) Agricultural production

Total estimated production value in 2007 was 57,605 billion VND, which accounts to an increase of 25.9% when compared with year 2005. Service trade-tourism: 36,921 billion, equal to 185.2% of plan. Industrial, small industry, construction: 9,684 billion, 92.4% of plan. Total estimated agriculture production is 11 billion VND, which consist of

- Cultivation: 1.4 billion VND

- Husbandry: 9.6 billion VND

Total number of farmer households: 1949

The production of rice in 2007 reached 5.189 tons/ha

The production of other crops was 8.5 tons/ha.

(5) Home craft industry and service

In last few years, this sector is growing at a rapid pace especially in household production. The local government created good conditions in bank loan, tax policy so as to promote the development of craft industry and services.

(6) The status of infrastructure development

1) Transportation

There is a convenient transport system in the commune. Besides the Lang – Hoa Lac high way, there are a good road network between communes and villages connecting all the villages to each other and to other parts.

2) Electrical power system

The low-tension line system is connected to all the villages. 100% of households have electricity with good service. Household electrical appliance selling has been carried out.

3) Irrigation

In general, the irrigation system of the commune is quite good and serves well to the requirements for production and living of the people. This has avoided any flood and water logging.

4) Educational infrastructure

Level of pre-school includes 30 teachers and 3 staffs.

Level of elementary school includes 35 teachers. The infrastructure has been maintained and upgraded frequently.

Level of secondary school includes 25 teachers, 100% are qualified.

The rate of annually graduation pupils is nearly 100%.

2.3.4 General comments:

1. In general, the natural conditions are good, especially the geographical location of the commune is convenient for the growth of the economy-society, and the infrastructure in particular. Due to the limited land budget, land use planning need to be examined carefully. Emphasis should be on high effective use of land considering the long-term orientation and development approach and vision for the district.

2. Although non-agricultural production is a major source of income for people in the commune but the agricultural production is also important and plays a big role in social stabilization. As the use of some area of sunken-slopping land is not very effective, it use need to be changed. This will assist in achieving high effective use of land and will also provide the stable development in term of ecology.

3. The requirement for living land is huge so as to accommodate the need of number of household. Not enough of land has been allocated. The population growth rate (both natural and mechanical) of 1.0 to 1.3% per year has been forecasted for the forthcoming years. Thus, while formulating the plans, attention needs to be given in expansion of the residential land area.

4. The infrastructure and cultural-social facilities are still limited, especially cultural area/square, sport square, green park, stadium, and leisure center etc. The need for developing industrial zones, industry and service-commercial center is huge. Thus during land use planning for the period of 2010-2015, sufficient land area that can serve these needs should be taken into consideration.

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CHAPTER 3 ASSESSMENT OF PROJECT IMPACT ON ENVIRONMENT

As presented in chapter 1, the content of the project is to construct the infrastructure in the Hoa Lac high-tech Park (HHTP) that includes the developments of infrastructures such as road, drainage system, electricity system, telecommunication and fascine.

3.1 ASSESSMENT OF PLANNING AND DEVELOPMENT OF HOA LAC HIGH-TECH PARK FROM ENVIRONMENTAL VIEWPOINT

3.1.1 Assessing plans on selection of location

Planning of Hoa Lac High-tech Park is organized on the basis of general planning of urban series of Mieu Mon- Xuan Mai- Hoa Lac- Son Tay as well as on the Orientation planning of development priority along axis of the national road No. 21 in the area of Hanoi (former Ha Tay Province). In the phase I, HHTP has the area of 1,036 ha and is located in the Western Hanoi, far 30km from Hanoi Capital along the route of Lang- Hoa Lac highway. With respect to environment, the location selection of the Project is reasonable and this limits the spread of any industrial pollutants to the inhabitants living in surrounding area.

HHTP has very favorable position in relation to area and inner province. The location is determined for an establishment of the national high-tech and large-scale park in Hoa Lac. The location was assessed with many advantages such as land fund for construction; natural landscape with half-mountain half-plain area; relatively near to remote forest of Ba Vi National Park and big lakes; and its attachment to the national and international cultural-tourism activities. Especially, HHTP is located in the area of Hanoi Capital, a center of national politics, administration, culture, technique and science. In addition, it converge three-quarter the National Institutes for Research. It is also a favorable position in terms of road, railway, airline and sea and thus have a good connectivity with other areas and the world. HHTP is placed near transport nodal such as: road transport with Lang- Hoa Lac highway and the national road No. 21; railway transport with local railway route connecting with rail-transit from Hoa Lac- Ba Dinh (UMRT route); seaway with Son Tay port which being on the important sea transport of Red River delta; and airline transport with Noi Bai international airport. Favorable transports also confirm this location especially in case of occurrence of any incident, good transport linkages and system will favor early response. Besides, the area has plentiful and skilful labor force because HHTP is near Hanoi capital, where majority of universities and vocational training schools exist and favorable land fund for industrial development. Moreover, HHTP is positioned in the area of Ha Tay province (now, Hanoi) with plentiful famous landscape. With advantages of natural landscape, HHTP can easily attract domestic and foreign visitors to work and relax.

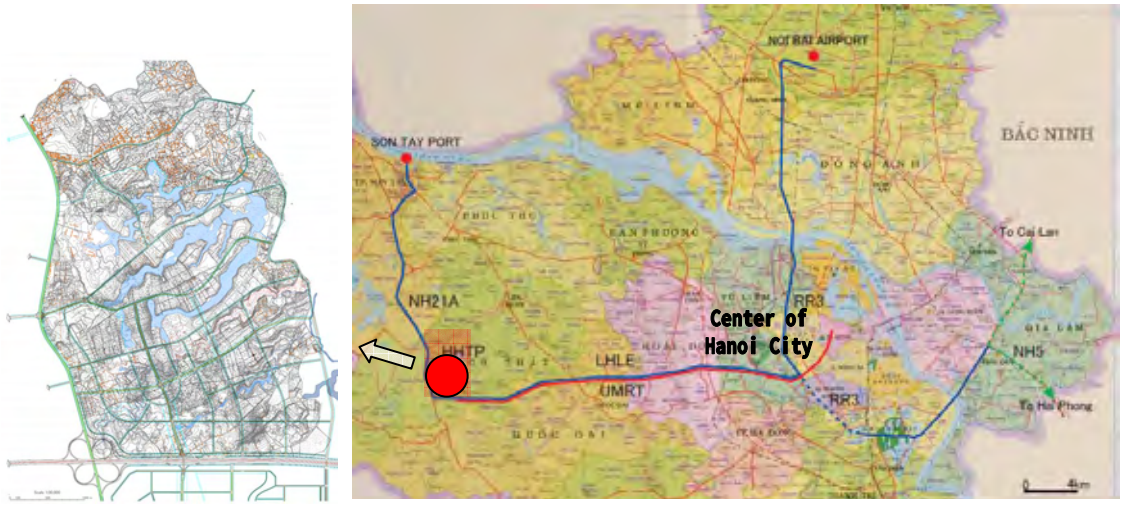


Figure 3-1: Location of the Project Site

3.1.2 Assessing functional zone of Hoa Lac High-tech Park

The functional zones within HHTP are shown in drawing of Planning. Diagram of total land use plan and the structure of land uses are as follows.

Table 3-1: Summarization of land use planning as per functional sub-areas

No	Type of land	Area (ha)	%
1	Land of software area	76	4.8
2	Land of research and development area	229	14.4
3	Land of high-tech industrial area	549.5	34.7
4	Land of educational and training area	108	6.8
5	Land of central area	50	3.2
6	General service area	87.5	5.5
7	Land of housing and office area	42	2.6
8	Land of tenement area	26	1.6
9	Land of convenient area	110	6.9
10	Land of entertainment and sport area	33.5	2.1
11	Road and infrastructure	115.5	7.3
12	Lake and buffer area	117	7.4
13	Fascine area	42	2.7
Total		1586	100.0

The project site is located on the axis of Lang- Hoa Lac highway connecting Hanoi with the Northwest provinces and the national road No. 21 to Son Tay and Xuan Mai. With the variety terrain, being high in the Northwest and passed by Lang- Hoa Lac highway, the High-tech Park is bordered by four ancient villages to the North serving the work of resettlement. It is also bordered by the resident area of Phu Cat commune to the South. Therefore, the North-South transport axis of the High-tech Park shall mainly be based on the connection with Lang- Hoa Lac highway. The connection point of such space axis shall create open and green spaces for the set up of general service area, complex area for accommodation and offices, and bonds. The East- West transport axis shall be in parallel with Lang- Hoa Lac highway and will connect to outside transport axis of the national road No. 21 and bordering route in the Eastern HHTP. The space axis shall set up sub-gates in the High-tech Park and placing there the functional sub-areas of general service, research and development (R&D), tenement and high-tech industry.

An area of 76 ha has been assigned for the development of software services. As this area is located next to Tan Xa Lake, it will create beautiful landscape and environment and shall assist in improving the effectiveness of the area. Indirectly, this beautiful landscape will improve the working capacity of high-standard workers associated with software industry.

R & D zone is one of the most important areas of HHTP. The area of R & D is placed in the centre of the High-tech Park embedding Software Park with the landscape view of Tan Xa Lake and next to the central area. As the area of R & D, the Software Park and the central area are adjacent to each other, it provides flexibility in terms of land use and functions. As per the demand in future, these areas if required can be adjusted, re-allocated or supplemented between the area of R & D and the Software Park.

Area of high-tech industry is placed on the plot of the Southeastern HHTP, far from Tan Xa Lake, and near Lang- Hoa Lac highway. As this area is located at the end of the major wind direction, it shall limit the spread of industrial pollutants to the inhabitants living and working in the High-tech Park.

In order to allow the good synergy between a theory and a practical research, the area of education and training is placed along the national road No. 21, next to the area of R & D. The area of education and training is adjacent to the area of the National University. Such settlement will have positive impact through the mutual join efforts of educational and training bodies with research centers.

Central area is placed at the central position of the High-tech Park, connecting the other major functional areas. This set up area shall function as the management and administration zone for the high-tech park. The central area is connected with the areas of R & D and general service. In addition, as this area will also be linked with green spaces, trees and water surfaces, it will create sustainable and friendly environment in the area.

Area of tenement, accommodation and office complex is located in the western part of the High-tech Park, bordering the national road No. 21. With the relative high terrain, this area will be good for setting up blocks for high-skilled labors and offices for rent. These blocks will make a reasonable use of the terrain factors and will create modern agricultural landscape harmonizing with surrounding environment. Constructions of high blocked building will create a noticeable point interlacing with green trees and water surface.

Respecting the natural terrain design and considering the limitations of operations like digging, embanking, and leveling, a number of small lakes and a hill have brought the best conditions for the landscape and open space. Landscape axle of Tan Xa Lake is the green core of the entire High-tech Park, connecting with other functional areas and creating a general connection system between agricultural constructions with the natural green trees and water surface. The system of green trees and water surface play a role of lung in regulation of necessary air and humidity for the entire area. It is set up of green, modern and sustainable development high-tech park. Areas of lakes and buffer have connected the system of green trees, water surface, hills and mountains and created a natural frame for the protection of sustainable environment.

The system of green trees within the High-tech Park not only antiquing the landscape but also plays an important role in the reduction of pollution and providing the health protection to the living and working environment in the High-tech Park. Besides this, green trees will also be planted along two sides of local road and in the campus of factories, enterprises and functional sub-areas. The dedicated green tree area will also be set up in the green buffer areas that will not only ensure safe environment to the surrounding areas but as well will be able to create ecological landscape for the entire High-tech Park. Land ratio for fascine is 42 ha (2.65%), which does take into account the areas allocated for lawns within the functional sub-areas.

Transport system is organized as per model of square net fitting with characteristics of the

High-tech Park as well as current terrain. The space of High-tech Park is interfered harmoniously between the transport system and the natural terrain, through those connecting functional sub- areas into a unified one. The axle of the national road No. 21 connects functional spaces of high-tech industrial area, educational and training area, general service area and office and agency area. The functional spaces on the axle of the national road No. 21 are connected harmoniously with landscape terrain of HHTP. The axle of Lang- Hoa Lac highway connects development motivation area of Hanoi. Area of Northern Lang- Hoa Lac highway connects the High-tech Park with Lang- Hoa Lac highway through the system of byroad into the High-tech Park, cooperating with landscape green trees, creating a natural landscape area for the High-tech Park.

Wastewater treatment plant is located on the plot of the High-tech Park. It is bordered the road A to the North, and boundary to the East (Eastern belt-road). Considering the drainage system of the entire High-tech Park and to ensure the friendly environment in the HHTP, this location is very suitable. Such structure of land use is completely suitable; and the detail planning has been approved by the Prime Minister (the Decision No. 621/QD-TTg on May 25, 2008 of the Prime Minister).

3.1.3 Planning of drainage system and waste treatment of the High-tech Park

HHTP has been constructing wastewater treatment plant in order to treat wastewater and to protect the environment. The sewerage plan includes system of drainage and wastewater treatment, facility such as treatment plant and pump stations. Outline of the sewerage plan has been described in chapter 1.

3.2 IDENTIFICATION OF ENVIRONMENTAL IMPACTS

Based on the plan for the development of infrastructure, the activities that might cause negative environmental impact are shown in three phases in the table below.

These activities might cause negative impact not only to one aspect but might also to other aspects of environment. When the project will be put into operation, the production and operation of factories/institutes in HHTP might cause some environmental impact. In order to specify quantitatively the emission source of waste, it is necessary to analyze operation characteristics, production technology and material line taking part in the operation process of the high-tech industrial park. The activities of developers as well as tenants that might cause environmental impacts can not be identified at this moment. However, these environmental impacts shall be considered by each developer and tenant before the implementation.

Table 3-3 identifies the environmental aspects that might be affected by these activities during the projects preparation and implementation stage. Significance of environmental aspects is assumed based on the analysis of the project plan and environmental conditions of the site.

Table 3-2: Activities in the project considered in EIA

Phase	Activity
Pre construction phase	Land acquisition
	Resettlement of people and assets
Construction phase	Alteration of land use
	Alteration of topography
	Operation of heavy equipment for construction
	Traffic of construction vehicle
	Disposal of residual soil and waste
Operation phase	Increase and concentration of population and traffic
	Discharge and operation of wastewater treatment plant
	Drainage for storm water

It is supposed that when the project is put into operation, the production and operation of factories/institutes in HHTP might cause some environmental impacts. In order to assess environmental impacts, it is necessary to analyze characteristics of activities of business, R & D, and Education & Training which will be introduced to the functional zones of HHTP. The activities of developers as well as tenants which may cause environmental impacts can not be identified at this moment. As an alternative, these environmental impacts shall be considered by respective developer and tenant before the implementation. The HHTP management board will direct any developer and tenant to comply with Governmental law and regulation for the environmental protection. They should also follow the guidelines as specified by the management board such as the Development Guideline for development with adequate environmental conscious and conservation.

It is predicted that around 90,000 people will come and work or study at HHTP in 2015. Housing areas will be probably developed in surrounding areas of the HHTP in accordance with the developments of HHTP, which will be necessary to accommodate workers or students in the HHTP. Since such developments will be carried out by private developers, the HHTP-MB can not control their activities and behavior. It is to be noted that the increase of population in housing area outside HHTP may cause negative environmental impacts too. It is required for investors of such developments at outside HHTP area to consider negative environmental impacts and measures to mitigate these impacts.

Table 3-3: Scoping of anticipated Environmental Impacts in the Project

Phase	Activity	Physical environment						Ecological environment					Socio-economic environment					Others			
		Air Quality	Water quality	Noise	Waste	Soil contamination	Odor	Flora, fauna, ecosystem	Hydrology	Ground water	Rain runoff	Topography and geology	Resettlement	Living and livelihood	Sanitation	Heritage	Landscape	Impacts during construction	Accident	Traffic accident	Global warming
Pre construction	Land acquisition												A	A							
	Resettlement of people and assets												A			B					
Construction	Alteration of land use							B	B								B				
	Alteration of topography								B	B		B					B	B	B	B	
	Operation of heavy equipment for construction	B		B														B			
	Traffic of construction vehicle	B		A														A		B	
	Disposal of residual soil and waste				A	A									B			A			
Operation	Increase and concentration of population and traffic	B	B	B	B										B				B	B	B
	Discharge and operation of wastewater treatment plant		B	B	B		B							B					B		
	Drainage for rainwater										A			B							

Note:
A: Significant impact is anticipated B: Moderate impact is anticipated

3.3 SUMMARY OF ENVIRONMENTAL IMPACTS OF THE PROJECT

The assessments of environmental impact of the project are summarized as follows.

Phase	Item	Environmental impact of the project
Pre Construction	Resettlement	1,200 households will be forced to be resettled by the development in F/S area. These households will be able to maintain their lives in local community after the implementation of resettlement, as the investor is preparing resettlement area.
	Living and livelihood	1,714 households will be affected by the land acquisition of the project. These households' livelihood will be affected as many households will not be able to continue their current occupation (mainly farming). Thus the investor is required to prepare land acquisition plan to compensate for affected households according to the project implementation schedule.
	Heritage	There are no historic relics and cultural assets in the area affected by the land acquisition. The investor is required to take residents intention into consideration when resettling cemetery in the project area.
Construction	Air Quality	Air quality in surrounding area will get worse temporary by the air pollutant discharged from construction vehicles and heavy equipment. It is considered that the concentration of air pollutant will not be high locally as topography condition in surrounding area is gentle. Impact of dust discharged in construction will be mitigated by washing vehicles and watering at the site.
	Water quality	It is necessary to equip facility to prevent water pollution by wastewater and sewage from construction workers. It is necessary to equip adequate facility to prevent water pollution by oil leakage from construction machineries and vehicles.
	Noise	Noise will be increased by moving of construction vehicle to site. However, impact on residents' living condition will be limited as most of construction vehicles will use main roads for movement. Noise from operation of construction machineries may affect residents' living condition. Consideration for noise mitigation is necessary by taking resettlement schedule into account when implementing construction work.
	Waste	Residual materials in construction and solid waste from construction workers will not cause impact by appropriate treatment of waste.
	Soil contamination	It was found by the field survey that the soil in project area was contaminated. Adequate measure for treatment and disposal will decrease environmental impact. The investor is required to consult with the concerned agencies and ensure safe disposal of soil from site.
	Flora, fauna and ecosystem	Growing area and habitat for plants and animal will be decreased by alteration of land use. On the other hand, Tan Xa Lake will be preserved as much as possible. As it was confirmed by the field survey that almost all species found in project area was also found in surrounding area, environmental impact on ecosystem will not be significant.
	Hydrology	It is judged development plan will not cause significant impact on hydrology as improvement of river system and retention of rainwater is considered in drainage planning.
	Ground water	Excavation work for construction of sewer pipe and wastewater treatment will reach in aquifer. However, condition of groundwater will not be affected by these excavation works。
	Topography and geology	Topography of project area is gentle and construction work of the project will not change the current topographic condition significantly.
	Sanitation	The HHTP-MB will pay attention to keep sanitary condition of the site as well as the surrounding area. Therefore serious impact is not anticipated.
	Landscape	The landscape plan will contribute to developing new landscape of the high-tech park while current scenery at the area will be lost. Consistency in landscaping will be kept in the park and the landscape will impress people who will visit, work and reside.
	Accident	Investor will try to prevent accident during construction work by adequate construction supervision. If explosive bomb is found, investor will inform to concerned organization and treat adequately.
	Traffic	Construction vehicles will be regulated to drive only on main roads and to refrain

Phase	Item	Environmental impact of the project
	accident	from travelling on living space of local residents. Development of LHLE will distinguish the travelling route for residents from travelling routes for construction vehicles.
Operation	Air Quality	Transportation of vehicles will increase in accordance with increase of human movement by the project operation. Emission of air pollutant will be reduced by introducing circulating public bus. Besides, JICA Study recommends introducing electrically electric car.
	Water Quality	The discharged wastewater from the F/S area will be treated by a wastewater treatment plant and discharged to the environment. This will abide the water quality environmental standards. Therefore water quality in surrounding environment will not be affected by the project. Developers must comply with the requirement for wastewater discharge as specified in the guidelines.
	Noise	Increase of traffic and transport vehicles will increase in accordance with increase of human movement by the project operation. Traffic jam and noise will be mitigated by introducing circulating public bus.
	Waste	All tenants in the park will have contracts with URENCO and solid waste generated in the park will be transported and disposed adequately outside the park. Developers must comply with the requirement for solid waste management as specified in the guidelines.
	Odor	Wastewater treatment plant, which may cause odor is proposed in High-tech industrial zone. To minimize bad odour and any negative impact on residents, sewage sludge will be dehydrated and treated adequately outside of the park.
	Rain runoff	Rain runoff will increase as per the development of the HHTP. However, impact on surrounding area will be decreased by the improvement of retention capacity of rainwater.
	Living and livelihood	Employment opportunity will increase by the project operation.
	Accident	It is necessary to prevent accident by adequate operation of each functional zone and facilities operated by the HHTP-MB.
	Traffic accident	Traffic demand will increase in accordance with increase of human movement and progress of the project operation. Security of passengers and smoothness of traffic will be ensured by introducing circulating bus system.
	Global warming	Transportation of vehicles will increase in accordance with increase of human movement and progress of the project operation. The amount of carbon dioxide generated by these vehicles is estimated to be about 26,000 ton/year.

3.4 PRE CONSTRUCTION PHASE

3.4.1. Impact on socio-economic environment

(1) Impact on resettlement

1) Criteria of evaluation

It is evaluated that do the conditions of settlement after the impact could keep to the similar level as to present conditions.

2) Condition of impact prediction

The number of household to be resettled during the project is shown in the following table. It is anticipated that total 1,200 households are need to be relocated and resettled.

Table 3-4: Number of Households for Resettlement and Compensation

Commune	Households to be resettled	Household to be compensated
Thach Hoa	933	959
Tan Xa	129	540
Binh Yen	138	215
Total	1,200	1,714

Source: PMU of Industrial and small scale industrial group and development and investment, Hanoi City

At the same time, the developments of resettlement areas have been authorized by the concerned Province People's Committee and being developed.

Table 3-5: Resettlement area for the Affected Households in Hoa-Lac Area

Area	Number of households can be accommodated	Description
7.8 ha	161	In operation
36.05 ha	653	Authorised by Decision of Ha Tay Province Construction of infrastructure work is on-going. It is unofficially targeted for completion by June 2009.
24 ha	350	Not authorized by official document. Under planning

Source: PMU of Industrial and Small-scale industrial Group and Development and Investment, Hanoi City

Compensations and resettlements have been preceded in the HHTP project up to 2008 following the relevant regulation and guideline of Ha Tay Province. From the beginning of 2009, the regulation of Hanoi City will be applied, which stipulate the procedure and value of the compensation. Values for compensation have been reviewed by the Province every year. In the course of the procedure of compensation, there are two occasions for the people to check the value and condition of compensations.

Table 3-6: Resettlement of household caused by HHTP Project

Commune	Up to 2004	Yr 2005	Yr 2006	Yr 2007	Yr2008	Total
Thach Hoa	175	0	0	0	0	175
Tan Xa	0	0	0	0	0	0
Ha Bang	0	0	0	0	0	0
Binh Yen	0	0	0	0	0	0
Phu Cat	0	0	0	113	17	130
Total	175	0	0	113	17	305

Source: PMU of Industrial and Small-scale industrial Group and Development and Investment, Hanoi City

3) Environmental impact

It is confirmed that the land acquisition of the project will cause 1,200 households to be resettled and 1,714 households to be compensated. So far, the number of houses allocated in the resettlement area can not cover all household that will be resettled. The concerned agencies need to take this matter seriously and should take necessary actions.

The impact of such number of people is not small. Even though the compensation following the relevant regulations has been executed, but is still suggested to pay careful attention to this issue. As the resettlement areas are rather big, it is expected that present communities in three communes could be remained even after resettlement.

(2) Impact on living and livelihood

1) Criteria of evaluation

It is evaluated that do the conditions of living and livelihood after the impact could keep to the similar level as to present conditions.

2) Condition of impact prediction

As shown in Table 3-4, 1,714 household likely to be affected during land acquisition of the project area of 1036ha. Land for agriculture as well as accommodation of the local people included in the project site need to be acquired and cleared.

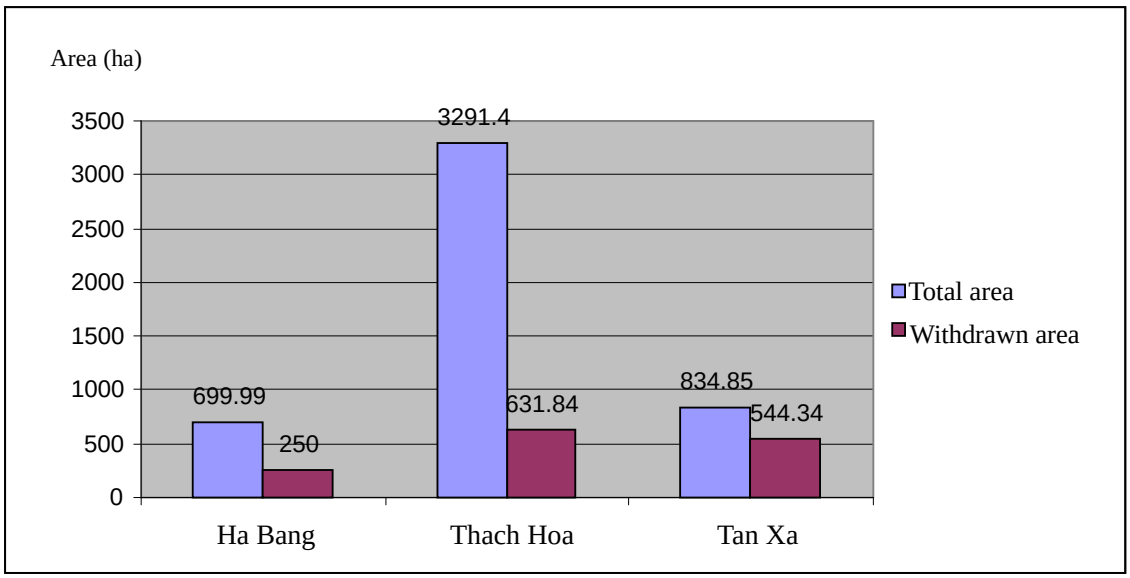


Figure 3-2: Total Area and Area of the HHTP of Three Communes

Area coverage of land acquisition in comparison with total area of land of each commune is presented in Figure 3-2. The figure shows that, in Tan Xa commune, total communal area is 834,85ha, of which the area of withdrawn land is 544.34 ha accounting for 65.2%, while the rate of Ha Bang and Thach Hoa is 35.7 and 19.2%, respectively. Considerably, most of withdrawn land area is agricultural land of the inhabitant. This affects seriously the living of inhabitants, because their main source of income is based on the cultivation of this land. Losing agricultural land means that the inhabitant loses part or all earning.

Out of the total, almost 100% inhabitants from Ha Bang commune suffered the impact. In Thach Hoa commune and Tan Xa commune 77% and 83% respectively suffered the impacts. The impacts to inhabitants of Thach Hoa commune is the most serious one as the 100% of the production lands of 1058 households will be acquired. Although Ha Bang commune has the larger amount of households and losing land but impact level is much lower as not totally their agricultural land is withdrawn. The remaining agricultural land area with Ha Bang commune after land acquisition & clearance is about 247 ha.

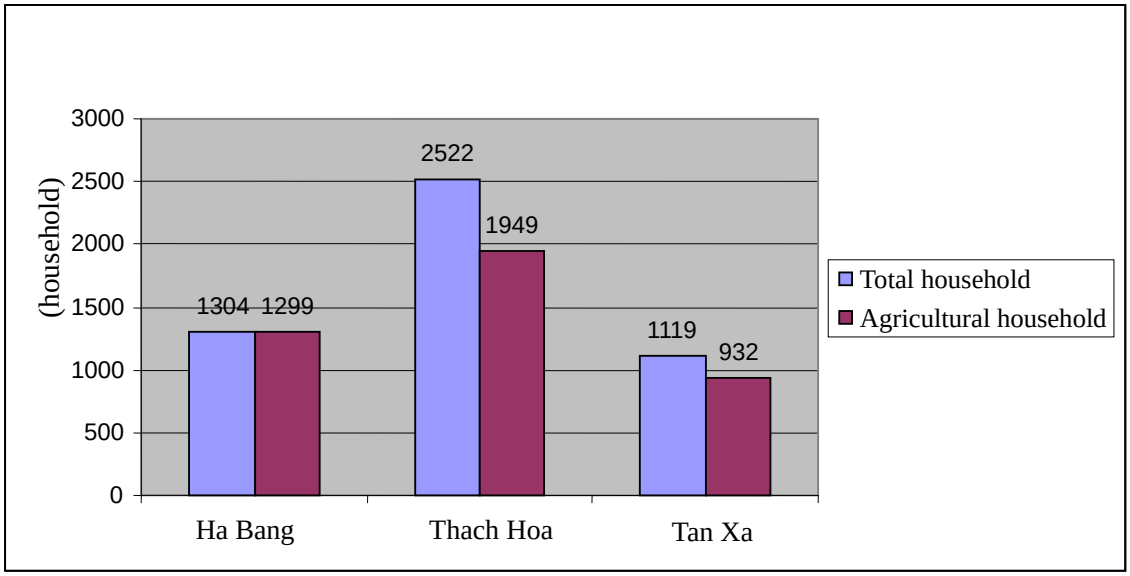


Figure 3-3: Number of Households Engaging Agricultural in Three Communes

3) Environmental impact

The impact on the living and livelihood is considered not small since it is obvious that inhabitants will find new works. HHTP-MB need to pay appropriate attentions on this issue to mitigate negative impact to the affected people, while it is likely that in future the development works in HHTP will offer job opportunities.

(3) Impact on heritage

1) Criteria of evaluation

Acceptance and satisfaction level of the concerned people affected by the resettlement.

2) Condition of impact prediction

Although cultural relics will not be affected by the land acquisition for the project, a large amount of graves need to be relocated. These graves count for 2,600 in Ha Bang commune, 1,300 in Thach Hoa commune. It is not easy to agree with all concerned inhabitants for relocation of such number of graves. It may face difficulty to find appropriate new location for resettlement of cemeteries.

In addition, a large amount of public constructions in Thach Hoa commune must be cleared including the communal People's committee, secondary schools, health station, post office, credit fund and cultural center.

3) Environmental impact

Although the resettlement of office, schools and other facilities would not be so serious but the resettlement of graves should be dealt carefully paying attentions to the perception and the emotions of local people.

3.5 CONSTRUCTION PHASE

During the construction phase, huge amount of soil and raw materials for construction shall be transported by construction vehicles to the project area to execute the work of land preparation and basic construction. Heavy equipment will be used for constructions.

And it is also fact that most of land use of the site will be changed to build new zone.

3.5.1. Impact on physical environment

(1) Impact on air quality

1) Criteria of evaluation

Environmental Standard defined by TCVN5837-2005

2) Condition of impact prediction

a. Emission from construction vehicle
According to construction plan, peak traffic of construction vehicle will be during Year 2013 to 2014. The number of construction vehicle and heavy equipment likely to be during this period are shown in the table below.

Table 3-7: Number of Equipment and Vehicle for Construction in 2013 and 2014

CP-1A: Major infrastructure development	Unit
Dump truck	47
Clamshell excavator 3.6m3	1
Tire crane 16T	1
Tire crane 25T	15
Roller 10T	3
Tire crane 16T	1
Vibrating roller 25T	1
Air compressor 600m3/h	1
Bulldozer 108CV	9
Grader 108CV	1
Bucket chain excavator 1.6m3	1
Cp-1B: Land reclamation of 3 zones	Unit
Dump truck	79
Clamshell excavator 0.8m3	1
Clamshell excavator 3.6m3	8
Tire crane 25T	1
Scraper 16m3	2
Bulldozer 108CV	3
Bulldozer 140CV	1

Based on these figures, the number of construction vehicle/equipment at peak of construction can be calculated by applying a peak rate of 1.5. Thus, the number of construction vehicle/equipment at peak of construction is 189. Number of trip of construction vehicles in a day is 3,024 (189 units x 2 trip/hr x 8hr/day).

Based on the construction plan, driving distance of one construction vehicle has been set as 20 km a day.

Box model is applied for calculation of concentration of air pollution. The space to be affected

by emission of construction vehicles was assumed as 10 km x 10 km x 10 m-height. Emission factors shown in Table 3-8 were adopted. Effect of wind was not considered.

Table 3-8: Emission factor of construction vehicle

Pollutant	Pollution coefficient (kg/ton-diesel)	Emission factor (kg/100km)
Dust	3.5	0.84
CO	20.81	4.99
NO_x	13.01	3.12
SO_2	7.80 S	1.87S
Hydrocarbon	4.16	0.99

Source: WHO

Note: one construction truck consumes about 30 liters of diesel/100 km

b. Emission from heavy equipment

Heavy equipment that will be operated at the peak period of the construction work are shown in Table 3-7. As these equipments will be operated as a party at each construction site, pollutants will be emitted in relatively narrow space.

There is not any steep topography in the project site. The major land uses of the site include agricultural area, water surface, and the community area such as accommodations of local people with low buildings.

It does not seem that ambient air is retained in certain space by topographic characteristic or structures.

The sequence of construction in the construction plan is as follows;

1. The road and infrastructure to be installed along the road,
2. Land reclamation of three functional zones

Site of construction and infrastructures along road is not fixed at any one particular location. It will move along the alignment in accordance with the progress of the works.

3) Environmental impact

a. Emission from construction vehicle

The result of calculation of the concentration of air pollutant is shown in the following table.

On comparing with TCVN 5937-2005, it can be seen that concentration of dust, NO_x and SO2 are higher than the values as specified in TCVN.

It must be noted that this prediction neglects many phenomenon, which normally happen in ambient air environment. For instance, since CO is not stable in ambient air, majority of CO is oxidized to CO2 very quickly in air environment. In addition, dust also does not remain in ambient air for long time because rather big particulates fall down to ground due to its weight.

It is fact that considerable amount of pollutant will be released to the air environment. It is possible that temporary deterioration of air quality will happen during the construction period of the project. It is thus required for HHTP-MB and the contractor to supervise and monitor the construction works so as to avoid any serious impact on the environment.

The dust by construction site may have big impact to the adjacent area. Mitigation measures such as watering should be considered and applied.

Table 3-9: Concentration of pollutants by construction vehicles

No	Pollutant	Concentration, (mg/m3)	TCVN 5937 - 2005 (mg/m3)
1	Dust	0.51	0.3
2	CO	3.02	30
3	NOx	1.89	0.2
4	SO2	1.13*	0.35
5	Hydrocarbon	0.60	-

Note: * concentration equivalent to sulfur

b. Emission from heavy equipment

Heavy equipment for constructions will produce air pollutant during its operation at the site. Judging from topographic features and present land use, it is assumed that serious situation of air pollution may not happen.

Sites of constructions, except construction of waste treatment plant and land reclamation of 3 functional zones, will not be fixed at one specific place for long time because most of infrastructure will be developed along the road. Considering the wide project area and the careful supervision of works by HHTP-MB and contractors, it is likely that the impact of emission by heavy equipment will not be serious one.

(2) Impact on water quality

1) Criteria of evaluation

Environmental Standard defined by TCVN5942-1995

2) Condition of impact prediction

Wastewater from daily domestic activities contains dregs, suspended substances, organic compound, nutrient substances (N, P) and microbe. According to the data of WHO, the amount of pollutants contained in the discharged wastewater due to daily domestic activities is presented in the following table.

Table 3-10: Load of pollutants in waste water from daily domestic activities

Pollutant	Quantity (g/person/day)	Microbe (MPN/100 ml)
pH	6.5 - 8	
COD	45 - 54	-
BOD5	72 - 102	-
TSS	70 - 145	-
T-N	6 - 12	-
T-P	0.8 – 4.0	-
Total Coli form	-	106 - 109
Feacal Coli form	-	105 - 106
Eggs of parasitical worms	-	103

Construction works will means a gathering of many workers. Accordingly, the huge amount of wastewater will be generated from the daily domestic activities. However, this will change as per duration and seasons in the year (average about 70 liters/worker/day and night). Assuming 2 shifts of 1,000 workers on site, the estimated amount of waste water is about 140 m^3/day.

3) Environmental impact

The wastewater discharge from the daily domestic activities of workers shall be included as one of works of construction & supervision as well.

The HHTP-MB and the contractor have to supervise and monitor environmental condition.

(3) Impact of noise

1) Criteria of evaluation

Environmental Standard defined by TCVN5949-1998

2) Condition of impact prediction

a. Impact of construction vehicle
As examined in the part of "impact on air quality", more than 3,000 trips is anticipated due to increase in traffic.

It is planned that only major road such as LHLH and National Roar 21 will be used for transportation relating to the movement of construction equipments etc. This will avoid any impact on the passing small roads as used by local people.

The present condition of noise along road cannot satisfy values of TCVN and it was also confirmed by field survey during this study.

b. Impact of heavy equipment
Table 3-11 shall present value of sound pressure level Leq of some equipment regarded as frequent noise sources in the construction. Though equipment listed in Table 3-7 is not necessarily included in the following table, it is obvious bulldozer as well as excavator produce noise during operation.

Table 3-11: Noise level of frequent noise sources

Types of noise source	Noisy level
Hole saw	94 - 98 dBA
Concrete vibrator	75 - 80dBA
Diesel driver, measuring far from 10 m	100 - 108 dBA
Generator 75 kVA, measuring far from 3 m	100 - 105dBA
Air-pressured hammer drill, measuring far from 1m	104 - 110dBA
Transport truck	70 - 80dBA

The noise level at receptor is deducted in accordance with the distance from noise source as calculated by the below given formula. In case of a distance is 10m and 100m, 20 dB and 40 dB is deducted respectively. In this formula other factors such as wind and obstacles are not considered.

$$L_{Aeq} = L_{wAeq} - 20 \log_{10} r - 8$$

Here L_{Aeq}: Equivalent noise level, "A" weighted at the point with r (m) distance from sound source (dB)

$L_{wAeq:}$ Acoustic power level of sound source (dB)

r: distance from sound source (m)

3) Environmental impact

The increase of noise level by construction vehicle is anticipated because more than 3,000 trips will be added to the traffic at the peak time of construction works. As the present condition of noise level has already exceeded the standard value of TCVN, the HHTP-MB and the contractor should pay attentions to this environmental issue. It is planed to use only major road for transportation purpose of constructions equipments & vehicles. It may reduce direct impact to the life of people and will not disturb the living environment.

Construction works by heavy equipment also cause high level noise. The noise level can be reduced by keeping distance. This should be considered while scheduling of constructions work, its progress work, and resettlement of residing inhabitants.

(4) Impact of waste

1) Criteria of evaluation

It is evaluated that do generated waste will affect the environment, and do method of waste treatment and disposal follow relevant regulations.

2) Condition of impact prediction

Residual soil will be generated from construction. The amount of residual soil and transportation is shown in Table 3-12. Besides this residual soil, solid waste from daily domestic activities of officers and workers on site is also anticipated.

Disposal of about one million of residual soil should need to be solved considering the impact of soil contamination as well (see the part of soil contaminations).

Table 3-12: Cut and Fill Volume (1,000m3)

	Filling	Excavation	Sub-Total	Disposal	Supplement	Total
Research & Development	8,125	200	8,325	662	662	9,648
Education & Training	990	611	1,601	258	258	2,118
Center of High- tech City	916	150	1,066	119	119	1,303
Sub-total	10,031	961	10,992	1,039	1,039	13,069

3) Environmental impact

Since the HHTP-MB and the contractor will follow appropriate method for waste disposal, environmental impact by waste is not anticipated as serious.

The amount of residual soil from construction is very huge. Therefore, proper site for disposal have to be secured before starting construction.

Solid waste from daily domestic activities is mainly paper, leftover of meals, containers of soft drink and beer. Assuming 1,000 workers of 2 shifts, the amount of waste from daily domestic activities is: 0.5 kg/worker/day x 2,000 workers = 1,000 kg/day. The amount of waste from daily domestic activities shall be collected and treated properly as one of aspect of construction management. Construction activities with local urban environment company should be considered.

(5) Impact of soil contamination

1) Criteria of evaluation

It is evaluated that do contaminated soil will affect the human life or natural environment.

The criteria of soil contamination adopted as specified in TCVN7209-2002.

2) Condition of impact prediction

It was confirmed that contaminated soil do exist and spreading in the project site. The result of analysis indicated a higher value of copper and arsenic as compared to the standard for agricultural soil. Considering the present land use of the project site, the sources of contamination are assumed to be due to its natural origin.

Relocation of the contaminated soil may be required during construction. According to land

reclamation plan, the amount of about 1 million square meters of soil disposal has been estimated as shown in the table.

3) Environmental impact

The HHTP-MB will treat and dispose the contaminated soils properly. It is necessary to consult with MONRE and relevant agencies to decide on the proper treatment of this issue.

Since HHTP-MB will follow instruction of the concerned agencies, it can be evaluated that soil contamination will not affect the human life and natural environment.

Cost for disposal of all soil which need to be moved from the HHTP area has been estimated as 0.54 billion JPY, which include cost for disposal area accounting for 38ha. It is fact that not all sample exceeded the standard value of soil contamination defined by TCVN. In addition, these results are not necessarily exceed the international standard such as that of Japan. It is suggested that Vietnamese side to adopt responsible way to treat soil contamination found in the area considering the said necessary cost and the fact that these substances probably came from natural origin.

Table 3-13: Comparison of Result of Soil Analysis and Standard Value of soil Contamination

Parameter	Unit	Results of Analysis (range of results for 7 location)	TCVN 7209-2002 (Vietnamese Standard)				Environmental Standard in Japan	
			Agricultural land		Industrial land		Paddy field	
			Value	Evaluation	Value	Evaluation	Value	Evaluation
Cu	mg/kg	43 – 163	50	6/7	100	3/7	125	2/7
Pb	mg/kg	10 - 143	70	3/7	300	0/7	-	-
As	mg/kg	7 - 18	12	1/7	12	1/7	15	1/7

Note: "Evaluation" indicates number of location where sampled soils exceeded the standard values defined by TCVN7209-2002 and Environmental Standard of Japan. Number of location among seven (7) that is total number of sampling locations is shown.

3.5.2. Impact on ecological environment

(1) Impact on flora, fauna, ecosystem

1) Criteria of evaluation

- Scale of loss of habitat
- Extent of impact to the present ecosystem and biodiversity of the surrounding area
- Effectiveness of measures to preserve the present environment

2) Condition of impact prediction

The result of flora and fauna survey clarified the biodiversity in and around area of the project site. Most species are very common in this region and these species are usually observed in the neighboring area of the project site. These species can be seen in the field including agricultural and plantation areas. Some important species were as well listed out as result of the survey. Although these species are stipulated by Government also by international NGOs of environment conservation, these can be found in other fields of this region.

According to the land use plan (see Table 1-4) of the project, total area covers 1,036 ha, in which area of Lake and buffer is 112 ha and the area of greeneries/trees is 31 ha. These two areas occupy about 14 % of the entire study area. Besides this, trees and green area will be prepared in every functional zone though detail plan of functional zones have not been clear except for 3 zones i.e. the center of hi-tech city, R & D Zone, and E & T Zone.

As per the present land use in the HHTP area, over 50% is occupied by agricultural area as

shown in Table1-1. The developed area is about 35% and the undeveloped area including forest is less than 5%. Water surface occupy around 10% of the area. It is recognized that in last few decades almost all area except water surface has been influenced by human activities.

It is planned to preserve shoreline of Tan Xa Lake which is recognized as important environment for regional eco-system. The distance of 25m will be secured between the shoreline of Tan Xa Lake and the development area. The setback of 25m has been illustrated in Figure 1-11 and Figure 1-23. In principle the Tan Xa Lake will not be affected by the various development projects.

Wastewater treatment plant will be developed as described in chapter 1. Direct discharge of agricultural wastewater and domestic waste water will reduce considerably after the operation of the treatment plant.

It is assumed that the population of the project area would increase gradually even without project realization considering recent population trend of former Ha Tay Province. Increasing individuals and companies might develop small sections in the area according to respective needs.

3) Environmental impact

The area of loss of habitat is about 530 ha, which consists of loss of water surface (about 20ha) and loss of agricultural area (about 500ha). It is fact that the spreading rural environment will be changed to modern environment.

With thoughtless development of the area by increasing companies or individuals, habitats of flora and fauna might be damaged. On the contrary, it is planned in the HHTP project to build green buffer zone and preservation of shore and water surface of Tan Xa lake. The project could contribute to preventing environmental condition from being damaged without any preservation plan.

In terms of biodiversity, it is analyzed that existence of species will not be damaged by the project since the species in the site is common in this area and these can be seen easily in the area where land use is similar to the these site conditions.

Tan Xa Lake, which is important component composing environmental conditions of the site, will be preserved. This measure of preservation will contribute to maintain natural environment as well as social environment. It is expected that existence of this lake will have positive influence on the life and work environment of workers and residents in the HHTP.

As a result of proper operation of sewerage system and the planned wastewater treatment plant, it is expected untreated discharge of domestic wastewater will not be seen.

(2) Impact on hydrology

1) Criteria of evaluation

It is evaluated do the development of infrastructures in the project will affect hydrology of the surrounding area.

2) Condition of impact prediction

In the drainage plan, the following facilities will be introduced to drain storm water.

1. Storm Water Collection Sewer
2. Tan Xa Lake Regulating Facilities

3. Dua Gai Stream Diversion & Improvement
4. Vuc Gaing Stream Retention Functions

Detailed concept and condition of drainage planning is described in Section 1.4.5.

The return period of 10 year was considered to prevent negative impact to the area in down stream.

After development of drainage system, storm water in the Hoa Lac Area will be discharged to the Tick River through the Tich Gang River and the Vuc Giang Stream as shown in Figure 3-4.

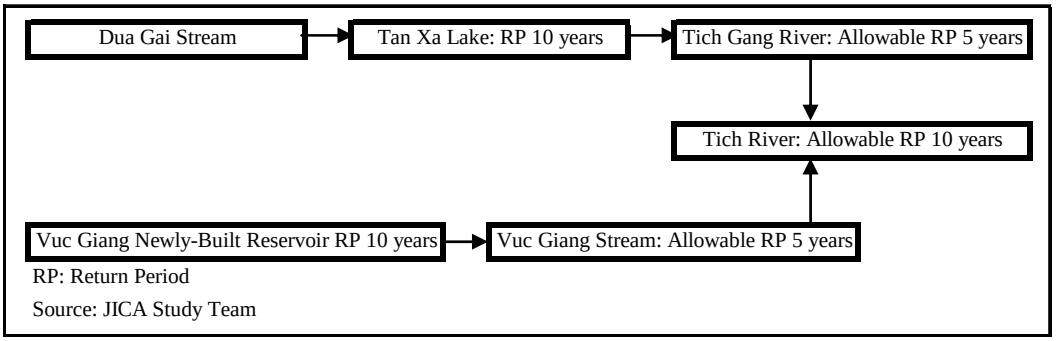


Figure 3-4: Storm Water Discharge Flow

3) Environmental impact

Even though the hydrological condition in the project site will be changed by the project, it is evaluated that hydrological condition of the region will not be affected seriously. For this purpose, the drainage planning and retention function were carefully studied and the planned infrastructure will contribute to maintain the condition of the region. However, the construction schedule while developing these facilities should be considered especially during the land reclamation works of 3 functional zones which may increase amount of water to be drained.

(3) Impact on ground water

1) Criteria of evaluation

It is evaluated do the development infrastructures of the project will affect aquifer of ground water.

2) Condition of impact prediction

As described in Section 2.2.4, the project site is located in the region where ground water is very rich in amount. Besides this, ground water layers are distributed widely in this area.

The excavation works during the construction of wastewater treatment plants and installation of sewerage pipes will not be deep as the shallow aquifer of ground water.

Tan Xa Lake will be preserved and buffer and green area will be secured in the HHTP.

It is assumed that the population of the project area would increase gradually even without project realization considering recent population trend of former Ha Tay Province. Increasing individuals and companies might change land use of small sections respectively.

3) Environmental impact

Ground excavation in the construction will not reach the aquifer. Compared to the wide spreading area of ground water, the area for the waste treatment plant is very small. It is

evaluated that the construction and existence of the structure of the plant will not damage the aquifer.

Although the artificial ground surface may affect recharging of ground water, the preserved Tan Xa Lake and other water surface and green area will keep recharging ground water. In addition, as long as the other area outside HHTP maintains the same land use, it is expected that ground water can be recharged from these areas too.

In case of without implementation of the HHTP, it could be afraid that land, water surface and its shore would be divided into small sections and used for various human activities without any regional coordination for environmental conservation. In such case, present capacity of recharging ground water might be affected without countermeasures. It could be recognized the HHTP project would contribute keeping this capacity by securing green area and preservation of water surfaces.

(4) Impact on topography and geology

1) Criteria of evaluation

It is evaluated that do conditions of topography and geology will not be affected by the construction of the project.

2) Condition of impact prediction

The topography of the project site is not steep but moderately hilly. There is a feature of water surface which occupies relatively big area.

Geological condition is described in Section 2.2.5. It is to be noted that there is no dynamic geologic phenomenon which may cause disadvantage to the construction steadiness in the project site. There is not any important topography and geology to be preserved.

3) Environmental impact

The construction will not significantly change topography and geology of the site.

3.5.3. Impacts on socio-economic environment

(1) Sanitation

1) Criteria of evaluation

It is evaluated that do the construction of the project will make the condition of sanitation worse.

2) Condition of impact prediction

A large number of workers will gather to the construction site. The HHTP-MB will require the contractor to take care of aspect of sanitation as well as of wastewater and solid waste. Management of these issues shall be considered as one of aspect of construction management and supervision.

3) Environmental impact

The HHTP-MB will pay attention to keep the hygienic sanitary condition on the site as well as in the surrounding area. Therefore, serious impact is not anticipated.

The HHTP-MB shall monitor the condition of the environment including sanitary conditions.

(2) Landscape

1) Criteria of evaluation

It is evaluated that do the project will keep landscape or make appropriate one to this region.

2) Condition of impact prediction

The present land use of the area will be changed during the construction of infrastructure.

Landscape plan was developed which contains building regulation for standardizing of structures to be constructed in the HHTP, concept of making green buffer zones, and preservation and utilization of landscape of the existing Tan Xa Lake and its shoreline.

3) Environmental impact

The landscape plan will contribute to developing new landscape of the high-tech park while current scenery at the area will be lost. Consistency in landscaping will be kept in the park and the landscape will impress people who will visit, work and reside at the HHTP.

3.5.4. Other impacts on environment

(1) Accident

1) Criteria of evaluation

It is evaluated that do accidents will be avoided. In case of accident then can it be dealt immediately.

2) Condition of impact prediction

Many traffic and operation of heavy equipment may increase risk of accident at the construction site. The HHTP-MB will require the contractor to follow strict supervision and management during constructions.

The project area is located within the site used for war of resistance against United State. So, the possibility of finding or coming across bomb, mine, explosive materials etc. cannot be ruled out.

3) Environmental impact

Risk of accident during construction can be minimized through the application of appropriate management and supervision. Nevertheless, necessary actions during any emergency including accidents should be considered and the action required should be distributed among the concerned people and organizations.

In case of finding explosive material in the site, it should be informed to the relevant organizations.

(2) Traffic accident

1) Criteria of evaluation

It is evaluated that do traffic accidents will be avoided. In case traffic accident takes place then can it dealt immediately.

2) Condition of impact prediction

The traffic in road network in and around area of the HHTP will be increased due to construction vehicles. This may affect the traveling demand of inhabitants and may increase the risk of traffic accident too.

It is planned that construction vehicle will use only major road such as LHLH and national road 21 so that to avoid any disturbance to local traffic condition. The HHTP-MB will require the contractor to manage traffic of construction vehicles during construction period. In addition, drivers of vehicles have to pay attention to traffic safety as well as to the safety of local residents.

Once LHLH will be constructed as designed, it is expected to separate the local traffic due to people's daily life with long-medium traffic such as between Hanoi and Hoa-Lac.

3) Environmental impact

The large flow of construction vehicles may cause traffic accident if no suitable measure for effective administration and management are taken. The HHTP-MB along with the contractor will take necessary actions to secure traffic safety and immediate response in case if any accident takes place.

3.6 OPERATION PHASE

3.6.1 Impact on physical environment

(1) Impact on air quality

1) Criteria of evaluation

Environmental Standard defined by TCVN5837-2005

2) Condition of impact prediction

Traffic demand in the HHTP was projected by using population forecast in the HHTP. Traffic parameters that have seen set for the Hanoi Metropolitan area by the Comprehensive Urban Development Program in Hanoi Capital City was used. Traffic demand was predicted as 27,358 pcu/day in 2015 and is shown in the following table.

Table 3-14: Traffic Demand Projection

Trip Demand

	Population		Trip Rate	Daily Trips	
	2015	2020		2015	2020
Residents within HHTP	65,140	98,625	2	130,280	197,250
Daytime Population	118,468	188,559			
People from outside HHTP	53,328	89,934	2	106,656	179,868

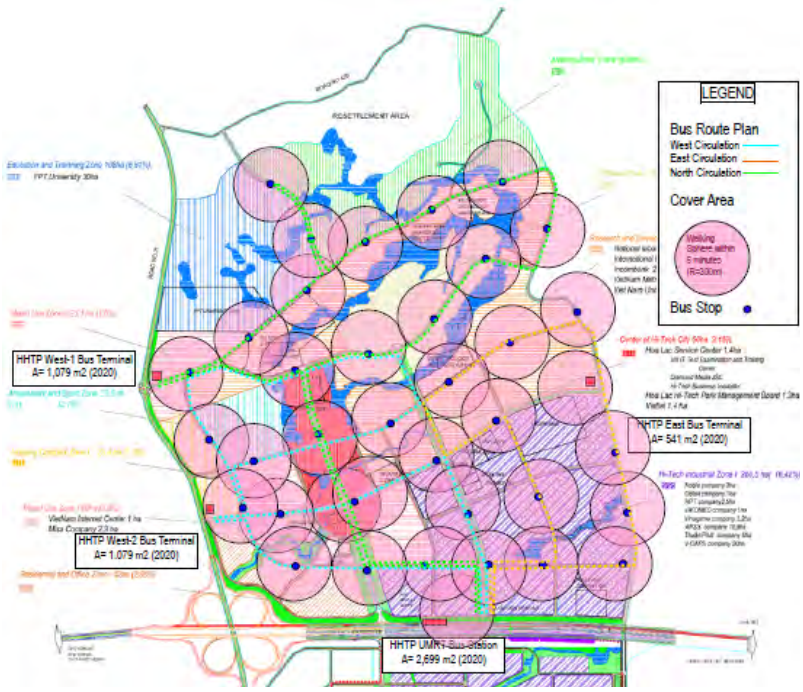
Modal Split

Mode	Share(%)		Daily Trips (PT)	
	2012*	2020	2015	2020
Bicycle	16	3.8	17,065	6,835
Motorcycle	61.1	52.9	65,167	95,150
Car	9.7	15.8	10,346	28,419
Truck	2.3	3.5	2,453	6,295
Public Transport	10.9	24	11,626	43,168
Total	100	100	106,656	179,868

Traffic Demand Projection

Mode	Occupancy Rate		Daily Trips (VT)		PCU	Daily Trips (PCU)	
	2012*	2020	2015	2020	Factor	2015	2020
Bicycle	1.13	1.13	15,102	6,049	0.2	3,020	1,210
Motorcycle	1.36	1.36	47,917	69,963	0.3	14,375	20,989
Passenger Car	2.02	2.02	5,122	14,069	1	5,122	14,069
Truck	1.7	1.7	1,443	3,703	2.5	3,607	9,258
Sub-total			69,583	93,784		26,124	45,526
Public Transport	23.56	30	493	1,439	2.5	1,234	3,597
Total			70,077	95,223		27,358	49,123

For the transportation within the HHTP area, public circulating bus has been planned. Routes of circulating bus and the locations of bus stop are illustrated in the following figure. Adoption of electric bus which does not produce pollutants and non environmental friendly gases in air from engine is recommended by JICA-FS.



Source: JICA feasibility study

Figure 3-5: Proposed Circulating Bus Routes and Bus Stops

3) Environmental impact

The traffic demand will increase in accordance with the increase in population and their demands and needs for transportation. This increase will result in the increase of emission of air pollutants from engines.

Introduction of public circulating bus will be able to restrain the increase in traffic. Thus, public buses will not only enable in reducing the traffic but will also assist in reducing the emission of air pollutants.

(2) Impact on water quality

1) Criteria of evaluation

Environmental Standard defined by TCVN5942-1995

2) Condition of impact prediction

Based on the predicted population and estimated discharge of wastewater, the sewerage plan was developed. It was targeted to fulfill the value as specified in Column B of TCVN shown above.

The following figures show the treatment process of sewerage and layout plan of sewerage treatment plant.

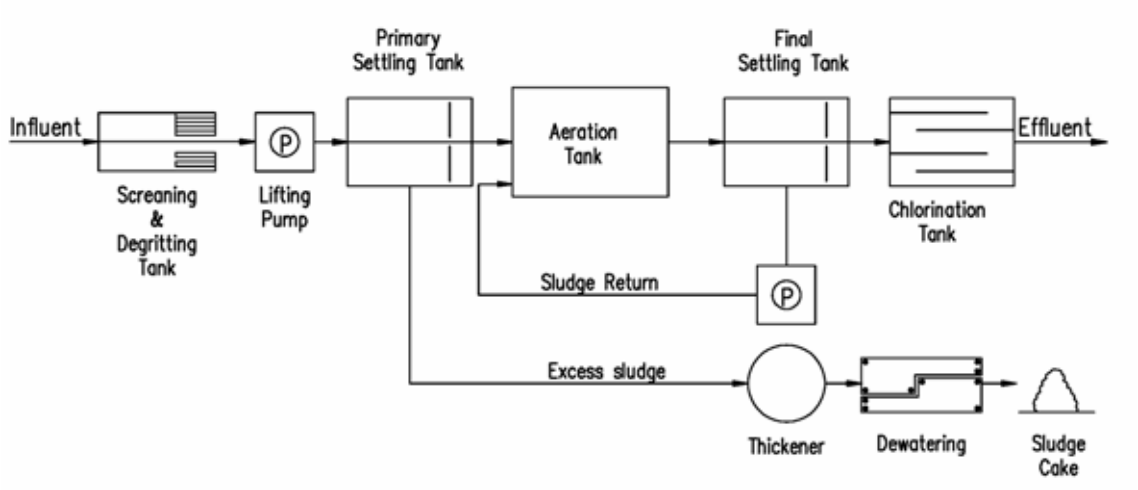


Figure 3-6: Outline of Wastewater Treatment Process

It was determined that six (6) units of wastewater treatment plant will be required. These units will have a total capacity of 36,000 m^3/day, excluding the capacity of existing wastewater treatment unit (6,000 m^3/day).

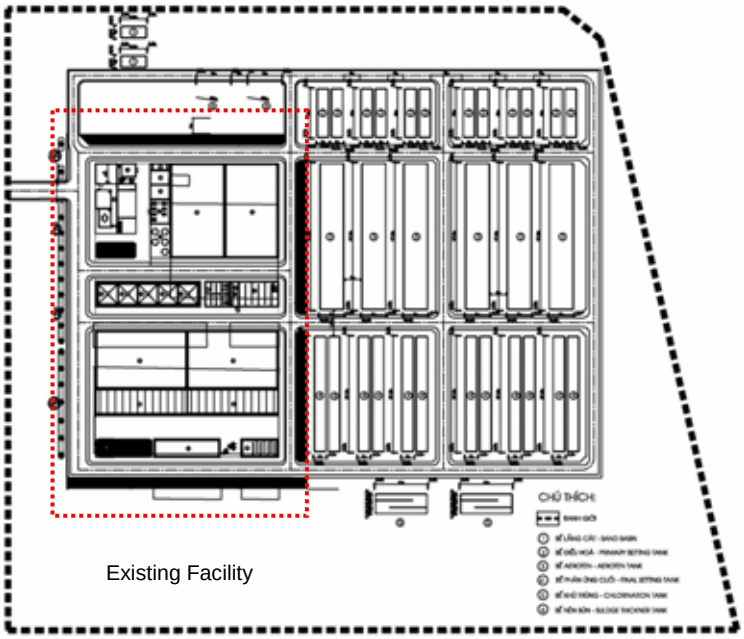


Figure 3-7: General Layout Plan of Wastewater Treatment Plant

3) Environmental impact

Sewerage generated in the project area will be collected to sewerage system and treated at the wastewater treatment plant.

The wastewater treatment plant has been designed to treat wastewater and it satisfies the TCVN norms. It will not cause serious negative environmental impact on water quality. As the treated water abides the TCVN norms, it will not damage water quality of dawn stream and won't affect the activities of residents relying on the river water such as aqua culture.

(3) Impact of noise

1) Criteria of evaluation

Environmental Standard defined by TCVN5949-1998

2) Condition of impact prediction

As described earlier during the impact on air quality that increase in traffic is anticipated.

It may affect the noise environment especially along the road. It is expected that Introduction of public circulating bus will enable to reduce the number of vehicles and traffic in the HHTP.

It is planed by MOT to construct LHLH which is one of the important external infrastructure developments for the HHTP. The width of LHLH is very wide, about 100m.

3) Environmental impact

The impact of noise due to driving vehicles may be bigger due to the increase in traffic during operation phase of the HHTP. The HHTP-MB has a plan to introduce public circulating bus, which will result in the restriction of number of vehicles and reduction in traffic.

After completion of the LHLH, it is expected that the distance will increase between the source of noise i.e. vehicles and residents living area. With this it is likely that the impact of noise in the daily life will be reduced considerably.

(4) Impact of waste

1) Criteria of evaluation

It is evaluated that do generated waste will affect the environment, and do the method of waste treatment and disposal follow relevant regulations.

2) Condition of impact prediction

Amount of waste generation has been estimated based on the predicted population in each zone. The waste generation rate was decided by following the building code.

As the population density of the HHTP has been projected to be 12,079 person/km^2, the Grade I level of urban management has been assumed for both Stage 1 and Stage 2 in HHTP. The solid waste generation unit rate of 1.3 kg/person/day as shown in table below and a collection ratio of 100 % has been adopted for domestic waste.

Table 3-15: Domestic Solid Waste Generation and Collection Ratio

Class of city	Solid waste generation rate (kg/person/day)	Solid waste collection ratio (%)	Population density criteria (person/km^2)
Special, I	1.3	100	> 12,000
II	1.0	≥95	> 10,000
III, IV	0.9	≥90	> 6,000
V	0.8	≥85	> 2,000

Note: Criteria for class of cities is given in Decree No.72/2001/ND-CP.
Source: Vietnam Building Code (QCVN:01/2008/BXD)

According to the solid waste management plan, all waste will be treated at the existing facilities located outside of HHTP. The facility and URENCO, which comply to the relevant regulation will be chosen by each tenant depending on characteristic of their wastes.

3) Environmental impact

The estimated amount of waste generation in the HHTP is 152.6 t/day in Stage 1 and 215.1 t/day in Stage 2. As collection ratio has been assumed to be 100 % for all kind of waste, the amount of generated and collected solid waste are equal.

Since all waste will be collected, treated and disposed under the contract that will be signed between tenants and competent URENCO, no serious environmental impact is anticipated. The HHTP-MB will secure appropriate solid waste management by developers by using the development guidelines.

Table 3-16: Predicted Amount of Generated and Collected Solid Waste in the HHTP

Unit: t/day

Name of Development Zone (Land Use Symbol)		Stage 1				Stage 2			
		Domestic	Office	Industrial	Total	Domestic	Office	Industrial	Total
1	Software Park	-	2.3	-	2.3	-	3.3	-	3.3
2	Research and Development Zone	-	2.1	-	2.1	-	3.6	-	3.6
3	High-tech Industrial Zone	-	-	59.2	59.2	-	-	69.5	69.5
4	Education and Training Zone	4.3	1.3	-	5.6	22.5	6.7	-	29.2
5	Center of High-tech City	6.4	1.9	-	8.3	6.4	1.9	-	8.3
6	Mixed Use Zone	5.3	0.7	-	6.0	9.9	1.3	-	11.2
7	Residential and Office Zone	44.4	-	-	44.4	44.4	-	-	44.4
8	Housing Complex Zone	24.3	-	-	24.3	45.1	-	-	45.1
9	Amenity Zone	-	0.1	-	0.1	-	0.1	-	0.1
10	Amusement and Sport Zone	-	0.4	-	0.4	-	0.4	-	0.4
Total		84.7	8.7	59.2	152.6	128.2	17.4	69.5	215.1

(5) Impact of odor

1) Criteria of evaluation

It is evaluated that do the project will cause any negative impact by odor generated by the facilities.

2) Condition of impact prediction

The wastewater collected to the treatment plant may have offensive odor. The existing treatment plant and the expansion of the facility are located in High-tech industry zone.

The sludge generated in the treatment plant will be dewatered and disposed at the existing disposal site.

3) Environmental impact

It is likely that offensive odor will be generated from sewage and its treatment systems. However, the HHTP-MB will operate the plant properly so as to prevent any serious negative impact of odor to the life of people. The location of the plant was selected considering that it wont affect the normal life style of workers and residents. The plant will be located in high-tech industry zone.

Thus, through the appropriate operation of treatment process and proper disposal of dewatered sludge, the impact of odor will not be serious.

3.6.2 Impact on ecological environment

(1) Impact of rain runoff

1) Criteria of evaluation

It is evaluated that do the infrastructures development in the project will cause any negative impact of rain runoff in the surrounding area.

2) Condition of impact prediction

Present land use will be changed. As occupancy of the artificial ground will be increased, it is anticipated that rain runoff will be increased especially during the progress of land preparation of 3 functional zones. This impact was considered during the planning of drainage system. Detailed concept and condition of drainage planning is described in Section 1.4.5.

Impact to the area at down stream were also considered and studied. As a result, the facilities and infrastructure that will mitigate any negative impact during heavy rains were decided.

In addition to the artificial facilities and infrastructure, buffer and green area were also considered during the land use planning exercise. Preservation of Tan Xa Lake will contribute in retaining rainwater.

3) Environmental impact

Increase of rain runoff is anticipated due to project implementation. However, negative impact to the surrounding area will not be serious because the retention function for the project area were studied and accordingly will be improved. It should be noted that JICA study team suggested Vietnamese side to improve storm water drainage functions also in outside areas of the HHTP such as Tich River.

3.6.3 Impact on socio economic environment

(1) Impact on living and livelihood

1) Criteria of evaluation

It is evaluated that do the conditions of living and livelihood during operation could be at same level as of present conditions.

2) Condition of impact prediction

With the general programming, HHTP project is a modern complex with functional areas of education, high-tech industrial area, combination service area, offices, residence and entertainment.

When the HHTP will be in operation, the main tasks of HHTP will be to develop high-tech industry, incubate high-tech enterprises, train labor force in high technologies and produce and trade the high-tech products.

Local people are looking forward to HHTP-MB to provide job opportunity to them at the time of operation of HHTP. Accordingly, the HHTP-MB has stated that they will try to generate job opportunities for the local people through coordination with local authorities. Here job opportunity mainly means simple works that does not require any advanced skills.

Local people also expect for the arrangement or promotion of vocational training by the HHTP-MB.

3) Environmental impact

It is believed that the project will make a positive impact to change this rural area into the sophisticated and advanced complex with high economic value of activities. If living and livelihood of local people will be promoted together with development of the HHTP, the living condition will be improved as compared to the one when mainly relying on agriculture.

Actually, the HHTP will need qualified workforce. Since, the main target is not to create work for farmers who lost land, improvement of living condition and livelihood of the affected people might not be easy. Thus considering this HHTP-MB will need to pay appropriate attention to it.

3.6.4 Other impacts

(1) Accident

1) Criteria of evaluation

It is evaluated that do accidents will be avoided. In case of accident then can it be dealt immediately.

2) Condition of impact prediction

The HHTP-MB will operate their facilities such as the wastewater treatment plant properly and prevent from any accident and trouble.

The HHTP-MB following the development guidelines will also supervise activities of developers and tenants. Objective would be to modify the activities or rectify the facilities that may lead to any accidents.

3) Environmental impact

It is evaluated that accident will not happen and even if it happen the HHTP-MB along with developers and tenants will take necessary actions to deal with it immediately.

(2) Traffic Accident

1) Criteria of evaluation

It is evaluated that do traffic accidents will be avoided. In case traffic accident takes place then can it dealt immediately.

2) Condition of impact prediction

Traffic demand in the HHTP was projected by using population forecast value in the HHTP. In 2015, the projected traffic demand will be 27,358 pcu/day. As a result, the traffic will increase.

The public circulation bus has been planned as one of mode of transportation within HHTP.

3) Environmental impact

The increase of traffic may increase risk of traffic accident if suitable measure for administration and management of traffic are not taken. The public bus will contribute in reducing the volume of traffic and restrain risk of traffic accidents within HHTP.

The HHTP-MB will instruct the developers and tenants to comply with traffic rules and traffic safety norms. In addition, they should immediately take necessary remedial measures in case if any traffic accident takes place.

(3) Global warming

1) Condition of impact prediction

Amount of CO2 emission from the traffic relating to the HHTP in 2015 is estimated base on the assumptions as shown below.

- Traffic of residents:

1. Daily Trip: 130,280 (see Table 3-14)

2. Assuming resident will not transport by using passenger car and truck but bicycle, motorcycle and public bus because the distance of transportation within HHTP area is relatively short.

3. Number of trip of bicycle, motorcycle and public bus, is 20,952trip/day, 66,512trip/day and 598trip/day respectively.

4. CO2 produced by transportation by bicycle is not estimated.

5. Driving distance of public bus is assumed as 10.4 km based on the distance of circulating route. That of motorcycle is assumed as 7km.

6. Average driving speed is assumed as 20km/h

- Traffic from outside:

1. Daily Trip: Private Vehicle 26,124pcu/day, public bus 493VT/day

2. People transfer to public bus at the bus stop near main gate. Private vehicle goes directly to their destination without transferring to public bus

3. Private vehicle 26,124pcu/day, public bus 493trip/day

4. Driving distance: private vehicle 2km, public bus 10.4km

* driving distance of private vehicle was assumed considering the distance from entrance to the each functional zone. People will use the entrance nearest to the office.

5. Average driving speed: private vehicle 40km/hr, public bus 20km/hr

2) Environmental impact

As a result, the amount of emission of CO2 is calculated as about 2,600 ton-CO2/year .

Residence	Mode	Daily trip (pcu, VT)	Fuel economy (km/L)	Driving distance (km/trip)	Fuel consumption (L/day)	CO2 emission (ton/day)	CO2 emission (ton/year)
HHTP	Bicycle	20,962	0.0	-	-	-	-
	Motorcycle	66,512	15.0	7	31,039	72.94	21,882
	Bus	493	9.0	10.4	570	1.53	459
Outside	Car	26,124	11.5	2	4,543	10.68	3,204
	Bus	493	9.0	10.4	570	1.53	459
	Total	26,617	-	-	36,722	86.68	26,004

Note: 1. Driving speed is assumed 30km/hr for car, 20km/hr for bus and motorcycle respectively.
2. Emission factor of fuel: 2.35 kg/L-gasoline, 2.69kg/L-diesel
3. VT: Vehicle Trip, pcu: passenger car unit

3.7 POTENTIAL ENVIRONMENTAL IMPACT BY OPERATION OF HIGH-TECH INDUSTRIES AND BUSINESS ACTIVITIES IN OPERATION PHASE

As mentioned above, the detail of investment as well as plans for each functional zone has not yet been established. Accordingly, the assessment of environmental impact due to these

activities were not considered in this EIA.

Table 3-17 shows example of environmental issues which might come up in HHTP due to specific activities or industries and is shown in the table.

Table 3-17: Example of environment issues by business in HHTP in Operation Phase

No	Industries	Arisen waste	Characteristics and impacts of waste
1	Group of electronic industry (high technology), - Manufacturing electronic accessories and equipments - Assembling the system of electronic-telecommunication equipment	Exhausted fumes: mainly welding smoke originated from the process of welding integrated circuit, electronic equipment Noise - Dust: originated from the process of welding point	Exhausted fumes: containing harmful substances, solvent, Sn, Pb gas - Metal dust → Air environnent pollution
		- Waste water: originated from the process of printing circuit cleaning by chemical, equipment cooling water	- Water containing metal such as Cr, CN^-, chemical… - Waste water from daily domestic activities containing organic substances, high BOD, COD … → Water environment pollution, effecting on the ecological system
		Solid waste: + Circuit, damage accessories … + Product package, packed bale hoop… + Waste from daily domestic activities..	Solid waste: + Can be recycled + Collecting, transporting and treating in line with technical rules → Land environment pollution
2	Group of mechanical industry - Assembling machines and equipment - Producing equipments specializing in industrial factories;	- Exhausted fumes: from the area of plating basin, phosphotizing surface of materials or spray booth; or exhausted fumes originated from the process of testing engine, machines… - Temperature	- Exhausted fumes: containing acid gas, alkali gas, SO_2, CO, NO_2, solvents and welding smoke … → Air environment pollution
		Dust: + from operation of transport vehicles + from the process of material surface processing of forging, curving, filing … + from the process of painting	- Dust: includes Silic dust, metal dust and paint dust → Air environment pollution
		Noise, vibration originated from the process of material surface processing, product test,…	- Big sound level in the production area → Air environment pollution
		Waste water: + Waste water from production: originated from the process of material surface treatment in details (process of plating, biting, greasing, phosphotizing surface…); + Waste water from daily domestic activities…	+ Waste water from production containing chemical (acid, alkali, phosphate liquid, heavy metal, grease…) + Waste water from daily domestic activities: containing organic substances, high COD, BOD → Water environment pollution, effecting on the ecological system
		Solid waste: + Including bavia metal, swarf… originated from the process of mechanical processing (sharpening, shaping…); + Metal dregs from cleaning and phosphatic; + Cover of container, can; package of chemicals, and additive; + Waste mud from the waste water treatment system;	- Solid waste with complicated components but mainly can be recycled: bavia metal, cover of container, can... → Land environment pollution

No	Industries	Arisen waste	Characteristics and impacts of waste
		+ Other solid waste: waste from daily domestic activities…	
3	Production group of medicines	Exhausted fumes: originated from the process of preparation and preliminary treatment of raw materials Exhausted fumes from steam boiler	Chemical steam, antibiotic smell … SO_2, NO_x, dust…. → Air environment pollution
		Solid waste: from the process of product completion	Damaged bottle, cork, label Fault products, out of expiry medicines … → Land environment pollution
		Waste water: from the process of equipment and raw material cleaning	Waste water contains high content of SS, detergent, antibiotic (if any) → Water environment pollution, effecting on the ecological system

3.8 ASSESSMENT OF ALTERNATIVE

The case of "no action" has been compared with the case of "implementation of FS project". While, in the course of the FS, some alternatives have been studied environmentally as well as technically for each infrastructures within framework shown in the master plan approved by the Government, it has been recognized that the drastic changes such as partly implementation is not realistic. For, some developments have been implemented in the project site in accordance with the Governmental authorization.

The example of alternative examination for development, i.e. the study on revetment for periphery of lake, has been described in Section 1.4.3.

The following table illustrates the result of assessment by comparing the three cases i.e. "no action", "implementation of FS project WITHOUT mitigation measures" and "implementation of FS project WITH mitigation measures". It was assessed that the case of "implementation of FS project with mitigation measures" is better option as compared to other two cases.

The following were found during this analysis;

- Although the project implementation might have some potential of certain negative impacts on the environment, it is possible to mitigate negative impacts by adopting and executing appropriate mitigation measures. It is to be noted that it will bring many positive impacts at the same time.
- Without implementation of HHTP project, it is highly unlikely that there would be any early development of social infrastructures on the project site and the surrounding area.
- It is possible, in the management of construction as proposed by JICA feasibility study, to adjust the timing of resettlement and land acquisition of certain area owned by local people. If timing can be adjusted in accordance to the progress of the project, local people can continue their current livelihood and can utilize the time of execution and compensation in finding new livelihood.

Table 3-18: Assessment of Alternative

Classification	Environment aspect	No Action	FS project		Possible Mitigation Measures for Negative Impacts
			W/O	With	
Physical environment	Air Quality	B	C	B	• Public circulating bus to reduce traffic • Pollution control following relevant regulations
	Water quality	C	C	A	• Sewerage treatment system • Pollution control following relevant regulations
	Noise	B	C	B	• Pollution control following relevant regulations
	Waste	C	B	A	• Waste management following relevant regulations
	Soil contamination	C	C	B	• Treatment and disposal of contaminated soil following relevant regulations and instruction by competent authority
	Odor	B	C	B	• Dewatering of sludge generated in wastewater treatment plant
Ecological environment	Flora, fauna, ecosystem	B	C	B	• Dewatering of sludge generated in wastewater treatment plant
	Hydrology	B	C	B	• Drainage facilities such as revetment of Tan Xa lake • Preservation of Tan Xa lake
	Ground water	B	C	B	• Preservation of Tan Xa lake • Green buffer zone
	Rain runoff	B	C	B	• Drainage facilities such as revetment of Tan Xa lake • Preservation of Tan Xa lake
	Topography and geology	B	B	B	-
Socio -economic environment	Resettlement	B	C	B	• Preparation of Resettlement plan and its monitoring with appropriate compensations to the affected people
	Living and livelihood	B	C	A	• Vocational training for the affected people • Employment of the affected people under the project and business in the area including activities by developers and tenants
	Sanitation	C	C	A	• Sewerage treatment system • Appropriate waste management
	Heritage	B	C	B	• Consideration in replacement of cemeteries in communes
	Landscape	B	C	A	• Consistency in landscaping based on the plan
Others	Accident	B	C	B	• Safety training on operation and maintenance
	Traffic accident	B	C	B	• Safety training on traffic
	Global warming	B	B	B	• Public circulating bus to reduce traffic
Evaluation		-	--	+	

Note. 1. W/O: without mitigation measures, With: with mitigation measures
2. A: Positive impact B: No impact C: Negative impact
3. "+" is better evaluation than "-"

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CHAPTER 4 METHOD FOR REDUCING NEGATIVE IMPACT ON ENVIRONMENT, PREVENTING AND TACKLING ENVIRONMENTAL POLLUTION

Project activities such as infrastructure construction and daily activities of people who will work or live in HHTP as mentioned in the chapter 3 may cause negative impacts on the environment.

In chapter 4, measures to reduce negative impacts on environment in three phases i.e. preconstruction phase, construction phase and operation phase are presented.

Since the investor endeavor to develop the HHTP as advanced and sophisticated space based in collaboration with R & D institutes, education & training and high-tech industries, environmental protection should be prioritized. Therefore, it is necessary to adopt effective methods to reduce negative impacts that might be caused by the project.

4.1 PRE CONSTRUCTION PHASE

4.1.1 General Planning

When carrying out the project, the investor will employ different methods to control and reduce negative impacts on the environment. It is thus essential to make a good general programming at the beginning of the project planning.

HHTP project has adopted following solutions to restrict negative impacts on the environment.

Organization of architectural spaces in the program area is effective. The project has used some small lakes and hills to avoid breaking of ecosystem and create natural scenery in the area.

Tan Xa Lake is the important natural area of the HHTP. This area has been connected to other areas, thus creating a harmonious relation between artificial developments and natural sceneries. Plantation of trees contributes to regulate air and humidity in the entire area. This helps to develop and create a green and modern high technology area, which is aimed for sustainable development.

The project has made an appropriate traffic system according to construction codes. This will ensure constant and safe traffic and minimize crashes between vehicles.

The project has made a proper division of functional zones such as Centre zone, software zone, R &D zone, high-tech industrial zone, education and training zone, apartment block and office zone, amenity and sport zone, lake, green buffer zone.

High-tech industrial zone, R &D zone, and software park zone and benefit zone are placed in the east of the HHTP. As these are located at the end of main wind direction, this arrangement helps to restrict the spread of polluting substances and reduces negative impact on households who live and work in the HHTP.

Education and training zone, apartment block and office zone are located in the west of the HHTP, along National Highway No.21. This location is at the beginning of wind direction and thus would rarely be affected by the industrial emissions.

4.1.2 Compensation for Land Acquisition, Clearance and Resettlement

The compensation actions for land acquisition and clearance and resettlement should be carried out based on the practical plan of these activities. The progress of these activities needs to be supervised and monitored to check if some actions for social and environmental consideration

are required. Therefore, such plan has to be developed first considering condition of the project site and the concerned local people and organizations.

At the same time, to minimize socio-economic impact and to provide an appropriate compensation based on applicable state and city regulations, the HHTP-MB will contact and co-ordinate with related state agencies such as Hanoi People's Committee, Hanoi Natural Resources and Environment Department, and people's committees of district and communes.

Compensation and support for the affected should be sufficient as specified in the policies. This will assist them in stabilizing their lives quickly. On an average, each resettling households will be given compensation for 300m^2 of land area.

Before reclaiming land, it is vital to ask households to harvest their crops. It is also essential to financially support the affected people in removing, clearing manufacturing and living works, cages and coops and cemetery.

It is vital to participate in addressing complaint during compensation, support and resettlement.

It is necessary to conduct sociological investigation before and after compensation so as to introduce effective policies and restrict unexpected negative problems. This will also support in resettlement (with a cycle lasting 2 years).

At state level: district compensation board has responsibility of collecting statistic data and submit to Hanoi People's Committee who makes compensation decisions for individual households.

Investors are required to take responsibility of financing site clearance in the area of the HHTP.

If solutions are adopted and implemented effectively in co-ordination with investor and local authorities, then it is likely that the affected people will enjoy better living standards in terms of power, road, school and medical station in resettlement areas as compared to their prior location. Moreover, in resettlement areas, ecosystem is also restored.

There must be good co-ordination among local authorities, the affected households and investor for compensation, support and resettlement. This coordination will stabilize the condition, improve people's lives, promote manufacturing and protect environment.

4.2 CONSTRUCTION PHASE

Polluting sources necessary to be controlled

In workers' camps

- Wastes and sewage
- Social evils and public order
- Relationship with citizens and local authorities

On construction site

- Solid, liquid and gas wastes
- Vehicles, safety devices and works
- Labor protection equipment

To reduce potential negative impacts during site clearance and infrastructure construction of HHTP project, HHTP-MB will:

- Direct contractors to adopt environmental protection methods as proposed by HHTP

while preparing for bidding and inviting procedures.

- Supervise requirement compliance during leveling and building as required by Vietnam's applicable laws.

4.2.1. Tracing and exploding remaining bombs

There may be remains of bombs left by wars at the depth of about 5m in the construction area.

To minimize the damage to life and wealth that can be caused by bomb explosion, HHTP-MB will trace and explode the remaining bombs in accordance to the applicable Vietnam's laws. It should consider:

- Signing contract with functional and competent unit to trace bomb.
- It is essential to explode bombs before the start of site leveling work.

4.2.2. Gathering and treating plants

Before performing site leveling work in construction area, investor will clear site:

- The crops and plants harvested by households.
- Other crops and plants that may be used as fuel or for other purposes.
- Remaining crops and plants will be cleared away before the start of leveling work.
- The crops and plants that cannot be used for trading or as fuel, it is essential to co-ordinate and sign contract with local urban environment company for removal and continual treatment to them.

4.2.3. Controlling materials after leveling

To minimize impact exerted by leveling materials, HHTP-MB will take the following solutions:

- Inviting contractors and selecting functional and competent unit to provide leveling materials for the project.
- In Bidding Documents, contractors are required to explain estimated material source and prove its compliance in terms of physical and properties. HHTP-MB will contact to the unit specialized in construction and environment to set standards for leveling materials.
- HHTP-MB will work as supervisors during site leveling and will follow the applicable Vietnam's laws (Decision No.18/2003/QD-BXD dated June 27, 2003 by Minister of Construction on issuing regulation on controlling construction work quality).

4.2.4. Reducing environmental pollution during site leveling and construction

As mentioned in chapter 3, impacts on air exerted during site leveling and construction work mainly attributed to dust originating from leveling, digging the ground, transporting materials, mixing concrete and exhaust fumes from vehicles in construction area.

To minimize these impacts, HHTP-MB will direct contractors to employ following methods during development:

(1) Methods for reducing environmental pollution due to dust

To restrict pollution due to dust, it is necessary to adopt solutions as follows:

- During transporting the site leveling materials from the source to the construction area, body of vehicles are required to be fully covered. This will minimize negative impact exerted by dust and spread of materials.
- After site leveling materials are poured to site from vehicles, it is vital to immediately smooth it. This will avoid any spread of materials due to wind.
- In hot and dry days, it is essential to make the construction site wet so as to restrict spread of dust and sand.
- Works in construction must be covered by canvas so as to avoid dust and potential occupational accidents.
- It is essential to provide labor safety equipment such as helmet, muffler, glove, shoes, safety clothing and other devices to workers so as to avoid any negative impact exerted by dust, gas and eroding substances such as cement and concrete and occupational accidents.

(2) Methods for reducing environmental pollution caused by exhaust fumes

During construction, activities such as spreading of asphalt, spraying paint are usually conducted outdoor. Therefore, polluting substances can easily be spread though the air. Although polluting substances are quickly diluted in the air, it is essential to apply methods for temporally covering and restricting the spread to the surrounding areas.

Besides this, exhaust fumes from vehicles contain polluting substances such as SO_2, NO_2, CO, CO_2 should also be minimized. To reduce the spread of polluting substances from the source, it is essential to employ methods as follows:

- Vehicles should be in compliant with standards set by Vietnam Standard. It should meet the levels of environmental pollution prior to serving for project development.
- Vehicles are prohibited from overloading.
- It is essential to restrict number of vehicles using diesel to reduce SO2 emission.
- It is vital to maintain the vehicles and not to use vehicles that are out of date.

(3) Methods for reducing noise pollution and vibration during development

Due to specific characteristics, noise and vibration are not constant and they do not exert destructive impacts on environment and nature like other types of pollution. However, it is essential to control and reduce these impacts on community health and in the surrounding area of the project. To avoid noise and vibration of equipment and facilities during construction, it is vital to adopt the following methods:

- Reducing noise and preventing vibration at source

- Designing vibration-resistant platform for equipment to reduce the noise generated due to vibration.
- Provide equipment with soundproofing coverage.
- Equipping the exit of the electric generator with sound-reduction pipes.

- Balancing machine and equipping switches to turn off vibration.

- Reducing noise and vibration during their spread.

- To restrict impact exerted by noise during construction of activities in the surrounding residential areas, noise generators such as steam hammer, digging machine, and driller should not be operated during night.
- To reduce vibration, it is vital to use elastic structures such as vibration-resistant oil box, metal elastic pillow, rubber elastic pillow, rubber elastic buffer, etc. These structures should be installed between the machine and platform and should be periodically investigated or replaced. Some structures are installed at fixed location in machines and treated as machine components such as vibration-resistant driving chair, free-vibration holding arm. Other structures are independent from machines such as vibration-resistant floor, vibration reducing clamp etc.
- Use of personal devices to resist vibration such as helmet, ear coverage, etc.

4.2.5. Methods for reducing impacts on water

To minimize amount of materials swept away down to Tan Xa Lake and Tich River under the impact of rain water and restrict any flooding during rainy season, it is essential to take the following measures:

- Drainage channels for rainwater should built in compliance with drainage plan of the entire area and the Project in particular.
- Before rainwater overflows surface area, it should go through the gas holes to restore maximum amount of site leveling materials from being swept away. Mud and sand traps will be built when temporary drainage channels for rainwater are constructed.
- It is necessary to build retaining walls prior to collection & storage of site leveling materials.
- It is not wise to gather materials near or next to drainage channels so to avoid any loss of materials.
- To avoid any obstruction in the drainage channels, it is necessary to make regular investigation of drainage channels, dredge them and prevent wastes from accumulating in them.
- It is also vital to restrict construction during rainy season.

4.2.6. Reducing social problems

Beside compensation, site clearance and job creation, it is essential to take the following measures to reduce social problems:

- Trying to hire as many as local employees: Prioritize employing local people who are competent and qualified.
- Coordinating with local authorities and concerned state agencies to organize programs on education, promoting awareness of workers, introducing local customs to immigrant workers in order to avoid conflict between local resident and immigrants due to misunderstanding.
- All workers are equipped with cards, which facilitates management.

- Coordinating with local concerned agencies to manage immigrant workers during construction.

4.2.7. Methods for controlling solid wastes

Developments require huge number of workers on site. Temporary camps and tents produce considerable amount of wastes, and cause environmental pollution on site and exert negative social impacts. Therefore, development units will take the following measures:

- Optimizing number of workers on site.
- Providing dustbins for camps and tents, signing contract with urban environment company to transport and bury wastes periodically
- It is essential to set regulations on sanitation at camps during construction, prohibit unsanitary activities and provide education about environment protection to workers.

4.2.8. Other methods

- Materials on construction site are prohibited from being fired and buried in the project area.
- Inflammable materials are banned from storing. They must be transported out of the construction site, destroyed or reused in compliance with standards.
- It is vital to provide methods and vehicles used for preventing and fighting fire and explosion to ensure labor safety.
- Devices and machines are maintained regularly and on schedule.
- Media means with huge capacity are prohibited from using on construction site.
- Dust blocking, obstructing and soundproofing equipment will be used temporarily in necessary places.
- Construction area is in safe condition round the clock per day (24/24).

4.3 OPERATION PHASE

4.3.1. Wastewater Treatment generated from Hoa Lac High-Tech Park

The plan of drainage system for sewage and rainwater for the HHTP has been presented in detail in chapter1.

Wastewater will be produced from water use by any people including workers and employees in HHTP. When the project comes into operation in phase 1, it is estimated that daily maximum wastewater flow will be about 28,300 m^3/day. All wastewater collected by sewerage system will be treated in a conventional activated sludge process as designed. Anaerobic microorganism will decompose organic substances in wastewater.

Sludge produced after wastewater treatment will be dewatered and disposed of at appropriate landfill site following relevant regulations.

4.3.2. Controlling rain and storm water

Rainwater as well as storm water is irregular and rather clean, so does not require any treatment.

Rainwater containing sand and floating solid substances will be poured in drainage system. Drainage pipe are designed to bear high pressure so as to avoid any damage that might be caused by mechanic impacts.

Major four facilities i.e. 1) Storm water collection sewer, 2) Tan Xa Lake regulating facilities, 3) Dua Gai Stream diversion & improvement, 4) Vuc Gaing Stream Retention Functions, are to be constructed for this purpose. In addition to these for facilities, revetment at Tan Xa lake increase capacity of retention of storm water. These facilities will prevent flood at the downstream area and impact on hydrology.

4.3.3. Preservation of environment and development of green buffer area

The green buffer area will be secured in HHTP such as shoreline of Tan Xa Lake.

It is also essential to comply with Vietnam's regulations and ensure green area in industrial area, excluding grass cover in plants. Twenty five meter will be secured from the shore of Tan Xa lake to development area of R & D zone.

The environment of Tan Xa Lake will be preserved. There is not any plan of construction in Tan Xa Lake except for revetment, road and bridges across streams. The environment as habitat for fish, immigrant birds etc will not be disturbed especially after development. In addition, proper wastewater treatment and solid waste management will improve the environment in terms of nature conservation as well as pollution control.

It is also recognized that water surface including Tan Xa Lake and green buffer area may function to maintain the capacity recharging ground water. These environmental conditions would be lost by thoughtless developments if HHTP was not realized.

4.3.4. On accommodation for workers and employees

HHTP-MB pay attentions to accommodation services for employees working in HHTP.

Residential area for employees and resettlement area were allocated for accommodation. This is an important factor, which will help in stabilizing workers' lives, reducing investor's expenditure and attracting investment to the HHTP.

4.3.5. Methods for preventing and controlling fire

(1) For HHTP-MB:

HHTP-MB will establish fire fighting team that will work in HHTP. They will be provided with necessary equipment and will be trained in techniques used for preventing fire and explosion. Some parameters are:

- Designing and deploying fire-detecting system, pipe system and water station.
- Preparing method for preventing and fighting fire.
- Establishing professional fire fighting team for High Technology Zone.

(2) Requirements for plants, companies and research zone:

- Designing program of fire fighting and prevention that suits to industrial production characteristics.
- For units using liquefied natural gas and liquefied petroleum gas, it is essential to

comply the regulations of distance and safety methods so as to prevent any fire or explosion.

- Methods for preventing and fighting fire employed in High-tech industrial zone and manufacturing units must be approved by state agency that is in-charge of fire prevention and fighting (Hanoi's Public Security Department).

4.3.6. Electricity safety

Electricity wires are required to have safety corridor, phase protecting system, and role for electric devices. The wires should be checked regularly to ensure electricity safety. It is essential to provide awareness to employees about regulations on electricity safety. It is also vital to equip workers in charge of operating and repairing of electric facilities.

4.3.7. Methods for managing and controlling pollution for fuel stores

For fuel warehouse, it is essential to take the following measures:

- Minimize the amount of lubricating oil absorbing into the ground and underground water layers. To do so, it is essential to make periodical investigation of fuel containers, especially underground containers prior to using.
- Building a fire prevention and fighting system for the fuel area and provide fire preventing and controlling equipment, regulations on fire prevention and fighting and action methods.

Leaked lubricating oil will be collected and filled in containers with cap before being treated by state related agency.

4.3.8. Reducing impacts on social and cultural environment

Problems caused by large number of employees will be restricted through the following methods:

- Employing as many as local workers as possible: local workers who have a desire to work along with competent and qualified, will be employed by the manufacturing & other industries.
- Coordinating with local authorities and related state agencies to organize program on education and popularizing citizen awareness to employees.
- Introducing the immigrant employees about local customs so as to avoid any misunderstanding between immigrants and the local residents.
- Coordinating with local authorities in managing immigrant employees.

Job creation for residents who lost land:

- Operating daily services for workers in HHTP and employing local residents whose land has been acquired. .
- Providing support in form of training in accordance of the requirement in industries to the competent residents and thereafter employing them.
- Giving priority to job creation for redundant workers who are trained in the affected area.

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CHAPTER 5 PROGRAM ON ENVIRONMENT MANAGEMENT AND CONTROL

5.1 PROGRAM ON ENVIRONMENT MANAGEMENT

For the preservation and protection of environment effectively, HHTP-MB will appoint employees for environment team of HHTP. These employees will be in charge of management and monitoring of environmental situation.

Beside technical solutions such as collection of all wastes and reduction in environmental pollution, the project will also introduce the methods to control the environment and will provide education and awareness about environment so as to restrict any significant negative impacts on the environment, specifically for:

Completion of environment management system of the project in phases such as construction and operation

Adoption of a program for pollution control considering measures such as cleaner manufacturing techniques, environmental friendly technologies, material replacement and reuse of materials.

Provision of education and enhancement of awareness about environmental protection. In addition, raising of awareness and understanding among employees towards environmental protection laws.

Promotion of monitoring and investigations towards compliance of rules. And commitment towards industrial pollution control and environmental protection.

Purpose of the program: To control the negative impacts exerted on ecosystem by manufacturing activities in HHTP, to comply with all Vietnam's applicable regulations on environment protection and to meet all changes and requirements for environment protection in the future.

Table 5-1: Methods for reducing impacts and controlling environment

No	Project activities	Type of wastes and	Environment aspect	Methods for reducing negative impacts	Methods for controlling environment
I.	*Construction phase*				
1	Site preparation	- Dust -Gas wastes containing SO_2, CO, CO_2, Hydrocarbon, NO_2.. - Welding smoke - Construction wastes - Noise - Vibration	Air environment Land environment	- Adopting advanced and mechanical deployment methods - Organizing implementation and choosing appropriate deployment time - Making suitable arrangement for roads and quantity of vehicles - Watering to minimize dust pollution. - Growing plants - No use of outdated vehicles and no overloading. - Vehicles must be covered. - Complying with	- Labor safety and fire fighting and explosion prevention during construction and installation phase - Deployment plan and progress for items - Device installation plan and progress. - Maintenance of mechanical vehicles - Controlling noise and methods for reducing noise - Managing solid wastes - Controlling sewage and surface water - Managing traffic and transportation vehicles.
2	Transporting, loading and unloading of construction materials and eliminating wastes				
3	Concrete mixing				
4	Deployment and installation				
5	Vehicles				
6	Deployment equipment				
7	Foundation deployment				

				drilling and driving techniques - Popularizing environment protection among workers and employees	
8	Living activities of workers	- Sewage - Wastes	Water environment Land environment	- Water treatment system - Collecting solid wastes	
II.	*Operation phase*				
1	Transporting, loading and unloading goods, activities of public transportation vehicles	Dust Emission gas containing SO_2, NOx, Hydrocarbon, etc. Solid wastes such as paper, wood, nylon and box Noise	Air environment	- Assigning workers regular job of clearing main roads - Watering periodically to restrict dust - Growing plants - Making appropriate arrangement of industries, companies and research institutions that requires machine and device maintenance - Encouraging industries and companies to economically use water and power and minimize losses. - Building sewage treatment system - Collecting, classifying and storing solid wastes - Popularizing environment protection among workers and employees.	Environment management along with other activities will be performed constantly during operation of HHTP. Management methods introduced by HHTP-MB are aimed at reducing environmental pollution, including: - Controlling source of air pollutants - Controlling solid wastes - Controlling noise and light. - treatment of wastewater into the environment - Introducing plan to treat likely environmental pollution
2	Manufacturing	Dust Emission gas containing SO_2, NOx, Hydrocarbon,… Water after cooling Solid wastes such as domestic solid wastes, papers Noise, vibration	Air environment Water environment Land environment		
3	Research and operation process of laboratories and schools	Emission gas containing Hydrocarbon,etc. Sewage containing chemicals Domestic sewage - Solid wastes such as domestic solid wastes, papers	Air environment Water environment Land environment		
4	Operation of trade and service zones, blocks, and amenity zone	Domestic sewage - Solid wastes	Water environment Land environment		

Table 5-2: Expenditure on construction of environment protection in phase I (2008 – 2015)

Infrastructure	Cost (million JPY)
Tan Xa Lake protection and green areas	109
Drainage system	2,307
Sewerage collection system	420
Soil Disposal	542
Wastewater treatment plant	3,806
Public circulation buses	348
Total	7,532

Total expenditure on the construction of environmental protection works has been estimated to 7532 million JPY. Environmental treatment facilities and major infrastructures should be constructed no later than the project's operation.

5.2 PROGRAM ON ENVIRONMENTAL MONITORING

5.2.1 Purpose

- It is aimed to submit the data to concerned state agencies so that it may facilitate in introducing efficient policies to manage environment. Accordingly, companies have to adjust their operation to comply with environment requirements.
- The data will trace the changes occurred in the environmental situation in HHTP. Thus accordingly the data will play a major role in formulating the local socio-economic strategy and plan towards environment protection and sustainable development.

Contents of the survey for environment impact are as follows:

Surveys and monitoring of environmental impacts are important contents in controlling environment. Environment survey will be focused on the physical parameters i.e. air, water and land along with wastewater and gas wastes from the HHTP. Periodical surveys is one of the compulsory requirement. Beside these periodical surveys, in some circumstances, HHTP-MB may also conduct urgent survey when required. As the results of the environment survey will be scientific and legal, the environmental assessment of HHTP can be done. Accordingly, the environmental reports can be produced which will assist in formulating the effective management and treatment plan.

5.2.2 Organization of implementation

HHTP-MB, specifically environment team will be in-charge of conducting monitoring. It is probable the contractor of construction works will be in charge of some aspect of environmental monitoring as one of works for contraction management

Signing of the contract with functional agency, which will be responsible for sample collection and its analysis.

Producing periodical report (once a year) and submitting it to state agency

5.2.3 Environment Monitoring Plan

(1) Summary

Environmental monitoring plan is summarized as shown in the following tables.

Environmental Monitoring shall be conducted during both construction stages as well as after completion of construction.

The types of environmental items have been classified into three as shown below, which resulted in deciding monitoring method:

Type1. Environmental items which might have direct impact to human health unless the negative impact can not be mitigate appropriately such as ambient air and surface water quality: to be monitored by field investigation together with field sampling or laboratory analysis as necessary

Type2. Social and economic condition conditions of the affected people: to be monitored by Interview to people and authorities concerned and checking record of compensation

Type3. Implementation and situation of mitigation measures applied for the project: to be monitored by field observation and using the record of construction and project operation

Table 5-3: Environmental Monitoring Plan (during construction)

Environmental Items	Frequency	Survey location	Survey method	Reason of monitoring
Surface water	Once in three months (quarterly)	Tan Xa lake, Tich river, discharge of wastewater treatment plant	Field sampling and laboratory analysis	Potentially direct impact to human health
Ground water	Once in three months (quarterly)	Well waters in and around HHTP area	Field sampling and laboratory analysis	Potentially direct impact to human health
Air quality	Once three months (quarterly)	In and around HHTP area (construction site, road and nearby residential area)	Field sampling and analysis	Potentially direct impact to human health
Noise	Once in three months (quarterly)	In and around HHTP area (construction site, road and nearby residential area)	Field measuring	Potentially direct impact to human health
Solid waste and residual soil	Twice a year	Amount and type of waste, way of treatment/disposal of wastes	Checking data of treatment/disposal and construction material	Potentially direct impact to human health
Social and economic condition of the affected people	Once in two years	- Resettlement area - Affected communes	Interview to people and authorities concerned and checking record of compensation	To be monitored along with the plan for land acquisition and resettlement
Mitigation measures	Continuously, to be reported once a year	Location where mitigation measures are introduced or applied	Construction records and field observation	Implementation of measures is basic condition for result of EIA

Table 5-4: Environmental Monitoring Plan (after construction)

Environmental Items	Frequency	Survey location	Survey Method	Reason of monitoring
Surface water	Twice a year (rainy and dray seasons)	Tan Xa lake, Tich river, discharge of wastewater treatment plant	Field sampling and laboratory analysis	Potentially direct impact to human health
Air quality	Twice a year (rainy and dray seasons)	In and around HHTP area (road and residential area)	Field sampling and laboratory analysis	Potentially direct impact to human health
Noise	Twice a year (rainy and dray	In and around HHTP area (road and residential area)	Field measuring	Potentially direct impact to human health

	seasons)			
Mitigation measures	Continuously, to be reported once a year	Location where mitigation measures are introduced or applied	Project records and field observation	Implementation of measures is basic condition for result of EIA

Note: Monitoring year: 1 year, 5 year, and 10 year after completion of construction.

(2) Monitoring Items

Direct items for environment survey are those environmental components and factors that may change considerably according to time and space and are as follows:

- Air quality;
- Quality of surface water, ground water, discharged water from wastewater treatment plant;
- Solid waste;
- Noise;
- Social and economic conditions;

(3) Locations for survey

To assess the impacts exerted on environment by industrial and urban pollution (urban traffic and operation), the focus survey area will be industrial and urban zones. The details are :

* For air environment:

- Measure places located in industrial zone and surrounding areas.

In HHTP, the 6 outer locations to the project area (plant) are selected.

The four locations outside of HHTP are:

+ Distance of 500m from the project area in the east
+ Distance of 500m from the project area in the south
+ Distance of 500m from the project area in the west
+ Distance of 500m from the project area in the north

- Locations measured at intersections.

* Location for measuring noise pollution are:

- Along expressway and highway.
- In industrial zone.
- At intersections.

Monitoring parameters and comparative standards:

Dust, CO, NO_2, SO_2, TSP, PM10, noise, microclimate

Comparative standards: TCVN 5937 - 1995.

* Locations for measuring the suffering from noise pollution are:

- Along expressway and highway
- In industrial zone
- At intersections.

* For ground water:

Surveying the underground water quality of selected wells in the area

* Surface water environment:

Location that will be used for surveying the surface water environment of Tan Xa lake and Tich River are :

Entrance into Tan Xa lake

Exit from Tan Xa lake into Tich River

Tich river forwards upper source at the distance of 1000m from wasting point. (N1)

Tich river forwards lower source at the distance of 100m from the project (N2)

Tich river forwards lower source at the distance of 1000m from the project area (N3)

Monitoring parameters: Temperature, pH, SS, turbidity, electric conductivity, BOD5, COD, DO, NH4-N, NO3-N, PO4, Cl, total iron, total Coli form, oil and grease

Besides this, depending on the characteristics of surveyed parameter and factors, if necessary, additional parameters such as heavy metal, pesticides etc. might also be analyzed.

Comparative standards: TCVN 5942 - 1995-B

Temperature, pH, SS, opaque level, conductive level, BOD5, COD, DO, NH4-N, NO3-N, PO4, Cl, total iron, total Coli form, oil and grease

Besides this, depending on the characteristics of surveyed parameter and factors, if necessary, additional parameters such as heavy metal, pesticides etc. might also be analyzed.

Table 5-5: Estimate for expenditures on methods for reducing and controlling environmental pollution

Items	Expenditure (thousand VND)
During Construction Phase	
Air quality (15 sampling points x 6 parameters x 300.000 VND/parameters)x4 times	108 000
Noise (15 sampling points x 100.000 VND/point)x 4 times	6 000
Microclimate (15 sampling points x 3 parameters x 100.000 VND/parameters)x 4 times	18 000
Ground water quality (5 sampling points x 20 parameters x 200.000 VND/parameters)x 4 times	80 000
Surface water (10 sampling points x 20 parameters x 200.000VND/parameters)x4 times	160 000
Social and economy condition (300 questionnaire sheet x 100.000VND/each)(once two years)	30.000
Solid waste and residual soil investigation (2 times)	100 000
TOTAL	502 000

Items	Expenditure (thousand VND)
After Construction Phase	
Air quality (15 sampling points x 6 parameters x 300.000 VND/parameters)x 2 times	54 000
Noise (15 sampling points x 100.000 VND/point)x 2 times	3 000
Microclimate (15 sampling points x 3 parameters x 100.000 VND/parameters)x 2 times	9 000
Surface water (10 sampling points x 20 parameters x 200.000VND/parameters)x 2 times	80 000
TOTAL	146 000

Note: Monitoring year: 1 year, 5 year, and 10 year after completion of construction.

Total expenditures on methods for reducing and controlling environmental pollution during construction phase has been estimated to 502,000,000 VND (approximately 2,700,000 JPY) for each year.

Total expenditures on methods for reducing and controlling environmental pollution after

construction phase has been estimated to 146,000,000 VND (approximately 795 000 JPY) for each year.

5.2.4 Control and Monitoring of Activities of Developers and Tenants

(1) Control by Development Guidelines

The developers of functional zones of HHTP will be required to comply with the Development Guidelines, which are being mentioned in Chapter 1.

The HHTP Management Board shall request developers to submit their annual report to confirm their performance in terms of environmental conservation and development.

(2) Controlling air pollution

Manufacturing sectors are required to develop the wastewater treatment systems in case their discharge does not able to meet the standards as set by HHTP management board.

(3) Controlling domestic and industrial solid wastes pollution

Monitoring system in form of maintaining records in form of tables is an investigation system implemented by Management Board of industrial zone. This will be done by means of periodic monitoring, taking notes and recoding the nature of waste from the time of its generation to disposing period. The aim is to have information about the quantity and type of solid wastes that are generated and disposed. This information will be shared with contractor for treating and disposing wastes.

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CHAPTER 6 PUBLIC CONSULTATIONS

In the course of environmental impact assessment of the project of Hoa Lac High-tech Park whose area covers three communes i.e. Thach Hoa, Tan Xa and Ha Bang in Thach That district, Hanoi City. The management board of HHTP has carried out consultations with the people's committee and the fatherland front committees of three communes. This was done through form of opinion reference (official letter No.493/CHCNL-QHXDMT, 494/CNCHL-QHXDMT, 495/CNCHL-QHXDMT) as given in Annex. The following information were provided:

Brief information of project: constructing site, scale and target, articles of construction investment.

Anticipated environmental impact by the project implementation and methods to minimize such impact.

The project investor and consultancy body formulated a report based on discussion with the people's committee of Tan Xa, Ha Bang, Thach Hoa Communes and the communal fatherland front committees. The discussion held on the contents of projects that have been performed in the localities in the area and the reporting about the investors' commitments to measures for the environmental protection during the implementation of the project. The people's committee and fatherland front committees of such communes have totally agreed with the implementation of the project in the localities. The local authorities, fatherland front and inhabitants have approved and supported the implementation of the project.

In addition, to assess the various opinions about the implementation of the project, the HHTP-MB held three (03) public meetings on November 14th, December 5th, 2008 and February 6, 2009 respectively. Results of such meetings are presented in the official letter No.58/UBND-TH, 05/UBMTTQ-TH, 29/CV-UBNDHB, 08/CV-UBMTTQ-HB, 28/UBND-VPTX, 04/UBMTTQ -TX and minutes of meetings (see Annex).

6.1 GENERAL OPINIONS OF COMMUNAL PEOPLE'S COMMITTEES

6.1.1 Opinions on negative impacts of the project on the natural environment and socio-economy

The establishment of HHTP is in line with the Government policies and guidelines that orient Vietnam to become an industrial country in the future. It also suits to the Vietnamese Parties. Moreover, as proposed in a well-position location suitable for economic, technical scientific development, the HHTP will operate effectively. Thus, it will contribute significantly in the scientific and technical achievement of the country.

The project when comes into operation will create number of jobs opportunities for communal inhabitants. This will lead in improving their living standard and will provide them new opportunities to access study, research and innovate scientific methods and technologies.

When project comes to real operation, the project might not avoid some negative effects to surroundings, especially to the living environment of the communal inhabitants. During the discussion with Tan Xa, Ha Bang and Thach Hoa communes, all negative impact, effects and mitigation measures on the natural and socio-economic environment were discussed. The communes along with mitigation measures understood all impacts. They realized that the effects can be minimized by using appropriate pollution reduction and treatment measures in each functional and working unit area of the project.

All project's activities have been noticed to protect inhabitants' interest, living environment and landscape.

As a result, the people's committee of Ha Bang, Tan Xa and Thach Hoa has totally agreed and provided their approval to invest, construct and establish the HHTP project in their communal area.

Disagreement: None

6.1.2 Opinions on methods and solutions to minimize negative impacts of the project on the natural and socio-economic environment

The HHTP project will be modern and at large scale. All solutions to exhausted fumes, wastewater and solid waste in the functional areas as well as in the business organizations within the project area have been discussed particularly when project would be in operation. The methods of treatment and minimization will be observed closely and carefully by the HHTP-MB and concerned bodies dealing with environment in Hanoi City.

The proposed methods for the environmental protection are reasonable. However, the Project has to comply fully with the Law on Environmental Protection as well as related circulars and decrees.

6.1.3 Suggested opinions to the project investor

In order to complete the project as scheduled and to contribute a major impact towards the development of the nation, the people's committee of Tan Xa, Thach Hoa, Ha Bang respectfully proposes the following requirements to the HHTP-MB to comply with:

To comply seriously with all regulations of Vietnam on land management, construction management and other related regulations during the construction

To coordinate closely with Thach That district and Hanoi City to ensure public security and order, fire prevention and fighting in the project area

To propose the measures to the Government for ground clearance and speedy implementation of the project. These actions should be taken ASAP as this will provide stability to the life of inhabitants

To support the local inhabitants to have more jobs, increase income, and have policy to support the vocational training for them

During the process of land clearance, the HHTP-MB should pay special attention to the compensation and moving of the large number of graves to other place (especially in Ha Bang commune which has the largest number of graves). As this is related to spiritual factor of the inhabitants, this is a sensitive matter and the HHTP-MB should follow people's desires.

6.2 CONCLUDING OPINIONS OF COMMUNAL FATHERLAND FRONT COMMITTEES

The Vietnamese fatherland front committee of Tan Xa, Ha Bang, Thach Hoa communes totally agreed for the project implementation in the area. The fatherland front committee suggests the HHTP-MB to carry out seriously all commitments and to execute environmental measures. Besides this, it was suggested to the HHTP-MB to create more opportunities and recruit the local inhabitant into business and manufacturing industries within the park. In addition, the inhabitants can also be recruited for the construction works of buildings, social and local infrastructure.

The fatherland front committee requires the investor and working unit to ensure public security and law-order at the working site. In addition, attention should be paid also to prevent any discord with local inhabitants during the execution of the projects and provision of temporary residences to the workers.

6.3 FEEDBACK AND COMMITMENTS OF THE PROJECT OWNER BASED ON THE OPINIONS OF THE PEOPLE'S COMMITTEE AND THE FATHERLAND FRONT COMMITTEE AT COMMUNAL LEVEL.

The investor commits to obey and implement seriously all opinions s of the people's committee and the fatherland front committee of Thach Hoa, Tan Xa and Ha Bang communes. The investor promises to ensure public security and order when the project comes into operation and during the construction period. Besides this, the investor will give priority to the recruitment of local inhabitants, open suitable vocational and training classes for the inhabitants who are in their working age, and provide support in building public infrastructure in communes. The investor will closely coordinate with the local authorities for the process of ground clearance and will immediately attend and solve the problems and difficulties of local inhabitants. The Investor commits to listen and understand the inhabitants' opinions, questions and suggestions, if any and will immediately provide the acceptable feedback or answers to the inhabitants.

The Investor commits to build the environmental mitigating facilities as presented in Chapter 3 and Chapter 4 and to conduct environmental monitoring as presented in Chapter 5. The Investor will execute the project in line with the regulations of Vietnamese Government.

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CONCLUSION AND RECOMMENDATION

1. The Hoa Lac High tech Park is located in the planned economic development zone of Hanoi City. When the project will be put into operation, it will bring both social as well as economic benefits to the society by means of attracting investment and social & physical infrastructure development. Such development and favorable conditions will not only be able to attract workers but will also contribute in improving the economic life and culture in the region. Finally, the entire development will contribute in transforming the economic dependency of the region from local to industrialized one.
2. Following the details described in the master plan for the HHTP project, it is envisaged that after completion of the construction, HHTP will be landmark of modern architecture and planning. The HHTP will accommodate and facilitate the functions for education and training, industries with high technologies, general services, housing, offices and entertainment. The project will have positive impacts and will change the rural backward region to busy and vibrant area. The economic value of the products and activities in the high technology will certainly be higher than the agriculture production. Development of information network, power supply system, water system, and other infrastructures will certainly contribute in improving the quality of life along with improvement of cultural and spiritual community life in the region. Finally, the activities of the HHTP project will contribute to the economic development at regional and national level.
3. Along with the number of benefits, that HHTP project will provide to the project area, the project will also have some negative impacts to the natural environment and may have certain unfavorable influences to the socio-economic conditions in the project area. However, once the HHTP-MB applies full measures as described in this EIA reports, the negative impact to the environment and local residents will be reduced in the project area and will be within the allowable limit.
4. As per the Governmental regulations, if for any project within HHTP, if requires to conduct EIA study then HHTP-MB will make sure that EIA study strictly following all the compliance measures for environmental protection is being carried out prior to the approval for the implementation of the project.
5. The HHTP-MB will complete the construction of wastewater treatment plant before full operation of the HHTP. The treated water will comply with TCVN 5945-2005 column-B before discharging it into the Tich river.
6. The HHTP-MB will implement the environment monitoring program as given in chapter 5 of this EIA report.
7. The HHTP-MB has committed to strictly implement the conditions written in the decision for approval of the EIA report, which includes construction and operation of the equipments and environment protection during the development process. These will be designed to protect the regional environment. The implementation of the environmental monitoring program, frequency and parameters of the environmental regulations will also be followed. Periodic reports will be submitted to the Ministry of Natural Resources and Environment to update the information about actions for environmental protection in HHTP area.
8. It is recommended that the concerned agencies and authority should review and create such conditions that are favorable for an early implementation of the project at selected locations. The activities for the HHTP will be carried out in accordance with environmental regulations and will be supervised at central and local level.

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