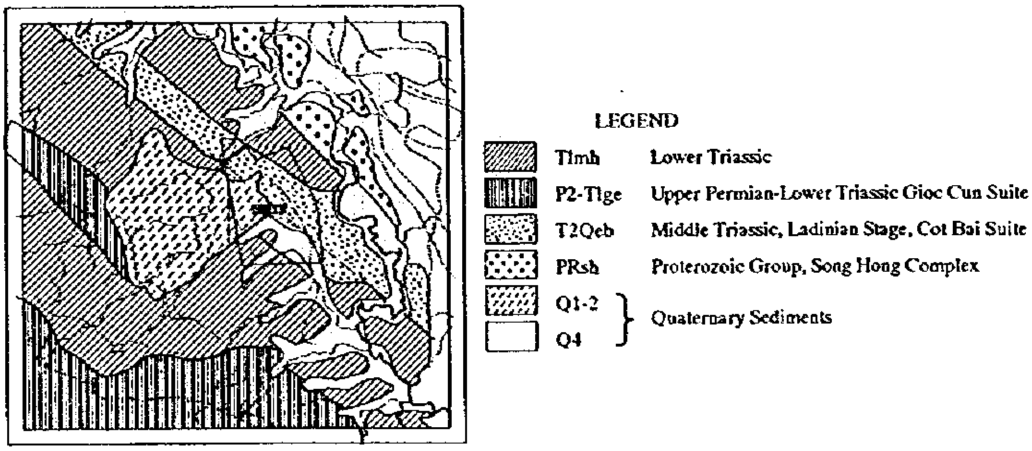
6.2 Land Grading Plan

6.2.1 Geological Condition

Conglomerate and sandstone formed on the hill area before the Triassic period (200 million years ago) and the diluvial soil as well as the alluvial sediments formed in the valleys 10,000 years before are observed as the general geological composition of the HHTP site. According to the results of the core boring survey conducted by the Study Team, a silty clay layer with a 10 ~ 20 m thickness exists on the base rock lying at MSL +0 ~ +6m in the hill area. In the valleys, a silty clay layer with a 15 ~ 30 m thickness is also observed on the base rock lying at MSL -8 ~ -14m. Appendix IV presents the details of the geological condition of HHTP.



Source: Geological Map (1:200,000),
General Department of Geology

6.2.2 Land Grading Method

Large-scale land grading by cutting of the hill area and filling of valleys is unrealistic in consideration of the undulated topography of the HHTP site. The top flat area of the hill could be developed so as to minimize the land grading cost. The paddy field located in the bottom of the valley will be reserved as the greenery landscape and part of it will be utilized as a retention pond for flood prevention.

The experienced flood level of the Tich River flowing 2 km east of the park, which is +9.5 m at Mean Sea Level (MSL), is estimated as the flood level with a 50-year return period. The existing villages in and around the park site are built over MSL +10 m. Considering these facts, the land grading elevation of HHTP is planned to be over MSL + 10m. A part of the southeast area planned for the high-tech industrial park and the northeast area planned for the new residential area are located lower than MSL +10m. Land grading work will be necessary to raise those lands and the filling earth volume in both areas is estimated at approximately 1 million m^3. Grading of the surface soil will be necessary for the rest of the HHTP area.

6.3 Development Plan of Infrastructure

6.3.1 External Infrastructure

The external infrastructure facilities are those the cost of which is not considered to be part of the HHTP Project cost, considering their contribution either to the broader regional economy or to the public. Specifically, they include the following:

* The facilities serving the region including Hoa Lac and other cities/towns/villages as well as the greater Hanoi region, which include the widening of the Hanoi-Hoa Lac Highway and regional trunk roads passing through HHTP.
* The facilities serving HHTP and the university area as well the Hoa Lac city.
* The trunk roads passing within HHTP, outside and between the zones, and the existing roads to be improved widening.

(1) Transportation Plan

<u>Road facilities</u>

The following road works are considered as external infrastructure works:

(a) Widening of the existing 2-lane Hanoi-Hoa Lac Highway, which is indispensable for the success of HHTP.

(b) Construction of the interchange at the junction of the Hanoi-Hoa Lac Highway and the main road of HHTP.

(c) In HHTP:

- roads serving the public utilities and facilities;
- expansion and improvement of the existing roads;
- roads to separate different land uses and zones;and
- the bus terminal planned in the center/business zone.

The road facilities considered as external infrastructure mentioned above are summarized in the table below and Figure 6-3-1.

	2005	2010	2020	Total
1) Hanoi-Hoa Lac Highway (widening from 2 lanes to 6 lanes)	28.3 km	-	-	28.3 km
2) Interchange	1 interchange			1 interchange
3) Main Road in HHTP	6.4 km	1.0 km	4.4 km	11.8 km
4) Sub-main Road in HHTP	6.5 km	-	2.0 km	8.5 km

The traffic demand in HHTP is estimated at 12,000 PCU (passenger car unit) per day in 2005 and 27,000 PCU per day in 2020 as shown in Table 6-3-1, and a main road with 2 lanes and 4 lanes will be necessary to cope with the traffic demand in HHTP in 2005[/1] and in 2020 respectively. In the planning of HHTP, the main road was designed to have 4 lanes in 2005 and 6 lanes in 2020.

<u>Other transportation facilities</u>

MOC has proposed the construction of a railroad for electric train service between Hanoi and HHTP. Though the proposal is still in the master plan stage, high speed train service with sufficient capacity will be contributive to the progress of HHTP and Xuan Mai/Hoa Lac new city development. It is recommended that the development method of the train service should be studied.

Since the railroad development should be conducted from the national or regional planning viewpoint, this railroad plan is still immature and therefore was not included in the external infrastructure in this Study. In the land use plan of HHTP, however, two stations are provided in the Urban/Business Zone and in the vicinity of the High-Tech Industrial Zone assuming that the train passenger demand is 3,000 persons per day as shown in Table 6-3-1.

A heliport is not included in the external infrastructure either. The Hoa Lac airport located to the northwest of the university area will be utilized.

(2) Water Supply Facilities

Apart from the HHTP Development Study, the Hanoi National University Development Project is being implemented by Vietnamese Government. The planned area of this project is closely adjacent to the HHTP area and the development time schedule almost coincides with that of the HHTP Project. Consequently, it is

Note :

/1 Capacity of one-lane urban road with a median is approximately 10,000 PCU per day, so 2 lanes (minimum number) and 4 lanes are necessary for 12,000 PCU traffic (both directions) in 2005 and 27,000 PCU traffic (both directions) in 2020.

recommended from the viewpoint of economical infrastructual development that the external water supply facilities will be used in common for the HHTP area and the Hanoi National University area. Da Chong, which is located 27 km from the HHTP and adjacent to the Da River, is recommended as the site for a raw water intake and water treatment station for the common external water facilities, as shown in Figure 6-3-2. The piping route from Da Chong to the HHTP area is relatively flat and is easily accessible from the existing national road. The selection is based on the fact that Da Chong is selected as the water production site.

1) Water demand and development phasing

The water demand for HHTP is projected to be 37,000 m^3/day at the final phase as described in the Sub-section 6.3.2. The water demand for both the HHTP area and the Hanoi National University area is projected to attain 68,000 m^3/day at the final target stage of 2020 as stated below.

Water Demand Projection for External Water Supply Facilities

Area	Cumulative Water Demand (m^3/day)		
	2005	2010	2020
HHTP Area	13,000	17,000	37,000
Hanoi National University Area /1	10,000	25,000	31,000
Total	23,000	42,000	68,000

Note : /1 : The water demand is quoted from "The Tentative Plan of The Hanoi National University" prepared by the Ministry of Education and Training on April 30, 1996.

Based on the water demand projected mentioned above, the external water supply facilities will be planned according to the following basic design conditions for the final development phase in 2020:

* Daily average water demand (DAWD):

  = 68,000 m^3/day

* Daily average water consumption (DAWC):

  = DAWD + (unaccounted water, ratio 20%)

  = 81,600 m^3/day

* Daily maximum water consumption (DMWC):

  = DAWC x (daily peak factor, 1.2)

  = 97,920 m^3/day

* Hourly maximum water consumption (HMWC):

  = DMWC x (hourly peak factor, 2.5) x 1/24

  = 10,200 m^3/hour

The external water supply facilities will be constructed stepwise in line with the water demand at the respective phase as follows:

Development Phasing of External Water Supply Facilities

Items	Phasing		
	2005	2010	2020
Water Demand (m^3/day)	23,000	42,000	68,000
Water Production Capacity (m^3/day)	2,5000 x 2 trains	25,000 x 3 trains	25,000 x 4 trains
Water Conveyance Pipes (ϕmm)	900 x 1 line	900 x 2 lines	900 x 2 lines

2) Outline of external water supply facilities

The external water supply facilities, which will be used in common by the HHTP area and the Hanoi National University area, comprise a water intake system, water treatment plant, water conveyance system and conveyance pipes to be laid between Da Chong and Hoa Lac, and water reservoirs inside the HHTP area. The water intake system and the water treatment plant will be constructed in Da Chong located adjacent to the Da River and require an area of about 6 ha. Water taken from the Da River will be treated by the water treatment plant which is shown in Appendix IV, employing the sedimentation process after coagulation and rapid sand filtration process. The water conveyance system will consist of transfer pumps and conveyance pipes. The conveyance pipes will be installed from Da Chong to Hoa Lac Town along the national road No. 422 through the southern side of the Xuan Mai Lake and the Dong Mo Lake. The area inside HHTP will be covered by water conveyance pipes to be installed around trunk roads, as shown in Figure 6-3-3.

The main specifications of the external water supply facilities at the final development phase are summarized as follows and the hydraulic profile of the water conveyance system is shown in Appendix IV.

Main Specifications of External Water Supply Facilities

Component System	Main Specifications
1. Water Intake System	Total intake capacity : 110,000 m^3/day Intake channel with screens and sand chambers Intake pumps
2. Water Treatment Plant	Total production capacity : 100,000 m^3/day (25,000 x 4 trains) Grit chambers with bar screens and grit chambers Flash mixing and coagulation tanks Sedimentation tanks Rapid sand filters Treated water reservoirs Power substation Administration and chemical handling room
3. Water Conveyance System	Total conveyance capacity : 100,000 m^3/day (50,000 x 2 trains) Transfer pumps Outside conveyance pipes (DIP 900 ϕmm x Total length 27 km x 2 lines) Inside conveyance pipes (in HHTP, DIP 400~800 ϕmm x Total length 17 km)
4. Water Reservoir	5.500 m^3 x 1 unit (for the high-tech industrial zone) 2,200 m^3 x 1 unit (for the new town zone and the urban/business zone) 1,700 m^3 x 1 unit (for the center area, the R & D zone, and the high-grade residential zone)

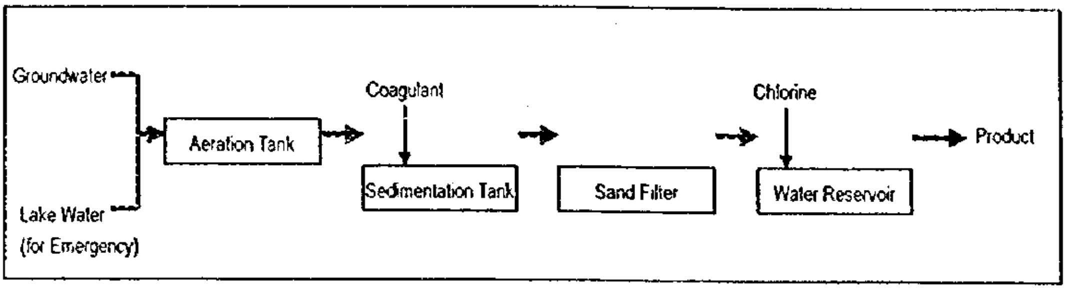
3) Water utilization for Tan Xa Lake

While the original water reserve of the Tan Xa Lake is some 3.0 million m^3, the present reserve is limited to some 2.0 million m^3 due to the break of the spill way. The spillway will be repaired in the construction works of the external water supply facilities. Incremental one million m^3 of water reserve resulting from this repair work will be allocated for irrigation of surrounding rice fields, irrigation of the golf course and green keeping in the HHTP area, and also for use as emergency water source for the temporary water treatment plant as detailed below.

4) Temporary water treatment plant

As stated before, the water source for the external water supply facilities is planned to be the Da River in the long term. Because the conveyance distance between the HHTP area and Da Chong is as long as some 27 km, requiring a long time for piping construction works, all the construction works for the external water supply facilities are scheduled to be completed at the end of 2004. Thus, a temporary water treatment plant using groundwater in the HHTP area will be provided in order to meet the water demand before 2005. The water treatment process is as described below.

Flow Diagram of Temporary Water Treatment Plant



(3) Sewerage and Drainage Facilities

1) External sewerage facilities

(a) Sewage generation and development phasing

Wastewater will be generated in the developed area through industrial and research activities, domestic use, etc. The separated collection system which is highly effective in terms of water environment preservation will be applied for sewerage facilities. Wastewater will be collected and treated by the sewerage system before being discharged into public water bodies. From the economical viewpoint, a common external sewerage system which covers both HHTP and the Hanoi National University area is recommended in the Study.

The basic design conditions for the external sewerage facilities for the above two development zones are set as follows, based on the total water demand of 68,000 m^3/day at the final development phase in 2020:

- Daily average wastewater (DAWW):
  = Daily average water demand = 68,000 m^3/day
- Daily maximum wastewater (DMWW):
  = DAWW x (1 + groundwater infiltration ratio, 20 %) x (daily peak factor, 1.2) = 97,920 m^3/ day
- Hourly maximum wastewater (HMWW):
  = DMWW x (hourly peak factor, 2.5) x 1/24 = 10,200 m^3/hr

The external sewerage facilities will be developed stepwise in line with the wastewater discharge in the respective phase as follows:

Development Phasing of External Sewerage Facilities

Items	Phase		
	2005	2010	2020
Daily Max. Wastewater (m^3/day)	33,100	62,100	97,920
Sewage Treatment Capacity (m^3/day)	20,000 x 2 trains (Total 40,000)	20,000 x 4 trains (Total 80,000)	20,000 x 5 trains (Total 100,000)

In terms of influent wastewater quality, BOD (Biochemical Oxygen Demand) and SS (Suspended Solids) are assumed to be 300 mg/l and for respectively design condition, considering the activity categories taking place in the respective development zone. In the event that sewer water contains hazardous or toxic substances with higher concentrations than the specified limitation, tenant enterprises are obligated to provide their own pretreatment.

The external sewage treatment plant will treat wastewater to meet the effluent limitation of the Level-B specified by the Vietnamese Government as shown in Appendix IV, i.e. less than 50 mg/l of BOD and less than 100 mg/l of SS. Treated wastewater will be discharged into the Tich River through the tributary running in the HHTP area. In order to save water consumption in the area, some 10 % of treated water is planned to be reused for irrigation for greenkeeping and other purposes, after being treated by a water reclamation system.

(b) Outline of external sewerage facilities

The external sewerage facilities, which will be used in common by HHTP and the Hanoi National University area apply the treatment process as shown in Appendix IV, and comprise a trunk sewage pipe system, sewage treatment plant, treated water discharge system, and water reuse plant. The sewage treatment plant will require an area of some 22 ha at the final development phase. While the plant site will be located in the southeast part of the initial development area of HHTP, it will be expanded beyond the boundary of the initial development area in the second phase. The oxidation ditch process will be applied for sewage treatment, for the following reasons: (i) durability against low temperature weather in the early months of the year, (ii) easier operation and maintenance, and (iii) meeting requirement on the removal of ammonia in wastewater as specified by the Government Standard.

The overall setting of the external sewerage facilities is shown in Figure 6-3-4 and their main specifications are as follows:

Main Specifications of External Sewerage Facilities

Component System	Main Specifications
1. Sewage Conveyance System	Total capacity : max. 10,420 m^3/hr Embedded sewage trunk pipes (HCP 200~1800mmDia x Total Length 18 km)
2. Sewage Treatment Plant	Total capacity : 100,000 m^3/day (= 20,000 x 5 trains) Grit chambers and screens Oxidation ditches Sedimentation tanks Disinfection systems Sludge dehydration systems Power substation Administration and chemical handling room
3. Water Reuse Plant	Total production capacity : 10,000 m^3/day Rapid sand filters Reuse water reservoir
4. Treated Sewage Discharge System	Total capacity : 100,000 m^3/day Water quality monitoring equipment Water discharge pipes and outfall

2) External drainage facilities

(a) Development plan of external drainage facilities

Stormwater in the HHTP area will be drained to the Tich River running to the east of the HHTP boundary through its tributaries streams and the Tan Xa Lake. The elevation of most land in HHTP is beyond MSL +10 m, except for the lowlying land of rice field. Even during a flood with a return period of 100 years, the water stage of the Tich River is not higher than MSL +10 m even at the flood time as shown in Appendix IV, therefore the HHTP area is rarely exposed to flooding risk.

Retention ponds with a sufficient storage volume will be provided in the HHTP area, so as to prevent increase of peak flow in the downstream discharge waterways at the time of heavy rain. Storm water ditches also will be developed as external drainage facilities along trunk roads.

The Son Tay meteorological observatory is undertaking the general recording of climatic data including daily rainfall, but hourly rainfall has not been measured. Therefore, the hourly rainfall intensity was computed by using the following formula which was specified by MOC of Vietnam. In terms of return period, ten years and five years were applied for the design of retention ponds and drains, respectively.

$$I = 0.36 \times 5426 \times (1 + 0.25 \times \log P \times t^{0.13}) \times 1 / (t + 19)^{0.82}$$

Where, I : Hourly rainfall intensity (mm/hr)
P : Return period (year)
t : Rainfall duration (min)

(b) Outline of external drainage facilities

Ditches along trunk roads within the HHTP area and retention ponds, which are shown in Figure 6-3-4, will be developed as external drainage facilities in the respective drainage basin. The main specifications of the external drainage facilities are as follows:

Main Specifications of External Drainage Facilities

Items	Main Specifications
Retention Ponds	
- Initial development area	No.1 2.8 ha, approx. 25,000 m^3
	No.2 12.2 ha, approx. 170,000 m^3
	No.3 21.2 ha, approx. 280,000 m^3
- Third development area	No.4 3.2 ha, 48,000 m^3
	No.5 24.8 ha, 250,000 m^3
Stormwater Drains	U-channel 600 to 1000 mm width x total length 30km

(4) External Electric Facilities

The total power demand for the development of the Xuan Mai / Hoa Lac urban series was estimated as summarized below. The power demand of each area except HHTP was assumed according to a general plan of urban series formulated by MOC.

	Population (1,000)			Required Land Area (ha)			Power Demand (MW)		
	Short term 2005	Medium term 2010	Long term 2020	Short term 2005	Medium term 2010	Long term 2020	Short term 2005	Medium term 2010	Long term 2020
Framework (Total)	285	620	1,000	6,000	11,000	17,000	150	281	586
1. Son Tay ·Tourism center	60	80	100	700	800	900	11	19	31
2. Hoa Lac ·Subcenter of Greater Hanoi	150	420	670	3,900	8,000	12,000	110	201	413
2-1 Dong Xuan Residential Area	58	260	370	800	2,700	3,600	4	28	64
2-2 Hanoi International University	5	10	20	100	200	300	1	1	3
2-3 Hanoi National University	30	60	110	500	1,000	1,200	2	6	18
2-4 Hoa Lac High-Tech Park (area of the Tan Xa lake)	22	35	45	800 (300)	1,200 (300)	1,800 (300)	48	61	135
2-5 Phu Cat Industrial Estate	5	10	15	600	850	1,200	54	102	180
2-6 Binh Yen Residential Area				200	300	600			
2-7 Dong Mo Resort (tourism, sport, and entertainment area of the Dong Mo lake to be developed)	20	25	80	900 (500)	1,750 (800)	3,500 (1,250)	1	3	13
3. Xuan Mai ·Industrial and commercial area	60	100	170	1,000	1,500	2,500	25	53	117
4. Mieu Mon (Mieu Mon airport) ·International airport/service center ·Strategic point for national defense	5	10	30	400 (300)	700 (300)	1,600 (1,000)	3	6	20
Mieu Mon Town's vicinity	10	20	30				1	2	5

Source: JICA Study Team

The Hoa Binh hydropower plant (1920 MW) is located 35km southwest of the project area. The plant is interconnected with Electricity of Vietnam (EVN)'s national grid, and has an enough capacity for power supply to the Hoa Lac and Xuan Mai areas. Electric power for the Son Tay will be fed from the existing 110 kV Son Tay substation.

In order to cope with the estimated power demand, MOC proposed to construct two 220 / 110 kV substations: Xuan Mai S/S (2×125MVA) and Hoa Lac S/S (2×250 MVA). The Xuan Mai substation was planned by EVN to be located in Xuan Mai district (installation of one 125 MVA transformer in 2000 and another 125 MVA transformer in 2005). Construction of 220 kV transmission lines (1×AC500 mm^2×70 km), which link the Xuan Mai substation with the Hoa Binh hydropower plant and the Ha Dong grid substation, is also projected to be completed by the year 2000. If the whole development plan of the Xuan Mai / Hoa Lac areas is implemented as programmed by MOC, another 220 kV substation (2×250 MVA) will be required to be constructed in Hoa Lac.

The planned Xuan Mai substation will have an enough capacity for extra power supply to HHTP and the University area, which are expected to be developed earlier than other areas. Therefore, power for HHTP and the University area was planned to be supplied from the Xuan Mai substation and transmitted by a 110 kV transmission line.

For the short term development phase (Phase 1, Phase 2) of HHTP, a new 110/22 kV on-site substation (2x40 MVA) on HHTP's side and a primary 110 kV transmission line (AC185 mm^2x2x20 km) connected with the Xuan Mai substation will have to be constructed for the exclusive use of HHTP. Another 110/22 kV on-site substation (2x40 MVA) and 110kV transmission line (AC185 mm^2x2x26 km) should be constructed for the long term phase (Phase 3).

In order to transmit power to each zone of HHTP, some 22 kV underground sub-transmission lines (XLPE cable) were planned to be constructed from the on-site substation to the switching stations to be installed in the respective zones of HHTP. In addition to the power supply system, street lighting facilities will also be installed along the main roads in HHTP.

On the other hand, in the university area, another new 110/22 kV on-site substation (2x16 MVA) and 110 kV transmission line (AC185 mm^2x2x20 km) connected with the Xuan Mai substation should also be constructed for power supply to the Hanoi National University and the Hanoi International University.

An integrated power supply system for HHTP and the University area is illustrated in Figure 6-3-5.

(5) External Telecommunication Facilities

The total number of telephone lines for the development of the Xuan Mai / Hoa Lac urban series was estimated as summarized below. The number of lines in each area except HHTP was assumed in accordance with a general plan of urban series formulated by MOC.

	Population (1,000)			Required Land Area (ha)			Telephone Demand (lines)		
	Short term 2005	Medium term 2010	Long term 2020	Short term 2005	Medium term 2010	Long term 2020	Short term 2005	Medium term 2010	Long term 2020
Framework (Total)	285	620	1,000	6,000	11,000	17,000	58,900	184,500	386,400
1. Son Tay	60	80	100	700	800	900	12,000	20,000	40,000
•Tourism center									
2. Hoa Lac	150	420	670	3,900	8,000	12,000	31,900	132,000	254,400
•Subcenter of Greater Hanoi									
2-1 Dong Xuan Residential Area	58	260	370	800	2,700	3,600	11,600	65,000	148,000
2-2 Hanoi International University	5	10	20	100	200	300	1,000	2,500	8,000
2-3 Hanoi National University	30	60	110	500	1,000	1,200	6,000	15,000	44,000
2-4 Hoa Lac High-Tech Park	22	35	45	800	1,200	1,800	8,800	10,300	20,900
(area of the Tan Xa lake)				(300)	(300)	(300)			
2-5 Phu Cat Industrial Estate	5	10	15	600	850	1,200	500	1,000	1,500
2-6 Binh Yen Residential Area				200	300	600			
2-7 Dong Mo Resort	20	25	80	900	1,750	3,500	4,000	6,300	32,000
(tourism, sport, and entertainment area of the Dong Mo lake to be developed)				(500)	(800)	(1,250)			
3. Xuan Mai	60	100	170	1,000	1,500	2,500	12,000	25,000	68,000
•Industrial and commercial area									
4. Mieu Mon	5	10	30	400	700	1,600	1,000	2,500	12,000
(Mieu Mon airport)				(300)	(300)	(1,000)			
•International airport/service center									
•Strategic point for national defense									
Mieu Mon Town's vicinity	10	20	30				2,000	5,000	12,000

Source: JICA Study Team

The telecommunication system should have to cope with not only ordinary telephone demand but also advanced service demands such as high speed digital data-communication for the high-tech industries and the Universities.

This concept requires that the telecommunication system for the project area should meet the high level demand, and be interconnected securely with the national and international networks.

For subscribers in HHTP and the Universities, which are expected to be developed in earlier stage than other areas, the following telecommunication services are proposed.

(a) Telephone : Local / Domestic / International and Public telephone

(b) Mobile : Cellular

(c) Advanced service : ISDN, Internet, Multimedia,

(d) Leased Line

In order to provide these services, a switching center shall be constructed near the urban block in the Phase 1 of HHTP. The switching center shall be connected with domestic and international networks by a new optical fiber cable transmission system. The transmission line will be designed as a ring network, which links directly the switching center with the telecommunication centres of Ha Dong and Hanoi, to ensure reliability of the system.

Another local loop network of optical fiber cable was also planned in HHTP by laying cables in underground ducts, in order to link the switching center to each zone of HHTP with access lines between the loop network and remote terminals to be installed in the respective zones. Further a radio system will be furnished in HHTP for the mobile telecommunication service. Antenna towers for the radio system are to be constructed in good harmony with the surrounding environment.

On the other hand, in the University area, a remote switching station should also be constructed for the telecommunication service to the Hanoi National University and the Hanoi International University. This switching station should be connected with the ring network by an optical fiber cable line.

An integrated telecommunication system for HHTP and the University zone is illustrated in Figure 6-3-6.

The dimensions of the external infrastructure are given in Table 6-3-2.

6.3.2 Internal Infrastructure

(1) Road Facilities

The location, design, quantity of internal roads in the development components of HHTP will be decided by the respective development bodies. Figure 6-3-7 presents the required internal roads with a total length of 14.4 km on the basis of the planned road network of the park.

(2) Water Supply Facilities

Internal water supply facilities will be developed to provide water necessary required for domestic and industrial uses, research activities, fire-fighting and other purposes in the HHTP area. Water distribution pumps, elevated tanks and water distribution pipes, etc. will be developed as internal facilities in each zone of the HHTP area by steps up to 2005, 2010 and 2020 in line with the required demand in the respective phase.

The quality of the water to be supplied to each tenant enterprise should meet the standard for drinking water quoted in Table 3-2-3. Tenant enterprises are obligated to furnish some suitable pure water production system which can produce high quality water, when needed for their respective activities.

The water demand was projected for the respective development zones and development phases based on the following unit rates:

Unit rate of water consumption :

• Domestic water for people's living	:	200 - 400 lit/day per capita
• Domestic water for daytime working people	:	200 - 300 lit/day per capita
• Water for R & D activities	:	20 m^3/day per lot-ha
• Industrial water for high-tech industry	:	90 m^3/day. per lot-ha on an average, computed based on the unit rate specified by the Japan Industry Location Center.

The total water demand in 2005, 2010 and 2020 is estimated at 13,000 m^3/day, 17,000 m^3/day and 37,000 m^3/day, respectively, as detailed in Table 6-3-3.

(3) Sewerage and Drainage Facilities

1) Sewerage facilities

Sewerage facilities of separated collection type will be developed for the HHTP area. They will consist of sewage collection pipes in the respective development zone and relay transfer pumps, where needed. Sewage is led to the swage treatment plant to be constructed as external infrastructure.

The daily average sewage generation in 2005, 2010 and 2020 is estimated at 13,000 m^3, 17,000 m^3 and 37,000 m^3 respectively, based on the water consumption projection. The internal sewerage facilities will be developed stepwise up to 2005, 2010 and 2020.

2) Drainage facilities

Internal drainage facilities will be developed stepwise phase up to 2005, 2010 and 2020, in line with the respective zone development. The internal drainage facilities will consist of ditches and pipes which are capable of draining rainfall intensity with a 5-year probable.

(4) Internal Electric Facilities

The power demand for HHTP was estimated on the basis of each development phase as shown in Tables 6-3-4 and 6-3-5. The total power demand is summarized below :

Electricity Demand

(MW)

	2005	2010	2020
1. R & D Zone	7.2	7.2	9.9
2. Center Area	0.7	0.9	4.7
3. High-Tech Industrial Zone	28.6	37.4	84.6
4. Urban/Business Zone	3.1	4.9	17.5
5. High Grade Residential Zone	0.8	1.0	1.0
6. New Town Zone	5.0	5.8	12.7
7. Others*	2.9	4.2	4.9
Total	48.3	61.4	135.3

Note:* Water purification plant and sewage treatment plant, etc.

In order to distribute electricity in HHTP, 22 kV switching stations are to be constructed at the entrance point of each zone. From the 22 kV on-site switching stations, 22 kV distribution lines will be provided to feed power to the respective consumers in the zone. Underground cable method is recommendable from aesthetic and security viewpoints, although either underground or overhead distribution line may be applicable for this Project.

Underground cables will be laid in PVC pipes buried in the ground. To cope with the increasing demand in future, it is recommended to install spare PVC pipes beforehand.

The 22 kV distribution system will be designed as an open ring network to secure reliable power supply. 22 kV switchgear units are also recommended to be installed at the service entrance points to consumers or the branch points of the distribution lines. In addition to the above, automatic line sectionalizers should be arranged in the respective 22 kV switchgear units on the line, in order to isolate the faulted line to avoid long hour interruption of other lines.

(5) Internal Telecommunication Facilities

The telephone demand for HHTP was estimated at 8,840 lines in the first phase, 10,300 lines in the second phase, and 20,890 lines in the third phase, as shown in Table 6-3-5.

In order to connect the telecommunication network with customers in each zone of HHTP, construction of distribution lines between customers will be required and a toll local switch should be installed at the center of the zone.

Considering the requirement of high speed telecommunication services for high-tech customers, optical fiber cables will be adopted basically as distribution lines.

The cables will be laid in ducts under the ground.

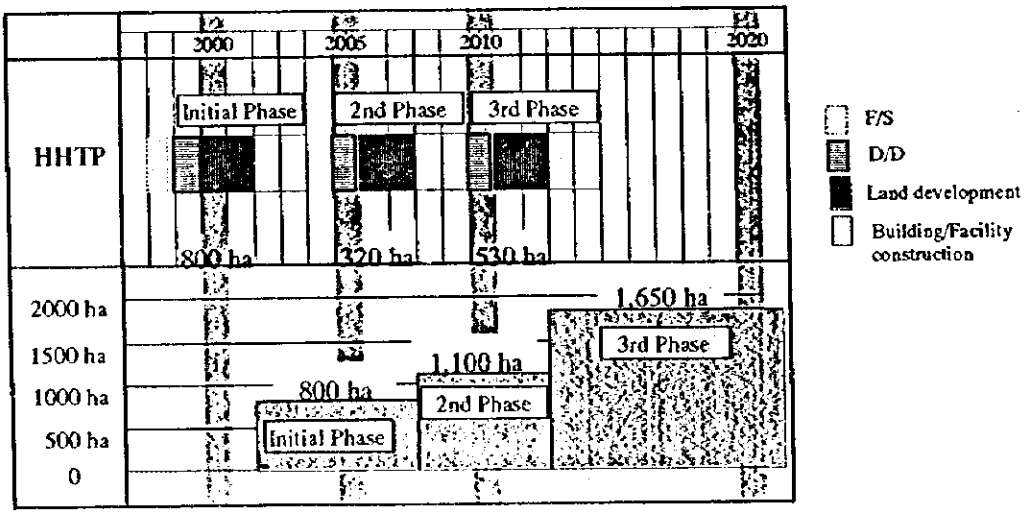
6.4 Development Schedule and Cost

(1) Development Schedule

Three-phase development is proposed for HHTP as shown below. The feasibility study for Phase 1 of the R&D Zone, High-Tech Industrial Zone and Residential Zone is scheduled to commence at the beginning of 1998 and the design work is scheduled to start in 1999. The construction work will be conducted during 2000 and 2001 and operation of R&D facilities and factories is expected from the year 2003.

A difficulty is foreseen in the on-time service of the external infrastructure due to the implementation procedure. The external water supply facilities, for instance, will be implemented in 2004 after F/S, design and construction and one year delay is foreseen for the operation of R&D facilities and factories which are expected to be open in 2003. Thus a temporary water supply system will be required in the start-up stage of HHTP utilizing the groundwater resources in the HHTP area.

The following diagram shows the development schedule of HHTP.



(2) Development Cost

The development cost of internal infrastructure was estimated at approximately USD 224 million as summarized below.

Development Cost of Internal Infrastructure of HHTP
(Price contingency is not included.)

(unit: USD million)

Item	2005	2010	2020	Total
1.Earthworks	3.2	5.4	2.7	11.3
2.Road	13.3	11.7	26.2	51.1
3.Water Supply	5.1	1.5	9.8	16.4
4.Sewerage	2.5	0.7	5.6	8.8
5.Drainage	7.5	2.3	16.3	26.1
6.Electric Power Supply	13.7	3.1	14.9	31.7
7.Telecommunication	3.3	0.8	4.2	8.3
8.Park & Sport Facilities	26.0	0.7	1.0	27.7
Sub-total	74.6	26.2	80.6	181.4
9.Engineering Service Cost	9.0	3.1	9.7	21.8
10.Physical Contingency	8.4	2.9	9.0	20.3
Total	92.0	32.3	99.3	223.6

Note: /1 Land acquisition cost or compensation cost is not included.
/2 Price escalation is not included.
/3 Engineering service cost and physical contingency are assumed at 12% and 10% respectively.
/4 Any building/housing construction cost is not included.
/5 External infrastructure cost is not included.
/6 A temporary water treatment plant is planned and included in the development of the external infrastructure

The external infrastructure shown below shall be developed in addition to the internal infrastructure. The external infrastructure facilities which would serve both HHTP and the prospective Hoa Lac city, should be implemented by the public sector.

Development Cost of External Infrastructure of HHTP
(Price contingency is not included.)

(unit: USD million)

Item	2005	2010	2020	Total
1.Road	57.8	6.5	36.9	101.2
2.Water Supply	75.8	18.2	20.6	114.6
3.Sewerage	26.6	19.3	11.6	57.5
4.Drainage	3.9	2.0	1.9	7.8
5.Electric Supply	44.2	2.2	10.1	56.5
6.Telecommunication	46.5	18.9	61.4	126.8
Total	254.8	67.1	142.5	464.4

Note: /1 Land acquisition cost nor compensation cost is not included.
/2 Price escalation is not included.
/3 Engineering service cost and physical contingency are assumed 12% and 10%.
/4 Any building/housing construction cost is not included.

As shown in the table above, the costs to be borne by the Government of Vietnam would be about USD 464 million for the three phases and USD 255 million for Phase 1. It should be noted that external infrastructure sub-projects covering telecommunications, water supply and electricity supply might be implemented on the BOT basis. In that case, the corresponding development costs will be shifted to the private sector. It should also be noted that all the estimated costs are preliminary figures at the stage of master planning. For Phase 1 area, however, a more detailed survey was carried out including topo and core drilling surveys, and the cost was refined.

Besides the above-mentioned costs for all the infrastructure facilites including land preparation, construction costs for the building structures will be necessary as shown below:

Development Cost of Buildings in Phase 1

Item	Dev. Cost (USD million)
1. Dwelling House in New Town	180
2. Dwelling House in High Grade Residential Area	58
3. Commercial Building in Urban/Business Zone	58
4. Center facilities in Center Area	45
5. Parks	13
6. Total	354

Table 6-1-1 Categories of High-Tech Industry to be Located in HHTP

Categorization by R&D Input Level (RDIL) /Productive Factor Intensiveness (PFI)	24 Categories of Hi-Tech Industry to be promoted in Vietnam	Screening Criteria for the HHTP: Inland Location	Screening Criteria for the HHTP: Less Water-Intensive	Screening Criteria for the HHTP: Clean Industry	Categories of Industry to be located at the HHTP	
Highest RDIL/ Brain-Intensive	· Pharmaceuticals	O	O	O	O	1
	· Medical Equipment, etc.	O	O	O	O	2
	· Detergents, Surfactans, Paints, etc.	O	O	O	O	3
Higher RDIL/ Engineering-Intensive	· Office/Service Industry Use Equip. - Cpier, Word processor, etc. - Airconditioner, etc.	O	O	O	O	4
Higher RDIL/ Capital-Intensive	· Organic Chemicals - Petrochemicals	×	×	△	×	
High RDIL Skilled Labor-Intensive	· Communication Equipment - Telecommunications equipment -TV, Tape player, Audio equip.	O	O	O	O	5
	· Industrial Electrical Machinery/Equip. - Motor, Connector, Switch, etc.	O	O	O	O	6
	· Other Electrical/Electronic Products - Tester, Disc Drive, Battery, etc.	O	O	O	O	7
	· Other Precision Instruments -Measuring instrument	O	O	O	O	8
	· Electronic Parts/Devices, etc. - Integrated circuit (IC) - Electronic ceramics, etc.	O	O	O	O	9
	· Optical Equipment & Lenses	O	O	O	O	10
	· Watches/Clocks & Parts	O	O	O	O	11
High RDIL/ Engineering-Intensive	· Electronic equipment - Computers, X Ray Equip. VTR, - Multimedia euip., Laser equip. etc. - Infomation terminal	O	O	O	O	12
	· Electrical Home Appliance	O	O	O	O	13
	· Rubber Tires & Tubes	O	△	△	×	
	· Motor Vehicles & Parts, etc.	O	O	O	O	14
	· Special Industrial Machinery (for food/wood processing, weaving, sewing, plastics, agriculture, etc.	O	O	O	O	15
	· Other Chemical Products - Cosmetics, Pesticide, Gule, etc.	O	O	△	O	
	· Other General Machinery/Equip. - Pump, Compressor, Bearing, etc. -Industrial robot, Mold/Die, etc.	O	O	O	O	16
	· Metal Processing Machinery/Equip. - Machining center, NCN, Tool, etc.	O	O	O	O	17
	· Glass and Glass Products - New glass, etc.	O	O	O	O	18
High RDIL/ Capital-Intensive	· Synthetic Fibers	O	×	△	×	
	· Fertilizers & Inorganic Chemicals	O	△	△	×	
	· Iron & Steel Products	O	△	△	×	

Note: O to meet criteria, △ difficult to meet criteria, × not to meet criteria.
Source: JICA Study Team

Table 6-1-2 Land Use Plan of HHTP

	Initial Phase		2nd Phase		3rd Phase		Total	
	Area (ha)	Ratio (%)	Area (ha)	Ratio (%)	Area (ha)	Ratio (%)	Area (ha)	Ratio (%)
1. R & D Zone	118	14.8	0	0.0	47	8.8	165	10.0
2. HHTP Center Zone incl. Training Area	16	2.0	0	0.0	32	6.0	48	2.9
3. High-Tech Industrial Zone	71	8.9	22	6.9	117	21.8	210	12.7
4. Urban/Business Zone	26	3.3	8	2.5	47	8.8	81	4.9
5. High Grade Residential Zone /3	76	9.5	56	17.7	0	0.0	132	8.0
6. New Town Zone	74	9.3	23	7.3	150	27.9	247	15.0
7. Infrastructure	144	18.1	18	5.7	116	21.6	278	16.8
1) Road	50	6.3	8	2.5	51	9.5	109	6.6
2) Park	46	5.8	10	3.2	35	6.5	91	5.5
3) Retention Pond	36	4.5	0	0.0	28	5.2	64	3.9
4) Sewage Treatment Plant	10	1.3	0	0.0	0	0.0	10	0.6
5) Electric Substation /2	2	0.3	0	0.0	2	0.4	4	0.2
8. Tha Xa Lake	120	15.1	180	56.8	0	0.0	300	18.2
9. Green, River & Reserve Area	151	19.0	10	3.2	28	5.2	189	11.5
10. Total	796	100.0	317	100.0	537	100.0	1,650	100.0

Note: /1 Local villages existing in 3rd phase area with the tract of approximately 150 ha are not included.

/2 Electric substation of the initial phase is planned to locate outside the HHTP site.

/3 Golf course is included.

Table 6-3-1 Projection of Traffic Demand in HHTP

Trip Demand

	Population			Trip Rate	Trip Demand (Trip end per day)		
	2005	2010	2020	/1	2005	2010	2020
to/from HHTP	12,600	14,800	30,600	2.01	25,300	29,700	61,500
Worker from ouytside to HHTP	7,900	10,100	21,790	2.01	15,900	20,300	43,800
Total	20,500	24,900	52,390		41,200	50,000	105,300

Note: /1 Trip by walk is not inclusive.
Resource: /1 "The Master Plan of Urban Hanoi Transport For Hanoi City in Vietnam, DF/R, October 1996"

Modal Split

Mode	Share (%) /1				Trip Demand (Trip end per day)		
	1995	2005	2010	2020	2005	2010	2020
Railway /2	0	0	2	5	0	1,000	5,300
Bus	4	7	10	14	2,900	5,000	14,700
Passenger Car	1	3	4	6	1,200	2,000	6,300
Motor Bike	35	45	52	65	18,500	26,000	68,400
Bicycle	60	45	32	10	18,600	16,000	10,600
Total	100	100	100	100	41,200	50,000	105,300

Note: /1 JICA Study Team set on the basis of the rsult of "The Master Plan of Urban Hanoi Transport For Hanoi City in Vietnam, DF/R, October 1996"
/2 45,000 daily railway passengers is predicted by the MOC and 2 % is shared to the HHTP on the basis of the population configulation in the Hoa Lac Area.

Traffic Demand Projection

Mode	Occupancy Rate	Trip Demand (per day)			Traffic Demand (per day)		
		2005	2010	2020	2005	2010	2020
Railway	-	0	1,000	5,300	-	-	-
Bus	25	2,900	5,000	14,700	100	200	600
Passenger Car	1.5	1,200	2,000	6,300	800	1,300	4,200
Motor Bike	1.4	18,500	26,000	68,400	13,200	18,600	48,900
Bicycle	1.05	18,600	16,000	10,600	17,700	15,200	10,100
Sub-total		41,200	50,000	105,300	31,800	35,300	63,800

Mode	Cargo Volume (Ton/day)/1			Capacity (ton)	Traffic Demand (per day) /2		
	2005	2010	2020		2005	2010	2020
Truck	1,140	1,490	3,420	4	430	560	1,280
Total					32,230	35,860	65,080

Note: /1 Annual working day is assumed 300 days (refer to Table xxxx)
/2 Truck Traffic Demand=Cargo Volume/Capacity x 1.5 (Idler ratio)

Traffic Demand Projection (PCU Converted)

Mode	PUC Rate	Traffic Demand (PCU per day)		
		2005	2010	2020
Railway	-	-	-	-
Bus	2.0	200	400	1,200
Passenger Car	1.0	800	1,300	4,200
Motor Bike	0.3	3,960	5,600	14,700
Bicycle	0.3	5,310	4,560	3,000
Truck	2.5	1,080	1,400	3,200
Total		11,350	13,260	26,300

Cargo Demand of HHTP Industrial Zone

	Cargo Demand (ton/year)			Daily Cargo Demand (ton/day)		
	2005	2010	2020	2005	2010	2020
1. Cargo Demand (Outflow)	163,300	212,600	487,500	540	710	1,630
2. Cargo Demand (Inflow)	180,000	234,000	536,000	600	780	1,790
3. Total	343,300	446,600	1,023,500	1,140	1,490	3,420

Table 6-3-2 Development Plan of External Infrastructure

HHTP

Facilities		Ph.1 (~2005)	Ph.2 (2006~2010)	Ph.3 (2011~2020)
1 Road	Expressway	28km	-	-
	Interchange	1	-	-
	Main Road in HHTP	6.4 km	1.0 km	4.4 km
	Sub-main Road in HHTP	7.6 m	-	2.0 km
	Bus Terminal	2,000 m^2	-	10,000 m^2
2 Water Supply Facility	Water Intake System	50,000 m^3/day	25,000 m^3/day	25,000 m^3/day
	Water Treatment Plant at Da Chong	50,000 m^3/day	25,000 m^3/day	25,000 m^3/day
	Temporary Water Treatment Plant in HHTP	2,800 m^3/day	-	-
	Water Conveyance Pipes	27 km x 1	27 km x 1	-
	Main Pipeline in HHTP	4.9 km	4.7 km	7.9 km
	Water Service Reservoir	16,000 m^3	9,000 m^3	16,000 m^3
	Repair of the Spillway of Tan Xa Lake	Whole	-	-
3 Sewerage Facility	Sewage Treatment Plant	40,000 m^3/day	40,000 m^3/day	20,000 m^3/day
	Main Sewer	13.9 km	2.0 km	2.1 km
4 Drainage Facility	Retention Ponds	475,000 m^3	-	298,000 m^3
	Drainage Canal pipe	15 km	7.5 km	7.5 km
5 Electricity Supply Facility	Xuan Mai Substation (220/110kV)	2 x 125 MVA	-	-
	Substation in HHTP (110/22kV)	2 x 40 MVA	-	2 x 40 MVA
	Transmission Lines (220kV, Hoa Binh-Xuan Mai)	70 km		
	Transmission Lines (110kV, Xuan Mai-HHTP)	20 km	-	26 km
	Sub-Transmission Lines (22kV)	27.6 km	9.5 km	16.0 km
6 Telecom-munication Facility	Optical Fiber Cable (Main)	15,000 Lines	10,000 Lines	40,000 Lines
	Switching Station	ditto		
	Remote Terminals	ditto		
	Mobile System	Full Set	-	-
7 Park & Sport Facilities	Central Park	46 ha	-	-
	Science Museum	5,000 m^2	-	-
	Gymnasium	3,000 m^2		
	Sport Courts	8 tennis courts, etc.		

Table 6-3-3 Water Demand Projection for Hoa Lac High-Tech Park (Basic Plan)

Categories	Phase		
	Initial phase (2005)	2nd. phase (2010)	3rd. phase (2020)
1. R & D Zone			
Net Area (ha)	102	102	141
Unit Rate (m^3/ha.d)	20	20	20
Water Demand (m^3/d)	2,040	2,040	2,820
2. Center Zone			
Gross Area (ha)	12	12	44
Daytime Population (capita)	200	200	780
Unit Rate (lit/cap.d)	200	230	250
Water Demand (m^3/d)	40	46	195
Unit Rate (m^3/ha.d)	3.3	3.8	4.4
3. High-Tech Industrial Zone			
Gross Area (ha)	71	93	210
Water Demand (m^3/d)	6,700	8,700	19,600
Unit Rate (m^3/ha.d)	94.4	93.5	93.3
4. Urban/Business Zone			
Gross Area (ha)	26	34	81
Daytime Population (capita)	1,300	1,900	5,400
Unit Rate (lit/cap.d)	200	230	250
Water Demand (m^3/d)	260	437	1,350
Unit Rate (m^3/ha.d)	10.0	12.9	16.7
5. High Grade Residential Zone			
Net Area (ha)	22.6		
Daytime Population (capita)	100	200	200
Unit Rate (lit/cap.d)	200	250	300
Daytime Water Demand (m^3/d)	20	50	60
Living Population (capita)	1,100	1,300	1,300
Unit Rate (lit/cap.d)	300	350	400
Living Water Demand (m^3/d)	330	455	520
Total Water Demand (m^3/d)	350	505	580
Unit Rate (m^3/ha.d)	14.6		
6. New Town Zone			
Gross Area (ha)	74	97	247
Daytime Population (capita)	100	100	200
Unit Rate (lit/cap.d)	200	250	300
Daytime Water Demand (m^3/d)	20	25	60
Living Population (capita)	11,700	13,700	29,700
Unit Rate (lit/cap.d)	200	250	300
Living Water Demand (m^3/d)	2,340	3,425	8,910
Total Water Demand (m^3/d)	2,360	3,450	8,970
Unit Rate (m^3/ha.d)	31.6	35.3	36.1
7. Existing Residential Zone			
Gross Area (ha)			150
Population (capita)			5,400
Unit Rate (lit/cap.d)			200
Water Demand (m^3/d)			1,080
Unit Rate (m^3/ha.d)			7.2
8. Other Uses and Contingency			
Water Demand (m^3/d)	1,250	1,822	2,405
Total Water Demand (m^3/d)	13,000	17,000	37,000

Table 6-3-4 Power Demand Projection in HHTP

	2005					2010					2020					Power Supply Substation (Planed)					
	Area (ha)		Household	Unit Demand (MW/unit)	Electric Demand (MW)	Area (ha)		Household	Unit Demand (MW/unit)	Electric Demand (MW)	Area (ha)		Household	Unit Demand (MW/unit)	Electric Demand (MW)	No.1 S/S			No.2 S/S		
	Net	Floor				Net	Floor				Net	Floor				2005	2010	2020	2005	2010	2020
1. R&D Zone					7.2					7.2					9.9	7.2	7.2	7.2			2.7
2. Center Area		1.2		0.6	0.7		1.5		0.6	0.9		7.8		0.6	4.7	0.7	0.9	0.9			3.8
3. High-Tech Industrial Zone					28.6					37.4					84.6	28.6	37.4	37.4			47.2
4. Urban / Business Zone		5.2		0.6	3.1		8.2		0.6	4.9		29.2		0.6	17.5	3.1	4.9	12.2			5.3
5. High Grade Residential Zone			265	0.003	0.8			325	0.003	1.0			325	0.003	1.0	0.8	1.0	1.0			0
6. New Town Zone			2,520	0.002	5.0			2,920	0.002	5.8			6,330	0.002	12.7	5.0	5.8	5.8			6.9
7. Water purisfication plant					0.4					0.6					0.7	0.4	0.6	0.6			0.1
8. Sewerage treatment plant					2.3					3.4					4.0	2.3	3.4	3.4			0.6
9. Drainage plant					0.2					0.2					0.2	0.2	0.2	0.2			0
Total					48.3					61.4					135.3	48.3	61.4	68.7			66.6

Table 6-3-5 Power Demand Projection of R&D and High-Tech Industrial Zone

	2005				2010				2020			
	Power consumption (MWh)		Operating hours per month	Max Electric Demand (MW)	Power consumption (MWh)		Operating hours per month. (hrs)	Max Electric Demand (MW)	Power consumption (MWh)		Operating hours per month. (hrs)	Max Electric Demand (MW)
	Per annum	Max per month			Per annum	Max per month			Per annum	Max per month		
	<E>	<N>	<T>	<P>	<E>	<N>	<T>	<P>	<E>	<N>	<T>	<P>
1. R&D Zone	14,000	1,300	364	7.2	14,000	1,300	364	7.2	19,250	1,800	364	9.9
2. High-Tech Industrial Zone	57,200	5,200	364	28.6	74,400	6,800	364	37.4	167,600	15,400	364	84.6
Total				35.8				44.6				94.5

Remarks:

$$N = \left(\frac{E}{12}\right) \times 1.1 \quad [MWh]$$

$$T = \frac{6[days] \times 14[hours/day] \times 52[weeks]}{12[month]} \quad [hours]$$

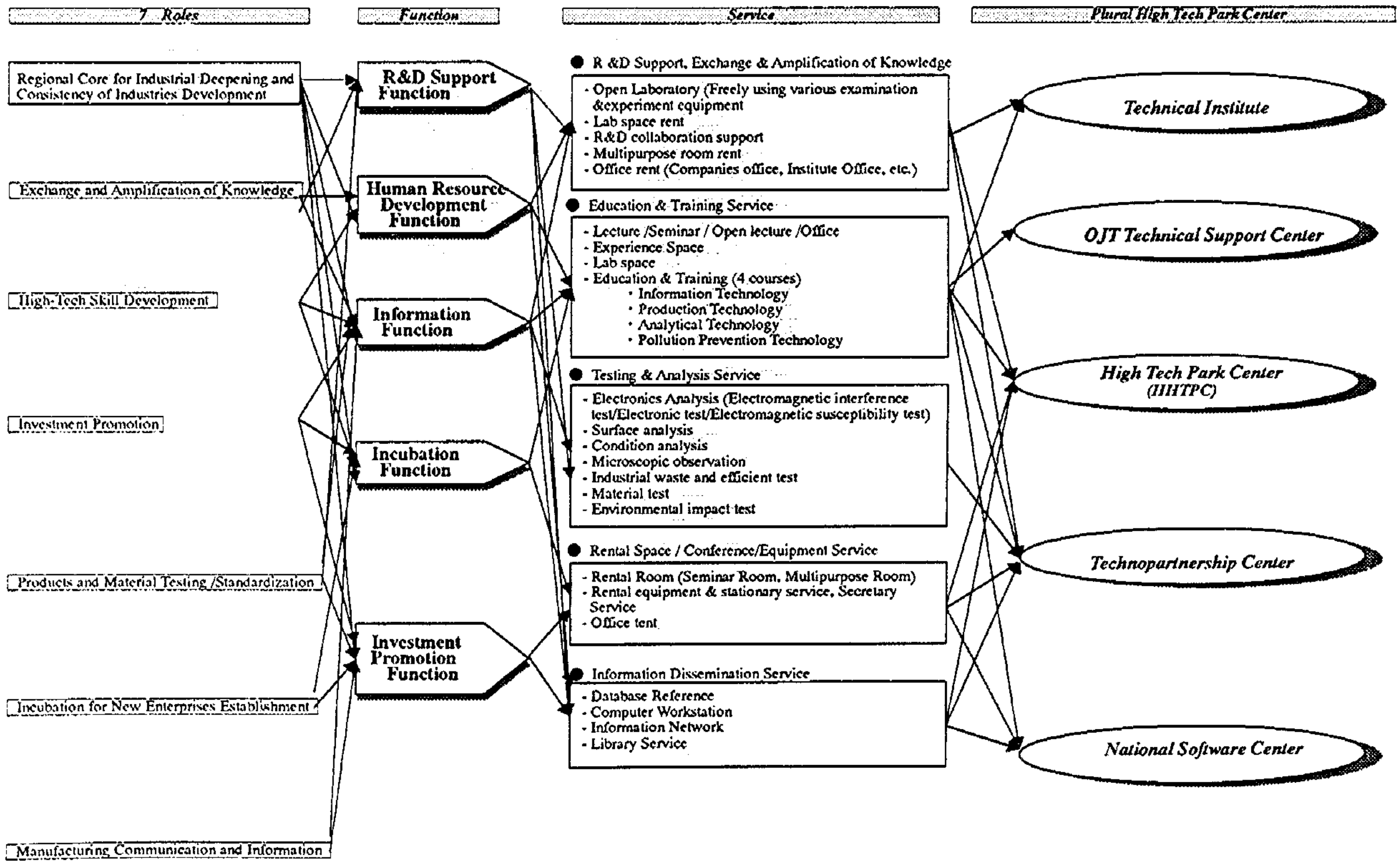
$$P = \left(\frac{N}{T}\right) \times \left(\frac{1}{L}\right) \times 100 \quad [MW]$$

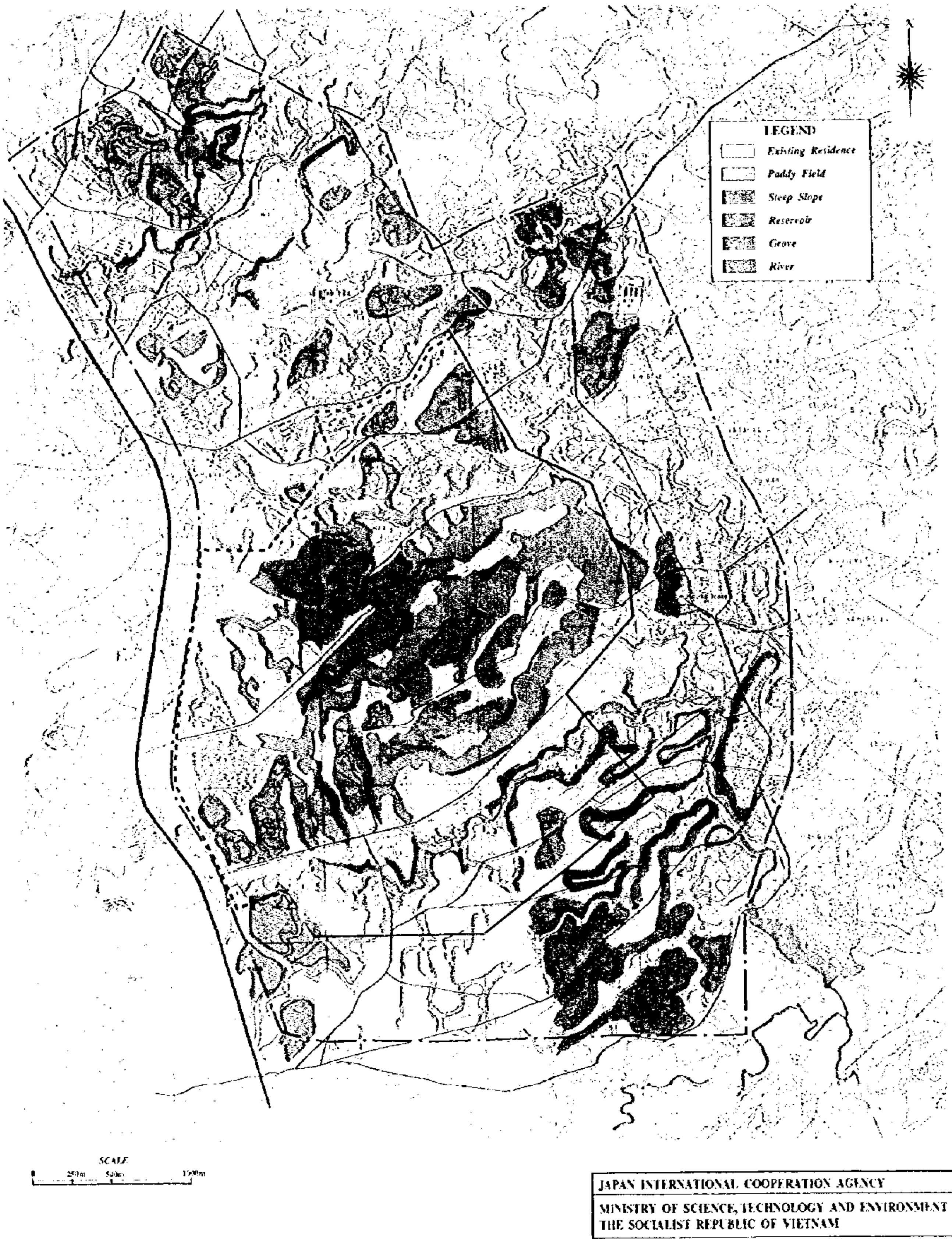
L : Monthly load factor = 50 [%]

Table 6-3-6 Telephone Demand Projection in HHTP

	2005				2010				2020			
	Population (Employee)	House-hold	Unit Demand (Line/Prs.)	Telephone Demand (Line)	Population (Employee)	House-hold	Unit Demand (Line/Prs.)	Telephone Demand (Line)	Population (Employee)	House-hold	Unit Demand (Line/Prs.)	Telephone Demand (Line)
1. R&D Zone	4000		0.5	2000	4000		0.5	2000	5500		0.5	2750
2. Center Area	200		0.5	100	200		0.5	100	780		0.5	390
3. High-Tech Industrial Zone	8600		0.1	860	11200		0.1	1120	25200		0.1	2520
4. Urban / Business Zone	1300		0.5	650	1900		0.5	950	5400		0.5	2700
5. High Grade Residential Zone	1100	(265)	0.5	550	1300	(325)	0.5	650	1300	(325)	0.5	650
6. New Town Zone	11700	(2520)	0.4	4680	13700	(2920)	0.4	5480	29700	(6330)	0.4	11880
Total				8840				10300				20890

Figure 6-1-1 Role, Function, Service and Cooperation of Plural Center Facilities in HHTP





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MINISTRY OF SCIENCE, TECHNOLOGY AND ENVIRONMENT
THE SOCIALIST REPUBLIC OF VIETNAM

THE MASTER PLAN AND FEASIBILITY STUDY ON
THE HOA LAC HIGH-TECH PARK PROJECT IN THE SOCIALIST REPUBLIC OF VIETNAM

Figure 6-1-2
Land Use Constraints

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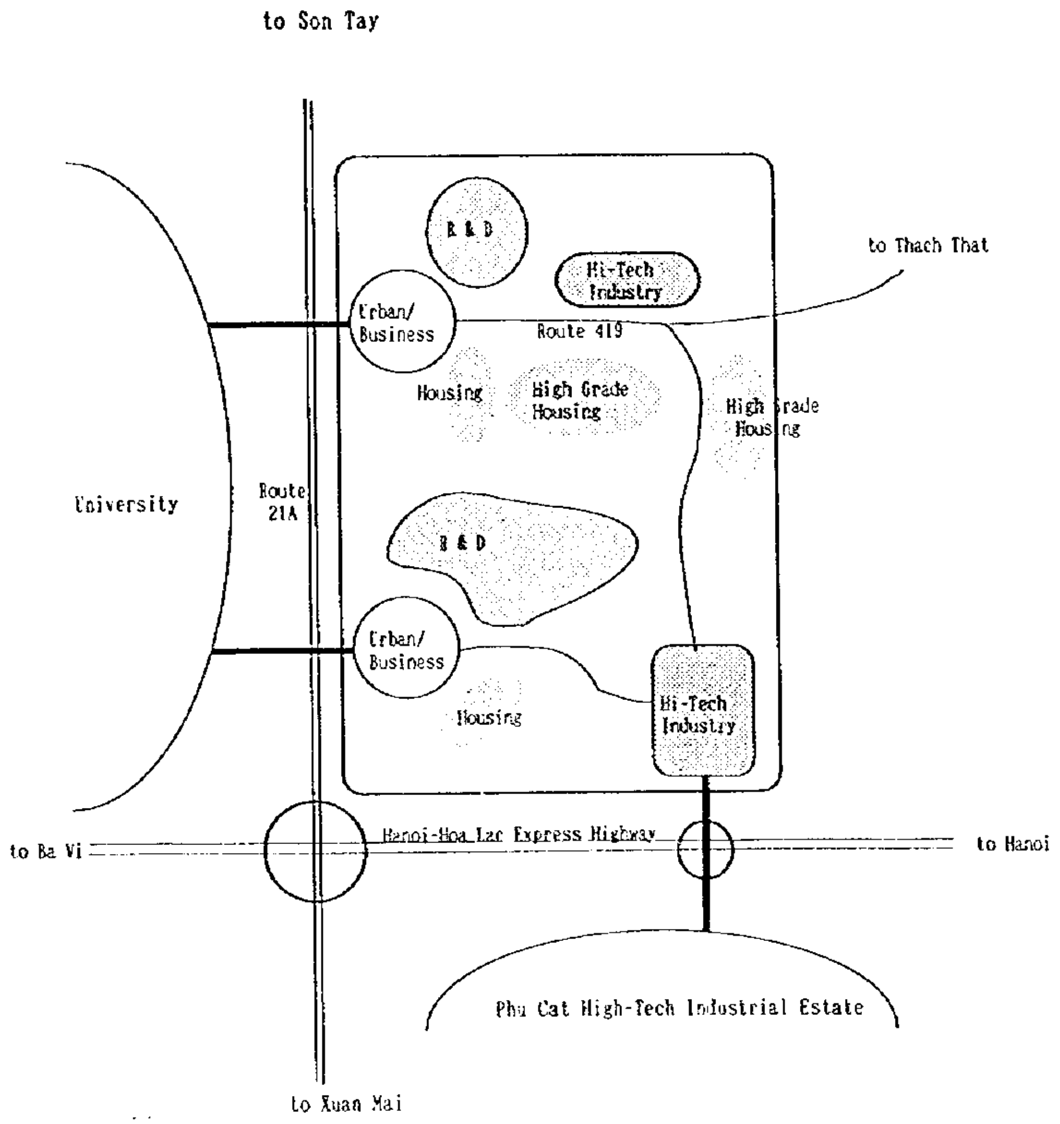

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Figure 6-1-3
Land Use Concept Alternative 1

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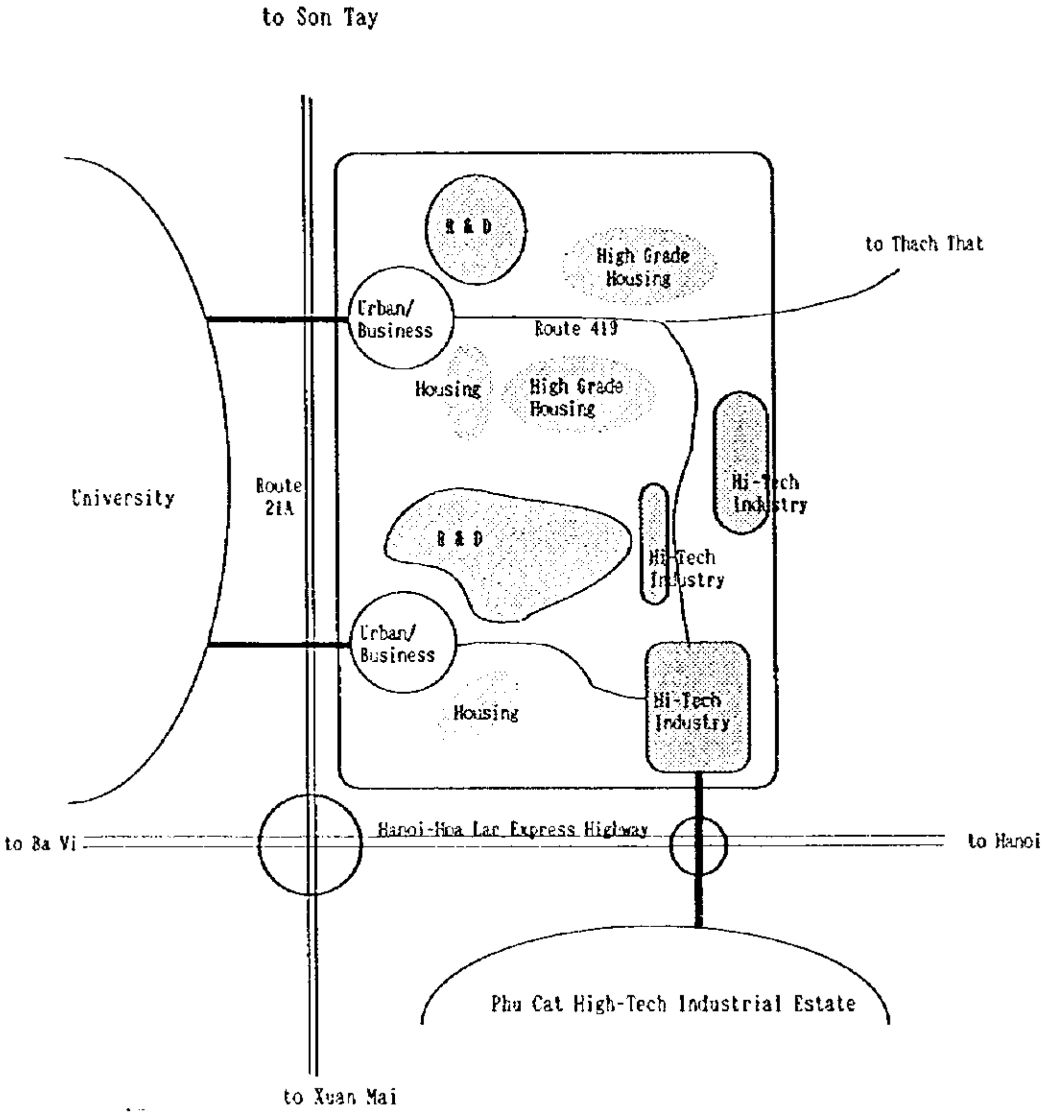

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THE MASTER PLAN AND FEASIBILITY STUDY ON THE HOA LAC HIGH-TECH PARK PROJECT IN THE SOCIALIST REPUBLIC OF VIETNAM

Figure 6-1-4
Land Use Concept Alternative 2

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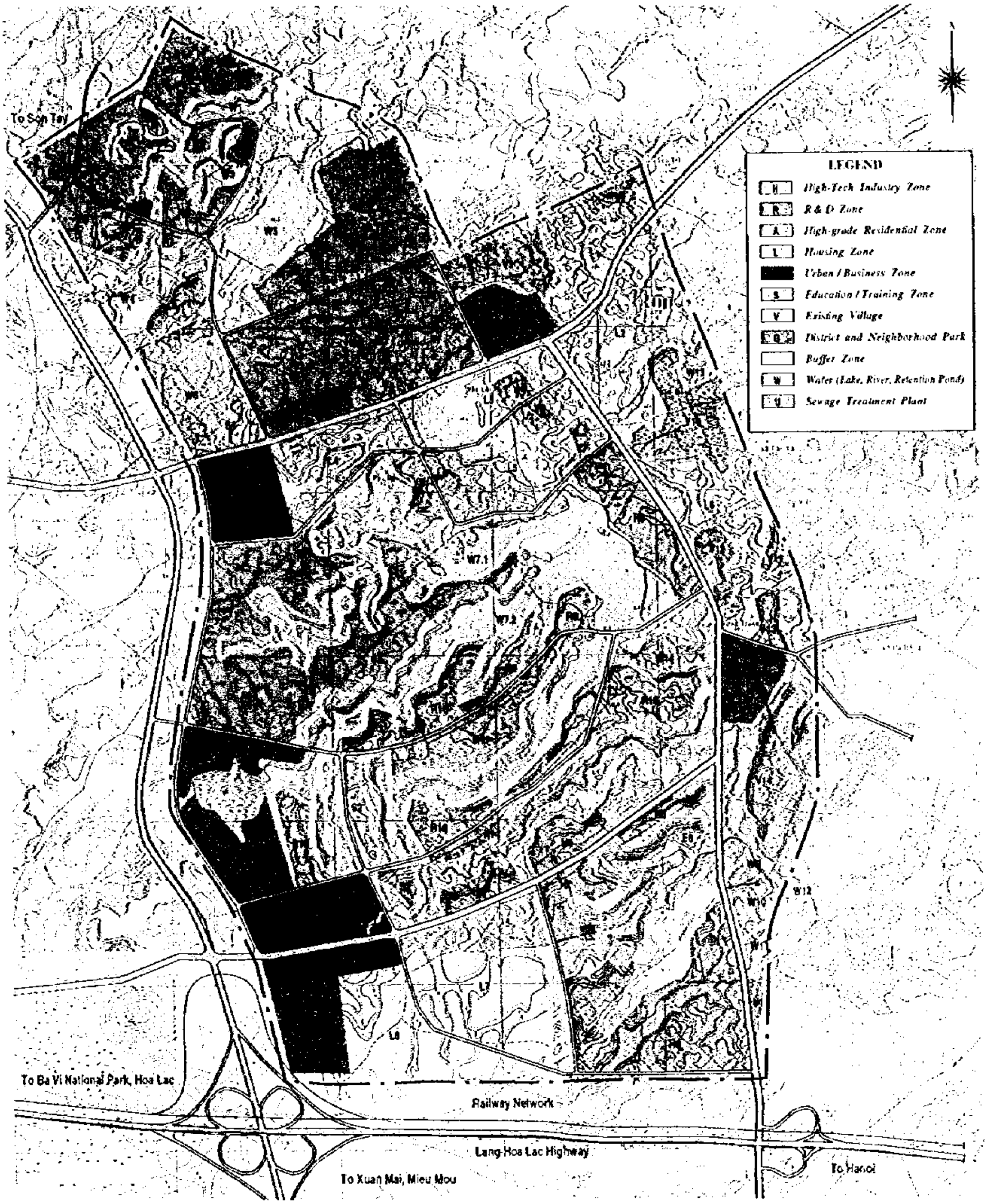

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THE MASTER PLAN AND FEASIBILITY STUDY ON THE HOA LAC HIGH-TECH PARK PROJECT IN THE SOCIALIST REPUBLIC OF VIETNAM
Figure 6-1-5 Land Use Plan of HHTP
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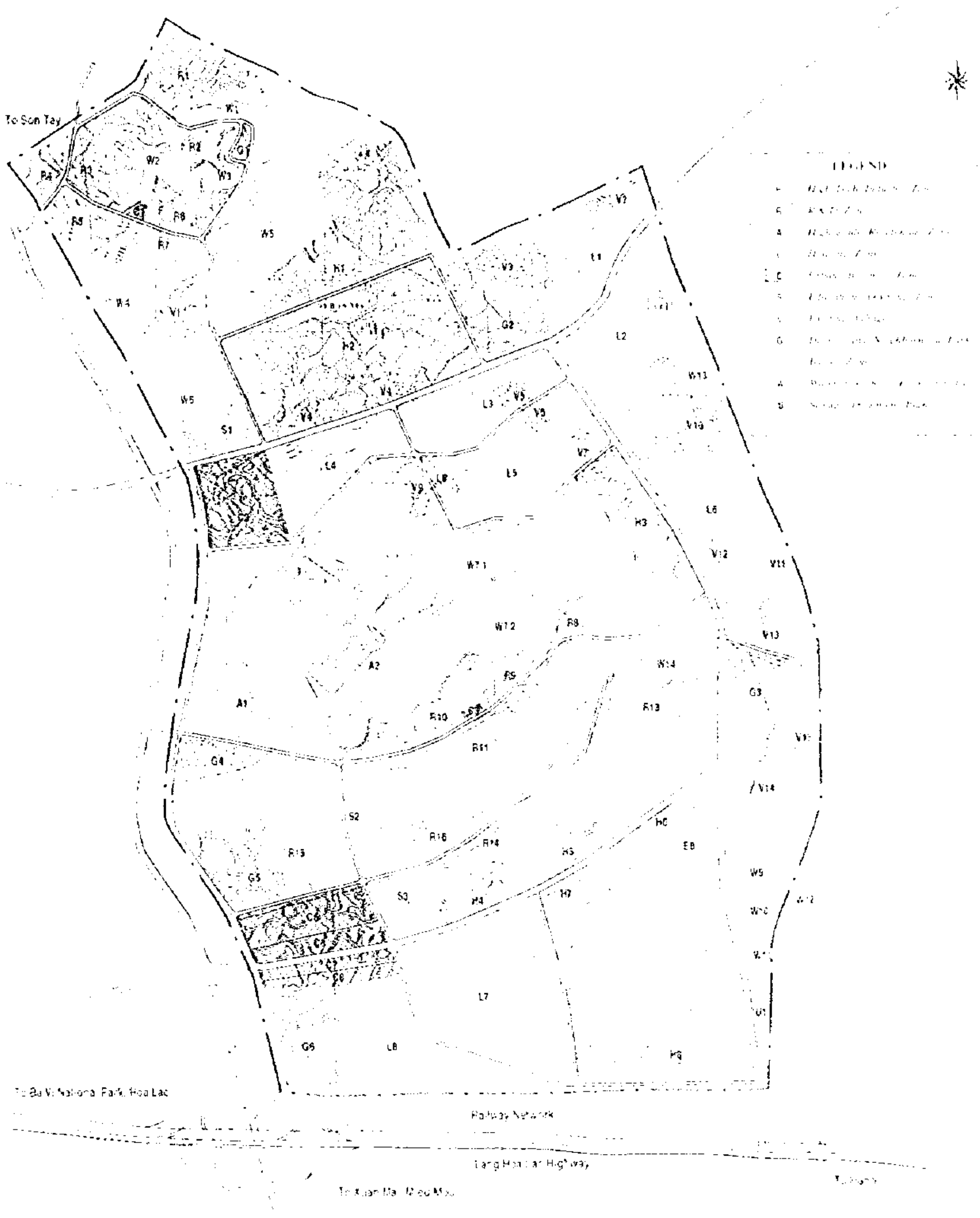

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Figure 6-1-5 Land Use Plan of HHTP

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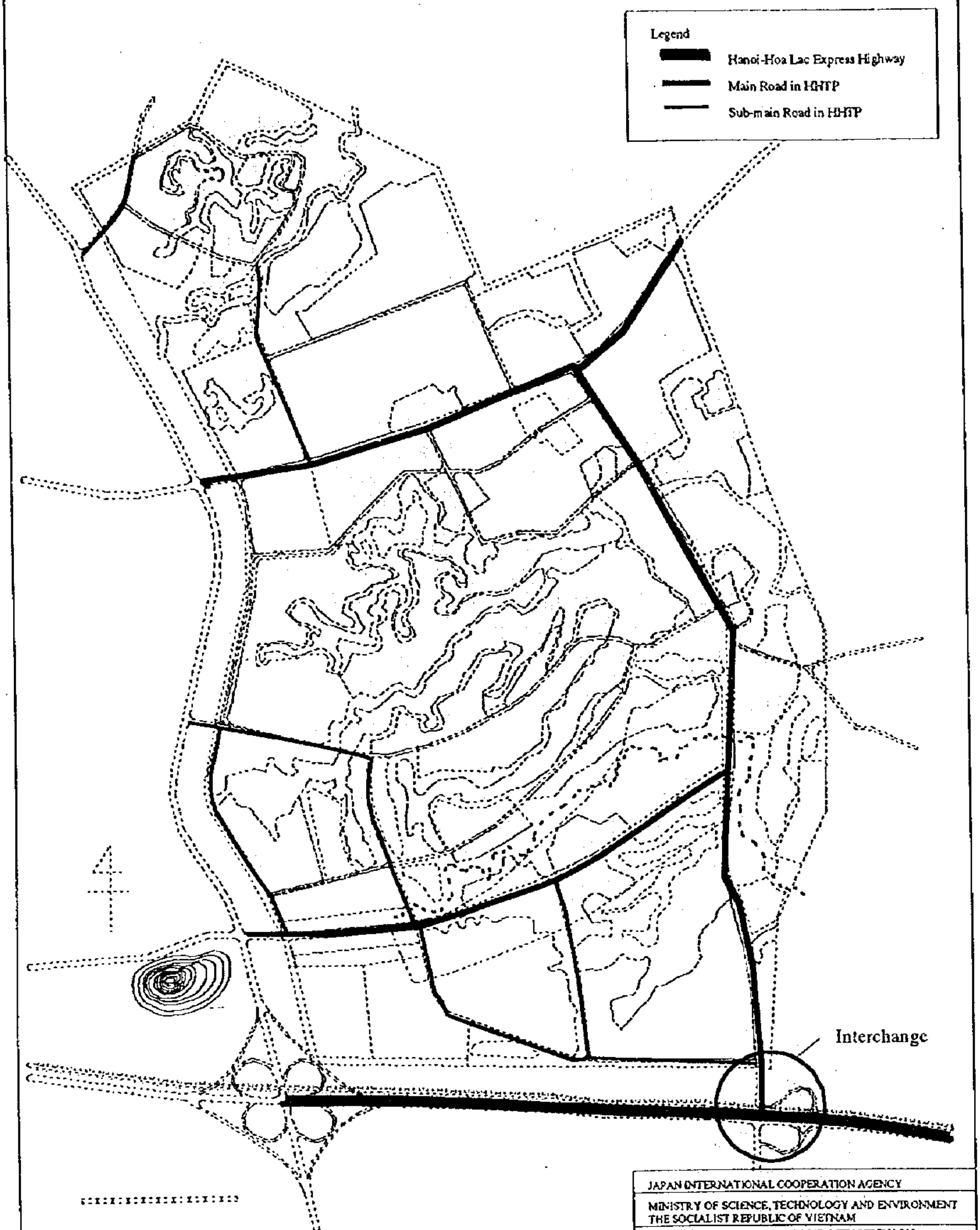

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Figure 6-3-1
External Infrastructure of Road Facility

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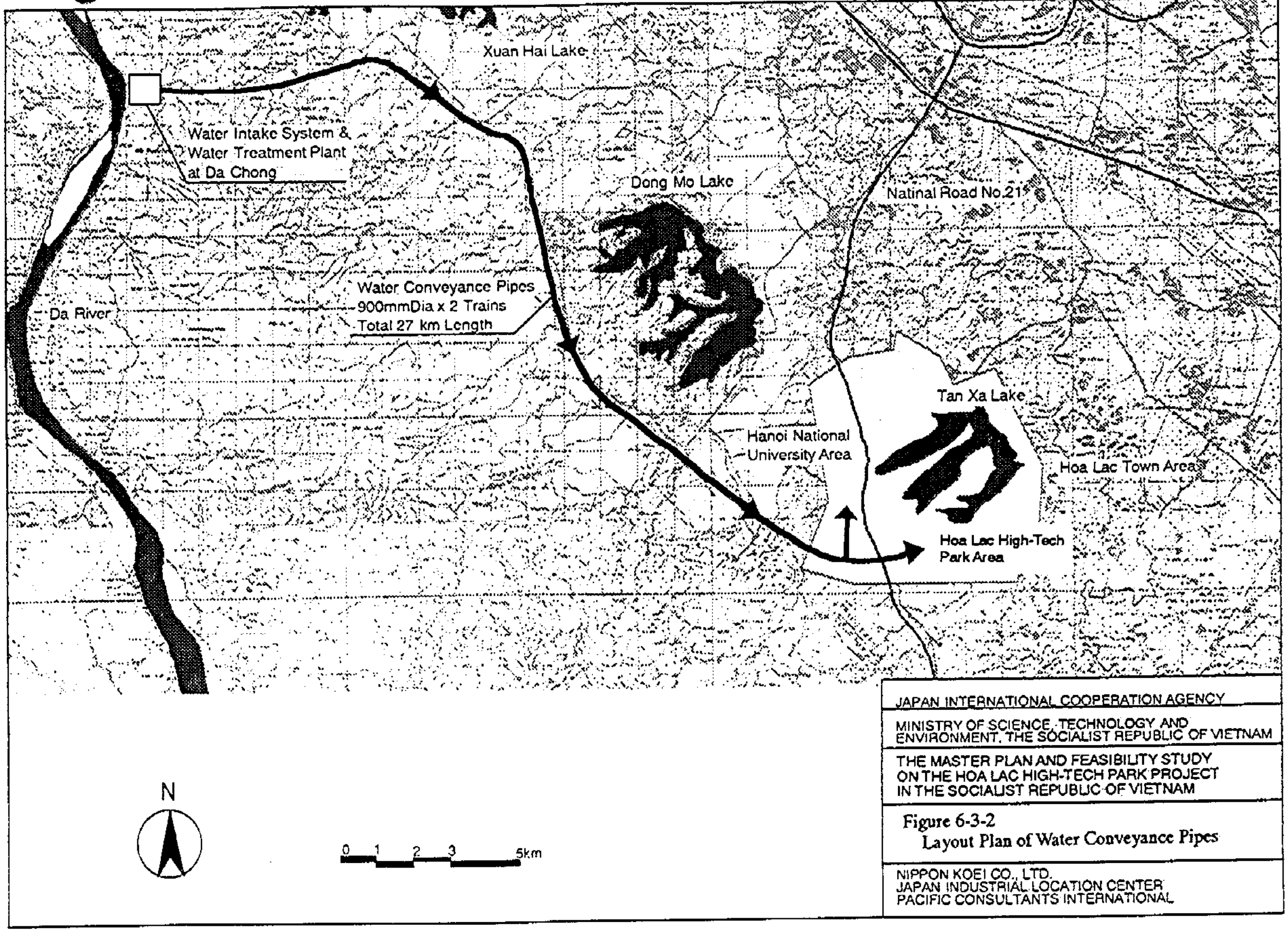

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THE MASTER PLAN AND FEASIBILITY STUDY ON THE HOA LAC HIGH-TECH PARK PROJECT IN THE SOCIALIST REPUBLIC OF VIETNAM

Figure 6-3-2
Layout Plan of Water Conveyance Pipes

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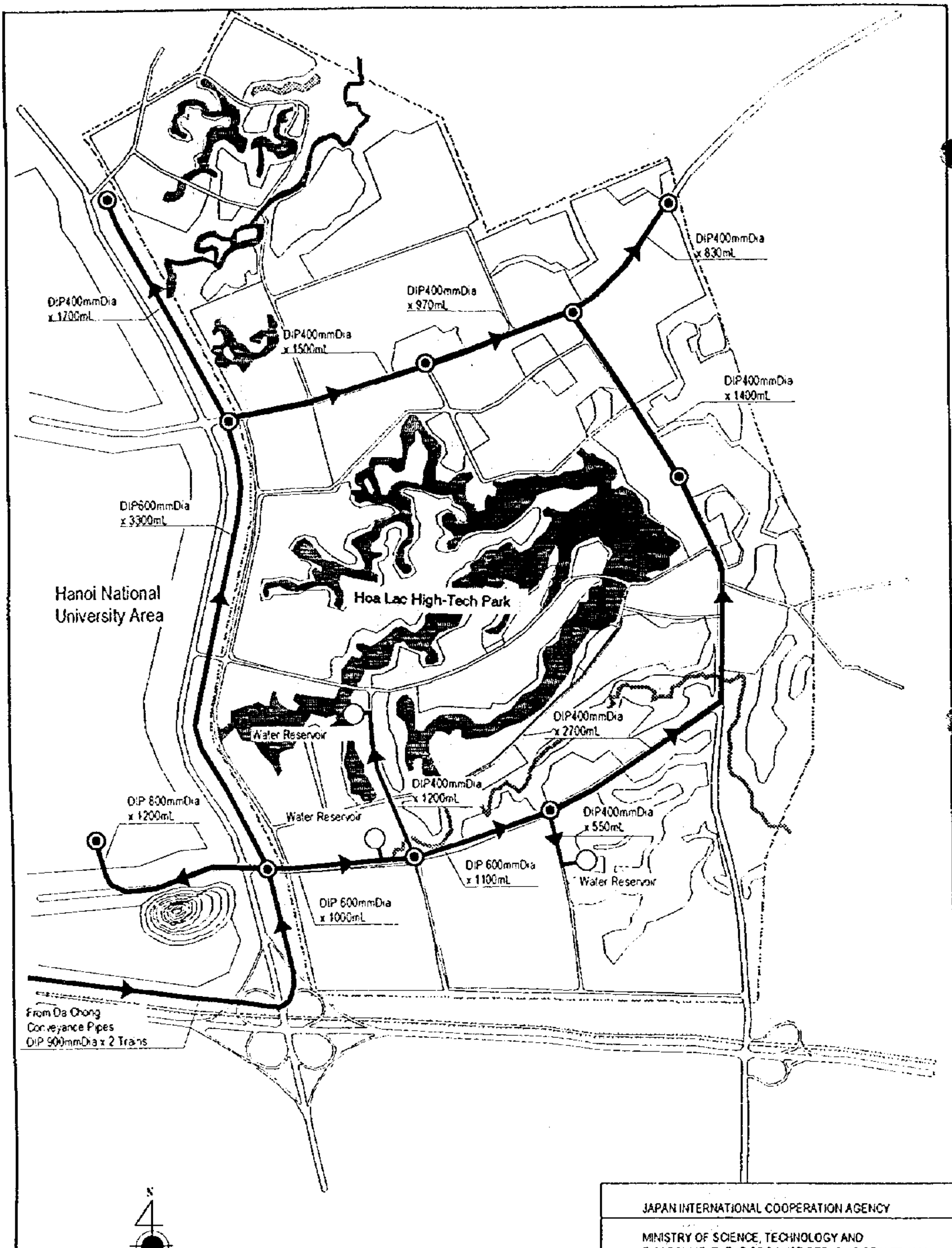
PACIFIC CONSULTANTS INTERNATIONAL



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THE MASTER PLAN AND FEASIBILITY STUDY ON THE HOA LAC HIGH-TECH PARK PROJECT IN THE SOCIALIST REPUBLIC OF VIETNAM

Figure 6-3-3
Layout Plan of External Water Supply Facilities

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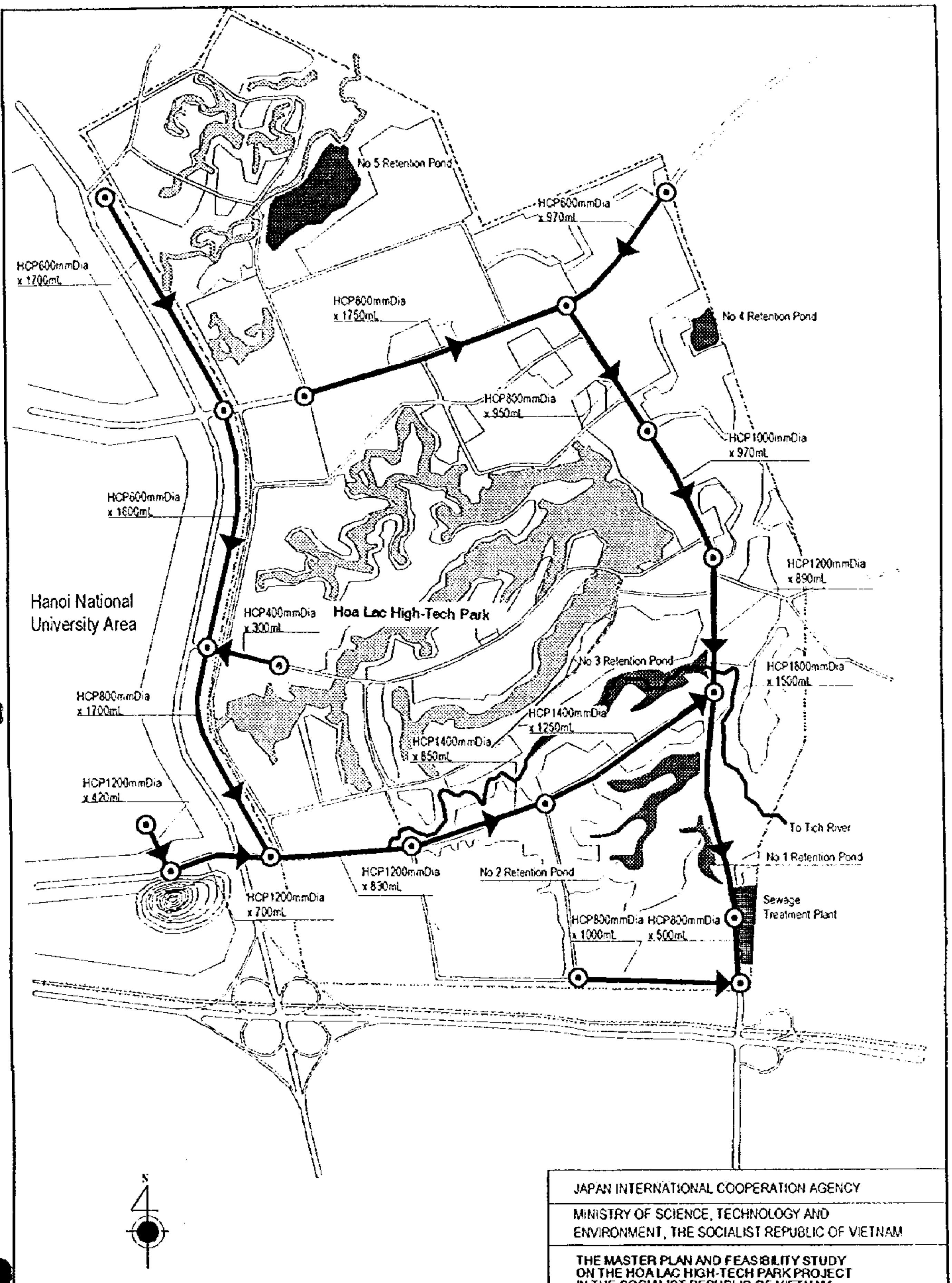

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THE MASTER PLAN AND FEASIBILITY STUDY ON THE HOA LAC HIGH-TECH PARK PROJECT IN THE SOCIALIST REPUBLIC OF VIETNAM

Figure 6-3-4
Layout Plan of External Sewerage and Drainage Facilities

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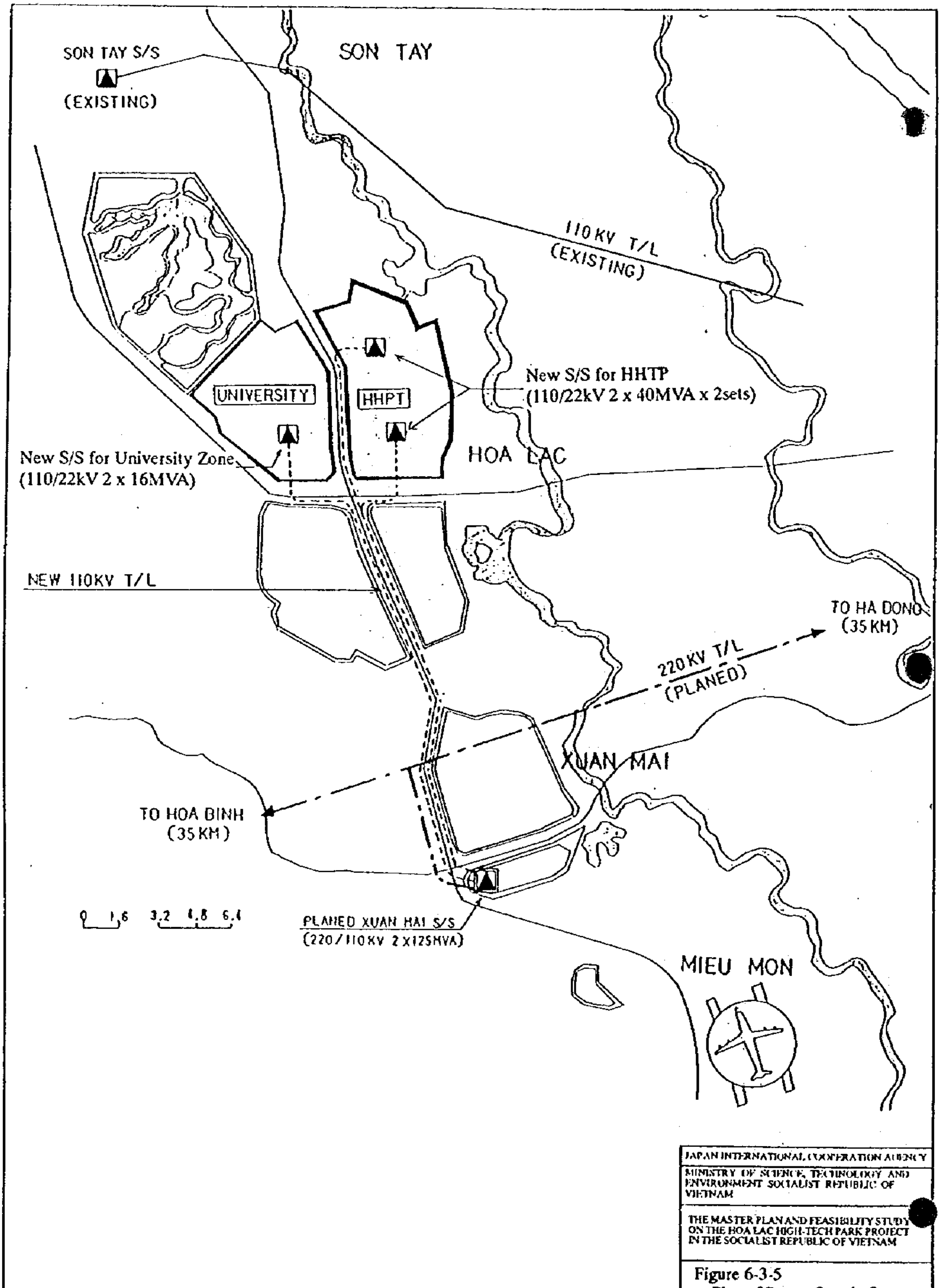

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THE MASTER PLAN AND FEASIBILITY STUDY ON THE HOA LAC HIGH-TECH PARK PROJECT IN THE SOCIALIST REPUBLIC OF VIETNAM

Figure 6-3-5
Plan of Power Supply System

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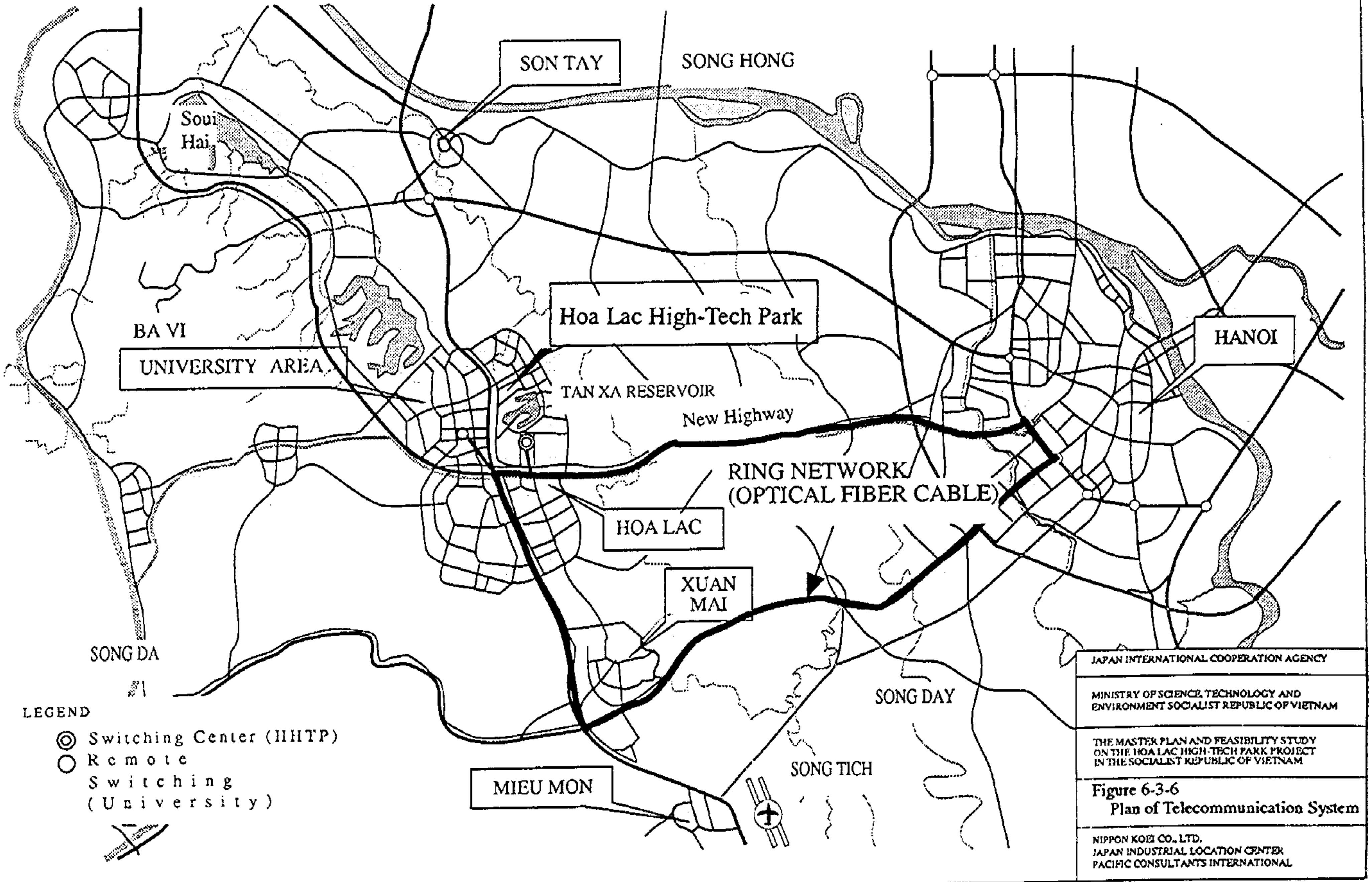

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THE MASTER PLAN AND FEASIBILITY STUDY ON THE HOA LAC HIGH-TECH PARK PROJECT IN THE SOCIALIST REPUBLIC OF VIETNAM

Figure 6-3-6
Plan of Telecommunication System

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IN THE SOCIALIST REPUBLIC OF VIETNAM

Figure 6-3-7
Internal Infrastructure of Road

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VII. FEASIBILITY STUDY ON INITIAL DEVELOPMENT PHASE

7.1 Selection of Initial Development Site

The initial development (Phase 1) site planned to be developed by 2005 with the tract of approximately 800 ha, is proposed to locate in the southern part of the HHTP area in consideration of following reasons as illustrated in Figure 7-1-1.

1) The ideal land use is pursued assuming that suitable land will be distributed to each development component considering the topography and present land use; for instance, waterfront area will be utilized as the R&D Zone.

2) The low productivity land such as cassava field shall be initially developed. Existing villages shall be excluded in order not to make the mass resettlement. Then, the development will be easily implemented.

3) Waterfront of Tan Xa Lake shall be utilized for the initial development of R&D area.

4) Area in the vicinity of the Hanoi-Hoa Lac Highway shall be initially developed for the initial area of high-tech industrial park in consideration of the accessibility to the interchange.

5) The business /commercial area along the national road 21A will be partially developed in the initial development phase.

6) A new town will be located next to the business commercial area in consideration of the sparse population and present land use of the site. High-grade residence area will be developed in the northern part of Tan Xa Lake to utilize the waterfront landscape.

7.2 Development Alternatives and Priority Plan

Development alternatives of the initial phase are conceived on the basis of development size of the residential area. The residential area in HHTP could be minimized in consideration of the presence of Dong Xuan residential area located next to HHTP and the high-grade residential area will be increased to cope with the housing demand of foreigner and high income Vietnamese.

Following two alternative plans are conceived for the initial development phase.

Basic Plan: The basic development plan corresponding to the master land use plan consists of the new town for the middle income technicians, researcher, etc. and high-grade residence for executives, in which a golf course, tennis courts, and swimming pools are facilitated. General workers in HHTP will commute from Dong Xuan residential area and other new housing area.

Alternative: The middle income technicians, researcher and general worker will reside in Dong Xuan residential area and the new town will not be built in HHTP. High-Tech Industrial Zone will be expanded in lieu of the new town. The high-grade residence is planned to cope with the increment of executives who work in the expanded High-Tech Industrial Zone.

Comparative Evaluation of Basic Plan and Alternative

Development possibility of both plans is evaluated as shown hereunder. It seems that the basic plan is a little superior, however, the choice is depending on the evaluation principles. If controllability and reliability of development is considered important, the basic plan will be chosen. The alternative plan will be preferable when the development profitability is paid more attention.

Since controllability, reliability and practicability of development is assumed to be important, the basic plan is chosen for this feasibility study/[1]. Impacts on social and natural environment by the development of both plans are considered to be almost same degree.

/[1] The detailed study of the alternative plan is also presented in Appendix III.

Item	Basic Plan Evaluation		Alternative Plan Evaluation		Reason
1. Controllability	6 elements of HHTP will be developed on time to funciton effectively.	◎	Since the different organization will develop Dong Xuan residential area, a difficulty is foreseen in residential supply to HHTP workers on time.	○	On time development of element is preferable.
2. Reliability	Quantity and quality required for the residential function of HHTP will be satisfied completely.	◎	Inconsistency is foreseen between the residential requirement and supply due to the different development organization of Dong Xuan residential area.	○	Residential demand and supply should be consistent.
3. Viability					
①Total Development Cost /1	688 million USD	-	558 million USD	-	-
②Private project cost Public project cost/2	388 million USD (private) 300 million USD (public) (including external infrastructure cost of 208 million USD)	◎	262 million USD (private) 296 million USD (public) (including external infrastructure cost of 222 million USD)	◎	Public project costs of two alternatives are same.
③Profitability (IRR)	FIRR=9.3~10.0%	○	FIRR=11.6~12.2%	◎	
④Practicability	When investment demand becomes bigger, 2nd and 3rd phase development could be developed continuously.	◎	Bigger scale high-tech industrial park is preferable in case of the large demand. If the investment demand turns out smaller, a lot of vacant lots will be presented and project profitability becomes worse.	○	Easy development is important in the initial phase.
4. Total evaluation		◎		○	○

Note: /1 Price contingency is not included.
/2 Private project: External telecommunication facility, High-Tech Industrial Zone, R&D Zone (Software Park), Urban/Business Zone, High Grade Residential Zone and building in New Town Project
Public project: R&D Zone (Institute Sub-Zone), New Town, external infrastructure; highway and interchange, main road of HHTP, electric facility, water supply facility, sewerage facility, drainage facility, central park, and centers of OJT Technical Center, Technical Institute, Technopartnership Center

7.3 Land Use and Zoning

7.3.1 Land Use Plan

(1) R&D, the main element of HHTP, is planned to locate alongside the Tan Xa Lake with the tract of 118 ha, and (2) High-Tech Industrial Zone with 71 ha will be developed in the neighboring site of the interchange of the Hanoi-Hoa Lac Highway. (3) where approximately 12,000 population will reside, is planned to locate next to the Center Area with 16 ha and (4) Urban/Business Zone with 26 ha are distributed at the entrance of HHTP between national road 21A and R&D Zone. (5) New Town with 74 ha, Center Area and Urban/Business Zone. (6) High Grade Residential Zone with 76 ha and 1,000 population will be developed in the northern lakeside of Tan Xa providing attractive new residence with rich green and recreation facility. (7) The Central Park with 46 ha is planned to serve for Hoa Lac area along national road 21A, in which the athletic facilities of stadium, gymnasium, etc., educational facility such as science technology museum and amusement facilities will be developed in addition to the park facilities.

The land use plan of Phase 1 is tabulated in the table below, and Table 7-3-1 and Figure 7-3-1 present detailed land use plan.

Item	Area (ha)	(%)	Remarks
1) R%D Zone	117.5	14.8	
2) Center Area	16.3	2.1	
3) High-Tech Industrial Zone	70.7	8.9	
4) Urban/Business Zone	25.7	3.2	
5) High Grade Residential Zone	75.6	9.5	inclusive of golf course
6) New Town Zone	74.3	9.4	
7) Main road, sewage plant, etc.	94.0	11.8	inclusive of retention pond
8) Park & green	153.5	19.3	
9) Tan Xa Lake	120.3	15.1	
10) Reserve Area	46.3	5.8	
Total	794.2	100.0	

7.3.2 R&D Zone

(1) Land Use Plan

Research institutes and software research enterprises will be established in R&D Zone to carry out the scientific research concerning information and electronic field, bio-technology field, new material field, machine and mechatronics field, environment and energy field, etc. Approximately 4,000 researchers are expected to work in 118 ha site of R &D Zone. A spacious area, rich green, and water front of Tan Xa Lake will realize the environment suitable for the research activity. Lot area of research institute is assumed approximately 3 ha referring the present site area of existing institute established in Hanoi and 5,000 m^2 lot is designed in Software Park in consideration of the precedents in Japan. A National Software Center with 1.4 ha lot, in which small scale software venture enterprises are expected to invest, will be developed at the entrance of the Software Park.

Land use plan of R&D area is shown below.

	Area (ha)	(%)
R&D		
1) R&D Zone (Institute Sub-Zone)	83.3	70.9
2) R&D Zone (Software Park)	15.0	12.8
3) Park	5.7	4.8
4) Road	13.5	11.5
Total	117.5	100.0

(2) National Software Center

In order to upgrade the technologies of software as one of the development targets of high technology, promote accumulation of software industries and investment, and develop entrepreneurs and human resources for software, a National Software Center will be established in HHTP for the promotion of high-tech industries in Vietnam. The roles of the National Software Center are as follows:

- To promote the software industries in Vietnam and to upgrade small and medium enterprises;
- To supply the manpower needed for software development for information services, high grade electric and telecommunication services, and computer industries; and
- To formulate intelligence building with a LAN network system to be installed by offices, computer center, information library, lecture room and training room.

The contents of the National Software Center are shown below and shown in Figure 7-3-2.

Prospective Features of National Software Center

Facilities	*Supporting Services*	*Floorage (m²)*
(1) Office rental floor for software companies & general enterprises	Rental office space to relocate software companies and general companies	1,621
(2) Multipurpose Room & Meeting room	- Managing meeting - Technical meeting - Upgrading meeting - Advanced technological products exhibition room - Skill training (Hi-Class, Middle Class) - Computer room	965
(3) Restaurant & Commercial floor	- Restaurant - Commercial floor	650
(4) Administration Office	- Administration and clerical works	150
(8) Common use floor	Entrance hall/Passage/Elevator hall/Night duty room/ Mechanical maintenance room / DS(dead space) / Heating &Cooling system room / etc.	2,630
Total		6,016

7.3.3 High-Tech Industrial Zone (HTIZ)

(1) Selection of Categories of Industries to be Located in HHTP

As mentioned in Sub-section 6.6.1, the area suitable for the site of HTIZ is 71 ha out of which the net area for factory lots is around 62 ha.

The selection of categories of industries to be located in HTIZ is based on the following conditions:

1) According to the questionnaire survey (QS) results, 15 enterprises are interested in locating their factory in HHTP. These cover 7 categories of high-tech industries among the 18 categories screened to be located in HTIZ. In other words, the categories of high-tech industry to be located in HTIZ includes the prospective 15 enterprises for 7 categories of high-tech industry in the questionnaire survey. Their aggregate factory site demand is 28 ha.

2) QS reflects not all the site demand for HHTP but only a limited demand due basically to its nature as a sampling survey. For this reason, it could be reasonable to expect the factory site demand for HHTP to be higher than that derived from the survey. Besides the high-tech factory site demand up to the year 2005 is estimated at 170 ha in view of the macroeconomy.

3) Accordingly, the number of factories and their factory site demand are estimated on the basis of the following considerations for all the 18 categories of high-tech industry selected to be located in HHTP:

(a) Each factory has 50 workers or more, based on the Census of Manufactures in Japan; and

(b) The categories of industries are divided into three groups to calculate the number of factories to be located in HHTP site as follows:

a) Group 1: categories of industries, of which the number of factories to be located in HHTP corresponds to the results of QS

Medical equipment, etc. (two factories: one factory of a Korean company, and one of a Japanese company producing medical equipment using X-ray)

Other electrical/electronic products (four factories: three of Korean companies, and one of a Japanese company)

Motor vehicles and parts, etc. (two factories: one switch gear factory of a Malaysian company, and one parts factory of a Korean company)

Special industrial machinery (two factories: one of a Japanese company, and one of a Vietnamese company)

b) Group 2: categories of industries of which the number of factories to be located in HHTP includes those indicated in QS plus proposed additional ones

Equipment for office/service industry use (two factories: one computing/accounting machine factory by an American company that responded to QS, and one factory producing "growth products" such as word processor).

Communication equipment (four factories: two factories of telecommunication equipment of a Hongkong's company and a Vietnamese company, and one CD-ROM factory of a Korean company, all of which responded to QS; and an additional factory for export such as one producing mobile phone), since the industry is skilled labor-intensive and one of the industries with the highest growth potential in the Vietnamese market.

Electronic parts/devices, etc. (three factories: one magnetic head factory of a Hongkong company that responded to QS, and additional two), in view of the industry's skilled labor-intensiveness.

c) Group 3: categories of industries with a possibility to be located in HHTP even being not indicated by respondents to QS

Pharmaceuticals (one factory with some locational possibility), considering that the medicine industry is one of the import-substitution industries with the highest growth potential in the Vietnamese market, and that biotechnology using herb has been strongly promoted in Vietnam.

Detergents, surfactants, paints, etc. (one factory), in view of its market growth in Vietnam and higher value-added.

Industrial electrical machinery/equipment (one factory producing high-tech micro-motors and electronic components), in view of its export potential and higher growth corresponding to Vietnamese industrialization.

Other precision instruments (one factory), considering that the industry could be locationally oriented to "high-tech park," since it produces instruments closely related to R&D activities and that in Vietnam there exist a sizable number of enterprises producing measures, analyzers, testers, surveyors and instruments for experimentation.

Optical equipment and lenses (one factory with some locational possibility), considering that factories of this industry as well as the electronic parts industry have been relocated from advanced countries to developing countries since the earliest stage of globalization, due mainly to its skilled labor-intensiveness, and that this industry will produce its products through division of labor between and among ASEAN countries expected to further expand in future.

Computer and electronics application equipment (two factories), in view of its higher growth potential not only in export market but also in the Vietnamese market.

Electrical home appliance (one factory with some locational possibility), considering that the industry will produce its products through division of labor between and among ASEAN countries expected to further expand, which might promote the factory relocation from the forerunners of ASEAN to Vietnam, while already some electrical appliance factories have been in operation in Vietnam.

Other general machinery and equipment (one factory with some locational possibility), due mainly to the fact that factories of this industry have been located globally correspondingly to the progress of industrialization, while producing diversified products such as molds and dies, bearings, piston rings, industrial robots, and oil pressure equipment.

Metal processing machinery and equipment (three factories with some locational possibility) in line with the future growth of the motor vehicle industry in Vietnam, while industries producing metal processing machinery or mechanical tools have had a tendency to locate their factories around an assembly plant of motor vehicles, due partly to their maintenance activities.

Glass and glass products (one factory) in line with the future growth of the electronics industry in Vietnam, including "new glass products."

Consequently, the number of factories to be located in HTIZ with an area of around 62 ha amounts to 33 for 18 categories of high-tech industry as shown in the following table:

Number of Factories to be Located in the HHTP Site

Categorization by R&D Input Level (RDIL)/ Productive Factor Intensiveness	(High-Tech Manufacturing Industries)	Investment Demand by Questionnaire Survey			Additional Demand (d)	Number of Factories (e) =c+d	Unit Factories Site (f) [ha]	Factory Site Demand =e * f [ha]
		by Local (a)	by Foreign (b)	Total (c) =a+b				
Highest RDIL/ Brain-Intensive	· Pharmaceuticals	0	0	0	1	1	4.62	4.62
	· Medical Equipment, etc.	0	2	2	0	2	1.48	2.96
	· Detergents, Surfactants, Paints, etc.	0	0	0	1	1	2.95	2.95
Higher RDIL/ Engineering-Intensive	· Equip. for Office/Service Industry Use - Copier, Word Processor, etc. - Air Conditioner, etc.	0	1	1	1	2	1.77	3.54
High RDIL/ Skilled Labor-Intensive	· Communication Equipment	1	2	3	1	4	1.26	5.04
	· Industrial Electrical Machinery/Equip.	0	0	0	1	1	1.54	1.54
	· Other Electrical/Electronic Products	0	4	4	0	4	2.14	8.56
	· Other Precision Instruments	0	0	0	1	1	1.12	1.12
	· Electronic Parts/Devices, etc.	0	1	1	2	3	0.96	2.88
	· Optical Equipment & Lenses	0	0	0	1	1	1.26	1.26
	· Watches/Clocks & Parts	0	0	0	1	1	1.20	1.20
High RDIL/ Engineering-Intensive	· Computers, X-Ray Equip., VTR, etc.	0	0	0	2	2	1.43	2.86
	· Electrical Home Appliances	0	0	0	1	1	1.74	1.74
	· Motor Vehicles & Parts (P), etc.	0	2	2	0	2	2.91	5.82
	· Special Industrial Machinery	1	1	2	0	2	2.12	4.24
	· Other General Machinery/Equip.	0	0	0	1	1	1.46	1.46
	· Metal Processing Machinery/Equip.	0	0	0	3	3	2.04	6.12
	· Glass and Glass Products	0	0	0	1	1	3.69	3.69
Total		2	13	15	18	33		61.60

Source: JICA Study Team

(2) Land Use Plan and Lot Design

62 ha site for factory lot will be developed in the High-Tech Industrial Zone of HHTP as shown below.

	Area (ha)	(%)	Remarks
High-Tech Industrial Zone			
1) Factory Lot	61.6	87.1	
2) Park	2.1	3.0	
3) Internal Main Road	0.5	0.7	Row: 26m
4) Internal Sub-Main Road	6.5	9.2	Row: 20m
Total	70.7	100.0	

Factory lot size as shown below is designed on the basis of the results of investor questionnaire survey conducted by the Study Team. Middle size lot with 0.6 ha -2.5 ha takes 65% of total lot number in the Zone, while the small lot with 2,500 m^2 - 5,000 m^2 and the large size lot with 5 – 10 ha occupy 19% and 16% of the lot number respectively. Large size lot and medium size lot are designed to be easily developed as medium or small size lot by means of division of the lot site.

	Size (ha)	Number of Lot	(%)
Small Size Lot	- 0.25	3	8
	0.3 - 0.5	4	11
Medium Size Lot	0.6 - 1.0	19	51
	1.1 - 2.5	5	14
Large Size Lot	2.6 - 5.0	3	8
	5.5 - 10.0	3	8
Total		37	100

7.3.4 Residential Zone

14,000 employment and 29,000 population are predicted to be induced in 2005 by the development of HHTP as described in 6.1.4. Assuming that the middle income household of technician and researcher and the high income household of enterprise executives and high rank officer are expected to reside in the New Town Zone and the High-Grade Residential Zone respectively, total population dwelt in the HHTP is estimated at approximately 13,000 population as shown below and in Table 7-3-2 detailedly, which is equivalent to 45% of total population induced by the development of the HHTP.

	Area (ha)		Population	Remark
	gross	net	2005	
1. New Town Zone	74.3	30.9	11,700	
2. High Grade Residential Zone	75.6	10.1	1,100	Inclusive of a golf course
3. Total	149.9	41.0	12,800	

(1) New Town

A high quality residences, educational facilities, neighboring commercial facility, parks and green will be constructed in the 74 ha site located next to Urban/Business Zone. Population and population density will be approximately 12,000 persons and 160 persons/ha. Detailed land use pan of the New Town is presented below.

	Area (ha)	(%)	Remarks
New Town			
1. Dwelling House	30.9	41.6	
1) Detached house	9.6		
2) Row house	7.5		
3) Medium rise apartment	13.4		
4) High rise apartment	0.5		
2. Neighboring shop	1.9	2.6	
3. Community center/clinic	0.3	0.4	
4. Education facility	6.9	9.3	
1) Kindergarten	2.1		2 kindergartens
2) Primary school	2.5		
3) Junior high-school	2.3		
5. Road	10.4	14.0	
1) Main road	4.0		Row:22m
2) Feeder road	4.2		Row:14m
3) Collector road	2.3		Row:7.5m
6. Park	13.7	18.4	
7. Reserved green	10.2	13.7	
Total	74.3	100.0	

Various types of dwelling houses will be provided for residents in the New Town as shown in the table below and Table 7-3-3. All types are designed to be more luxurious than the Vietnamese housing standard for the urban area.

	Number of House	Number of Building	House Size (m^2)		Vietnamese Standard Minimum Plot Size (m^2)/1
			Plot	Total Floor	
1) Detached house	340	340	280	120	250
2) Row house	370	62	96	100	72
3) Medium rise apartment	1,650	55	-	72	48 /2
4) High rise apartment	80	2	-	84	48 /2
5) Shop house	80	-	120	120	-
Total	2,520	459			

Note: /1 Construction Code of Vietnam, volume 1, 1997

/2 Present average floor area of 4 persons (inclusive of common space)

(2) High Grade Residential Zone

High Grade Residential Zone is planned to receive high rank officers and enterprise executives including foreigners who work in HHTP. Luxurious detached house and apartment with 200 m^2 and 150 m^2 floor area will be built, comprising of amenity facilities such as a 9 holes golf course, swimming pools, tennis courts, playground. Residential area will be 24 ha and the 52 ha golf course is planned as shown below. Residential population is estimated at 1,100 persons and 50 persons/ha density is planned as shown in Table 7-3-3.

	Area (ha)	(%)	Remarks
High Grade Residential Zone			
1. Residential Land			
1) Dwelling	10.1	13.4	
a) Detached House	4.9		Plot area: 500 m^2, Total floor area: 200 m^2
b) Middle rise apartment	5.2		Total floor area: 150 m^2
2) Road	4.3	5.7	
3) Park	1.0	1.3	Swimming pool, tennis court, playground
4) International School	1.4	1.9	
5) Reserved Green	6.8	9.0	
Sub-total	23.6	31.2	
2. Golf Course	52.0	68.8	9 holes
Total	75.6	100.0	

7.3.5 Urban/Business Zone

Urban/Business Zone, locating at the entrance of HHTP alongside the national road 21A, will create the bustling flourish center in cooperation of the center area of HHTP. Superiorly designed business/commercial buildings will be constructed in the comfortable green. The 26 ha Urban/Business Zone will be initially developed facing the main road, and 80 ha is designed as the final development area on the basis of the assumption that 5% of the High-Tech Industrial Zone area is to be distributed for the

Urban/Business area in consideration of the examples of existing high-tech parks in Japan. The Urban/Business Zone composes three areas; (1) business and commercial building area, (2) urban park with attractive urban landscape created by green and water stream landscape, (3) bus terminal as the transportation center of HHTP. Land use plan of Urban/Business Zone is shown below.

	Area (ha)	(%)
Urban/Business Zone		
1. Business/Commercial Building Area	13.6	52.9
2. Park	10.3	40.1
3. Bus Terminal	1.8	7.0
Total	25.7	100.0

The bus service plan is shown in Figure 7-3-3.

7.4 Center Area

7.4.1 High-Tech Park Center (HTPC)

A High-Tech Park Center will be developed in HHTP, aiming at the promotion of high-tech industries and the development of state enterprises in Vietnam. The development of the Center will contribute to the accumulation of high-tech industries, investment promotion, development of state enterprises, and dispersion of effects from the congestion in the Hanoi center area. The roles of the High-Tech Park Center are as follows:

1) To participate in the Board of Management for O&M of HHTP, the implementation body for HHTP, MOSTE, MPI, Custom Office, the related ministries, the branch offices of People's Committees, commercial facilities such as post office and bank;

2) To construct as a core of HHTP the center facilities to be located in HHTP; and

3) To make the implementation of the HHTP Project a symbol of HHTP.

The major facilities of the High-Tech Park Center are office facilities such as office floor, conference room, rental commercial office, recreation facility, rest room, and medical room. The prospective features of the High-Tech Park Center are shown below and in Figure 7-4-1.

Prospective Features of High-Tech Park Center (HTPC)

Facilities	*Supporting Service*	*Floorage (m^2)*
(1) Office-1	BOM/HTZ, other government offices, Representative/ Head offices /Business offices including meeting and consulting service office	3,000
(2) Office-2	Office for customs, police station, post office, bank, others, public service office, etc.	1,000
(3) Information Facilities	Floor for a telecom switching station	1,000
(4) Commercial Facilities	Shopping floor/Restaurant/Fast food restaurant/Shopping floor	600
(5) Recreation Facilities	Tennis court/Swimming pool /Badminton court	(1,000) (Outside)
(6) Medical & Athletic Gym		350
(7) Small Hotel	Small hotel	430
(8) Common Floor	Entrance hall /Passage /Night-duty room / Lavatory /Air conditioning equipment room / Electronic machine room / etc.	
Total		6,380 m^2

7.4.2 Technopartnership Center

A Technopartnership Center will be developed as a trigger of technology development and support, and exchange among industry, universities and government for the major purpose of establishing HHTP. The major functions of the Technopartnership Center are as follows:

1) To provide the fundamental services concerned with product and material examination, inspection, measurement and testing, quality control and standardization, etc.;

2) To provide information on collection, accumulation, and utilization of high technology, exchange of technology, registration of developed technology, and technology transfer;

3) To provide technology exchange services among industry, universities and government, and promotion of cooperative and consignment researches; and

4) To provide supporting services for entrepreneurs and small and medium venture enterprises.

The research theme shall be decided in accordance with the high-tech industrial categories proposed in the "Master Plan for the High-Tech Industrial Policy" (Volume I). The R&D facilities, testing and measurement equipment shall be transferred to Vietnamese R&D organizations, after the joint research activities have been completed.

The organizations related to MOSTE such as STAMEG, QUATEST and DOSTE or their branch offices shall be relocated in the Center.

The Center will consist of a "Joint Research Wing" for joint R&D activities and a "Technical Partnership Wing" for other activities as shown below and Figure 7-4-2.

Prospective Features of Joint Research Wing

Facilities	Supporting Services	Floorage (m^2)
(1) Laboratory Rental Floor for Joint R&D	Rental lab space for joint R&D researches	1,200
(2) Laboratory & Office for Researches	Laboratory or office where researchers in joint R&D activities can use examination and experiment equipment. - Facsimile, telephone, photo copy, typing, secretary, etc.	500
(3) Laboratory for Experiment & Manufacturing Room	Laboratory facilities, office equipment, and office services and machines for trial manufacture by joint R&D researchers.	500
(7) Control Office	- Administration	150

Prospective Features of Technopartnership Wing

Facilities	Supporting Services	Floorage (m^2)
(1) Laboratory Rental Floor for Joint R&D	Rental lab space for joint R&D researches	294
(2) Open Laboratory for Researches	Laboratory for rent	600
(3) Testing and Analysis Center	Examination, measurement, and standardization of industrial products and office supply service, and equipment rental service. - Electromagnetic interference test - Electronic test - Electromagnetic susceptibility test - Surface analysis - Condition analysis - Other testing	1,020
(4) Incubation Rental Room	Laboratory facilities, office equipment and office services for those who try to establish new high-tech business. - Secretary service(photo copy, typing, fax, etc.) - Office furniture, equipment rental service	576
(5) Information Center/Technical Library	- Database reference room - Computer workstation rental room - Information network room (Network with Hanoi National University, other industrial estates, high-tech parks) - Library (technical books, industrial standards, articles, papers, etc.), - Information room for regional industries	500
(6) Multipurpose Room (Seminar &Training Room)	- Management seminar - Technical seminar - Upgrading seminar - Advanced technology seminar - Skill training	500
(7) Office	- Administration	250
(8) Common Use Floor	Entrance hall/Passage/Elevator/Night duty room/Mechanical maintenance room / DS(dead space) / Heating &cooling system room / etc. (①+②)	4,070
Total		10,160

7.4.3 Technical Institute

The developer should maintain the Technical Institute (TI) for the promotion of high-tech industries and the development of high-tech human resources such as engineers and highly skilled technicians in the Center Area in HHTP.

TI offers 2-year technical education and 6-month in-plant training for high school graduates, 3-year technical education and institutional training and 6-month in-plant training for lower secondary school graduates. TI provides 2 courses of 20 students each and 2 courses of 10 students each, i.e. 60 students in total per year for high school graduates and the same number for lower secondary school graduates. Thus the capacity of the Technical Institute is 300. The TI staff consists of 15 engineers and 30 senior technicians, 45 in total. The courses provided include Information Technology Course (20 students/year) and Pollution Prevention Technology Course (20 students/ year).

The adopted curriculum is as follows : In the first year (for lower secondary school graduates only); mathematics, physics, chemistry, English, and other fundamental subjects; in the second year: computer, electronics, mathematics, automation as the core subjects of Analytical Technology and Pollution Prevention Technology; in the third year: electronics, communication, systems design, artificial intelligence, etc. as special courses on Information Technology; CAD / CAM / CNC, robotics, production quality control, etc. as special courses on Production Technology; analytical chemistry, physical chemistry, bio-technology, etc. as special courses on Analytical Technology; water pollution prevention technology, air pollution prevention technology, waste management, etc. as special courses on Pollution Prevention Technology.

Since it is impossible to balance the budget only by long-term institutional training, TI needs to offer services such as short-term re-training courses, contracted courses, and consulting and technical guidance in cooperation with the industry. Thus even if TI projects concentrate only on long-term institutional training, it is desirable that TI operate jointly with other organizations such as the OJT Technical Support Center and Technopartnership Center under the same management body, or carry out itself services, production services, extension services , joint projects with enterprises.

The prospective features of TI is shown below and in Figure 7-4-3.

Prospective Features of Technical Institute

Facilities	*Supporting Services*	*Floorage (m^2)*
(1) Master Program	- For 300 students Classroom/ Traioing/labo room/Language Labo room/Lecture room	2,600
(2) Short Courses and Seminars	Hall (Multipurpose room) (Resource Speakers 15 pers.)	600
(3) Others	Office room /Library	320
(4) Outreach Activities	Restaurant /Convenient Store	150
(6) Dormitory	Dormitory rooms	300
(7) Common Use Floor	Entrance hall/Corridor/Night watchman room/Air conditioning room /Machinery	2,200
Total		6,170 ㎡

7.4.4 OJT Technical Support Center

The OJT Technical Support Center offers workers re-education and re-training to adapt themselves to high-tech industries. The target trainees are mainly the employees of high-tech small and medium enterprises located in HHTP, however general employees are not excluded. This Center provides a place for foreign enterprises and others, which are going to locate in HHTP and other industrial estates nearby, to give training to new employees and technical training. Specific equipment necessary for the training is provided by the enterprises. In training of employees, the enterprises play a major role by sending their engineers to the Center to be trained as instructors and others. In general re-training and technical training, foreign enterprises and others are expected to play an important role by sending engineers for giving lectures, seminars, technical guidance, consulting etc. The Center offers mostly short-term courses, and its capacity is around 200 with a staff of 25 to 30 instructors. The courses include CAD/electronic circuit design, CAM/automation/process design, mould die, casting/forging/plating, precision machining, and total quality management (TQM) including testing, measurement, production process, energy saving, pollution control, etc. A technical laboratory for the training of English, Japanese, etc., and a technical library offering technical information services are included in the Center.

To make participation of the industry easier, it is desirable that the OJT Technical Support Center operate in coordination with the technical institutes. For enterprises, it is difficult to send engineers to many different institutions, to implement contracted training courses and joint production projects at many different institutions. Also since it is impossible to balance the budget only by long-term institutional training, it is necessary for sustainability of the Center to combine long-term training with short-term re-training, contracted training, extension services, joint projects, etc. with strong participation of the industry.

The prospective features of OJT Technical Support Center is shown below and in Figure 7-4-4.

Prospective Features of OJT Technical Support Center

Facilities	*Supporting Services*	*Floorage (m^2)*
1) Training Labo	Training lab space	1,200
2) Language Laboratory	Language laboratory which trainees of private foreign enterprises can use	100
3) Lecture Room	Managing lecture (Technical lecture/ Upgrading lecture/Advanced technology lecture/ Skill training	150
4) Multifunction Room (Hall)	Multiple room facilities, lecture machines, and office services for trainees in re-training courses	500
5) Dormitory		300
6) Restaurant		200
7) Technical Library	Library where trainees can use technical and language books	100
8) Control Office	Control clerical and trainers working in facilities at this center	100
9) Common Floor	Entrance hall/Corridor/Night watchman room/Air conditioning room /Machinery	2,180
Total		4,830m^2

7.5 Guidelines for Landscaping

(1) Principles

The goal of landscaping is to convey a feeling of creation, harmonizing with surrounding natural environment while maintaining and maximum use of scenery such as geographical features and natural resources.

To create the "Park" atmosphere, the following issues are considered;

1) Contact with the immediate surroundings should be made best use of by making a backdrop of magnificent views.

2) Physical contact with trees, flowers, water and other features of the natural landscape is a key item.

3) Especially, an affluent landscape needs to incorporate lake resources into an interesting design and still reflect existing local uniqueness.

4) The "Park" may be expanded to take advantage of the good scenery of the pastoral mountains / hills, while maintaining contact with not only adjacent developments but also the natural surroundings.

(2) Geographical Features

1) Further natural features such as gentle undulations should be used to emphasize special features and water runoff while constructing facilities.

2) Abundant scenery resources of the surrounding area such as hill, forest and lake resources should be well conserved.

3) Especially, the shoreline of the lake must be carefully maintained to create a rich waterfront landscape and to prevent erosion. Permanent shore-protection works must handle water level changes of the dry and rainy seasons. Several types of shore-protection works are recommended, both natural and artificial, to harmonize with the facility character.

The types of bank protection are various types as shown in Figure 7-5-1.

(3) Plantation

1) Existing vegetation such as planted eucalyptus, fruit trees, bamboo, etc. , should be maintained and include possible transplanting in case of inconvenient location on the site layout.

2) New trees, shrubs or ground cover planting must be suitable to both of the soil and climatic conditions of the area.

3) The lot should be planted with vegetation as much as possible and create an attractive atmosphere conductive to relaxation and be pleasing to the eye, and the green coverage ratio should be more than 30% of the lot area.

4) Each lot must be have a green belt along the perimeter line of the boundary, and the width of the green belt should be at least 3 (three) meters.

5) Screening of objectionable views and keeping peace.

6) Provision of a buffer to prevent unpleasant noise, smells and dust.

7) Arrangement of plants for shade from intense sun glare and sudden showers and to reduce surface temperatures, along the footpath, beside the parks and car parking areas.

8) Minimizing the effects of strong winds yet still allowing for gentle breezes.

9) Enhancing a building line or facade, to gradually unfold an attractive vista or to frame a major entrance area.

10) Arrangement and massing of trees and shrubs, particularly native flowering species such as yellow apricot, camellia and lotus in the water, to provide coordination of dramatic color and various shapes.

11) Especially, it is also recommended to introduce famous Japanese species of cherry trees. It may possible to have cherry blossoms bloom in the season under the climate of Ha Tay province. The cherry trees will be planted for roadside trees to create a boulevard as a symbol of friendly relations between Vietnam and Japan.

The concept of an integrated landscape is shown in Figure 7-5-2.

(4) Signs

All signs arranged in the "Park" area should be for information purposes, and only company and laboratory sings can be allowed on principal signs.

1) The principal signs should be ground-oriented, not more than 3 meters in height above ground level and at most 2 signs for 1 company/laboratory.

2) The sign should be made of harmonized materials and color, and not include fluorescent paint, blinking signals or red.

3) The signs should not be used/located windows, roof-tops, penthouses, etc.

(5) Fencing

Between the lot along perimeter, fences and retaining walls may be provided on the boundary.

1) Natural materials or unobtrusive wire are desirable for fencing, and height should exceed 2.5 meters.

2) Concrete, concrete blocks, clay bricks, zinc or other corrugated metal may not be used. When fencing shall be made of the preceding materials, it must be designated in a manner which minimizes the visual impact with vegetation or a screening wall.

(6) Parking

A large area for the car parking shall be needed in the facility lot. Even the parking space must be prepared in the park atmosphere.

1) The surface of parking area may be covered by concrete, gravel and vegetation screen block.

2) Further the screening around the parking and islands between parking lots must be planted with vegetation and have mounds to prevent viewing into the parking area.

3) Planted vegetation may fulfill a shade function in the hot season.

7.6 Infrastructure Development Plan

7.6.1 Land Grading Plan

(1) Land Elevation Plan

The experienced flood level of the Tich River flowing 2 km east of the park is observed at Mean Sea Level (MSL) +8.0m, +8.5, +9.5 m, and +10.0 m as the return period of 5 years, 10 years, 50 years and 100 years respectively. Although the large earth work will be avoided due to the environmental conservation and cost reduction, part of the HHTP site should be raised by the land filling in order not to cause the flood problems. R&D Zone, High-Tech Industrial Zone, etc. will be raised higher than MSL +10.0 m and internal road be constructed MSL +8.5 m to cope with the 100 years and 10 years return period flood respectively.

(2) Earth Work Volume

A filling earth work will be necessary in a part of the High-Tech Industrial Zone in terms of average filling height of 1.9 m. Total filling volume is estimated at 690,000m3 and highest filling height will be 4.6m to raise the existing MSL+5.4 m land to MSL+10.0 m. 740,000 m^3 filling material is available from the neighboring hill area where MSL+20.2m hill top will be cut to MSL+16.0m. Figure 7-6-1 shows the land grading plan of the High-Tech Industrial Zone. The cut and filling volume distribution is shown in Appendix IV.

The main road connecting the High-Tech Industrial Zone with the interchange of the highway will also require the filling earth work. The highest filling height of the main road will be seen where the existing MSL+5.0m land is designed to be MSL+8.5m making 3.5m height filling.

(3) Estimate of Settlement

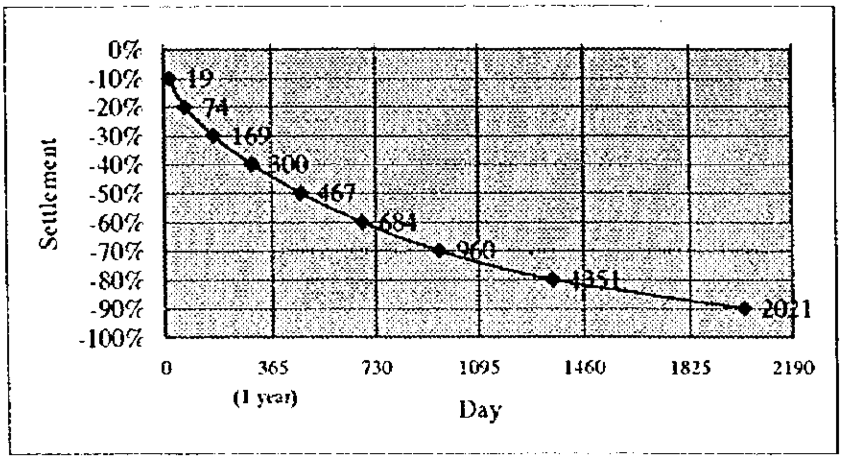
Consolidation settlement at the highest filling area is predicted as shown below and Appendix IV. The maximum settlement is estimated at 24 cm and 1.3 years and

5.5 years are forecasted to reach the 50% and 90% settlement. The rapid settlement will be happened within the period of half year after the completion of filling work, then the residual settlement will be continued. 7 cm at 6 months, 11cm at 1 year, 15 cm at 2 years, and 18 cm at 3 years of settlement will be observed after the completion of the filling work.

To cope with the consolidation settlement, extra filling with approximately 40,000 m3 shall be made and appropriate period, i.e. the half year shall be reserved after the completion of earth filling before the start of utility construction.

	High-Tech Industrial Zone (at the maximum filling Area)	Main Road (at the maximum filling Area)
Consolidation Settlement	11 – 24 cm	10 – 20 cm
Settlement Period	1.3 years: 50% settlement 5.5 years: 90% settlement	1.3 years: 50% settlement 5.5 years: 90% settlement

Residual Settlement Lapse Graph



(4) Design of Foundation

According to the result of the core boring tests conducted by the Study Team, base rock with N value of more than 50 is expected around 20 m deep from the surface. A silty clay with 10 N value is sandwiched by surface and the base rock. Detailed geological condition of HHTP is presented in Appendix IV.

Low rise factory as well as residential house will be built on the surface in terms of the spread foundation on the surface with 10 N value. Medium and high rise buildings, however, will require 20 m long pile foundation to reach the base rock. The base rock will be observed at 28 m deep from the surface in the Urban/Business Zone, so the longer pile foundation will be necessary for the medium and high rise business and commercial building.

7.6.2 Road Plan

(1) Road Type

Following 7 types of internal road will be constructed to cope with the different requirement by various kind of land use in HHTP such as R&D Zone, High-Tech Industrial Zone, Residential Zone, Urban/Business Zone, etc. Road length of the internal road and the external road will amount to 19.8 km and 13.7 km respectively as shown below. Road distribution plan is presented in Figure 7-6-2 and standard section design by type is shown in Appendix IV.

(Unit: m)

	Type by ROW							
	50m	26m	22m	20m	14m	12m	7.5m	Total
I. Internal Road								
1. R&D Zone		4,450			1,400			5,850
2. Center Area								0
3. High-Tech Industrial Zone		200		3,225				3,425
4. Urban/Business Zone								0
5. High Grade Residential Zone			950		450	1,350		2,750
6. New Town Zone			1,820		2,990		3,000	7,810
7. Sub-total	0	4,650	2,770	3,225	4,840	1,350	3,000	19,835
II. External Road	6,360	6,460			850/1			13,670
III. Others	Expansion of Hanoi-Hoa Lac Highway (L-28.27km, W=12m35.5m), etc.							
IV. Total	6,360	11,110	2,770	3,225	5,690	1,350	3,000	33,505

Note: /1 Back yard road in Urban/business area
/2 Service road to the apartment in residential area is not included.

(2) Pavement Design

The traffic volume generated from HHTP is forecasted to be 65,000 vehicles per day in 2020, of which 1,300 lorries and 600 buses as the heavy vehicles are included. The pavement thickness is calculated on the basis of the heavy vehicle traffic and design CBR (California Bearing Ratio) of base course of the road. With the assumption of 5% CBR, the pavement thickness by road type is designed as shown below and in Appendix IV in detail.

	Type by ROW						
	50m	26m	22m	20m	14m	12m	7.5m
I. Total Thickness (H) cm							
1. Internal Road							
1) R&D Zone		35			35		
2) Center Area							
3) High-Tech Industrial Zone		41		35			
4) Urban/Business Zone							
5) High Grade Residential Zone			35		35	35	
6) New Town Zone			35		35		35
2. External Road	49	41			35		

To satisfy the total pavement thickness of 49 cm, 41 cm, and 35 cm as shown above, pavement structure composing surface and binder layer, base course, and sub-base course are designed as illustrated below. Detailed design method of the pavement structure is shown in Appendix IV.

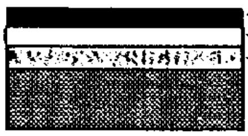
Road Pavement Design

5cm Surface & binder layer (Hot asphalt mix)
5cm Base Course (Bituminous stabilization)
8cm Base Course (Gravel & slag)
17cm Sub-base Course (Crusher-run, slag)

22m, 20m, 14m, 12m, 7.5m road
(L traffic)

5cm Surface & binder layer (Hot asphalt mix)
8cm Base Course (Bituminous stabilization)
8cm Base Course (Gravel & slag)
20cm Sub-base Course (Crusher-run, slag)

26m road
(except for R & D Zone)
(A traffic)



8cm Surface & binder layer (Hot asphalt mix)
8cm Base Course (Bituminous stabilization)
10cm Base Course (Gravel & slag)
25cm Sub-base Course (Crusher-run, slag)

50m road (B traffic)

7.6.3 Water Supply Facilities

(1) Deign Conditions

The water supply facilities for the Phase 1 are comprised of distribution pumps, elevated tanks and water distribution pipes. As mentioned before, the demand projection of water supply for the Phase 1 is as follows:

Demand Projection of Water Supply for the Phase 1

Functional Zones	Demands for Water Supply (m^3/day)
1. R&D Zone	2,040
2. Center Area	40
3. High-Tech Industrial Zone	6,700
4. Urban/Business Zone	260
5. High Grade Residential Zone	350
6. New Town Zone	2,360
7. Others	1,250
Total	13,000

The design flow rate for the Phase 1 is assumed as follows, based on the water demand projected before:

Design Conditions of the Water Supply Facilities for the Phase 1

Items	Water Flow	Remarks
Daily average water demand (DAWD)	13,000 m^3/day	
Daily average water consumption (DAWC)	15,600 m^3/day	Unaccounted water ratio = 20 %
Daily maximum water consumption (DMWC)	18,720 m^3/day	Daily fluctuation factor = 1.2
Hourly maximum water consumption (HMWC)	1,950 m^3/hr	Hourly fluctuation factor = 2.5

The capacity of distribution pumps and distribution pipes in the respective zone is designed under the consideration for the fire-fighting water of 1.0 to 1.5 m^3/min in addition to the ordinary water consumption.

The following relevant code and standards in Japan and Vietnam are applicable for the planning and design for the water supply facilities:

- Guideline Manual of Water works (Japan Water Works Association),
- Design Standards for Core Industrial Estate (Regional Promotion and Development Public Corporation),
- Manual for Housing Estate Development (Compilation Committee of Manual for Housing Estate Development), and
- Relative Codes and Standards in Vietnam.

(2) Design Criteria

The water supply facilities are designed according to the following criteria:

1) Supplied water pressure

The residual water pressure of 15 m is applicable at the ground level of supply points.

2) Hydraulic design of distribution pipes

The Hazen-Williams' Formula is applicable for hydraulic analysis of distribution pipes.

$$I = 10.666 \times C^{-1.85} \times D^{-4.85} \times Q^{1.85}$$

Where,
I : Hydraulic gradient (-)
C : Roughness coefficient of pipes, 110, (-)
D : Pipe diameter (m)
Q : Water flow rate (m^3/sec)

3) Hydraulic analysis for loop-wise pipe networks

The Hardy-Cross Method is applicable for the analysis of loop-wise pipe networks. Therefore, the water flow distribution which satisfies the following equations is selected at each node point:

$$\Sigma Q_{inflow} = \Sigma Q_{outflow}, \text{ and}$$

$$\Sigma \Delta H_{clockwise\ direction} = \Sigma \Delta H_{anti\text{-}clockwise\ direction}$$

Where, Q : Water flow rate
ΔH : Head loss of each pipe

4) Pipe materials

- Over 100 mm of nominal diameter : Ductile Cast Iron Pipe with internal mortar lining (DIP)
- Below 70 mm of nominal diameter : Hard polyvinylchloride pipe for water works (VP)
- Minimum diameter :Nominal 50 mm

5) Fire-fighting hydrant

The 4 inch-diameter hydrants are installed with the interval distance of some 200 m.

6) Earth covering of pipes

Water distribution pipes are embedded at 1.2 m below the ground level in principle.

7) Appurtenances

- Lot connection piping : To be installed around the boundaries of industry lots or research institute lots with water meter and stop valve.
- House connection piping : To be installed around the boundaries of organization lots or house lots with water meter and stop valve.
- Other accessories : Air valves, drain valves and stop valves to be installed at appropriate places.

(3) Outlines of Water Supply Facilities for Phase 1

The hydraulic design results, the layout plan and the main specifications of the water supply facilities for the Phase 1 are shown in Appendix IV, Figure 7-6-3 and the table below, respectively:

Main Specifications of the Water Supply Facilities for the Phase 1

Items	Specifications
1. High-Tech Industrial Zone	
Distribution pumps	8.0 m^3/min x 75 kw x 4 sets (including 1 standby)
Distribution pipes	DIP 100 - 500mmDia x Total 5920mLength
2. New Town Zone	
Distribution pumps	5.3 m^3/min x 50 kw x 3 sets (including 1 standby) (The pumps are commonly used for the New Town Zone and the Urban/Business Zone)
Distribution pipes	DIP 100 - 400mmDia x Total 4160mLength VP 50 - 75mmDia x Total 7560mLength
3. Urban/Business Zone	
Distribution pipes	DIP 100mmDia x Total 1860mLength
4. Center Zone	DIP 100 - 200mmDia x Total 620mLength
5. R & D Zone	
Distribution pumps	4.9 m^3/min x 50 kw x 3 sets (including 1 standby) (The pumps are commonly used for the R&D Zone, Center Area and High Grade Residential Zone)
Elevated tanks	100m^3 x 1 set, 120m^3 x 1 set (The 100m^3 elevated tank is commonly used for R&D Zone and Center Area)
Distribution pipes	DIP 100 - 300mmDia x Total 8530mLength
6. High Grade Residential Zone	
Elevated tank	50m^3 x 1 set
Distribution pipes	DIP 100 - 200mmDia x Total 3820mLength

7.6.4 Sewerage and Drainage Facilities

(1) Sewerage Facilities

1) Design conditions

The sewerage facilities for Phase 1 are comprised of sewage pipes. Based on the water demand projected before for respective development zone, design sewage flow is assumed as follows:

Design Conditions of Sewerage Facilities for Phase 1

Items	Water Flow	Remarks
Daily average wastewater (DAWW)	13,000 m^3/day	
Daily maximum wastewater (DMWW)	18,720 m^3/day	Groundwater infiltration = 20% Daily fluctuation factor = 1.2
Hourly maximum wastewater (HMWM)	1,950 m^3/hr	Hourly fluctuation factor = 2.5

The following relevant code and standards in Japan and Vietnam are applicable for the planning and design for the sewerage facilities:

- Guideline Manual of Water works (Japan sewerage Works Association),
- Design Standards for Core Industrial Estate (Regional Promotion and Development Public Corporation),
- Manual for Housing Estate Development (Compilation Committee of Manual for Housing Estate Development), and
- Relative Codes and Standards in Viet Nam.

2) Design criteria

The following criteria are applicable for the planning and design of the sewerage facilities:

(a) Hydraulic design of sewage pipes

The Manning's Formula is applicable for the hydraulic design of sewage pipes.

$$Q = A \times V$$
$$V = (1/n) \times R^{2/3} \times I^{1/2}$$

Where, Q : Sewage flow rate (m^3/sec)
A : Cross sectional area of pipe (m^2)
V : Velocity (m/sec)
n : Roughness coefficient of pipe, 0.013, (-)
I : Hydraulic gradient (-)
R : Hydraulic radius, (m)

(b) Standard gradient of sewage pipe

- Over 500 mm of nominal diameter : Minimum 2‰
- From 250 to 400 mm of nominal diameter : Minimum 3‰
- Below 250 mm of nominal diameter : Minimum 5‰

(c) Standard velocity

- Minimum : 0.6 m/sec
- Maximum : 3.0 m/sec

(d) Pipe material

- Over 200 mm of nominal diameter : Hume concrete pipe (HCP)

- Below 150 mm of nominal diameter : Hard polyvinylchloride pipe for sewerage works (VP)

- Minimum diameter : 150 mm

(e) Type of pipe connection

The " Pipe Bottom Connection" type is applicable.

(f) Earth covering of sewage pipe

Sewage pipes are embedded at minimum 1.2 m below the ground level in principle.

(g) Manhole

Manholes are installed at places where the sewage flow direction or the pipe gradient are changed or sewage is incoming. Also, manholes are installed with the following minimum interval distance depending on the nominal diameter of pipes.

- Over 700 mm of nominal diameter : Minimum 100 m
- From 400 to 600 mm of nominal diameter : Minimum 75 m
- Below 300 mm of nominal diameter : Minimum 50 m

3) Outline of the sewerage facilities for Phase 1

The hydraulic design results, the layout plan and the main specifications of the sewerage facilities for the Phase 1 are shown in Appendix IV, Figure 7-6-4 and the table below, respectively:

Main Specifications of Sewerage facilities for the Phase 1

Items	Specifications
1. High-Tech Industrial Zone	
Sewers	HCP 200 - 600mmDia x Total 3830mLength
2. New Town Zone	
Sewers	HCP 200 - 600mmDia x Total 6980mLength VP 150mmDia x Total 1980mLength
3. Urban/Business Zone	
Sewers	HCP 200mmDia x Total 2040mLength
4. Center Area	
Sewers	HCP 200mmDia x Total 1250mLength
5. R&D Zone	
Sewers	HCP 200 - 500mmDia x Total 5840mLength
6. High Grade Residential Zone	
Relay pump	Submersible type x Total 4 sets (including 2 standby)
Sewers	HCP 200 - 300mmDia x Total 2200mLength VP 150mmDia x Total 1520mLength

(2) Drainage Facilities

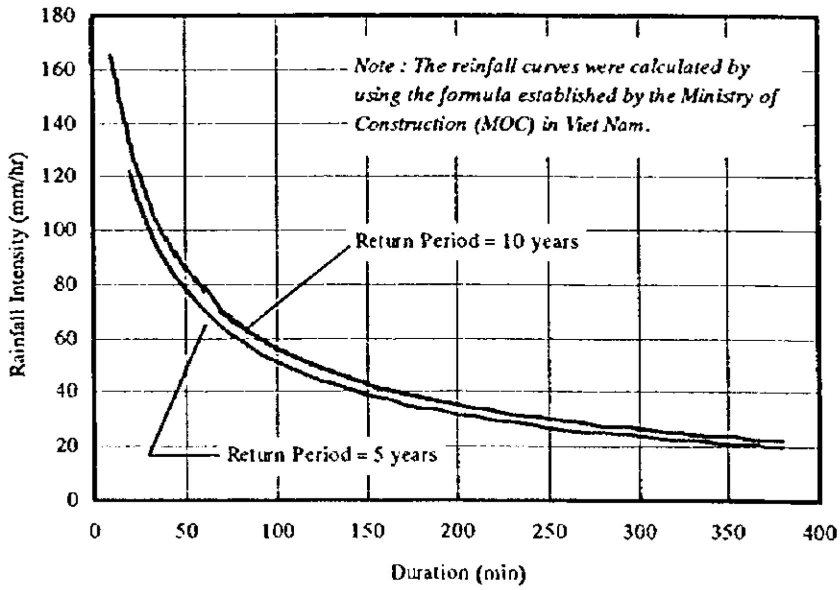
1) Design conditions

The drainage facilities for Phase 1 are comprised of rain water drains which are of concrete-made U-channel and hume concrete pipe. Rainwater runoff is calculated with using the rainfall intensity formula under the conditions of return period of five (5) year, as shown the following figure:

The following relevant code and standards in Japan and Vietnam are applicable for the planning and design for the sewerage facilities:

- Guideline Manual of Water works (Japan sewerage Works Association),
- Design Standards for Core Industrial Estate (Regional Promotion and Development Public Corporation),
- Manual for Housing Estate Development (Compilation Committee of Manual for Housing Estate Development), and
- Relative Codes and Standards in Vietnam.

Rainfall Intensity



2) Design criteria

The following criteria are applicable for the planning and design of the drainage facilities:

(a) Design runoff

The following Rational Formula is applicable for the calculation of peak flow:

$Q = (1/360) \times C \times I \times A$

Where, Q : Peak runoff (m3/sec)
C : Runoff coefficient, 0.8 for developed areas, (-)
I : Design rainfall (mm/hr)
A : Area of drainage basin (ha)

(b) Hydraulic design of drains

The Manning's Formula is applicable for the hydraulic design of sewage pipes.

$Q = A \times V$

$V = (1/n) \times R2/3 \times I1/2$

Where, A : Cross sectional area of pipe (m2)
V : Velocity (m/sec)
n : Roughness coefficient of pipe, 0.013 for hume pipe and 0.020 for U-channel, (-)
I : Hydraulic gradient (-)
R : Hydraulic radius, (m)

(c) Standard velocity

- Minimum : 0.6 m/sec
- Maximum : 3.0 m/sec

(d) Pipe material

- Open channel : Concrete-made U-channel
- Embedded pipe :
  Over 200 mm of nominal diameter : Hume concrete pipe (HCP)
  Below 150 mm of nominal diameter : Hard polyvinylchloride pipe for sewerage works (VP)
- Minimum diameter : 150 mm

(e) Type of pipe connection

The " Pipe Bottom Connection" type is applicable.

(f) Earth covering of sewage pipe

Embedded pipes are placed at minimum 1.2 m below the ground level in principle.

(g) Manhole

In the embedded pipe lines, manholes are installed at places where the rain water flow direction or the pipe gradient are changed or sewage is incoming. Also, manholes are installed with the following minimum interval distance depending on the nominal diameter of pipes.

- Over 700 mm of nominal diameter : Minimum 100 m
- From 400 to 600 mm of nominal diameter : Minimum 75 m
- Below 300 mm of nominal diameter : Minimum 50 m

3) Outline of the drainage facilities for Phase 1

The hydraulic design results, the layout plan and the main specifications of the drainage facilities for Phase 1 are shown in Appendix IV, Figure 7-6-5 and the following table:

Main Specifications of the Drainage Facilities for the Phase 1

Items	Specifications
1. High-Tech Industry Zone Drains	U-Channel 400 - 1400mmWidth x Total 12940mLength
2. New Town Zone Drains	HCP 400 - 2200mmDia x Total 1290mLength
3. Urban/Business Zone Drains	HCP 600 - 1200mmDia x Total 2010mLength
4. Center Area Drains	U-Channel 400 - 1000mmWidth x Total 3380mLength
5. R&D Zone Drains	U-Channel 300 - 1200mmWidth x Total 10350mLength
6. High Grade Residential Zone Drains	HCP 600 - 1200mmDia x Total 2970mLength

7.6.5 Electricity

(1) Basic Design Concept

Electric power for HHTP will be supplied from EVN power grid. The basic design concepts essential for HHTP are as follows:

1) Sufficient power supply system

2) High reliable power supply system

3) High stability of supplying voltage

4) Environmental harmony

(2) Power Demand

The initial power demand of HHTP is estimated as given below.

Power Demand Projection of Phase 1

	Net Area (ha)	Electric Demand (MW)
1. R&D Zone	98.3	7.2
2. Center Area	16.3	0.7
3. High-Tech Industrial Zone	61.6	28.6
4. Urban / Business Zone	13.6	3.1
5 High Grade Residential Zone	22.6	0.8
6. New Town Zone	40.0	5.0
7. Water purification plant		0.4
8. Sewerage treatment plant		2.3
9. Drainage plant		0.2
Total		48.3

(3) Power Supply System

1) External system

In order to cope with initial power demand of HHTP, a new 110/22 kV substation with capacity of 2×40 MVA is planed to be constructed near HHTP. The new substation will receive power from the projected 220/110kV Xuan Mai substation (2×125MVA) via a new 110kV transmission line (AC185·x2/20km) and transmit power to the 22kV switching stations to be constructed in the respective zones of HHTP, by 22kV sub-transmission cables.

The 22kV sub-transmission cables are designed as double circuits in order to secure the reliable power supply and to increase the line capacity. The cables will be laid in PVC pipes (in dia.100mm) buried in the ground.

In addition to the above, open ring management (automatic line sectionalizer) system with automatic reconfiguration, monitoring and control facilites will be recommended to be arranged in the new substation to avoid long time power interruption and to cut faulted section off.

To cope with the increase in power demand, some spare pipes shall be recommended to be installed beforehand.

In addition to the power supply system, the street lighting of high-pressure sodium lamps with single and / or double arm steel poles will be constructed along the external roads at intervals of 35 - 40 meters. The electricity for the street lighting system will be supplied from the new substation.

2) Internal system

The internal power supply system is composed of 22kV switching stations and the distribution system. The 22kV switching stations are to be constructed at the entrance point of each zone, in order to receive power from the new substation via 22kV sub-transmission lines. The 22kV distribution lines will be constructed to feed power from the switching station to respective consumers in the zone. Either underground or overhead distribution line may be applied for this project, but underground cable method is recommendable from aesthetic and security viewpoints. Only low voltage distribution lines in the New Town and High-Grade Residential Zone are planed by overhead lines in view of easy tapping to small consumers and economic advantage. Use of colored concrete poles is recommended for the low voltage distribution lines in view of environmental harmony.

The 22kV distribution lines are designed as open ring formation in order to secure the reliable power supply. 22kV ring main switching units are also recommended to tap consumers easily, without long hour interruption of distribution line at any time. The ring main unit is installed at the service entrance point of each consumer , In addition to the above, an automatic line sectionalize device should be arranged at each line of switching stations and ring main units to establish the open ring management system.

Telecommunication cables are laid between the switching stations and ring main units in each zone to control the open ring management system from the new substation. The 22kV cables and telecommunication cables are designed to be laid in PVC pipes buried in the ground, the former in PVC pipe with diameter 100mm and the latter in one 40mm. Some spare pipes should be also installed for the future expansion of the power supply system. The pipes shall be buried at a depth of not less than 1.2m under the carriage way, and 0.6m under the pedestrian way.

The schematic diagram and distribution plan for power supply are shown in Figure 7-6-6 and 7-6-7, respectively.

7.6.6 Telecommunications

(1) Basic Design Policy

The telecommunication system should meet not only the basic telephone demand but also special requirements of HHTP such as high speed digital data-communication. To cope with the above advanced demands, the telecommunication system for HHTP should be interconnected securely with the national and international networks. These requirements will be satisfied by the following systems ;

1) Optical fiber trunk lines to interconnect the national and international networks

2) Optical fiber local transmission lines between a new switching center and remote terminals in HHTP.

3) Digital switching and transmission systems to carry digital information including computer data-communication.

4) Mobil system for cellular telephone

(2) Telecommunication Demand

1) The basic telephone demand in HHTP is estimated at 8,840 subscriber lines in the Phase 1 as shown below.

Telephone Demand Projection of Phase 1

	Population (Employee)	Telephone Demand (Line)
1. R&D Zone	4,000	2,000
2. Center Area	200	100
3. High-Tech Industrial Zone	8,600	860
4. Urban / Business Zone	1,300	650
5. High Grade Residential Zone	1,100	550
6. New Town Zone	11,700	4,680
Total		8,840

2) In addition to the above , the following demands are assumed as digital data-communication services.

- Additional 20% of telephone demand for the New Town Zone.
- Additional 50% for other Zones

(3) Telecommunication System

1) External system

In order to satisfy the basic telephone demand and special requirements of HHTP , a new transmission system of optical fiber cables shall be constructed in Phase 1. The trunk lines of optical fiber cables (32c×2) are recommended to be laid as a ring network, which interconnects the new switching center of HHTP with main exchanges of Ha Dong and Hanoi City. The line will be installed along the national road 6, 21 and a new highway. The new switching center is planed to be located in the High-Tech Park Center.

Another local loop network of optical fiber cable is planed in HHTP, in order to link the switching center, and remote terminals to be installed at the respective zones.

In addition, a radio system will be furnished in HHTP for the mobile telecommunication service. An antenna tower for the radio system shall be constructed on the rooftop of HHTP center building to cover the area of Phase 1. All cables are to be laid in PVC pipes under the ground in view of environment harmony.

2) Internal system

The internal telecommunication system of HHTP is composed of distribution lines, and splice boxes at the service entrance point of subscribers, so that subscribers can join easily from the box any time. The distribution lines for High Grade Residential Zone and New Town Zone are planed by metallic cable, however for other zones, distribution by optical fiber cables is proposed to cope with the requirements of advanced telecommunication services (ISDN, Internet, Multimedea, Leased line ,etc.) in future.

Cables will be laid in PVC pipes in the ground along pedestrian ways of roads. The buried depth of PVC pipes shall be not less than 1.2m under carriage ways and 0.6m under pedestrian ways. Some spare pipes should be installed for the future expansion of the telecommunication system.

The schematic diagram and wiring plan of the telecommunication system are shown in Figure 7-6-8 and 7-6-9.

7.6.7 Waste Management and Disposal

(1) Classification of Waste

There are innumerable classifications for waste. However, they can be grouped by:

1) origin, e.g. clinical wastes, household or urban solid wastes, industrial wastes, nuclear wastes, agriculture;

2) form, e.g. liquid, solid, gaseous, slurries, powders;

3) properties, e.g. toxic, reactive, acidic, alkaline, inert, volatile, carcinogenic;

4) legal definition, e.g. special, controlled, household and industrial, where specific definitions or criteria are employed.

In general, it is more convenient to divide solid wastes generated as a result of human activities into two categories, municipal or urban waste and industrial waste. Furthermore, industrial wastes are classified into two types of waste, those that present a hazard to the environment as a result of improper disposal or handling, and those that do not.

In HHTP, each area zoned into 6 produces wastes with its activity. Solid wastes generated from these areas are also classified into above mentioned two categories, namely municipal waste and industrial waste. Municipal waste is mainly generated from the 4 zones of Center Area, Urban/Business Zone, High Grade Residential Zone and New Town Zone. On the other hand, industrial waste is mainly generated from the R&D Zone and the High-Tech Industrial Zone. These wastes should be disposed of properly, otherwise they will eventually cause various types of environmental problems such as water contamination and soil contamination. In order to minimize the negative environmental impacts caused by the waste generated from HHTP, it is necessary to formulate a careful waste management and disposal plan such as a collection and transportation plan, a selection of available treatment and disposal method, etc. The following are the principles and the procedures in relation with waste management which should be considered in case of formulating waste management plans.

(2) Principles of Proper Wastes Management

The waste management is a coherent flow at all stages from production, handling, storage, transport, processing and ultimate disposal. In order to work a function of the waste management sufficiently, variety of technologies and procedures concerning the treatment of waste have been developed. The overall waste treatment flow is shown in Figure 7-6-10.

As for waste management, especially industrial waste management, there is a hierarchy of waste management which begins with waste minimization before proceeding to actual disposal. In other word, waste management should begin with waste minimization described as below:

1) Do not creat the waste product in the first place.

2) If there is a waste product, re-use it.

3) If it cannot be re-used, recover or reclaim the primary material for new manufactured products.

4) If primary materials recovery is not practicable, recover it for secondary materials or if combustible use it fuel.

If none of these is practicable proceed to the various waste disposal options choosing the one that has the least environmental impact.

Waste disposal options for industrial wastes follow after the efforts of waste minimization. There is a wide range of options available and given that a strategy for waste minimization is followed, and that recovery, re-use or recycling options are exhausted or not feasible, then the choice boils down to waste disposal options such as landfill, treatment, etc. Fundamental concepts of waste disposal options are stabilization and reduction of volume in sanitary conditions after recovering resources for re-use and recycling as can as possible. In this meaning, only landfiling is a complete and final treatment. Therefore, other options available and given, such as incineration and composting etc., are considered to be intermediate treatment. The characteristics of waste disposal options are summarized in Appendix IV.

(3) Management of Municipal Waste in the HHTP

Regarding municipal waste, collection and disposal of it is responsibility of central or local agencies. In the case of the HHTP, municipal waste generated in the area will be collected, transported and treated by the central/local agency or the public corporation/venture company such as URENCO entrusted by this agency. The planned disposal method of the municipal waste is sanitary landfilling and in the future part of the waste will be treated by incineration. Disposal site will be selected near the area of the HHTP. Concept and criteria for selecting proposed disposal site are described in section 7.8.3.

(4) Management of Industrial Waste in the HHTP

In the HHTP, industrial wastes are mainly produced from High-Tech Industrial Zone and R&D Zone. Estimation of quantity and characteristics of the industrial waste are dealt with in section 7.8.4. As for the industrial waste management in HHTP, administrative entity in the HHTP or the company entrusted by this entity is responsible for all waste collection, transfer, treatment and disposal activities. Therefore, treatment and disposal of wastes, after they are sorted by each factory, are entrusted to this entity/company. This entity/company will charge each factory which generates wastes a treatment fee, which includes collection and transportation fees, depending on the quantity and the quality of the wastes. The treatment facility should be constructed by this entity or the company. Operations of this entity/company are regulated by the government.

General wastes produced in the Project area are collected, transported and treated after recovering resources for re-use and recycling as much as possible at each factory. Treatment method is determined considering the characteristics, quantity, source location, etc. Sanitary landfill, which is the typical treatment method, will be adopted for the disposal and treatment of general industrial waste generated from the HHTP. As mentioned before, landfill is the final disposal of waste and is divided into three types.

As for the treatment and disposal of hazardous wastes, all these hazardous waste should be treated by the specified facilities which are designed and constructed for the treatment and disposal of hazardous wastes. The methods to be applied for the treatment of hazardous wastes will be the physical-chemical treatment, solidification, stabilization, incineration and/or the combined treatment system of these. The typical treatment facilities for industrial wastes are shown below. The treatment methods, the scale of disposal and location for Phase 1 of HHTP shall be studied in detail in the next stage.

1) Type of landfill

(a) Control type landfill

This type of landfill can accept such industrial waste as cinders, sludge, and that waste which is likely to be putrefied and to contaminate the groundwater. The internal walls of the disposal facility are lined with rubber or plastics sheets (seepage control work) to prevent the water contained in the waste from leaking out of the facility. The water accumulated near the internal water blocking walls is collected to a leachate treatment station for purification before release.

(b) Shield type landfill

This type of landfill accommodates industrial waste which is difficult to process into harmless substances using ordinary disposal methods. The facility is a rugged structure of reinforced concrete, with a roof provided to prevent rain from entering. The water accumulated inside should never be pumped out.

(c) Stable type landfill

This type of landfill accommodates only those substances which never corrupt nor exude toxic substances, such as waste plastics, waste rubber, metal scrap, demolition debris (concrete fragments, etc.), or refuse glass and ceramics. There is no water blocking work between the disposal facility and the surrounding environment.

2) Treatment facilities for industrial wastes

(a) Incineration facility

A facility equipped with an incinerator to burn waste. The incineration is operated with an exhaust gas treatment system to prevent smoke from polluting the air.

(b) Neutralization facility for waste acid & alkali

Strong waste acid and alkali must be neutralized before being discharged. In the neutralization of waste acid containing toxic metals, these metals can be collected utilizing the formation of metal precipitations. The neutralization tank is equipped with an agitating unit.

(c) Dehydration facility for sludge

Sludge containing a lot of water cannot be dumped. A centrifugal dehydrator, a vacuum dehydrator, or pressure dehydrator is used.

(d) Regeneration facility for waste oil

A facility to produce reusable oil by separating the oil content in the mixed waste oil containing water and oil and distilling or filtering the used oil.