8.13 Rolling Stock Maintenance

8.13.1 Current Conditions

Collected data and information are as follows; Outline of some depots, maintenance result, required maintenance days from in-coming to out-going, future plan of workshops and depots, layout drawing of some depots, list of existing and necessary machines, specification of principal equipment of DL, lubricant control rule, criteria of overhaul for D4H, and daily average running km. Some of the collected data are rearranged as the following tables.

Table 8.13.1 Locomotive Inspection Cycle

Type of Inspection	RO (km)	RT (km)	R1 (km)	R2 (km)	R3 (km)	RK (km)	RG (km)
D4H	1,000 ±20%	5,000 ±20%	10,000 ±20%	30,000 ±20%	–	60,000 ±10%	240,000 ±10%
D5H	2,500	10,000	30,000	75,000	–	200,000	600,000
D11H	–	5,000	10,000	40,000	–	120,000	480,000
D8H	3,000 ~3,500	6,000 ~7,000	18,000 ~20,000	60,000	–	120,000	–
D9E	–	5,000	25,000	50,000	100,000	200,000	600,000
D12E	1,000 ±20%	10,000 ±20%	30,000 ±20%	100,000 ±20%	–	200,000 ±20%	800,000
D13E	–	5,000	25,000	50,000	100,000	200,000	600,000
D18E	4,000 ±20%	12,500 ±20%	25,000 ±20%	75,000 ±20%	125,000 ±20%	250,000 ±20%	800,000
Place of Inspection	Depot	Depot	Depot	Depot	Depot	Depot	Workshop

Table 8.13.2 Maintenance Days by Locomotive Type (Actual Average Values)

(Kind-wise Maintenance Days)

Locomotive Type	Yearly	RK (Semi-overhaul)	RG (Overhaul)
DL			
D4H		38	64
D11H		45	–
D9E		70	80
D12E		45	–
D13E		85	90
DL Average		57	78
PC	21		33
FC	14		23

Table 8.13.3 Maintenance Man Hours by Locomotive Type

(Kind-wise Maintenance Man-hour)

Locomotive Type	RK (Semi-overhaul)	RG (Overhaul)
DL		
D4H	4,727	10,283
D8H	7,029	--
D11H	13,711	24,846
D9E	11,997	18,852
D12E	13,368	20,566
D13E	13,711	24,840
D18E	15,141	30,849
DL Average	11,022	20,671
PC		
Main line 1st sleeping		5,040
" 2nd sleeping		4,714
" 2nd coach		3,238
Local 2nd coach		2,109
" 3rd coach		1,988
PC Average		3,190
FC		
Covered		664
High side		577
High capacity		628
Tank		497
FC Average		592

Table 8.13.4 Specification of Principal Equipment of DL

1. Diesel Locomotive Dimension

Type	Number	Weight (t)	Length (mm)	Width (mm)	Height (mm)	Wheel Arrangement
D4H	254	24	9,600	2,550	3,560	B0-B0 Russia
D5H	3	40.6	11,100	2,820	3,810	B-B Austria
D8H	4	78	14,290	3,200	4,440	B0-B0 Russia
D11H	10	56	14,006	2,780	3,650	B0-B0 Rumania
D9E	39	52	11,644	2,743	3,775	B0-B0 America
D12E	40	56	13,306	2,754	3,850	B0-B0 Szecho.
D13E	14	72	14,326	2,730	3,635	C0-C0 India
D18E	16	84	15,500	2,880	3,800	C0-C0 Belgium

2. Bogie Dimension

Type	Weight (t)	Length (mm)	Width (mm)	Height (mm)	No. of Axle	No. of Bogie
D4H	3.5	2,300	1,600	750	2	2
D5H	5.9	3,100	2,340	1,000	2	2
D8H	11.8				2	2
D11H		2,350	1,489	935	2	2
D9E	10.6	2,356	1,626	1,120	2	2
D12E		2,400	1,650	845	2	2
D13E	13	3,504	1,546	1,200	3	2
D18E		4,931	1,900	1,031	3	2

3. Engine Dimension

Type	H.P.	Weight (t)	Length (mm)	Width (mm)	Height (mm)	Remark
D4H	400	1.7	1,775	1,052	1,043	1 ㄱ 12-400
D5H	500	3.2	1,870	900	1,625	D353E
D8H	800	9.2	3,355	1,665	2,290	3A3-6 ㄱ 49
D11H	1,200	5.7	2,635	1,605	1,925	12KYD 18/21-AL5
D9E	900	5.4	2,700	1,300	1,700	D398
D12E	1,250	7.5	4,094	1,567	1,996	KGS 230DR
D13E	1,350	10.8	3,720	1,620	2,140	1200BHI
D18E	2,000	11.9	4,450	1,850	2,270	L8TR 240CO CIM

4. Main Generator Dimension

Type	Weight (t)	Length (mm)	Width (mm)	Height (mm)	Rating			
					kw	r.p.m.		
D9E	3.3	1,020	1,245	1,092				
D12E	3.5	1,193	1,245	1,245	800	1,250		
D13E	5.1	1,150	1,510	1,520				
D18E	4	1,400	1,530	1,370	1,070 ~1,092	1,000		

5. Traction Motor Dimension

Type	Weight (t)	Length (mm)	Width (mm)	Height (mm)	Rating		Remarks
					kw	r.p.m.	
D9E	1.6	870	970	690	1,525	3,100	5GB, 761, A3
D12E	1.8	830	860	710	265	3,100	CKD, TB, 015B
D13E	1.8	863	1,135	700	101	3,600	TM460B B2
D18E	1.6	892	893	753	1,546	478	LD325, ACEC

Table 8.13.5 Daily Average Running km

Gauge	Kind	Year	Union 1		Union 2		Union 3		Total Average	
			PT	FT	PT	FT	PT	FT	PT	FT
1000mm	DL	1993	253.6	207.8	331.1	255	391.8	303.4	296.8	227.5
		1994	229.9	207.6	506	213.7	410.2	309.8	268.4	226.8
	SL	1993	155	153					155	153
		1994	177	141.6					177	141.6
	PC	1993	274.2		344.4		303		303.2	
		1994	329.3		367.1		250		314	
	FC	1993		49.5		86.4		87.1		63.6
		1994		59.6		94.0		133.2		74.4
1435mm	D8H	1993	295.3	224.5					295.3	224.5
		1994	300	197.8					300	197.8
	SL	1993	371	188.3					371	188.3
		1994	64.5	180.4					64.5	180.4
	PC	1993	239						239	
		1994	200						200	
	FC	1993		17.5						17.5
		1994		18.2						18.2

8.13.2 Current Problems

(1) Washing and cleaning work is not sufficient

The washing and cleaning of car body, wheels and axles, bearings, engine and rotating machines, etc. are not being carried out to sufficient level.

(2) Flaw detecting work is not sufficient

In addition to the insufficient washing and cleaning, the detection of flaws is limited to only visual inspection.

(3) No consideration is given to dust proofing and moisture proofing

Rotating parts such as axle-journal, bearing and engine, etc. are the parts which need to be protected from dust and rust. No consideration is given to dust proofing and moisture proofing in the work on and the storage of such components.

(4) Maintenance takes too many days

The number of days between the incoming and outgoing of all kinds of rolling stock for semi-overhaul (RK) and overhaul (RG) is overly long. The maintenance of diesel locomotives (DL) is particularly time consuming. (See Table 8.13.2).

(5) Maintenance man hours are too long

Because many days are spent on the maintenance of rolling stock, the man hours involved in the maintenance also tend to be overly long (see Table 8.13.3).

(6) Inventory control system for spare parts is insufficient

Spare parts that need to be replaced during maintenance work should be prepared and stored in advance. However, as there are no such parts on hand, much time is wasted on parts procurement and the maintenance process is needlessly extended. The inventory control of DL spare parts is particularly poor.

(7) Post-maintenance performance testing is insufficient

In particular, the engine and traction motor, etc. of DL need to undergo individual performance testing after maintenance in order to confirm function and guarantee quality, however, such testing is not carried out enough.

(8) Maintenance machinery and equipment is insufficient

Each workshop and depot does not possess enough maintenance machinery, equipment and tools and, in addition to this, the existing equipment is deteriorated with poor levels of precision and functioning.

(9) Maintenance buildings are deteriorated

Some of the buildings for maintenance are badly deteriorated or damaged. Moreover, there are some buildings where the installation of electric overhead traveling cranes (EOTC) is not possible and such a situation not only leads to poor work efficiency levels but also creates problems in terms of work safety.

(10) Some shops require transfer of maintenance site

Due to a poor working environment in terms of geography and topography, it is considered that some locations need to transfer their work site.

(11) Work site environments are poor

In some of the workshops and depots, the floors of the work site are bumpy and covered with oil and dust making them very slippery, and some work pits are filled with water and oil, and so on. Such situations mean that work safety cannot be secured and contribute to falling work efficiency. Further, there are some sites with poor working environments due to insufficient lighting.

(12) Necessary documents for rolling stock management are insufficient

The comprehensive accumulation of statistics on rolling stock accidents, breakdowns and maintenance, etc. by cause, rolling stock type, maintenance type and maintenance location is not sufficiently carried out.

8.13.3 Recommendations

The following recommendations are to be realized upto 2010. However, it is recommended that the items realizable without any investments should be immediately improved in order to level up the quality of maintenance.

(1) Maintenance work mechanization and labor saving

Most of the works including washing, cleaning, processing and flaw detecting etc. are carried out manually and visually and many works are ineffective despite the large amounts of labor

put into them. By mechanizing these works, it would be possible to improve finishing precision levels and also save on man-power.

1) Washing and cleaning work

Depending on the sort of item to be washed and cleaned, good results can be obtained by selecting the optimum methods or combinations of such methods.

(a) Jet washing : The jet spraying of chemicals or hot water.

(b) Rock washing : The shaking objects around inside chemical or hot water tanks.

(c) Kerosene washing : The spraying kerosene or dipping items into kerosene.

(d) Ultrasonic cleaning : Using ultrasonic liquid in chemicals.

(e) Soda bath : The dipping of items into chemical tanks.

(f) Soft blast cleaning : The jet spraying of polishing material.

(g) Air blow cleaning : The jet blowing of compressed air.

(h) Flushing : Washing engine interiors with flushing oil.

(I) Other methods

2) Flaw detecting work

Depending on the item under examination, the optimum methods of flaw detecting should be selected.

(a) Ultrasonic flaw detection

The use of ultrasonic waves makes the detection of flaws on axle and shaft interiors possible. The judgment work requires high level technology (axles, rotating shafts, etc.).

(b) Magnet particle flaw detection

This is the detection of surface flaws through the use of magnetism, magnet particles and fluorescent lamps (axle, crank shaft, connecting rod, gear, bogie frame and other iron material).

(c) Fluorescent penetrant flaw detection

This is the detection of surface flaws through the use of liquid penetrant, liquid developer and fluorescent lamps.

(d) X-ray flaw detection

This is the detection of flaws on internal parts of iron material through the use of X-rays.

(e) Color check

This is the detection of surface flaws on engine body, casting frame, pistons and large equipment, etc. through the use of washing liquid, liquid penetrant and liquid developer.

3) Engine repair work

This is the repair work on engine and in particular the fitting of valves and valve seats.

4) Electric rotating machine repair work

This is the repair and insulation work of electric rotating machine rotor and stator.

5) Performance testing

This is the performance testing of engine and traction motors after maintenance.

6) Bearing replacement work

This is the disassembling, cleaning and assembling of bearing.

7) Car body repair work

This is the cutting, processing and welding of car body frame and external plate.

8) Parts production work

This is the domestic production of air brake valve, brake shoe, coil and leaf spring, etc.

9) Painting work

This is the painting of car body equipment and parts.

10) Other works

Other works include the transfer of rolling stock equipment, etc.

(2) Replacement of deteriorated facilities

1) Replacement of facilities

Deteriorated articles should be replaced with high performance items in order to improve the precision and efficiency of maintenance work.

(a) Wheel-axle repair facility

(b) Lathe turning machine

(c) Drilling or boring machine

(d) Milling machine

(e) Planing or shaping machine

(f) Sawing or cutting machine

(g) Shearing machine

(h) Others

2) Rebuilding of maintenance buildings

Buildings that are badly deteriorated with much damage and rain-leaks should be rebuilt in order to improve the safety of the work and raise the work efficiency level.

Moreover, it is desirable that some shops be relocated due to deterioration in the working environment caused by geographical and topographical changes.

When rebuilding or relocating shops, they should be made into modern, safe and pleasant work areas installed with electric overhead traveling cranes (EOTC).

(3) Improvement of working environments

The improvements of work environments will make possible the carrying out high quality and reliable maintenance in a safe and pleasant working area.

1) Installation of dust proofing and moisture proofing equipment

Working areas for repair on engine and bearing, etc., which must be kept away from dust and rust, have to be partitioned off as separate rooms in order to prevent dust and moisture entering from other work areas.

Moreover, for axle journal, it is desirable that rustproof grease and other oils be coated and that protectors be attached in order to prevent scratching.

2) Improvement at working area environment

As well as removing oil, dust and other sediment from working floors, waste water, waste oil and sediment shall be removed from pits. Work corridors shall be kept permanently open and house cleaning shall be performed in order to keep clean and safe working environments. Moreover, natural and artificial lighting shall be improved and working lamps shall be used in order to make the working area brighter places.

(4) Rationalization of maintenance work

The maintenance work shall be rationalized in order to reduce the maintenance days and man hours.

1) Examination of maintenance periods, etc.

Rolling stock maintenance periods, maintenance methods and procedures, etc. shall be examined and revised to match the actual conditions. (In order to achieve this, long-term data on rolling stock maintenance results and breakdowns, etc. need to be accumulated).

2) Utilization of circulating spare parts

Circulating spare parts shall be effectively utilized as a means of reducing maintenance days. (Further description of circulating spare parts is given in a separate section).

3) Provision of instruments and tools

By using electric or compressed air instruments in the disassembly, processing and assembly work, faster and more reliable work can be performed and more precise maintenance work can be achieved. This will enable maintenance man hours to be reduced.

4) Concentration of maintenance work of main del equipment

By concentrating the overhaul work on main equipment of DEL such as engine, main generator and traction motor, etc. in the Gia Lam Workshop, it will be possible to supply equipment which has completed performance testing, to each of the depots and thus contribute to rationalization of the overall management of VNR.

5) Concentrated manufacture of castings and springs, etc.

By concentrating the manufacture of casting (air brake valve, brake shoe, etc.) and spring (coil spring and leaf spring) in one or two workshops (for example, Gia Lam and Dian workshops) and distributing them to the using sites, it will be possible to obtain high quality and uniform products and thus contribute to rationalization of the overall management of VNR.

(5) Promotion of reliable maintenance

By checking the function of individual equipment when conducting DL overhaul through engine performance testing and a traction motor running test, etc., it will be possible to guarantee quality. By fitting such performance checked equipment to locomotives, wasted work caused by the failure of such equipment can be eliminated and rational maintenance can be made possible. Moreover, by carrying out performance testing on locomotives after they have been fitted with the checked equipment, it will be possible verify overall locomotive performance and ensure reliability.

(6) Inventory control system for spare parts

Parts that require replacement in rolling stock maintenance should be systematically procured in advance and stored as spare parts. Moreover, replaced parts should immediately be repaired and restored to their complete states for use at any time as spare parts and kept on permanent store to act as circulating spare parts.

It is therefore necessary to decide the part name and quantity of parts to be kept in permanent store as circulating spare parts and to maintain full control of the maintenance process in order to ensure that parts neither run out nor are idle due to excess storage.

By carrying out such control properly, it will be possible to shorten the maintenance processes, reduce maintenance man hours and improve quality levels.

(7) Domestic production of rolling stock parts and equipment

The biggest bottleneck in rolling stock maintenance is caused by the procurement of parts from overseas. Many problems exist in terms of currency framework, cost and procurement period, etc. However, as the domestic technical level is high, efforts should be made to domestically produce the rolling stock parts and equipment that are currently imported. Even though materials may not be suitable or the useful life may be short in the initial stage, the experience accumulated through research and testing will eventually allow parts that are just as good as imported items to be domestically produced.

(8) Maintenance system and others

Regarding the preparation of documents on the maintenance system, maintenance standards and limits, and rolling stock management, the following recommendations are made.

1) Concerning the maintenance organization and system (see Fig. 8.12.1)

VNR is divided into Union 1 (north), Union 2 (central) and Union 3 (south) and each union manages the depots, while the workshops are under the direct control of the head office. Seen in terms of rolling stock maintenance, this is considered to be an appropriate form of management organization. (Management of rolling stock maintenance in the case of JNR, too, is a similar system).

(a) Charge of Gia Lam Workshop

a. Overhaul of the Union 1 DL (excluding standard gauge DL)

b. Overhaul of DL and PC of all VNR high speed trains

c. Concentrated overhaul of main DL equipment (engine, main generator, traction motor, etc.) of all VNR.

d. A portion of PC and FC overhauls

e. A portion of PC and FC manufacture and remodeling

(b) Charge of Haiphon Workshop and Dian Workshop

a. A portion of PC and FC overhauls

b. A portion of PC and FC manufacture and remodeling

(c) Charge of the Depots

Except for the overhaul of the DL, PC and FC belonging to each union, the depots are responsible for all other maintenance work. (Overhaul is possible at some of the big depots, for example, Thuan Hai Shop, etc.).

2) Maintenance standards and limits

Manuals, which form the basis for maintenance, are followed, however, repair standards and limits, etc. should be clarified and thoroughly put into effect in order to improve quality.

(a) Repair work standards

Technical specific items and prohibited items such as finishing tolerances, sectional adjustment allowances and numerical limits, etc. should be established for the purpose of rolling stock repair.

(b) Repair limit standards

These are limit levels relating to such conditions as shape, dimension, hardness, insulation resistance and fitting clearance, etc., which must be conformed with upon the completion of repair work.

(c) Service limits

These are limit levels set for abrasion and deterioration growing from the start of use of parts after their fitting to rolling stock, and the use of parts is prohibited in cases where these levels have been reached.

3) Preparation and utilization of materials required for rolling stock management

As well as preparing materials giving all VNR's, statistical data on running kms, car failures and accidents, and maintenance results to act as the basic materials for rolling stock management, it is important to feed back such data into actual rolling stock management and make full use of it. Statistics should be prepared each year in an easy to understand manner by rolling stock kind; maintenance kind, maintenance place and causes of failure or accident.

(a) Cause-wise totaling of car failures and operating accidents

(b) Maintenance records by maintenance place and rolling stock kind

(c) Control of rolling stock histories

Histories relating to rolling stock operation (name of depot in change and running kms etc.) and maintenance (main part repair and replacement, etc.) after manufacturing should be kept for each rolling stock and utilized in future maintenance work.

(9) Lubricating oil control

Regarding the lubricating oil used for diesel engine, oil sample is taken from each engine depending on running km and oil quality check is made to determine oil exchange time. Oil exchange is also carried out every decided running km.

Needless to say, lubricating oil affects diesel engine function and even influences engine life, and thus the control of lubricating oil has a great effect on the locomotive operation and maintenance. It is therefore desirable that lubricating oil control be carried out in a more rational and practical manner.

(10) Bearing maintenance

Regarding the maintenance of bearing, the aforementioned establishment of separate room and consideration of dust proofing and moisture proofing measures are important. In addition, attention needs to be paid to the following points.

1) Bearing box cover must not be opened or removed for daily maintenance check purpose. This can lead to the unwanted entry of dust and so forth.

2) Only open bearing box cover when there is an obvious defect such as overheat or abnormal noise, etc.

3) When washing, assembling or greasing bearing, always take care not to allow the entry or attachment of dust.

4) As for larger bearing than medium size never detach inner-race from axle or outer-race from case.

5) Applying pressure or heat when detaching bearing not only reduces fitting allowances, but also may causes inner race deformation or non-conformity of usable bearing. Inner races must, therefore, never be detached, except in case of bearing replacement.

6) As the small bearings used in supercharger, blower and charging generator lack good durability for given load and rotating speed, it is desirable that they are all replaced at each regular maintenance.

(11) Training and education

The education and training system for rolling stock maintenance shown in Figure 8.13.1 is provided for the engineers and workers of VNR. Rolling stock technology is constantly evolving and new techniques in such areas as mechanical and electrical engineering and even electronics are always being introduced.

It is desirable that the training and education system be fully utilized so that personnel may learn new technologies and skills, and may keep the rolling stock in best condition.

(12) Maintenance of facilities used in rolling stock maintenance

The long-term use of maintenance facilities naturally results in falling precision and performance levels. Such facilities must therefore be continually maintained and kept in normal working order.

The lowering of precision and performance levels and failures of maintenance facilities have serious consequences for rolling stock maintenance processes and quality. Therefore all necessary measures must be taken to ensure maintenance facilities in good condition on a daily basis through the establishment of maintenance systems for maintenance facilities and through the training and education of specialists for that.

(13) Other points

1) Sewage treatment facilities

The outside discharging of effluent and sewage from car toilets and wash basins is not only problematic in terms of social pollution, it hinders rolling stock performance and adversely affects maintenance work environments, thus giving rise to problems in terms of worker health. New high speed trains adopt sewage treatment systems by which sewage from cars is not externally discharged. Therefore sewage must be treated at the terminal stations

The installation of sewage treatment facilities is required at the following sites:

(a) Hanoi Station Yard,

(b) Vinh Station Yard,

(c) Da Nang Station Yard,

(d) Nha Trang Station Yard,

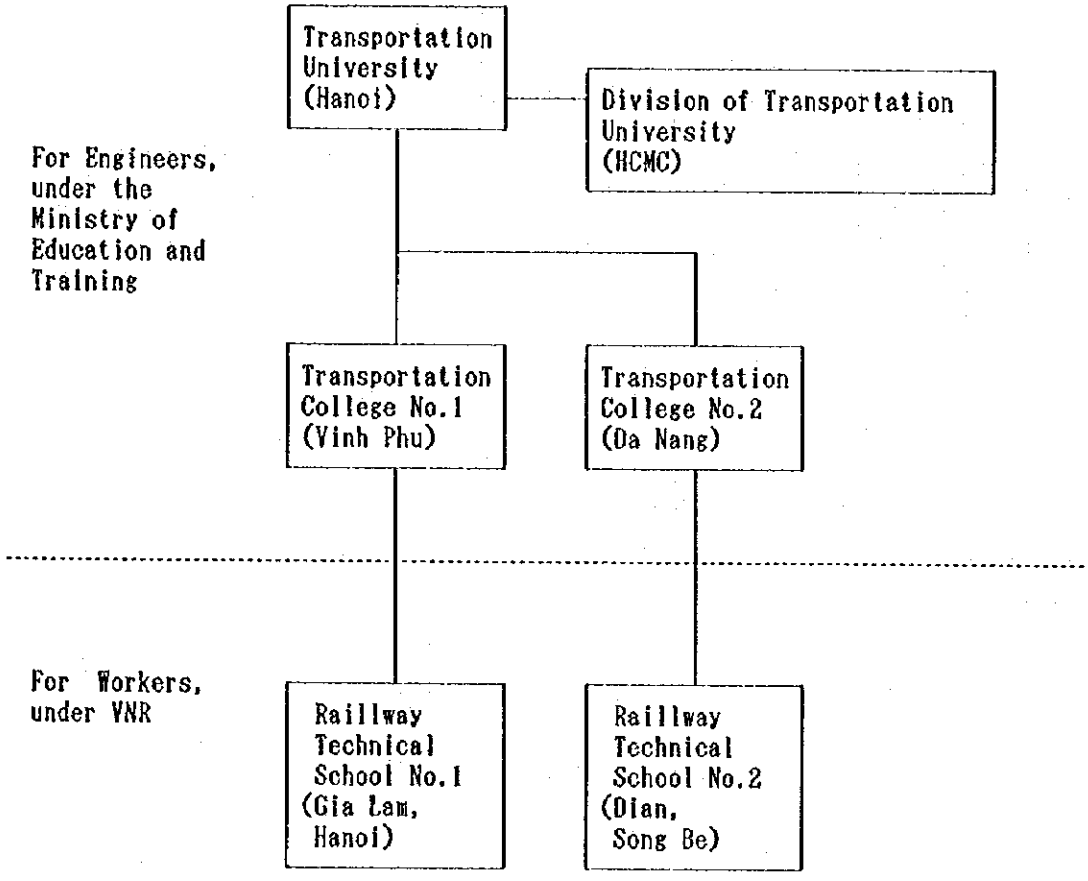
(e) Saigon Station Yard

2) Effluent treatment plants

The effluent from all workshops and depots is currently discharged in an untreated manner. As this can be expected to lead to environmental problems, the installation of effluent treatment plants for the oil separation and PH treatment, etc. of effluent is necessary.

Fig. 8.13.1 Education and Training System for Rolling Stock Maintenance

Engineers and Workers



8.13.4 Investment Schedule and Cost

(1) Investment schedule

The improvement plan is divided into the First Stage (1996 to 2000), the Second Stage (2001 to 2005) and the Third Stage (2006 to 2010).

The investment schedule for the First Stage (1996 to 2000) is as indicated below.

1) Gia Lam Workshop improvement
2) Installation of sewage treatment facilities(at the station yards in Hanoi, Vinh, Da Nang, Nha Trang and Saigon)

(2) Investment cost

1) Gia Lam Workshop improvement (see Clause 8.14)
2) Installation of sewage treatment facilities

(a) Investment cost per site

(Unit: Million US$)

Sewage storage tank (underground, 40 m^3)	0.1
Sewage treatment equipment and sludge incinerator	0.4
Piping, pumps, electrical equipment and others	0.1
Total	0.6

(b) Item-wise rough estimation of investment cost for 5 sites (1996 to 2000)

(Unit: Million US$)

Equipment, etc.	Installation and On-site Work, etc.		Total		Grand Total
F/C (US$)	F/C (US$)	D/C (US$)	F/C (US$)	D/C (US$)	US$
2.0	0.5	0.5	2.5	0.5	3.0

8.13.5 Improvement Plan upto 2010

The Feasibility Study is carried out on the rehabilitation and improvement plan upto 2000. However, the detailed items of phased improvement plan upto 2010 on the rolling stock maintenance are shown in Table 8.13.6 for reference.

Table 8.13.6 Phased Improvement Items

★ First Stage (1996 to 2000)

1. Gia Lam Workshop

(1) Workshop improvement for DEL maintenance

1) Working area improvements and new provisions

* Partitioning of work areas, roofing, floor paving and painting, etc.

* Introduction of engine performance testing room and painting shop, etc.

2) Improvement of maintenance installation and other facilities

* Pits, rails, work scaffolding, roads, etc.

3) Introduction of maintenance facilities

* Engine maintenance facilities
(Washing, repairing, painting and testing equipment, etc.)

* Electrical instrument maintenance facilities
(Washing, repairing, insulation and testing equipment, etc.)

* Car body maintenance facilities
(Washing, repairing and painting equipment, etc.)

4) Improvement of maintenance tools and instruments, etc.

(2) Introduction of PC maintenance equipment and others

1) Introduction of maintenance equipment for air conditioning equipment of new high speed trains

2) Partial improvement of PC maintenance work areas

* Partitioning, paving and painting, etc. of work areas

3) Introduction of sewage treatment facilities for PC of new high speed trains

(3) Provision of spare parts for DEL maintenance (1)

* Provision of engine assembly, generator assembly, motor assembly, etc. and their parts with the aim of reducing DEL maintenance days

2. Station yards in Hanoi, Vinh, Da Nang, Nha Trang and Saigon

(1) Installation of sewage treatment facilities for PC of new high speed trains

(Note) EOTC = electric overhead traveling crane

★ Second Stage (2001 to 2005)

1. Gia Lam Workshop

(1) Provision of spare parts for DEL maintenance (2)

2. Dian Workshop

(1) Improvement of maintenance mechanical facilities
(Washing, repairing and painting equipment, etc.)

(2) Improvement of maintenance tools and instruments, etc.

3. Hai Phong Workshop

Same items as for Dian Workshop

4. DL maintenance depots (Hanoi, Vinh, Yen Bai, Yen Vien, Da Nang and Saigon)

(1) Improvement of DEL maintenance facilities
(Washing, repairing, painting and general performance testing equipment, etc.)

(2) Improvement of maintenance tools and instruments, etc.

★ Third Stage (2006 to 2010)

1. Gia Lam Workshop

(1) Provision of spare parts for DEL maintenance (3)

2. PC and FC maintenance depots (Hanoi, Yen Vien, Vinh, Da Nang, Saigon, Thuan Hai, Song Than)

(1) Rebuilding of main maintenance buildings
(Hanoi and Da Nang)

Rebuilding to allow higher heights for the installation of EOTC

(2) Installation of EOTC (2 sites)

(3) Improvement of maintenance facilities
(Washing, repairing and painting equipment, etc.)

(4) Improvement of maintenance tools and instruments, etc.

3. Installation of effluent treatment plants in all maintenance workshops and depots

8.14 Gia Lam Rolling Stock Workshop

8.14.1 General

Gia Lam Workshop located in Hanoi is the only comprehensive rolling stock repair workshop in Viet Nam. The workshop has overhauled diesel hydraulic locomotives (DHL), passenger cars (PC) and freight cars (FC), and new PCs and FCs have been manufactured.

However, many machines and workers are not under employed, because the overhaul of steam locomotives (SL) that needed many parts to be made in the workshop has been stopped. Revitalization of the workshop is essential for the development of VNR, as there is a major demand for repair and manufacturing of rolling stock.

Results of these improvements will have a beneficial impact on the economy and industries in Northern Viet Nam.

8.14.2 Current overhaul of rolling stock in VNR

Rolling stock has to be inspected and maintained to keep their performance and function and also repair. And they have to be overhauled after several years of use.

The locomotive fleet of VNR has been modernized from steam to diesel locomotives. However, the overhaul system and facilities are not provided. As VNR has no facilities to overhaul diesel electric locomotives (DEL) especially, overhaul has been executed inadequately at the same place used for periodic inspections and repair at workshops and depots. It is necessary to upgrade and strengthen the facilities and capacity of the workshop in order to implement full overhaul of DEL and DHL.

Overhaul of engines, the most difficult maintenance work has not been executed fully.

8.14.3 Current Condition (Fig. 8.14.1)

(1) Overhaul of DHL (D4H)

Overhaul of DHL (D4H) belonging to UNION 1 has been executed only in an unsatisfactory way and manually making use of the approximate one third of Building 3B. Overhaul of engines has not been carried out fully and a performance test is not performed.

All buildings of the workshop are in a deteriorated condition.

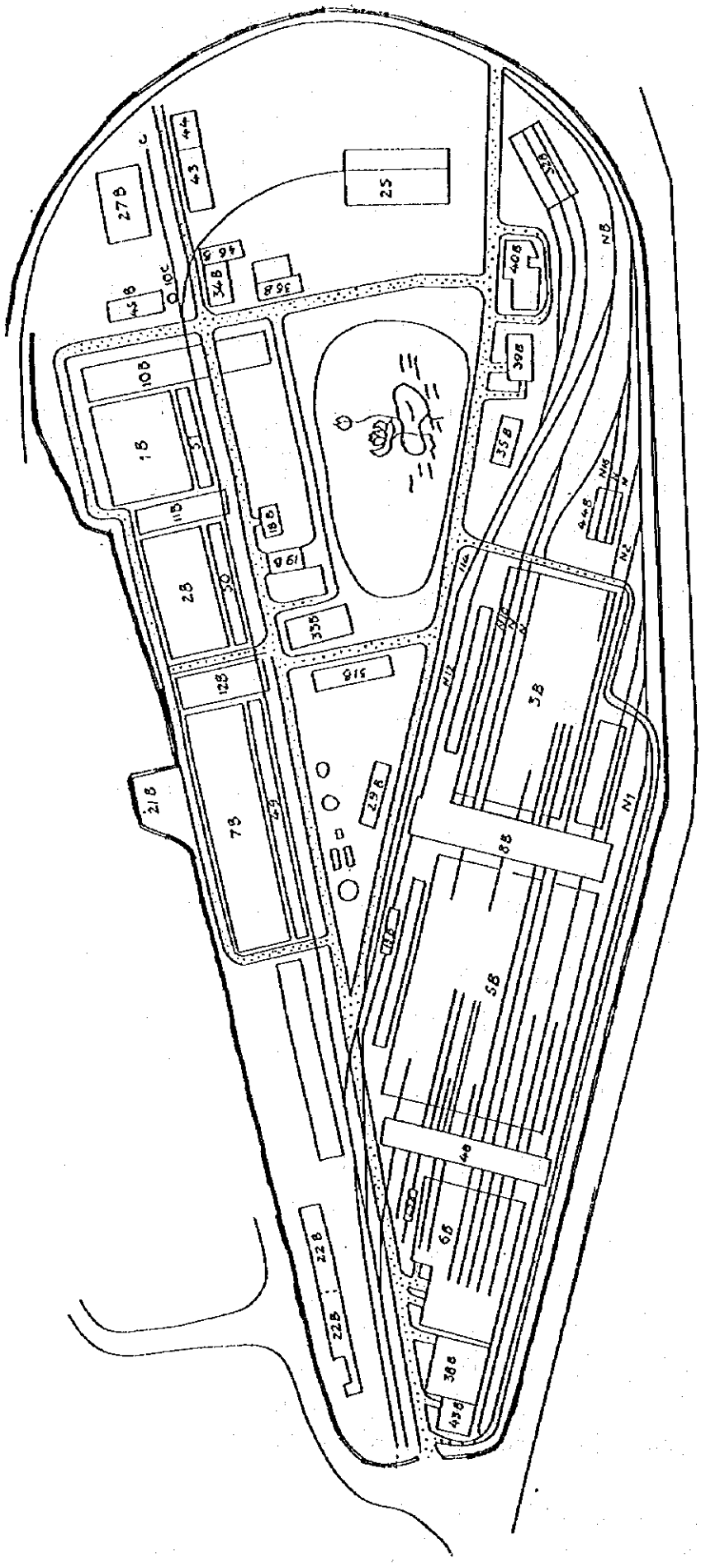


Fig. 8.14.1 Layout Plan of Gialam Rolling Stock Factory

(2) Overhaul and Manufacture of PCs and FCs

Overhaul and manufacture of PCs and FCs make use of most of Building 5B. Maintenance, inspection and repair of wheel sets, including DHL, are executed in this building. Also PCs and FCs have been manufactured, about 5 cars annually of each.

But it is necessary to increase the capacity of the workshop in order to overhaul and manufacture higher grade PCs and FCs.

(3) Machine Shop

Parts manufacture for DL, PC and FC is carried out in the machine shop of Building 7B. The parts working except VNR are practiced because many machines are not properly used. There is a plating area in Building 7B. Most of plating jobs are one except VNR.

(4) Other Shops

1) Almost all the machines in the forge shop (Building 2B) are not properly used.

2) Foundry shop (Building 1B) casts the rolling stock parts once or twice a week.

3) Painting shop (Building 6B) is rented to another company.

(5) Office

Main offices are built around the central lake and each shop has offices and a clinic room.

8.14.4 Problem of Gia Lam Workshop

Train speed is now rather low (less than 50 km/h), as unsatisfactory repairs are responsible for such a low speed. However, after the bridge and track will be improved, many troubles, faults and failures will occur from the higher speed operation in the near future, as program 2000 plans to raise train speed to more than 80 km/h.

(1) Overhaul of DHL

1) Almost all repair work is carried out manually on the concrete floor. Inspection and repairs, like this method is inefficient and is bad for quality control from the grease dust and other foreign matter.

2) The engines of D4H after repair do not have a performance test, and only have running-in period.

Also another parts only have confirmation of movement and have not been performance tested under each service condition.

(2) Maintenance of Bogie and Axle Shafts

1) The dust and foreign matters sticking to bogie frames are only cleaned manually and are not been inspected completely.

2) Basic brake parts are only cleaned manually and do not have a non-destructive test.

3) Axle shafts are not non-destructive tested to discover internal flaws.

4) When tire and gears are taken off and re-set on the axle shaft when changing tires and gears, the tire and gear are heated by the primitive methods such as open fire.

5) Bearings

(a) Mounting and de-mounting roller bearings is practiced without heating methods, so journal point of axle shaft is damaged and roller bearings are sometimes broken. Dustproofing and dampproofing of removed roller bearing is not done.

(b) Metal for plain bearings is re-used after melting again, but the ingredients are not controlled.

(3) Casting

Brake shoes are cast in the foundry. When the material is thrown into the furnace, the ingredients are not measured . Coals melting method is applied by VNR. However, in Japan the cokes melting method is applied. Cokes melting can get higher temperatures and high quality. Therefore, technical improvements will be postponed until coke can be obtained cheaply in Vet Nam.

(4) Building and others

Buildings of the workshop are deteriorated and there is a major leak in the roof. The concrete floor is damaged. Buildings lack windows, so illumination in the building is poor. This gives rise to doubt about quality control and work safety.

Houses for the workshop staff are deteriorated and need repairs.

8.14.5 Countermeasure for the problem of Gia Lam Workshop

(1) Establishment of a system for the overhaul, inspection and repair

VNR needs to establish a modern system for the overhaul, inspection and repair of rolling stock. Especially, the establishment of a perfect overhaul system is important for safety to run the rolling stock.

(2) The partial charge of Gia Lam Workshop

Gia Lam Workshop overhauls DHL and DEL belonging to UNION 1, and overhaul the engines that are entrusted from other depots and workshops of the other UNION. Therefore, the proper machines and equipment must be installed.

(3) Upgrading of manufacturing capacity

Through put capacity and machines for manufacturing parts for DHLs, DELs, Passenger cars and Freight cars should be upgraded.

(4) Inspection and washing

An inspection and carbody washing facility should be equipped in order to upgrade inspection, testing and repair work.

(5) Buildings

Buildings should be repaired, and skylights and lighting improved together with bright paint on the walls of the buildings.

(6) Accustoming to new machines

New systems, machines and facilities need skills to use. Therefore, it needs approximately 2 years to accustom staff and training should be included in the project.

8.15 Natural Conditions

Ha Noi - Ho Chi Minh Line is located in plans, mountains, river deltas and coastal areas. The line passes under complicated topographical and geological conditions.

The line had suffered various natural disasters; submergence of railway facilities (tracks and stations), slope failure (falling rocks), cutting slope failures (obstacle of construction gauge), erosion of bank (on the river dike), erosions (banks and structural foundations), and sediments of sand.

Natural disasters had occurred in many places, the principal problems of serious natural disasters and their locations are shown as follows:

Submergence (tracks and stations)

- Vinh - Hue;	319km+000 - 688km+300
- Le Track - Tra Kieu (in pond);	804km+100 - 824km+700
- Phu Cang - An My (in marsh);	841km+700 - 857km+100

Erosion of bank (on the river dike)

- Hoa Duyet - Thanh Yen;	357km+000 - 369km+600

Slope failure (falling rocks)

- Hue - Da Nang;	688km+300 - 719km+400
- Thuy Trach - Phuoc Lanh;	977km+100 - 1,139km+400
- Phu Hiep - Dai Lanh;	1,210km+600 - 1,232km+200
- Ca Na - Vinh Hao;	1,436km+300 - 1,454km+900

Seismography

Map of seismic intensity distribution is shown in Fig. 8.15.1. The classifications of seismic intensity in Viet Nam is adopted the seismic criteria of Mercalli scale. There is no earthquake recorded in Viet Nam, during last fifty years.

8.15.1 Current Problems of Natural Disasters and Recommended Priorities of Countermeasure

Each Union had selected priority sections for the feasibility study on Ha Noi - Ho Chi Minh Line. The priority sections and the outside of the priority sections are studied natural disaster problems respectively.

The current problems of natural disasters in priority sections are shown as follows:

(1) The priority sections

1) Ha Noi - Thanh Hoa (175.2km, Union I); 0km+000 - 175km+200

There are no serious problems on natural disaster, but a freeboard of bridge shall be studied when a superstructure of bridge will be planned replacement.

The current slight problems on natural disaster in this section are shown as follows:

Slope failure

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
126km+500			*	
148km+200 - 148km+400			*	
149km+450 - 149km+650			*	
158km+800 - 158km+820			*	
159km+500 - 159km+650			*	

2) Hue - Da Nang (103.1km, Union II); 688km+300 - 791km+400

There is the Hai Van pass in this section. This section is serious for safety train operation. In this section, the line had suffered several natural disasters; slope failure (falling rocks), and cutting slope failures(obstacle of construction gauge).

It is impossible to prevent these natural disasters completely. However safety train operation should be keep constantly. Countermeasures of the natural disaster shall be planned based on keep safety train operation.

The current problems of natural disasters in this section are shown as follows:

Slope failure (falling rocks)

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
761km+500	*			
762km+500 - 762km+600	*			
769km+000 - 769km+150	*			
771km+000 - 771km+100	*			
773km+700 - 774km+000	*			

Cutting slope failure

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
759km+300	*			

Cutting slope failure (obstacle of construction gauge)

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
757km+950 - 758km+000	*			
763km+200	*			

3) Muong Man - Sai Gon (175.4km, Union III); 1,550km+800 - 1,726km+200

There are no serious problems on natural disaster in this section. Some parts of this section had suffered only submergence of railway facilitiy (tracks). However freeboard of bridge shall be studied separately when superstructure of bridges will be planned replacement.

The current problems of natural disaster in this section are shown as follows:

Submergence of railway facilitiy (tracks)

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
1,620km+750 -1,629km+250			*	
1,696km+500 - 1,697km+250			*	
1,710km+800 - 1,714km+000		*		

(2) Outside of the priority sections

1) Thanh Hoa - Dong Hoi (346.6km, Union I); 175km+200 - 521km+800
Dong Hoi - Hue (166.5km, Union II); 521km+800 - 688km+300

The section had suffered several natural disaster; submergence of railway facilities (tracks and stations), erosion of bank (on the river dike), erosions (banks and structural foundations), slope failure (falling rocks), cutting slope failures (obstacle of construction gauge), and sediments of sand.

The current problems of natural disasters in this section are shown as follows:

Submergence of railway facility (tracks)

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
331km+000 - 338km+125	*			
340km+500 - 343km+800			*	
345km+000 - 350km+000				*
349km+000 - 354km+500		*		
354km+500 - 355km+900		*		
357km+700 - 364km+500		*		
364km+500 - 371km+000	*			
375km+800 - 385km+100	*			
385km+740 - 389km+300				*
391km+100 - 397km+500	*			
402km+600 - 406km+250				*
421km+000 - 423km+000				*
424km+000 - 428km+000		*		
428km+000 - 436km+800	*			
448km+950 - 454km+000	*			
454km+000 - 458km+000				*
463km+000 - 464km+500	*			
470km+000 - 471km+600				*
472km+000 - 473km+000				*
473km+000 - 474km+000	*			
474km+900 - 475km+600	*			
476km+000 - 478km+000	*			
524km+000 - 525km+000			*	
614km+000 - 618km+000			*	
676km+000			*	
678km+000			*	

Submergence of railway facility (stations)

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
351km+400		*		
369km+600	*			
380km+600	*			
386km+700				*
404km+400				*
425km+900		*		
436km+300		*		
449km+500	*			
481km+700			*	

Erosion of bank (on the river dike)

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
363km+000 - 364km+000		*		

Erosions (banks and structural foundations)

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
351km+200 - 351km+700		*		
354km+200 - 354km+700		*		
355km+100 - 355km+600		*		
362km+750 - 363km+250		*		
420km+920 - 421km+170			*	
421km+000 - 421km+500			*	
434km+400 - 435km+100		*		
451km+500 - 452km+000		*		
460km+400 - 460km+900			*	
555km+000 - 562km+000			*	
559km+000 - 599km+559			*	
599km+000 - 599km+559			*	
614km+200 - 614km+400			*	
614km+500			*	
622km+600 - 623km+600			*	
625km+000 - 625km+700			*	
626km+800 - 628km+700			*	
663km+400 - 664km+200			*	
678km+500 - 678km+700			*	
680km+000 - 680km+250			*	
681km+274 - 681km+380			*	
682km+150 - 682km+350			*	

Slope failure (falling rocks)

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
408km+600 - 425km+900		*		

Cutting slope failure (obstacle of construction gauge)

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
408km+600 - 425km+900				*

Sediment of sand

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
631km+600 - 646km+800				*

2) Da Nang - Dieu Tri (304.1km, Union II); 791km+400 - 1,095km+500
and Dieu Tri- Muong Man (455.3km, Union III); 1,095km+500 - 1,550km+800

The sections had suffered several natural disaster; submergence of railway facilities (tracks), erosions (banks and structural foundations), slope failure (falling rocks), cutting slope failures (obstacle of construction gauge), and sediments of sand.

The current problems of natural disaster in this section are shown as follows:

Submergence of railway facilitiy (tracks)

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
800km+000 - 800km+200			*	
801km+700 - 802km+500			*	
812km+400			*	
814km+860			*	
815km+000 - 816km+500		*		
815km+860			*	
817km+500 - 819km+000			*	
817km+788			*	
820km+600 - 822km+500			*	
838km+900 - 839km+500			*	
848km+200			*	
848km+700			*	
853km+950 - 856km+000			*	
862km+050			*	
902km+150 - 902km+300			*	
933km+000 - 934km+500			*	
985km+300 - 985km+500			*	
1,022km+930 - 1,022km+980			*	
1,024km+250 - 1,024km+400			*	
1,044km+400 - 1,044km+800			*	
1,054km+800 - 1,055km+300			*	
1,117km+000 - 1,117km+350			*	
1,164km+300 - 1,166km+500			*	
1,166km+600 - 1,167km+900			*	
1,172km+000 - 1,175km+000			*	
1,204km+000 - 1,206km+500			*	
1,209km+600 - 1,210km+400			*	
1,212km+000 - 1,217km+000			*	
1,306km+992 - 1,307km+500			*	
1,325km+000 - 1,327km+400			*	
1,341km+500 - 1,342km+250			*	
1,363km+250 - 1,373km+000			*	
1,392km+250 - 1,393km+750			*	
1,409km+750 - 1,410km+250			*	
1,413km+500 - 1,414km+000			*	
1,463km+250 - 1,465km+250		*		
1,465km+250 - 1,466km+500			*	
1,466km+500 - 1,466km+800			*	
1,490km+300 - 1,491km+100		*		
1,493km+800 - 1,494km+300			*	
1,508km+150 - 1,508km+450			*	
1,527km+200 - 1,533km+800		*		
1,535km+000 - 1,550km+800			*	

Erosions (banks and structural foundation)

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
881km+200 - 881km+600			*	
889km+100 - 889km+500			*	
984km+200 - 1,027km+200				*
1,026km+900 - 1,027km+200			*	
1,211km+700 - 1,212km+500			*	
1,260km+600 - 1,260km+900				*
1,389km+500 - 1,390km+200			*	
1,464km+000 - 1,466km+500		*		

Slope failures (falling rocks)

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
822km+800 - 822km+900			*	
984km+500 - 984km+600		*		
985km+450 - 985km+550		*		
987km+050		*		
987km+550 - 987km+650		*		
994km+400 - 994km+700		*		
995km+450 - 995km+550		*		
1,134km+500 - 1,135km+500			*	
1,217km+300 - 1,219km+600			*	
1,218km+400			*	
1,219km+500			*	
1,220km+000			*	
1,220km+600 - 1,220km+900			*	
1,222km+000 - 1,222km+100			*	
1,222km+300 - 1,222km+400			*	
1,223km+623 - 1,224km+820			*	
1,224km+820			*	
1,437km+800 - 1,437km+900		*		
1,437km+900 - 1,438km+000		*		
1,438km+150 - 1,438km+200		*		

Cutting slope failures (obstacle of construction gauge)

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
1,142km+300				*
1,226km+100 - 1,226km+200			*	
1,226km+300 - 1,226km+450			*	
1,226km+700 - 1,226km+800			*	
1,227km+700 - 1,227km+800			*	
1,306km+000			*	

Cutting slope failures

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
850km+400 - 850km+500			*	
1,088km+530 - 1,088km+850			*	
1,168km+800 - 1,169km+000			*	
1,222km+200 - 1,222km+400			*	
1,230km+100 - 1,231km+470			*	
1,306km+990 - 1,307km+300			*	

Sediments of sand

Recommended priority of countermeasure	Program 2000 Project	Program 2000 Study	Up to 2010 Study	Future Study
910km+990 - 911km+100				*
971km+700 - 971km+960				*
1,013km+000 - 1,014km+000				*
1,018km+000 - 1,020km+500				*
1,040km+100 - 1,040km+200				*

8.15.2 Advises for Planning Countermeasure Against the Natural Disasters

The countermeasure of the natural disasters shall be planned by each civil engineers, however advises for planning countermeasure based on keep safety train operation. Advises on each kinds of countermeasure for preventing natural disaster are shown as follows:

(1) Submergence of railway facilities

1) In areas where will have a plan of a flood control, conferences shall be held on the countermeasure of railway project with governmental authorities concerned when detail countermeasure of submergence will be planned.

2) Basic direction for preventing submergence of railway facilities are follows:

(a) Installation of side and cross drainage

(b) Rising bank formation

The rising bank formation should be used suitable soil materials for banking, but if it will be impossible to use a good material for rising bank, countermeasure plan shall be study method of soil stabilization and compacting method for rising bank formation.

3) Planning relocation of a track for preventing submergence, the detail study shall be carried out separately.

4) Submergence of bridges

Freeboard of bridges shall be studied when superstructure of bridges will be planned replacement for preventing submergence. The detail study for replacing or relocating of railway bridge shall be carried out separately.

(2) Slope failure

1) Falling rocks

Falling rocks had occurred by heavy rain usually. It is impossible to prevent falling rocks completely. However safety train operation should be keep constantly. The countermeasures shall be planned separately two visual conditions, areas of keeping up visual distance sufficiently and areas of not keeping up visual distance.

In the areas where visual distances does not keep sufficiently, the countermeasures shall be carried out in program 2000. Countermeasures for preventing falling rocks shall be suggested following measures.

(a) Re-movement of loose rocks

(b) Installation alarm device

In the areas where visual distances keeps sufficiently, countermeasure shall be carried out study up to 2010. Countermeasures for preventing falling rocks shall be suggested following measures.

(c) Watching out for falling rocks as stationary and patrol warning

2) Cutting slope failure

Cutting slope failures had occurred by heavy rain usually. Construction gauge should be keep for safety train operation. Countermeasure for preventing slope failure shall be suggested following measures.

(a) Reform slope gradient

(b) Installation for protecting of slope surfaces as follows:

- Vegetation
- Gabion
- Retaining wall
- Wet masonry

(3) Erosion (banks)

Erosion of banks had occurred by river water rising, flash flood and sea wave. Countermeasure for protecting erosion of banks shall be suggested following measures.

(a) Installation of side and cross drainage

(b) Installation for protecting of slope surface as follows:

- Vegetation
- Gabion
- Retaining wall
- Wet masonry
- Precast concrete armor unit

(4) Erosion (structural foundations)

Erosion of structural foundations had occurred by flash flood usually. Countermeasure for protecting erosion of bridge foundations shall be suggested following measures.

(a) Protection of bridge substructure as follows:

- Gabion
- Retaining wall
- Wet masonry

(5) Sediments of sand

Sediments of sand had occurred by strong wind, sea wave and flash flood. Countermeasure for preventing sediment of sand shall suggest following measures.

(a) Protect against wind as follows:

- Installation of wind break fences
- Installation of wind break forest

(b) Protection sea wave

- Installation of precast concrete armor unit

(c) Installation of drainage for flashing out flood water smoothly

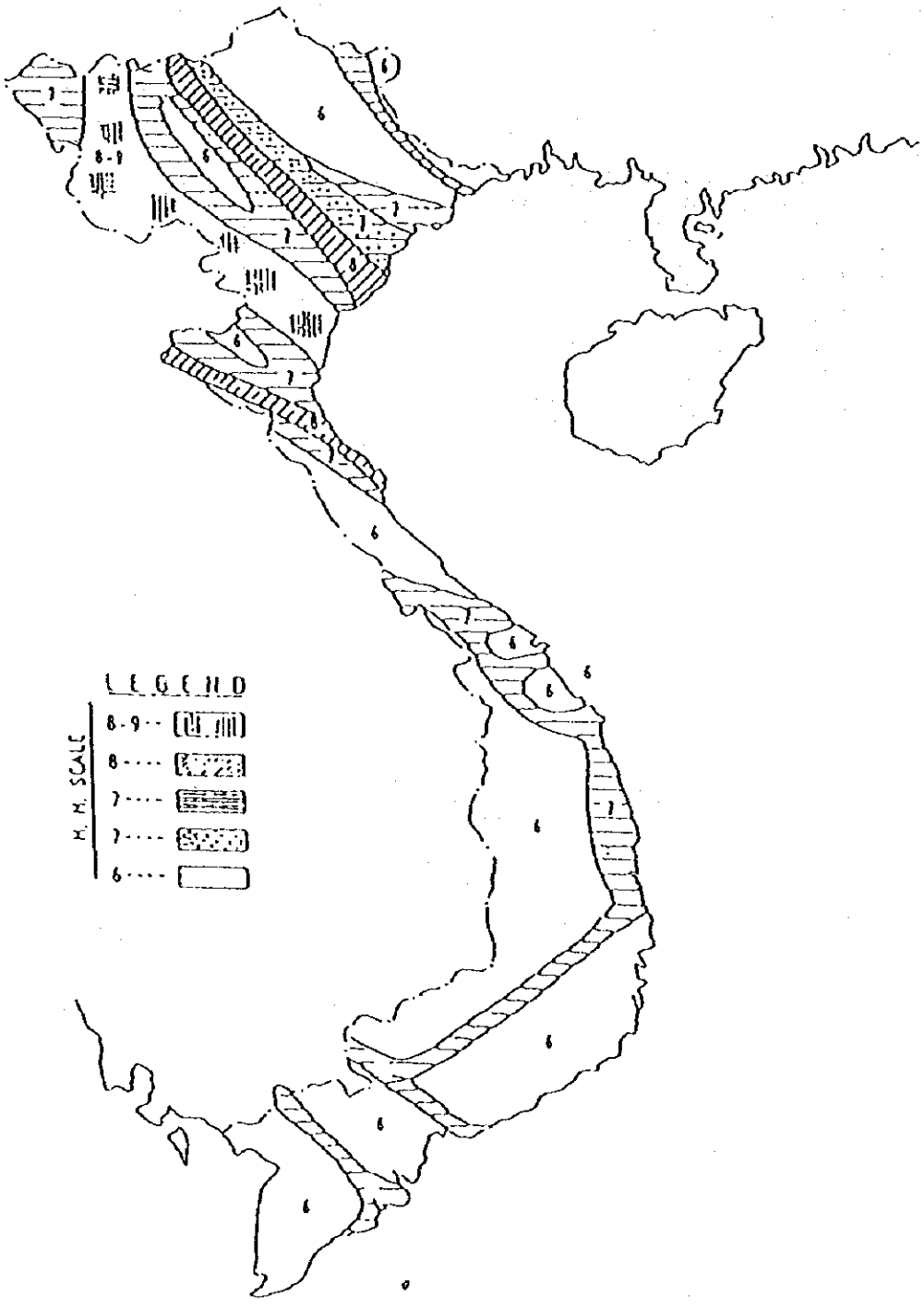


Fig. 8.15.1 Distribution Map of Seismic Intensive in Viet Nam

8.16 Existing Environmental Conditions

8.16.1 Environment and Natural Resources

(1) Climate

The climate of Viet Nam belongs to tropical climate type. It is influenced by the monsoon. The monsoon is also influenced by topographic conditions and others. Generally, the climate of Viet Nam can be divided into two periods as follows:

- Southwestern monsoon summer season
  from May to September
- Northeastern monsoon winter season
  from October to April

The southwestern monsoon blows from the Bay of Bengal and the South Pacific. It brings hot air and humid air. As a result, amount of rainfall is concentrated this season. End of this season, there is heavy rain and typhoon season. However, amount of rainfall and rainfall pattern depend on location and topographic conditions.

The northeastern monsoon blows from the northern Pacific and brings comparative warm and humid air, and also rain initially. It brings dry air after that. It is dry season from November to March.

As was mentioned before, the Monsoon is influenced by topography conditions and others. Hai Van Pass divides climate pattern into the north and the south regions. Temperature of the south region is little variation between summer and winter seasons. Monthly climate data is shown in Table 8.16.1 and Fig. 8.16.1. In Hanoi, the mean monthly temperature of 32.9 °C is highest in July, and lowest in January at 13.7 °C. In Ho Chi Minh City, other hand, the mean highest temperature is 34.6 °C in April, the lowest temperature is 21.1 °C in January. Variation of temperature of Hanoi is larger than Ho Chi Minh City.

Monthly mean humidity of Hanoi and Ho Chi Minh City range from 81 % to 87 % and from 70 % to 85 % respectively. The average annual rainfall of Hanoi is 1,676 mm. The monthly average rainfall from June to September accounts for 66 % of annual rainfall. Ho Chi Minh City, other hand, annual rainfall is 1,931 mm that is much than Hanoi. The maximum mean monthly rainfall is over 300 m in June and September. The mean monthly rainfall from June to October accounts for 76 % of annual rainfall.

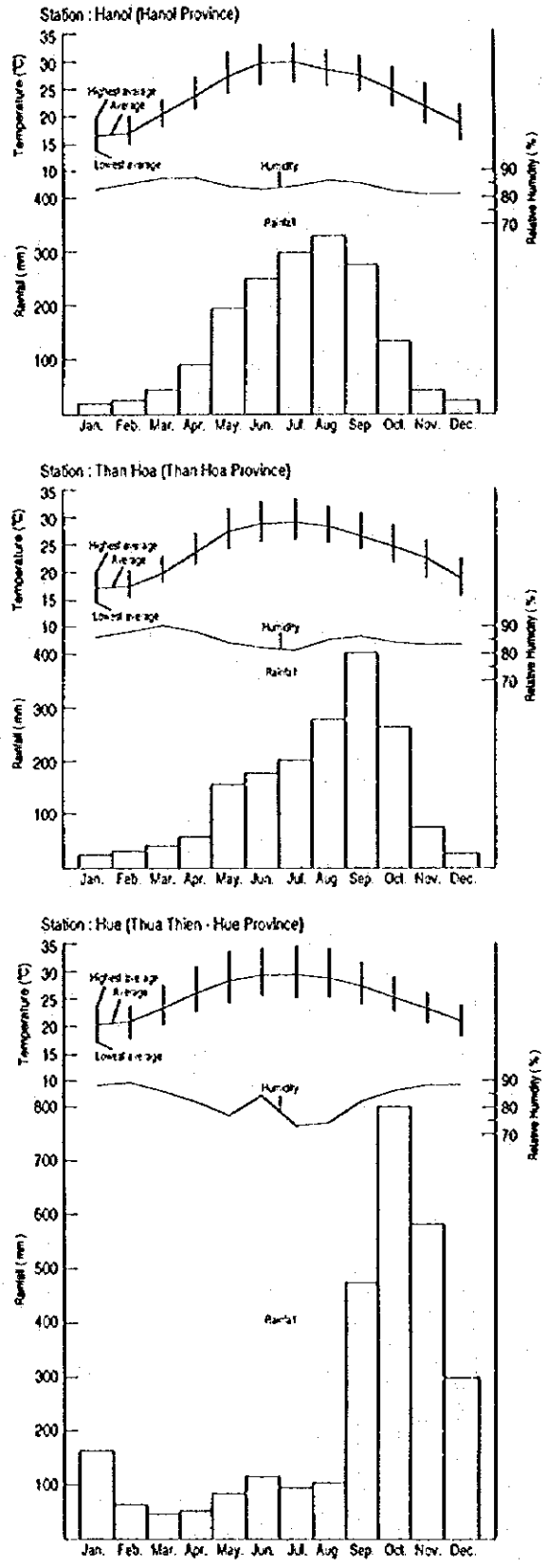


Fig. 8.16.1 (1) Monthly Climate Data on Hanoi - Ho Chi Minh Line

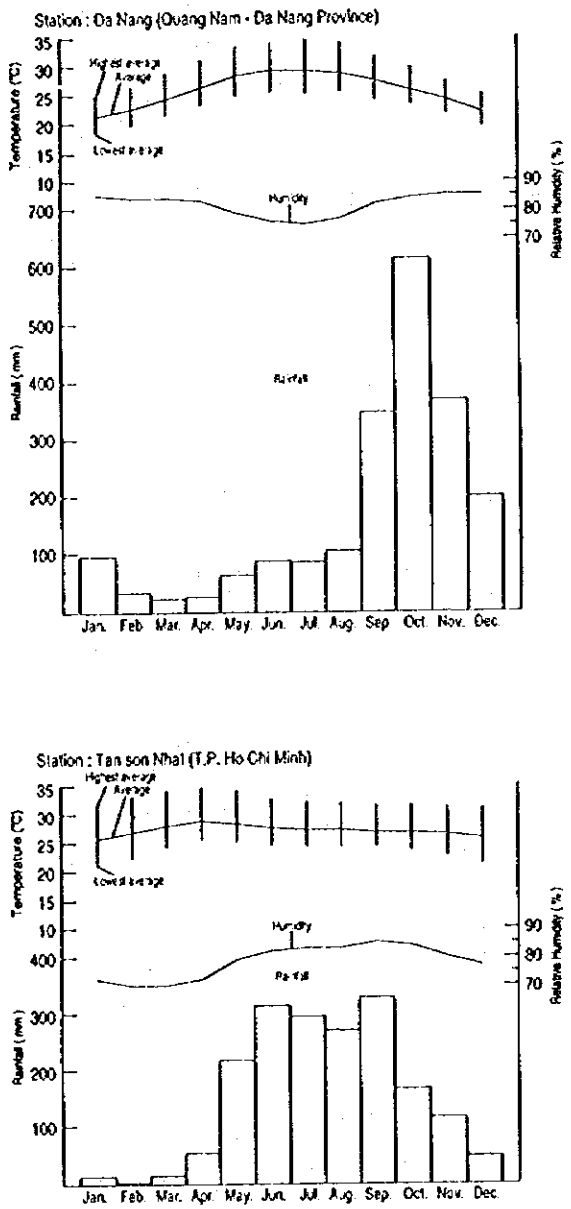


Fig. 8.16.1 (2) Monthly Climate Data on Hanoi - Ho Chi Minh Line

Table 8.16.1 (1) Monthly Climate Data on Hanoi - Ho Chi Minh Line

Station: Hanoi (Hanoi Province) Elevation: 5 m

Parameter	unit	January	February	March	April	May	June	July	August	September	October	November	December	year
Temperature														
Monthly ave.	C	16.4	17.0	20.2	23.7	27.3	28.8	28.9	28.2	27.2	24.6	21.4	18.2	23.5
Monthly highest ave.		19.3	19.9	22.8	27.0	31.5	32.6	32.9	31.9	30.9	28.6	25.2	21.8	27.0
Monthly lowest ave.		13.7	15.0	18.1	21.4	24.3	25.8	26.1	25.7	24.7	21.9	18.5	15.3	20.9
Relative humidity	%	83	85	87	87	84	83	84	86	85	82	81	81	84
Rainfall	mm	18.6	26.2	43.8	90.1	188.5	239.9	288.2	318.0	265.4	130.7	43.4	23.4	1,676.2
Rainy day	days	8.4	11.3	15.0	13.3	14.2	14.7	15.7	16.7	13.7	9.0	6.5	6.0	144.5
Wind														
Average wind Speed	m/sec.	1.5	2.4	2.3	2.5	2.4	2.1	2.1	1.8	1.8	1.8	1.9	2.0	2.0

Rainfall: year means total amount of a year

Station: Than Hoa (Than Hoa Province) Elevation: 5 m

Parameter	unit	January	February	March	April	May	June	July	August	September	October	November	December	year
Temperature														
Monthly ave.	C	17.0	17.3	19.8	23.5	27.2	28.9	29.0	28.2	26.4	24.5	22.4	18.6	23.6
Monthly highest ave.		19.9	20.0	22.7	26.9	31.4	32.7	33.1	31.9	30.5	28.2	25.3	22.1	27.1
Monthly lowest ave.		14.5	15.5	18.1	21.4	24.4	25.8	26.0	25.4	24.3	21.8	18.8	15.7	21.0
Relative humidity	%	86	88	90	88	84	82	81	85	86	84	83	83	85
Rainfall	mm	24.9	30.9	40.8	59.2	156.9	178.7	202.7	278.3	404.0	263.5	76.5	28.5	1,744.9
Rainy day	days	8.9	12.0	13.8	11.1	11.7	11.2	11.8	14.0	15.4	11.6	8.4	6.7	136.6
Wind														
Average wind Speed	m/sec.	1.8	1.8	1.7	1.9	2.0	1.9	1.9	1.5	1.7	1.9	1.8	1.7	1.8

Rainfall: year means total amount of a year

Station: Hue (Thua Thien-Hue Province) Elevation: 17 m

Parameter	unit	January	February	March	April	May	June	July	August	September	October	November	December	year
Temperature														
Monthly ave.	C	20.2	20.9	23.1	26.0	28.3	29.3	29.4	28.9	27.1	25.1	23.1	20.8	25.2
Monthly highest ave.		23.2	23.5	27.5	30.8	33.2	34.0	34.3	34.0	31.3	28.9	26.0	23.6	29.2
Monthly lowest ave.		17.2	17.9	20.4	22.8	24.4	25.6	25.2	25.3	24.1	22.8	20.8	18.2	22.1
Relative humidity	%	88	89	86	82	77	84	73	74	82	86	88	88	83
Rainfall	mm	161.3	62.6	47.1	51.6	82.1	116.7	95.3	104.0	473.4	795.6	580.6	297.4	2,867.7
Rainy day	days	15.5	10.9	9.7	8.7	9.5	8.7	7.7	9.8	15.9	20.7	21.6	19.2	157.9
Wind														
Average wind Speed	m/sec.	1.8	1.9	1.9	1.7	1.7	1.8	1.7	1.6	1.6	1.8	1.9	1.7	1.8

Rainfall: year means total amount of a year

Table 8.16.1 (2) Monthly Climate Data on Hanoi - Ho Chi Minh Line

Station: Da Nang (Quang Nam - Da Nang Province) Elevation: 6 m

Parameter	unit	January	February	March	April	May	June	July	August	September	October	November	December	year
Temperature														
Monthly ave.	C	21.3	22.4	24.1	26.2	28.2	29.2	29.1	28.8	27.3	25.7	24.0	21.9	25.7
Monthly highest ave.		24.8	26.1	28.7	31.0	33.4	33.9	34.3	33.9	31.5	29.6	27.0	24.9	29.9
Monthly lowest ave.		18.5	19.8	21.5	23.3	24.9	25.5	25.3	25.5	24.1	23.2	21.6	19.3	22.7
Relative humidity	%	85	84	84	83	79	76	75	77	82	84	85	85	82
Rainfall	mm	96.2	33.0	22.4	26.9	62.6	87.1	85.6	103.0	349.7	612.8	366.2	199.0	2,044.5
Rainy day	days	13.7	6.9	4.8	5.6	8.9	8.0	8.6	11.4	15.4	21.2	20.9	18.6	144.0
Wind														
Average wind Speed	m/sec.	1.8	2.0	2.1	1.9	1.8	1.5	1.5	1.5	1.7	1.9	2.2	1.7	1.8

Rainfall: year means total amount of a year

Station: Tan son Nhat (T.P. Ho Chi Minh) Elevation: 9 m

Parameter	unit	January	February	March	April	May	June	July	August	September	October	November	December	year
Temperature														
Monthly ave.	C	25.8	26.7	27.9	28.9	28.3	27.5	27.1	27.1	26.8	26.7	26.4	25.7	27.1
Monthly highest ave.		31.6	32.9	33.9	34.6	34.0	32.4	32.0	31.8	31.3	31.2	31.0	30.8	32.3
Monthly lowest ave.		21.1	22.5	24.4	25.8	25.2	24.6	24.3	24.3	24.4	23.9	22.8	21.4	23.7
Relative humidity	%	72	70	70	72	79	82	83	83	85	84	80	77	78
Rainfall	mm	13.8	4.1	10.5	50.4	218.4	311.7	293.7	269.8	327.1	266.7	116.5	48.3	1,931.0
Rainy day	days	2.4	1.0	1.9	5.4	17.8	22.2	22.9	22.4	23.1	20.9	12.1	6.7	158.8
Wind														
Average wind Speed	m/sec.	2.3	3.1	3.6	3.3	2.5	2.7	2.9	3.8	2.7	2.2	2.2	2.0	2.8

Rainfall: year means total amount of a year

(2) Geology/Topography/Soil

1) Priority sections

As you know, Viet Nam is S-shaped in the north and south. It stretches from 8° 30' N and 23° 22' N. Land of Viet Nam is long and narrow. Length of land is 3,260 km long, and total land area is approximately 331,000 km^2.

Hanoi - Ho Chi Minh Line passes from the north and south of Viet Nam on the east side of countries. Hanoi - Ho Chi Minh Line connects capital of Viet Nam, Hanoi, and Ho Chi Minh city that is the largest city in Viet Nam. Distance between Hanoi and Saigon Station is 1726.2 km.

Topography and geography of the priority sections are as follows:

Hanoi - Than Hoa

Hanoi - Than Hoa section is located in the northwest of Viet Nam. This line passes through plain area.

Hue - Da Nang

Hue - Da Nang section is shorter than other sections. However, topographic condition of this section has a variety. From Hue to Thanh Phu Mon in Phu Loc district, railway goes through inland. From Thon Phu Mon, railway goes along inlet and coast. Railway from Hue crosses the Hai Van Pass. There is Mt. Hai Van that is 724 m high at the Hai Van Pass. Railway goes at the foot of Mt. Hai Van. According to Geography of Viet Nam (Nguyen Trong Dieu, 1995), the Hai Van Pass forms the frontier between the northern Truong San and the southern Truong Son Range.

Muong Man - Saigon

The portion of between Muong Man and Dong Nai river is hilly area. Around Muong Man is located on Di Ling Plateau. In the Di Ling Plateau, altitude of 1,000 m falls gradually to 500 m that is like a valley. From Don Nai river to Saigon station, railway passes through plain area.

2) Gia Lam Workshop

Gia Lam Workshop is located between Hong river and Duong river which is tributary of Hong river. Gia Lam Workshop is located on flat area.

(3) Air quality

We have only limited information on air quality. In recent years, however, it can be said that air quality of urban areas is deteriorating, because load of emission gas from motor vehicles such

as motorbike and car are rising. Ambient air quality such as CO, NOx, Suspended Particles Matters (SPM), and lead are rising. Examples of the existing ambient air quality in Hanoi and Ho Chi Minh city are shown in Table 8.16.2.

According to Viet Nam Environmental Program and Policy Priorities for a Social Economy in Transition (World Bank 1995), there were 700,000 motorcycles and 75,000 other vehicles in Hanoi in 1990/91. Hanoi had 200,000 motorcycles and 34,000 cars and trucks. Most vehicles are older, and are not well maintained. Concentration level of SO_2, dust and lead in Ho Chi Minh city frequently exceed permissible levels.

Emission gas from factories also contributes to increasing load of air pollutants. According to Viet Nam Environmental Program and Policy Priorities for a Social Economy in Transition (World Bank 1995), as a result of 70 % of plant inspection by the Hanoi Environmental Committee in 1992, emissions exceeded air quality standards.

Table 8.16.2 Conditions of Ambient Air Quality

Hanoi

Station	CO mg/m3	SO2 mg/m3	NH3 mg/m3	Dust mg/m3	Date of Survey
Kham Thien - Le Duan Cross	8.6	0.01008	0.02766	5.09	Oct. 5, 1993
O Cho Dua	16.4	0.02206	0.05794	3.37	Oct. 5, 1993
Nguyen Thai Hoc - Ton Due Thang Cross	7.5	0.01623	0.03526	5.31	Oct. 5, 1993
Tran Nhat Duat Street	2.9	0.0058	0.03986	2.26	Oct. 5, 1993

Station	CO mg/m3	SO2 mg/m3	NH3 mg/m3	Dust mg/m3	Date of Survey
Kham Thien - Le Duan Cross	8.6	0.01008	0.02766	5.0879	Oct. 5, 1993
O Cho Dua	16.4	0.02206	0.05794	3.37	Oct. 5, 1993
Nguyen Thai Hoc - Ton Due Thang Cross	7.5	0.01623	0.03526	5.31	Oct. 5, 1993
Tran Nhat Duat Street	2.9	0.0058	0.03986	2.26	Oct. 5, 1993

Ho Chi Minh

Station	CO mg/m3	SO2 mg/m3	NH3 mg/m3	Dust mg/m3	Date of Survey
Thu Duc Station	-	0.23	0.07	0.42	June 1993
Tan Son Nhat Station	-	0.16	0.06	0.35	June 1993
Thu Duc Station	-	0.2	0.07	0.37	July 1993
Tan Son Nhat Station	-	0.16	0.05	0.35	July 1993

Source: Center for Control and Management of Atmospheric and Water Environment

(4) Surface water

1) Gia Lam Workshop

There is drainage system for waste water and rain water in Gia Lam Workshop (see Fig. 8.16.2). According to interview survey of Gia Lam Workshop, there was waste treatment facilities, however, it is not used for a long time. Therefore, waste water from factories is not treated, and it is discharged directory to outside of workshop at the present. Waste water flows into rain water drainage system within Gia Lam Workshop.

Drainage system of Gia Lam Workshop is divided into two systems. One is to collect at pond thorough drainage pipe and channel. The pond in the workshop has three inlets. Impounded drainage water is discharged into a large pond that is located in the south of the workshop. Other system is to discharge into the same pond as the former that is located backyard of No. 5 building. The coverage area is not larger than the former. Discharging large pond is used for not only drainage water from the workshop but also domestic waste water around the this pond.

The JICA Study Team has surveyed water quality at four points at inside and outside of the workshop in July, 1995. Location of sampling points is shown in Fig. 8.16.2. Result of this survey is shown in Table 8.16.3.

Sample of W-1 was taken from ditch of 3B building. W-2 and W-3 were taken from ponds of inside of the workshop and from discharged pond where is located outside of the workshop respectively. Water quality of W-1 was better than surface water. On the other hand, water quality of W-2 and W-3 is almost same level.

Impounded water from factories in pond inside of workshop is discharged. Water of this pond is compared with "Maximum Permissible Concentration of waste water", Haugiang People's Committee No. 2281/QD, 1991 (see Table 8.16.4). The following water quality of this pond is below Class-I (for water supply, tourism, fishing) of this Standard.

Table 8.16.3 Result of Water Quality Survey at Gia Lam Workshop

Date: July 17, 1995

Items	Stations / Unit	W - 1	W - 2	W - 3	W - 4
Time		11:15	11:00	12:10	11:35
Water temperature	C	26.9	32.6	30.0	25.4
pH	-	7.6	8.1	7.6	6.8
DO	mg/l	3.7	6.6	4.0	0.3
COD	mg/l	13.8	24.1	18.9	10.1
BOD	mg/l	5.2	8.8	8.6	4.2
SS	mg/l	27.5	55	40	10.5
Turbidity	FTU	4	20	40	< 1
Total phosphate	mg/l	0.039	0.063	0.078	0.031
Total nitrogen	mg/l	0.63	0.74	1.42	3.84
Pb	mg/l	0.0017	0.0035	0.0013	0.031
Zn	mg/l	0.0063	0.0065	0.0058	0.0148
Hg	mg/l	0.0002	0.00052	0.00056	0.00041
Ni	mg/l	0.028	0.048	0.064	0.024
Cd	mg/l	0.00016	0.00013	0.00011	0.00008
Cr(VI)	mg/l	0.006	0.011	0.013	0.004
As	mg/l	0.0052	0.0074	0.0062	0.002
n-Hexane Extraction Matters	mg/l	< 0.001	< 0.001	< 0.001	< 0.001
Coliform	MPN/100ml	3.5 X 102	4.3 X 102	5.5 X 102	0

Weather: Cloudiness

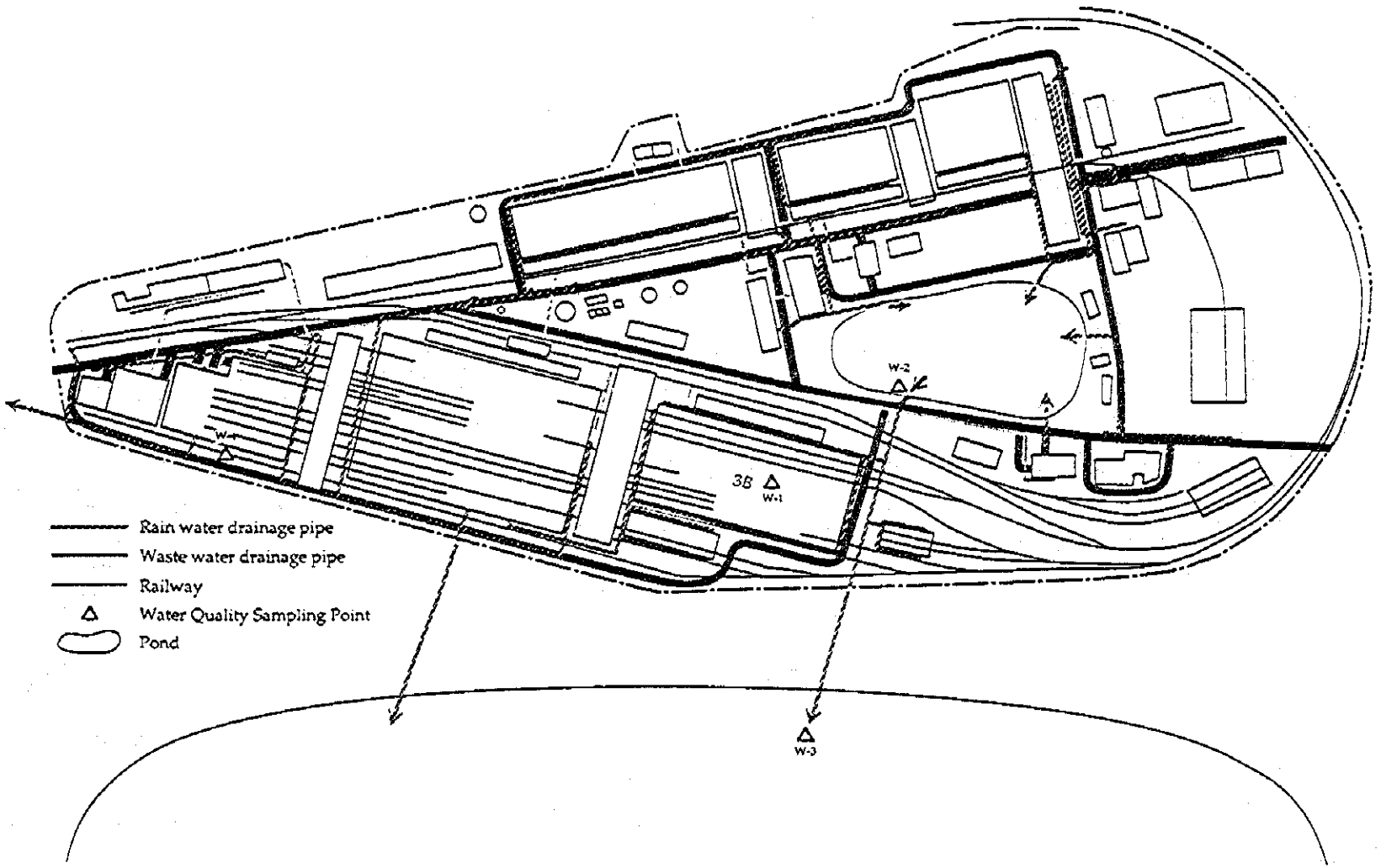


Fig. 8.16.2 Drainage System and Water Quality Sampling Points at Gia Lam Workshop

Table 8.16.4 Maximum Permissible Concentration of Waste Water

Elements	Unit	Class - I	Class - II
pH	-	5 - 8	4 - 9
COD	mg/l	160	200
BOD	mg/l	80	100
SS	mg/l	50	100
Pb	mg/l	0.2	1
Zn	mg/l	1	5
Hg	mg/l	0.01	0.05
Cd	mg/l	0.02	0.1
As	mg/l	0.1	0.5
Total Coliforms	MPN/100ml	5000	10000

sources: Haugiang People's Committee 2281/QD, 1991

Maximum Permissible Concentration of Waste Water's Constituent Discharging into Water Sources

Class I: water sources using for water supply, tourism, fishing.

Class II: water sources not using for Class I

Sample of W-4 was taken from a well of 24 m deep. Groundwater quality is compared with surface water, W-2 and W-3. Organic matters (indicator: COD, BOD) and metals except lead and zinc are almost lower than surface water.

The following elements of this sample except total coliforms are below the standard of "Groundwater Quality Using for water supply", Haugiang People's Committee 2281/QD, 1991 (see Table 8.16.5).

Table 8.16.5 The Groundwater Quality for Water Supply

Elements	Unit	Minimum Requirement	Maximum Requirement
pH	-	6.0 - 8.0	6.5 - 8.0
SS	mg/l	100	25
Pb	mg/l	0.05	0
Zn	mg/l	5.0	1.0
Hg	mg/l	0.001	0
Cd	mg/l	0.01	0
As	mg/l	0.1	0
Total Coliforms	MPN/100ml	3	0

sources: Haugiang People's Committee 2281/QD, 1991

The Groundwater Quality Using for Water Supply

(5) Noise

1) Priority sections

The JICA Study Team has surveyed noise level from traveling trains on priority sections in August, 1995. Results of survey are shown in Table 8.16.6, and maximum permitted noise level is shown in Table 8.16.7. Locomotives generate higher noise rather than when passenger cars and freight cars. Noise level is higher at 5 m from railway, then the noise level gradually decreases. Noise level at 10 m from railway is 20 - 30 dB higher than background.

Table 8.16.7 Maximum Permited Noise Level

No.	Types of Area	Time		
		6:00 - 18:00	18:00 - 22:00	22:00 - 6:00
1	area requiring special quietness area: hospitals, library, resort place, kindergarten, school	50	45	40
2	residential area, hotel, houses, offices	60	55	45
3	commercial area	70	70	50
4	production area: workshop, factory	75	70	50

Viet Nam's Standard TCVN No. 5949, 1995

2) Gia Lam Workshop

The JICA Study Team has surveyed noise level within and around Gia Lam Workshop. Result of noise level survey is shown in Table 8.16.8, 9. Noise level in building of 2B and 5B in Gia Lam Workshop is an intermittent, because noise sources are hammer work and steel metal work. Noise of building 33B is a continuous type, because noise sources are air compressers.

St. N-1 and N-2 are located in commercial area. The noise level of these points exceeds Maximum Permited noise level (see Table 8.16.7). St. N-2 is located in the south of Gia Lam Workshop, there is small road connected with national road. Noise level of St. N-2 ranges from 62 dB to 78 dB. Higher peak noise level, this is 78 dB, is occurred during passing vehicles. On the other hand, St. N-3 is lower than Maximum Permitted Noise Level (residential area: 60 dB).

Table 8.16.6 (1) Result of Noise Level Survey on Hanoi - Ho Chi Minh Line

Location: Hanoi-1 Date: July , 1995

No. of Survey		1	Background	2	Background	3	Background
Survey Time		13:15	13:20 - 13:25	14:02	14:10 - 14:15	15:00	15:05 - 15:15
Type of Train		D4H (93)		D5H (YB1)		D4H (HP1)	
Noise Level* dB(A)	St. 1	97	49	93	52	98	52
	St. 2	103	67	108	67	103	67
	St. 3	93	57	87	59	105	58
	St. 4	95	60	93	61	98	62
Data of Train							
Direction		Hanoi→Than Nguyen		Hanoi→Yen Bai		Hanoi→Hai Phong	
No. of cars		Locom.+7cars		Locom.+7cars		Locom.+8cars	
Use		for passenger		for passenger		for passenger	
Train speed (km/h)		14		18		12	

*: reffer to survey location map, Fig.

Location: Hanoi-2 Date: July 4, 1995

No. of Survey		1	Background	2	Background
Survey Time		10:00	10:05 - 10:15	11:05	11:06 - 11:11
Type of Train		D12E (S5)		D12E (S4)	
Noise Level dB(A)	5 m	103	75	102	75
	10 m	95	72	91	70
	20 m	85	68	81	67
	50 m	78	61	71	60
Data of Train					
Direction		Hanoi→Saigon		Saigon→Hanoi	
No. of cars		Locom.+13cars		Locom.+11cars	
Use		for passenger		for passenger	
Train speed (km/h)		25		27	

Location: Thanh Hoa Date: July 20, 1995

No. of Survey		1	Background	2	3
Survey Time		14:10	14:15 - 14:20	14:25	14:33
Type of Train		D6E		D6E	D12E
Noise Level dB(A)	5 m	87	52	79	92
	10 m	80	54	80	95
	20 m	77	62	74	89
	50 m	73	49	67	68
Data of Train					
Direction		Vinh→Hanoi		Vinh→Hanoi	Hanoi→Saigon
No. of cars		Locom.+7cars		Locom.+5cars	Locom.+13cars
Use		for passenger		for passenger	for passenger
Train speed (km/h)		27		33	24

Table 8.16.6 (2) Result of Noise Level Survey on Hanoi - Ho Chi Minh Line

Location: Hue — Date: July 21, 1995

No. of Survey		1	Background	2	3	4
Survey Time		12:50	12:55 - 13:00	13:12	13:30	13:52
Type of Train		D12E (S6)		D4H	D4H (DH1)	D4H
Noise Level dB(A)	5 m	88	55	91	93	89
	10 m	88	54	87	84	88
	20 m	79	54	84	80	83
	50 m	68	50	69	70	68
Data of Train						
Direction		Saigon→Hanoi		Hue→the north	Hue→Da Nang	Hue→the south
No. of cars		Locom.+14cars		2 Locom.s*	Locom.+5cars	Locom.+8cars
Use		for passenger		for freight	for passenger	for freight
Train speed (km/h)		25		31	31	53

*: one locomotive works, other locomotive does not work

Location: Da Nang — Date: July 22, 1995

No. of Survey		1	Background	2	3	Background
Survey Time		8:17	8:20-8.25	8:43	11:20	11:25 - 11:30
Type of Train		D12E (S3)		D12E (S6)	D12E (LH2)	
Noise Level dB(A)	5 m	92	64	100	90	75
	10 m	88	61	97	85	73
	20 m	85	62	89	82	67
	35 m	76	60	79	78	62
Data of Train						
Direction		Hanoi→Saigon		Saigon→Hanoi	Saigon→Hue	
No. of cars		Locom.+13cars		Locom.+13cars	Locom.+7cars	
Use		for passenger		for passenger	for passenger	
Train speed (km/h)		15		51	43	

Location: Muong Man — Date: July 22, 1995

No. of Survey		1	Background
Survey Time		14:44	14:50 - 14:55
Type of Train		D9E (S6)	
Noise Level dB(A)	5 m	99	50
	10 m	92	47
	20 m	88	48
	35 m	73	44
Data of Train			
Direction		Saigon→Hanoi	
No. of cars		locom.+13cars	
Use		for passenger	
Train speed (km/h)		35	

Table 8.16.6 (3) Result of Noise Level Survey on Hanoi - Ho Chi Minh Line

Location: Saigon-1 Date: July 24, 1995

No. of Survey		1	Background	2	Background
Survey Time		12:01	12:05 - 12:10	13:50	13:52 - 13:57
Type of Train		D9E (S3)		D9E (S7)	
Noise Level dB(A)	5 m	97	65	94	66
	10 m	92	65	92	64
	20 m	87	60	83	55
	40 m	76	60	78	59
Data of Train					
Direction		Hanoi→Saigon		Hanoi→Saigon	
No. of cars		Locom.+11cars		Locom+12cars	
Use		for passenger		for passenger	
Train speed (km/h)		24		28	

Location: Saigon-2 Date: July 24, 1995

No. of Survey		1	Background	2	3	Background
Survey Time		6:17	6:20 - 6:25	7:04	10:05	10:10 - 10:15
Type of Train		D9E		D9E	D9E (S6)	
Noise Level dB(A)	5 m	97	73	102	94	64
	10 m	91	70	89	91	73
	20 m	90	80	85	86	59
	35 m	90	52	72	78	67
Data of Train						
Direction		Saigon→Bien Hoa		Saigon→the north	Saigon→Hanoi	
No. of cars		Locom.+2cars		One Locom.	Locom.+11	
Use		for passenger		-	for passenger	
Train speed (km/h)		30		30	23	

Table 8.16.8 Result of Noise Survey Inside of Gia Lam Workshop

Survey date: July 18, 1995

Survey Points	2B		5B		33B	
	Inside of building	Outside of building	Inside of building	Outside of building	Inside of building	Outside of building
Survey Time	10:15 - 10:20				9:40 - 9:50	
Noise Level dB(A)	84	65	78	63	91	73
Noise Sources	hammers electric fan furnaces	including noise from 33B	hammers sheet metal work		compressor	

Table 8.16.9 Result of Noise Survey at Outside of Gia Lam Workshop

Survey date: July 18, 1995

Survey Points	N-1	N-2	N-3
Survey Time	10:50 - 11:00	11:10 - 11:15	11:25 - 11:30
Noise Level dB(A)	79	71 62 - 78*	54
Location	gate of workshop front of national road	backyard of workshop	residential area

*: minimum - no passing vehicles
maximum - passing vehicles

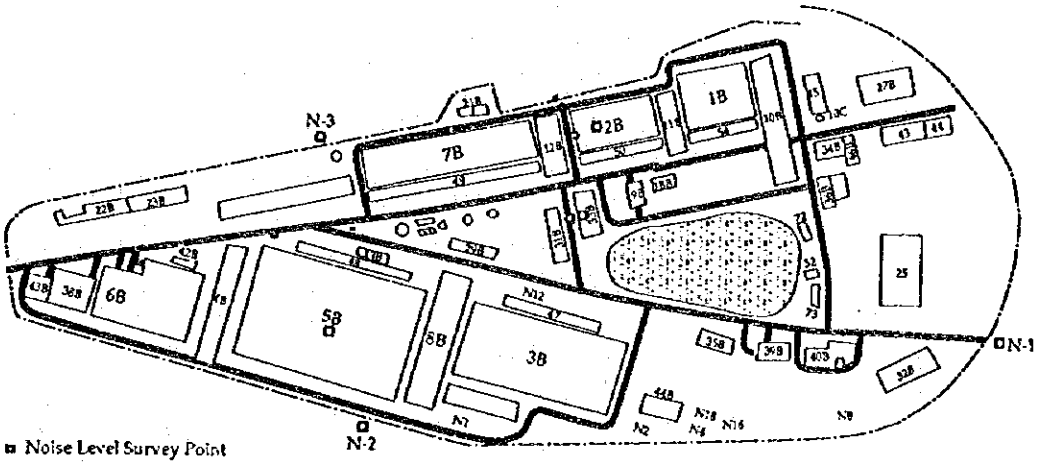


Fig. 8.16.3 Location of Noise Level Survey at Gia Lam Workshop

8.16.2 Biological Resources and Ecosystems

(1) Flora

1) Priority sections

In Viet Nam, coverage of forest depends on climate, topographic and soil conditions. The forest consists several types of plant. Intertropical plants are distributed in the plain areas and at the foot of mountains. Subtropical plants are distributed in mountain area while wood lands and savannas predominate in the drier region. Vegetation map in Viet Nam is shown in Fig. 8.16.4. According to Viet Nam Environmental Program and policy Priorities for a Socialist Economy in Transition, World Bank, 1995, the 7,000 species of flora are identified in Viet Nam, and 40 % are found nowhere else in the World.

Priority sections of Hue - Da Nang, the railway goes through forest area around Hai Van Pass. The railway which is Muong Man - Ho Chi Minh goes through secondary forest in mountain area from around Mt. To Ong where is at about 8 km from Muong Man Station to boundary village between Xuan Truong and Xuan Tho, Dong Nai Province. Forest area along railway on Muong Man - Ho Chi Minh section is approximately 55 km long.

2) Gia Lam Workshop

According to survey that was carried out by Center for Control and Management of Atmospheric and Water Environment, invaluable flora can not be identified around Gia Lam Workshop.

(2) Fauna

According to Viet Nam Environmental Program and policy Priorities for a Socialist Economy in Transition, World Bank, 1995, there are many species of fauna in Viet Nam as follows:

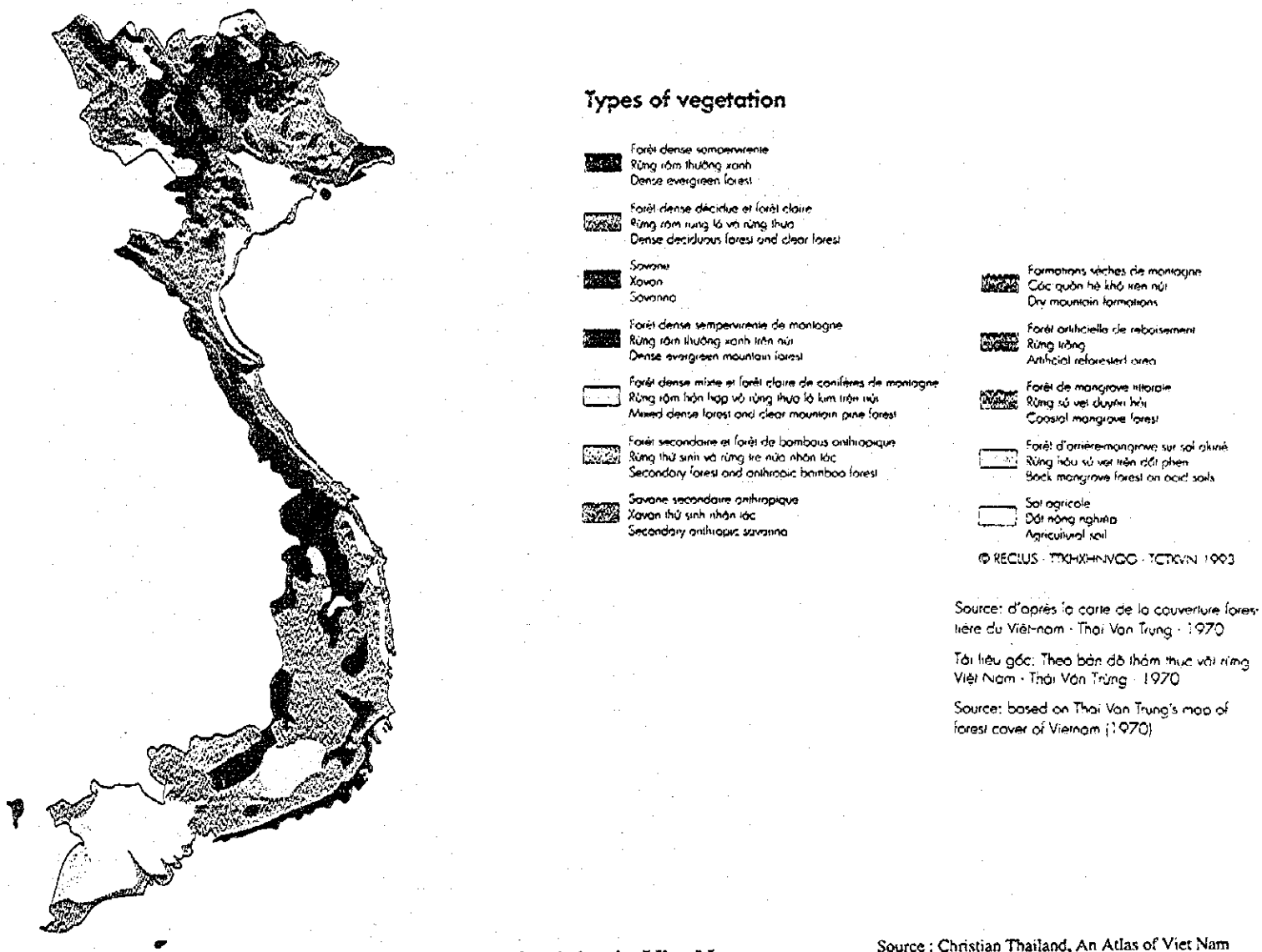


Fig. 8.16 4 Vegetation Map in Viet Nam

Source : Christian Thailand, An Atlas of Viet Nam
RECLUS - La Documentation Franchise

mammals	275	species
birds	800	species
reptiles	180	species
amphibians	80	species
fish/invertebrates	2,500	species

Some species of fauna are facing and extinct, for example, 28 % of the mammals, 10 % of the birds, and 21 % of the amphibians and reptiles are listed as endangered species.

8.16.3 Quality of Life

(1) Population/Community

Population change of Viet Nam is shown in Fig. 8.16.5 and Table 8.16.10. Population of Viet Nam's is 70.80 million and annual population growth between census year of 1979 and 1989 has been 1.6 %. According to Statistical Yearbook (General Statistical Office, 1947), population of urban area accounts for about 20 % of total population since 1970.

1) Priority sections

Population density along railway is shown in Table 8.16.11. This population density is calculated town or village level which are crossed railway.

Hanoi - Thanh Hoa Section

Hanoi - Thanh Hoa section, around Hanoi Station is 20,800 persons/km^2, and is highest population density on this section. Population density of Nam Ha, Ninh Binh and Thanh Hoa is 6,748 persons/km^2, 4,931 persons/km^2 and 5,928 persons/km^2 respectively. Population density of these areas is higher than others that are around 1,000 to 2,000 persons/km^2.

Hue - Da Nang Section

Hue - Da Nang section, around Hue and Da Nang stations have higher population density 5,826 persons/km^2 and 3,896 persons/km^2 respectively. However, section between Hue - Da Nang is hundreds persons/km^2.

Muong Man - Ho Chi Minh Section

Muong Man - Ho Chi Minh station, the east of Bien Hoa Station is lower population density than the west portion from Bien Hoa Station, and is almost hundreds persons/km^2. Higher density areas are distributed on the west from Bien Hoa Station.

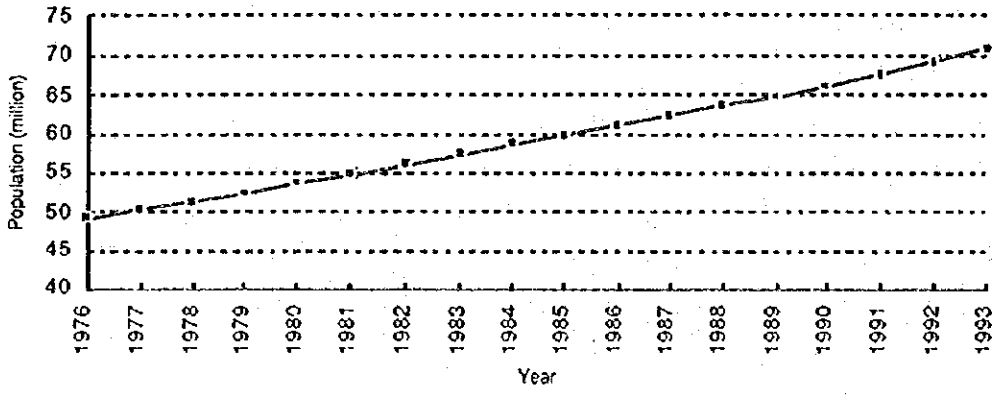


Fig. 8.16.5 Population Change, 1976 - 1993

Source: ADB, Key Indicators of Developing Asian and Pacific Countries

Table 8.16.10 Population Change, 1976 - 1993

Unit: Million

Year	1976	1977	1978	1979	1980	1981	1982	1983	1984
Population	49.16	50.41	51.42	52.46	53.72	54.93	56.17	57.37	58.65

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993
Population	59.87	61.11	62.45	63.73	64.77	66.23	67.68	69.31	70.8

Source: ADB, Key Indicators of Developing Asian and Pacific Countries, 1994

2) Gia Lam Workshop

Gia Lam Workshop is located in Capital of Viet Nam, Hanoi. Population of Hanoi is 2048,000, and population density is 2,225 persons/km^2.

(2) Economic Activities

The Gross Domestic Product (GDP) of Viet Nam is 170,258 billion dongs in 1994 (at current price). The Gross Domestic Product by sectors is shown in Table 8.16.12. Growth rate of GDP is 24 % per annual between 1992 and 1994. Composition of GDP in Viet Nam, primary sector (agriculture, forestry, fishery) was the highest rank with 40 % of total GDP in 1991. However, rate of primary sector is decreasing, primary sector is second rank since 1992. On the other hand, service sector is increasing. Rate of service sector accounts for 42 % of total GDP in 1994.

Table 8.16.11 (1) Population Density along Railway

Hanoi - Thah Hoa Section

Station	Province	District	Town/Village	Area (ha)	Population	Population density (persons/km2)
Hanoi		Dong Da		1,400.0	291,379	20,813
Giap Bat	Hanoi	Thanh Tri	Dinh Cong	250.0	5,490	2,196
	1992		Dai Kim	270.0	5,566	2,061
			Hoang Liet	460.0	7,682	1,670
			Tam Hiep	340.0	7,423	2,183
			Tu Hiep	470.0	7,282	1,549
			Ngu Hiep	360.0	7,213	2,004
			Ngoc Hoi	330.0	5,881	1,782
			Lien Minh	420.0	6,956	1,656
Thuong Tin	Ha Tay	Thuong Tin	Nhi Khe	168.7	4,341	2,573
	1992		Van Binh	520.6	5,370	1,032
			Van Phu	323.0	4,273	1,323
			Quat Dong	334.6	5,354	1,600
			Thang Loi	411.8	6,087	1,478
			To Hieu	408.9	7,280	1,780
			Van Tu	384.4	6,033	1,569
			Minh Cuong	355.5	6,790	1,910
Phu Xuyen		Phu Xuyen	Phu Xuyen	683.0	6,750	988
			Phuc Tien	569.9	6,135	1,077
			Dai Xuyen	751.3	6,692	891
			Phu Yen	325.4	3,798	1,167
			Chau Can	661.0	7,856	1,189
		Hoai Duc	An Khanh	-	-	-
			Duong Noi	-	-	-
			La Phu	-	-	-
		Ha Dong	Kien Hung	405.0	8,513	2,102
		Thanh Oai	Phu Luong	730.7	11,820	1,618
	Nam Ha	Duy Tien	Duy Minh	433.3	4,770	1,101
	1992		Dong Van	421.9	4,520	1,071
			Hoang Dong	630.0	6,921	1,099
			Tien Tan	727.4	4,386	603
			Lam Ha	783.6	7,504	958
		Nam Ha		463.4	31,269	6,748
		Thanh Liem	Liem Chung	349.4	4,122	1,180
			Liem Tiet	567.3	4,272	753
			Liem Cau	701.7	6,313	900
			Liem Phong	534.0	3,864	724
		Binh Luc	Don Xa	738.7	5,371	727
			An My	632.6	5,519	873
			Trung Luong	822.8	6,625	805
			My Thuan	817.3	5,869	718
			My Thinh	687.6	4,626	673
			My Thanh	618.2	3,832	620
			My Hung	672.6	6,829	1,015
Nam Dinh		Nam Dinh	Loc Hoa	-	5,284	
			Loc An	-	3,112	

Table 8.16.11 (2) Population Density along Railway

Hanoi - Thanh Hoa Section

Station	Province	District	Town/Village	Area (ha)	Population	Population density (persons/km2)
		Vu Ban	Tan Thanh	360.0	3,139	872
			Thanh Loi	1,080.6	12,353	1,143
			Lien Minh	1,026.7	8,249	803
			Tam Thanh	664.4	4,571	688
		Y Yen	Yen Ninh	830.9	8,344	1,004
			Yen Tien	845.2	9,582	1,134
			Yen Hong	717.3	4,892	682
			Yen Quang	639.0	4,220	660
			Yen Bang	1,007.8	7,501	744
	Ninh Binh	Ninh Binh		812.96	40,083.0	4,931
	1992					
		Hoa Lu	Ninh Phong	626.2	6,524	1,042
			Ninh An	529.7	5,043	952
		Tam Diep	Khanh Thuong	1,312.1	9,060	691
			Yen Thang	1,170.4	7,212	616
			Yen Binh	1,198.7	6,579	549
			Tam Diep	-	-	
			Quang Son	3,592.7	3,951	110
	Thanh Hoa	Bim Son	Ha Trung	-	-	
	1992		Ngoc Trac	724.5	5,914	816
			Quang Trung	980.5	7,687	784
		Ha Trung	Ha yen	343.0	2,674	780
			Ha Binh	1,024.5	4,779	466
			Ha Phong	267.2	2,071	775
		Hau Loc	Dai Loc	572.4	4,106	717
			Trieu Loc	925.2	3,840	415
		Hoang Hoa	Hoang Trung	697.3	4,726	678
			Hoang Kim	270.0	5,261	1,949
			Hoang Quy	342.0	4,053	1,185
			Hoang Trinh	501.9	6,006	1,197
			Hoang Quy	489.0	5,618	1,149
			Hoang Ly	334.0	3,436	1,029
			Hoang Anh	400.0	4,563	1,141
			Hoang Long	377.0	3,671	974
		Thanh Hoa	Nam Ngan	289.5	17,158	5,928
			Dong Tho	364.7	10,117	2,774
Thanh Hoa			Phu Son	274.8	14,018	5,102

Table 8.16.11 (3) Population Density along Railway

Hue - Da Nang Section

Station	Province	District	Town/Village	Area (ha)	Population	Population density (persons/km2)
Hue	Thua Thien Hue	Hue	Phuong Duc	151	8,772	5,826
	1992		Phuoc Vinh	-	10,746	-
			An Cuu	-	12,183	-
			Thuy An	1,178.31	11,979	1,017
		Huong Thuy	Thuy Duong	1,191	8,084	679
			Thuy Phuong	2,159.01	9,560	443
			Thuy Thanh	840.57	6,404	762
			Thuy Chau	1,155.59	7,651	662
			Thuy Luong	778.69	5,282	678
			Thuy Phu	2,311.16	9,039	391
		Phu Loc	Loc Bon	2,678	10,436	390
			Loc Son	1,770	5,944	336
			Loc An	2,420	11,138	460
			Loc Dien	8,108	12,808	158
			Phu Loc	2,310	9,464	410
			Loc Tri	6,532	7,030	108
			Loc Thuy	7,640	10,183	133
			Loc Vinh	2,878	4,387	152
			Loc Hai	10,396	8,958	86
	Quang Nam Da Nang	Hoa Vang	Hoa Hiep	6,431	17,340	270
	1992		Hoa Vinh	-	-	-
			Hoa Khanh	2,027	18,532	914
			Hoa Minh	817	7,809	956
Da Nang		Da Nang city		9,515	370,670	3,896

Muong Man - Ho Chi Minh Section

Station	Province	District	Town/Village	Area (ha)	Population	Population density (persons/km2)
Muong Man	Binh Thuan	Ham Thuan Nam	Muong Man	6,120	4,747	78
	1992		Ham Kiem	11,780	5,163	44
			Ham Cuong	7,080	5,310	75
			Tan Lap	18,470	12,168	66
		Ham Tan	Tan Nghia	10,430	10,457	100
			Tav Minh	21,580	7,572	35
		Tanh Linh	Suoi Kiet	21,610	1,605	7
			Gia Huynh	13,300	1,989	15
	Dong Nai	Xuan Loc	Xuan Thanh	6,848	4,219	62
	1992		Xuan Truong	11,303	25,705	227
			Xuan Tho	4,021	13,749	342
		Long Khanh	Xuan Vinh	4,837	19,902	411
			Xuan Loc	1,761	42,275	2,401
			Xuan Lap			

Table 8.16.11 (4) Population Density along Railway

Muong Man - Ho Chi Minh Section

Station	Province	District	Town/Village	Area (ha)	Population	Population density (persons/km2)
		Thong Nhat	Gia Kiem	2,935	18,797	640
			Hung Loc	3,594	13,991	389
			Trang Bom 2	2,634.37	23,920	908
			Trang Bom 1	7,336.66	28,969	395
			Ho Nai 4	4,625	23,169	501
			Ho Nai 3	2275.28	14,756	649
		Bien Hoa	Tan Hoa	384.68	22,237	5,781
			(Military Area)	-	-	-
			Tam Hoa	225.1	18,571	8,250
			Tam Hiep	320	21,642	6,763
			Block No. 8			
			Thong Nhat	334.18	15,824	4,735
			Hoa An	680.4	7,731	1,136
	Song Be	Thuan An	Tan Dong Hiep	1,400	7,872	562
	1992		An Binh	1,500	15,447	1,030
	Ho Chi Minh City	Thu Duc	Tam Phu	268	11,582	4,322
	1992		Linh Dong	227	16,413	7,230
Binh Trieu			Hiep Binh Chanh	1,728	11,528	667
		Binh Thanh		2,055	322,577	15,697
		Go Vap		1,892	162,642	8,596
		Phu Nhuan		491.88	171,858	34,939
Saigon		District No 3		-	238,842	-

Table 8.16.12 Gross Domestic Product by Sectors

(at current prices) (unit: Billion Dongs)

Year	1991	1992	1993	1994
Total	76,707	110,535	136,571	170,258
Agriculture,Forestry, Fishery	31,058	37,513	40,796	48,865
Industry, Construction	18,252	30,135	39,472	50,481
Service	27,397	42,887	56,303	70,912

source: General Statistical Office, Statistical Yearbook, 1994

(3) Land use

1) Priority sections

Land use along railway on Hanoi - Thanh Hoa, Hue - Da Nang and Muong Man - Saigon is shown in Fig. 8.16.6. Outline of land use conditions is as follows:

Hanoi - Thanh Hoa Section

Hanoi is capital city of Viet Nam so that economic activities are higher than other cities without Ho Chi Minh city. Land use around Hanoi Station is commercial and residential areas. In the some parts of commercial area, there are a lot of buildings that are used for shop on first floor and resident on second and third floor. The section between Hanoi - Thanh Hoa is agriculture area. Although there is residential area around Thanh Hoa Station, this is not high population density area.

Hue - Da Nang Section

Land use of Hue - Da Nang section consists of three types: residential area, forest area and agriculture area. Around Hue Station and Da Nang Station are residential area. Hai Van Pass is located in center of this section. This mountain area is covered with forest. Between residential area and forest area, Hue - Hai Van Pass and Hai Van Pass - Da Nang, are used as agriculture.

Muong Man - Ho Chi Minh Section

Major land use of this section is agriculture and forest/bush. Railway goes through in high density residential area around Saigon Station. Saigon Station is located in Ho Chi Minh city that is the most activity city in Viet Nam. Width of railway and structures is a very narrow. On the some sections, width of railway and houses is less than 50 cm, and passenger cars bump trees.

2) Gia Lam Workshop

Land use around Gia Lam Workshop is shown in Fig. 8.16.17. Gia Lam Workshop is located in the east of Red river. The south and east of Gia Lam Workshop is commercial area. The north of Workshop is used as agriculture. Communities are distributed in this agriculture area.

(4) Traffic

1) Priority sections

Many parts of Hanoi - Ho Chi Minh Line go along Highway No. 1A. There are railway crossings on the line. The tracks and passenger cars also cross railway where there is not level crossing protection device.

Some bridges are used for crossing railway and vehicles in common. The vehicles run on the bridges, so that the vehicles stop at railway crossing when train crosses the bridge.

2) Gia Lam Workshop

Gia Lam Workshop and its suburbs are located in the place of good transportation network (see Fig. 8.16.8).

Gia Lam Workshop is faced with Gia Lam Railway Station. It is located between Hanoi Station and Yen Vien Station on Cai Lan, Lao Cai and Dong Dang Lines. Gia Lam Station also connected with Hai Phong Line.

In the south of the workshop, there is a national road, named Highway No. 1A. Highway No. 1A runs from Lan Son to pass Hanoi. This road is one of the major roads so that traffic volume is relatively high. Highway No. 5 is connected with Highway No. 1A for Hai Phong. This road is located in the east of the workshop.

There is Gia Lam Bus Terminal in the southwest of Gia Lam Workshop. The buses are for northern provinces from this bus terminal.

(5) Cultural property/Archaeological site

1) Gia Lam Workshop

Survey of cultural property and archaeological site have been entrusted to Viet Nam local consultant. As a result, major cultural properties are Giaquat Pagoda and Giathuy temple. Giaquat Pagoda belongs to Giaquat community. Giathuy temple has an ancient as accepted as historical event by the Viet Nam Government.

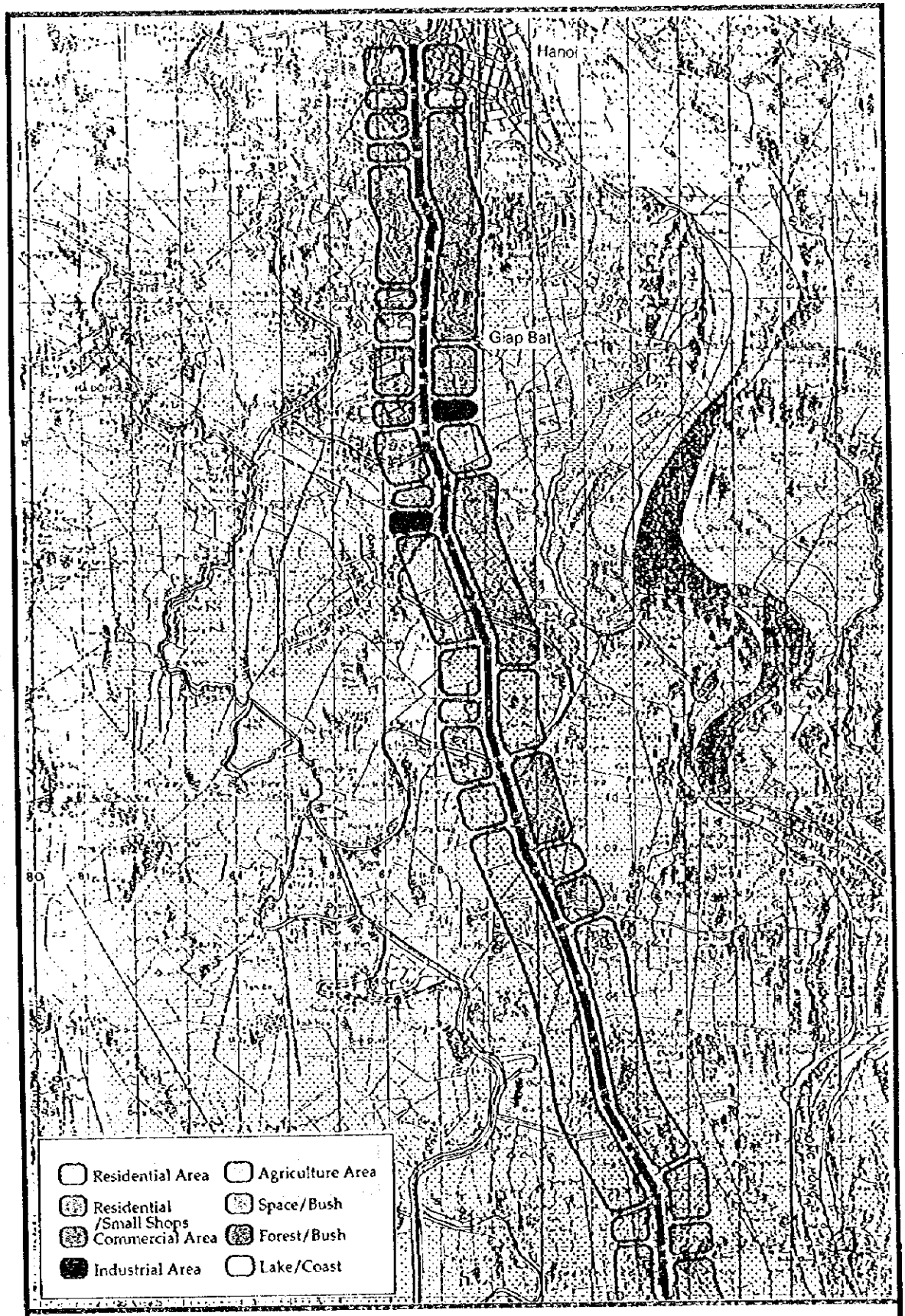


Fig. 8.16.6 (1) Land Use along Railway on Hanoi - Ho Chi Minh Line (Hanoi - Than Hoa)

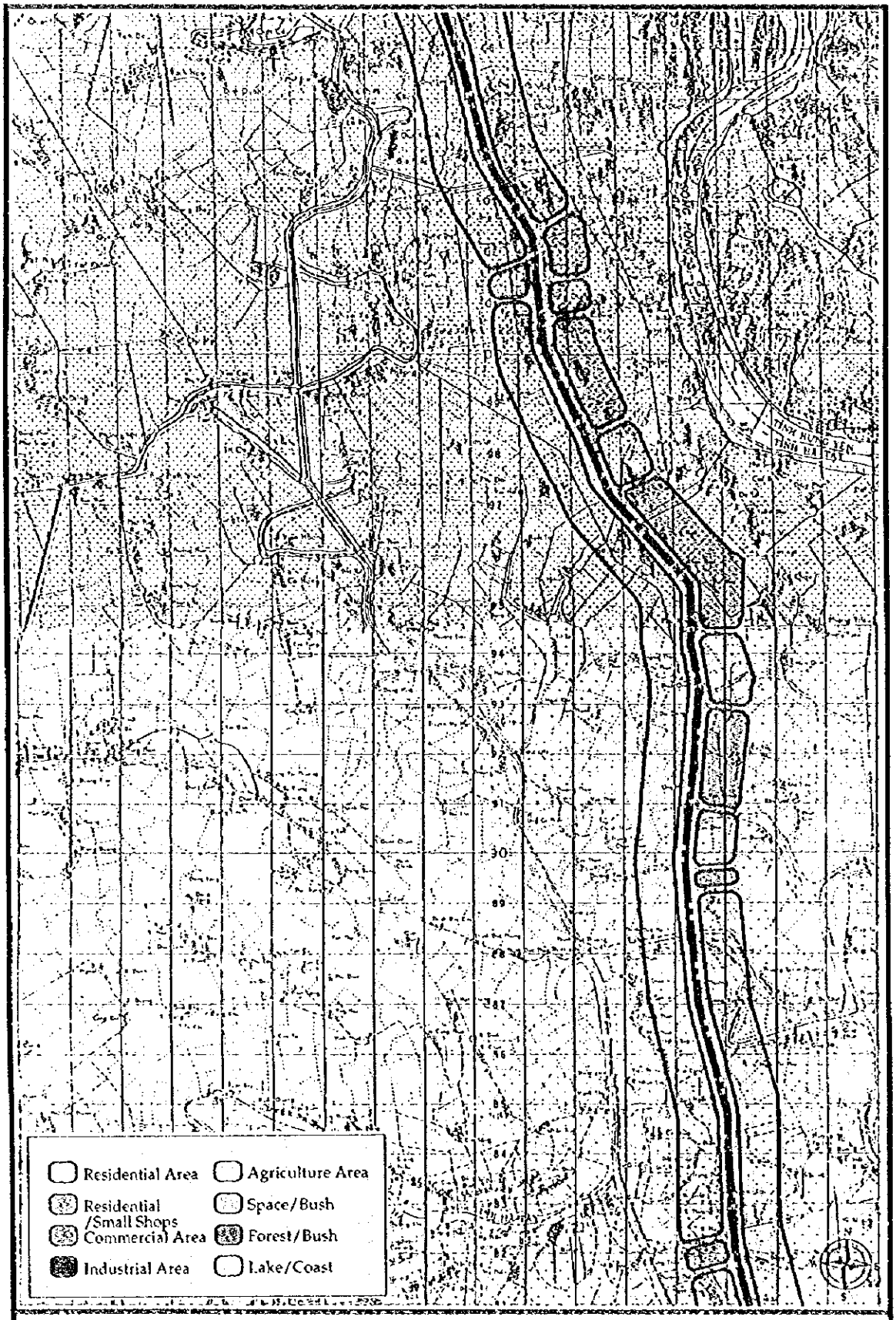


Fig. 8.16.6 (2) Land Use along Railway on Hanoi - Ho Chi Minh Line (Hanoi - Than Hoa)

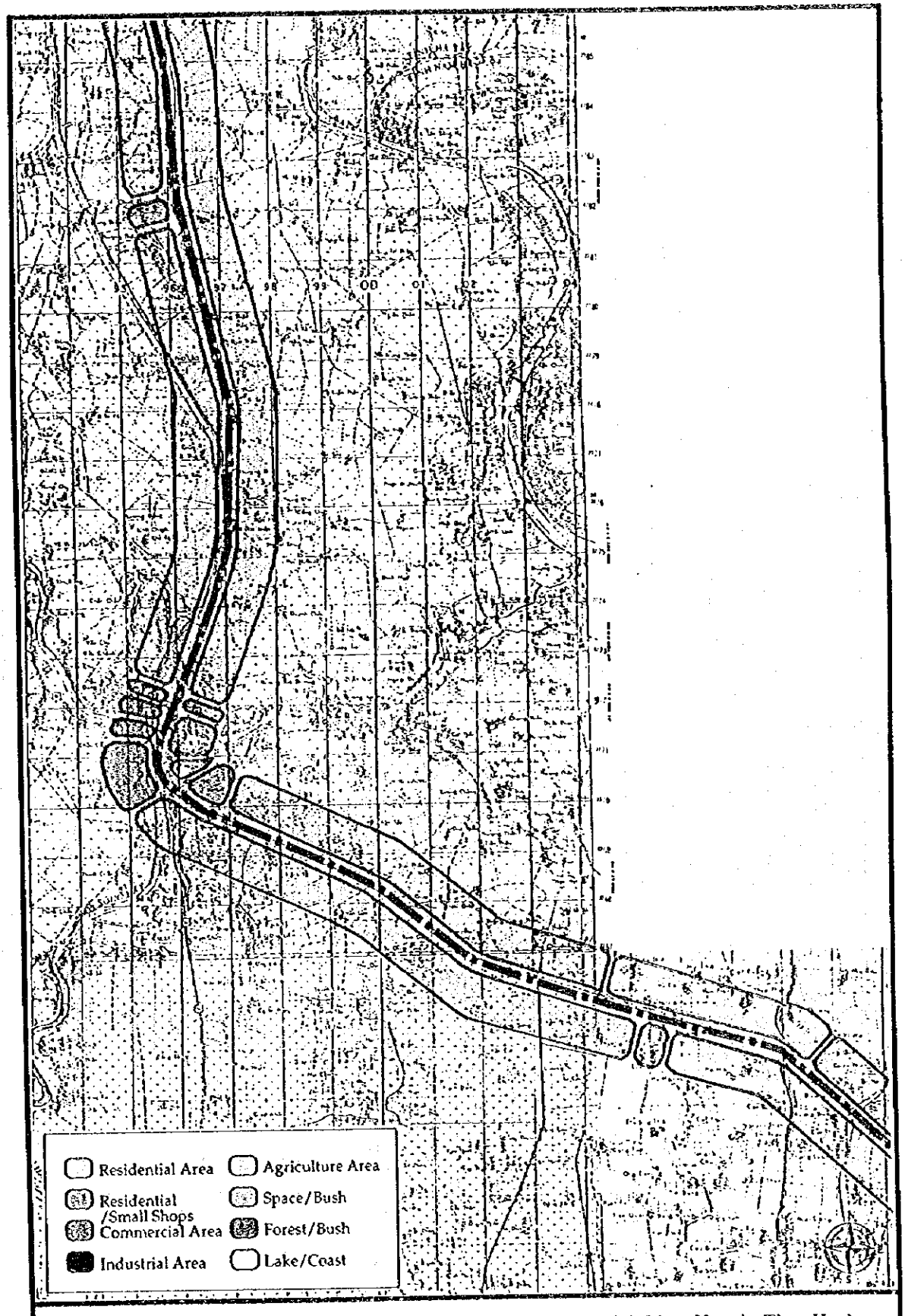


Fig. 8.16.6 (3) Land Use along Railway on Hanoi - Ho Chi Minh Line (Hanoi - Than Hoa)

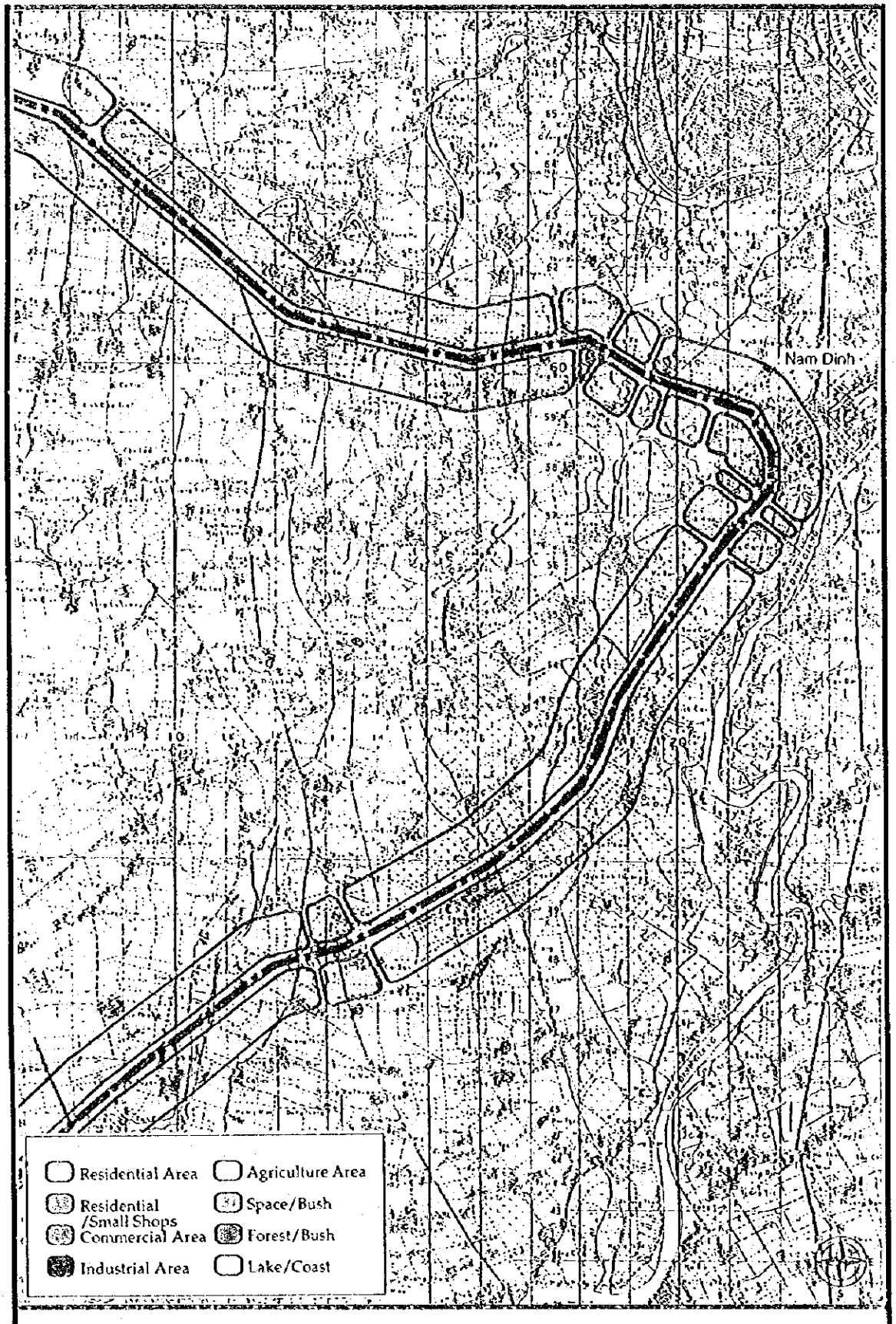


Fig. 8.16.6 (4) Land Use along Railway on Hanoi - Ho Chi Minh Line (Hanoi - Than Hoa)

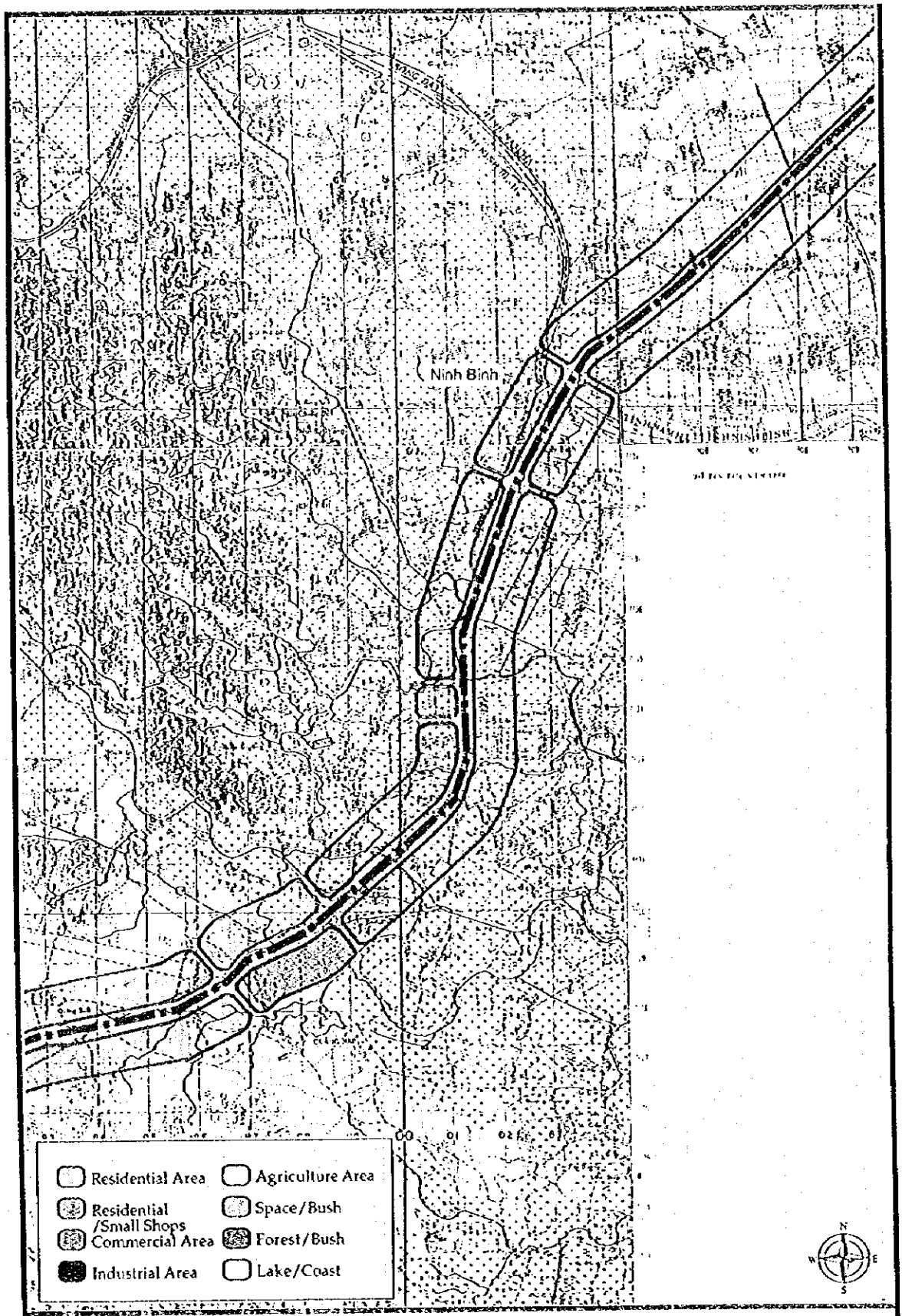


Fig. 8.16.6 (5) Land Use along Railway on Hanoi - Ho Chi Minh Line (Hanoi - Than Hoa)

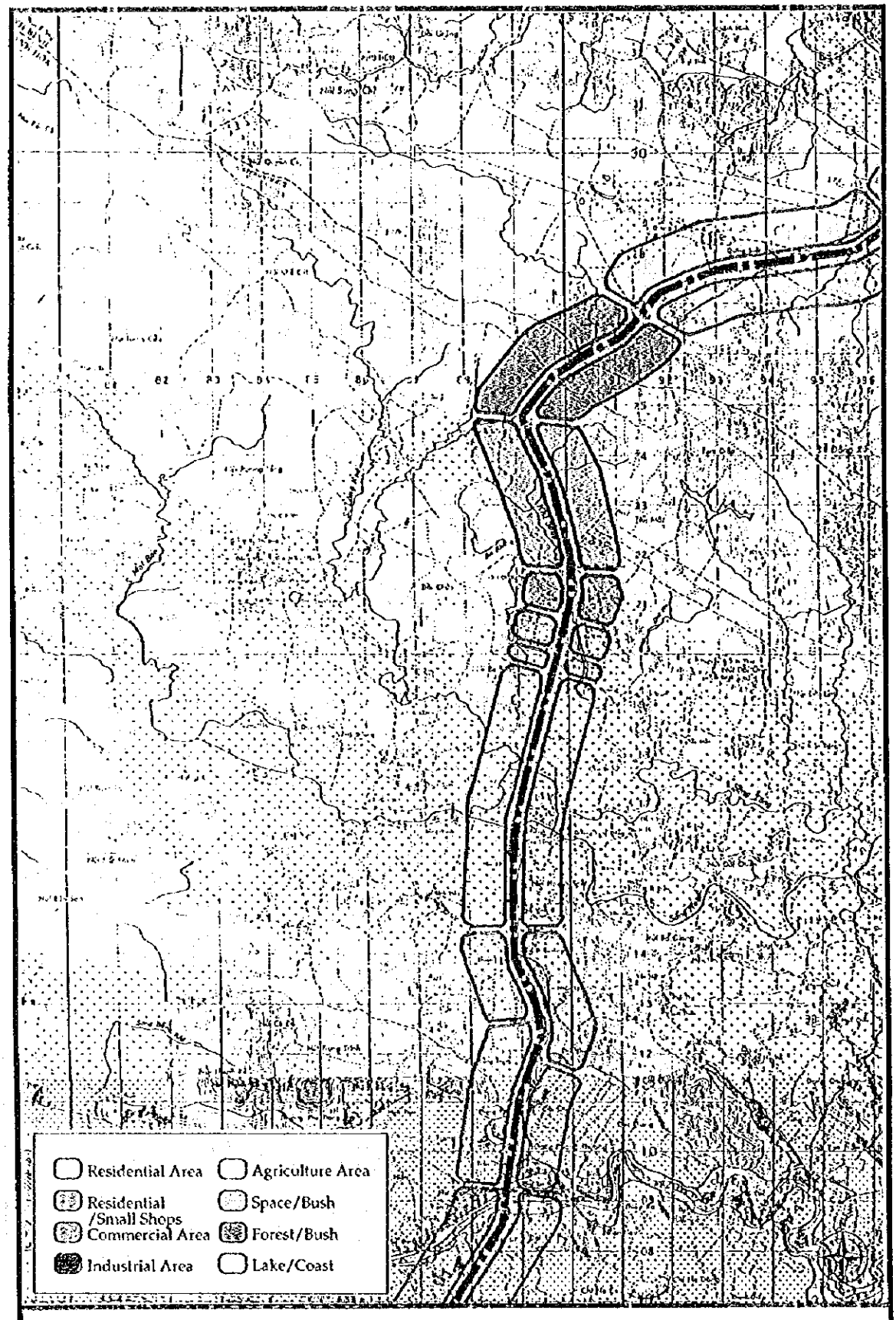


Fig. 8.16.6 (6) Land Use along Railway on Hanoi - Ho Chi Minh Line (Hanoi - Than Hoa)

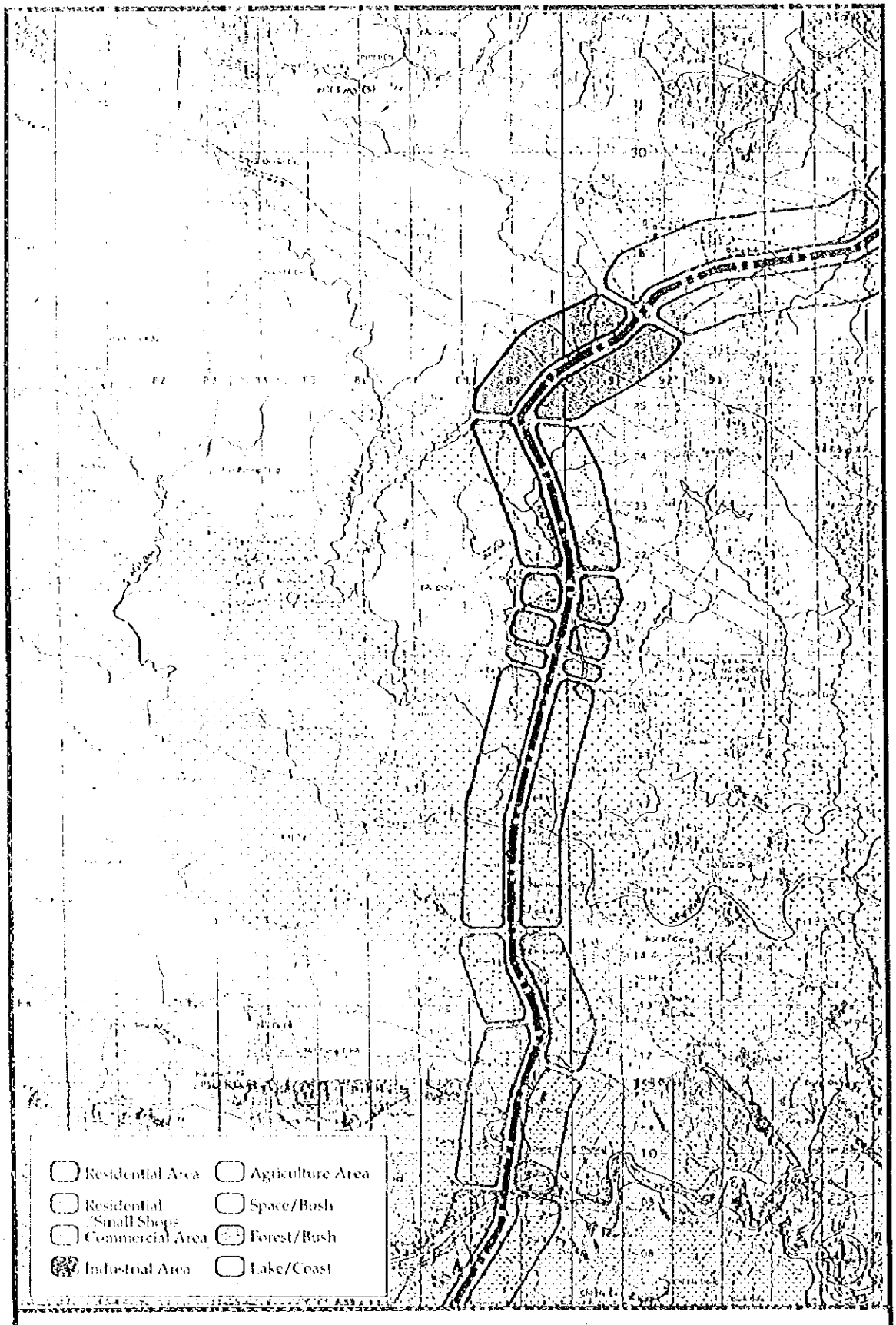


Fig. 8.16.6 (6) Land Use along Railway on Hanoi - Ho Chi Minh Line (Hanoi - Than Hoa)

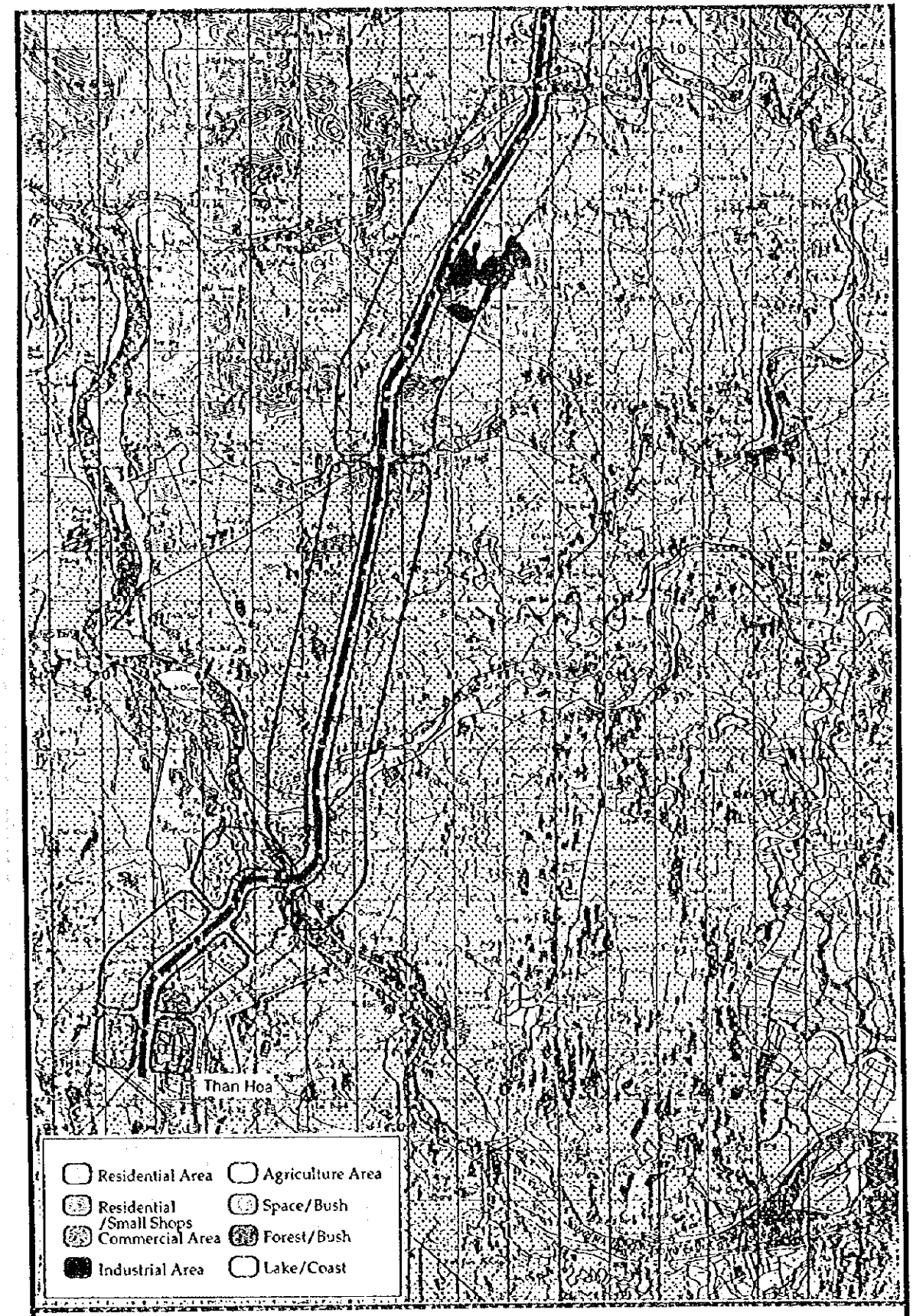


Fig. 8.16.6 (7) Land Use along Railway on Hanoi - Ho Chi Minh Line (Hanoi - Than Hoa)

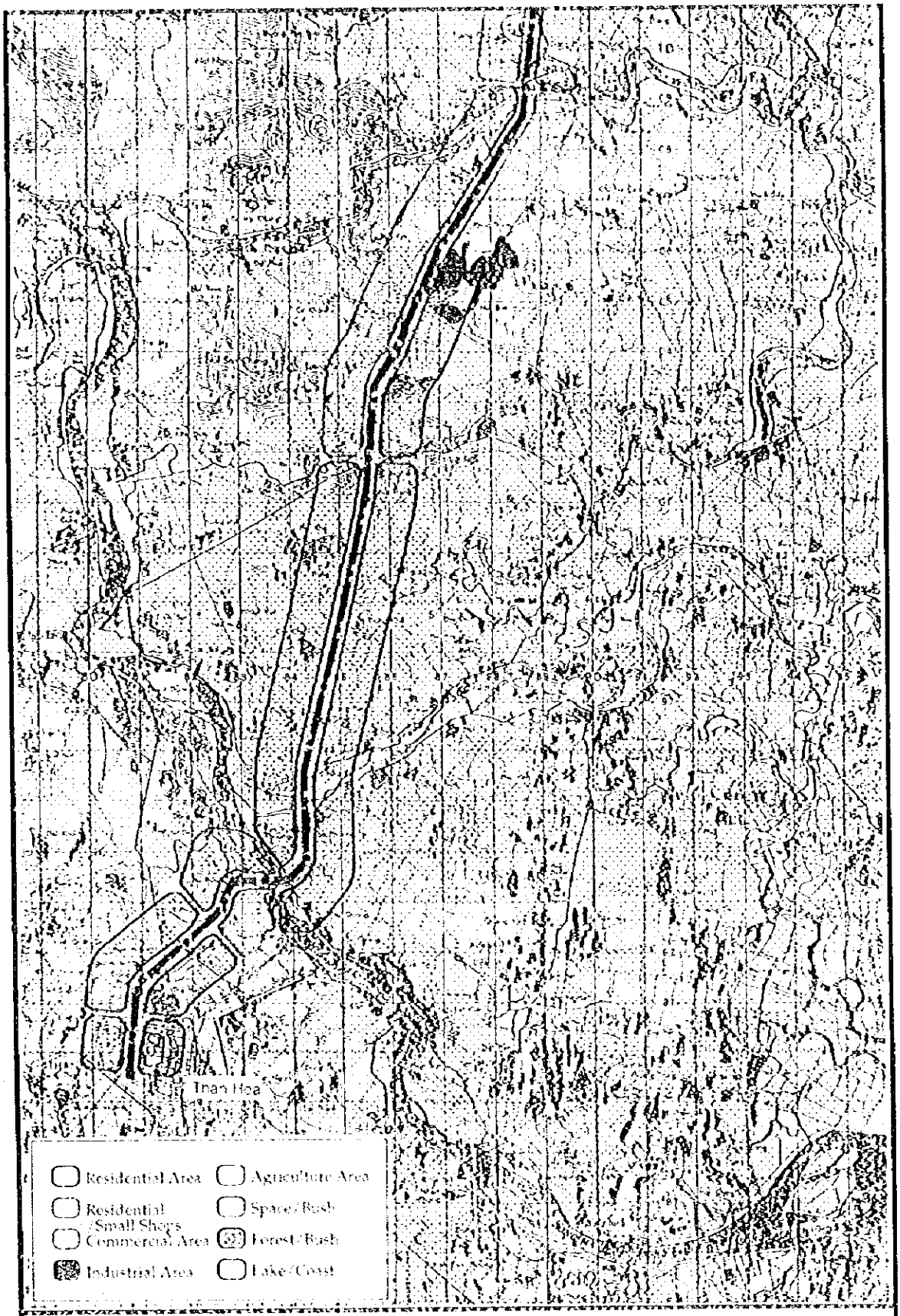


Fig. 8.16.6 (7) Land Use along Railway on Hanoi - Ho Chi Minh Line (Hanoi - Thanh Hoa)

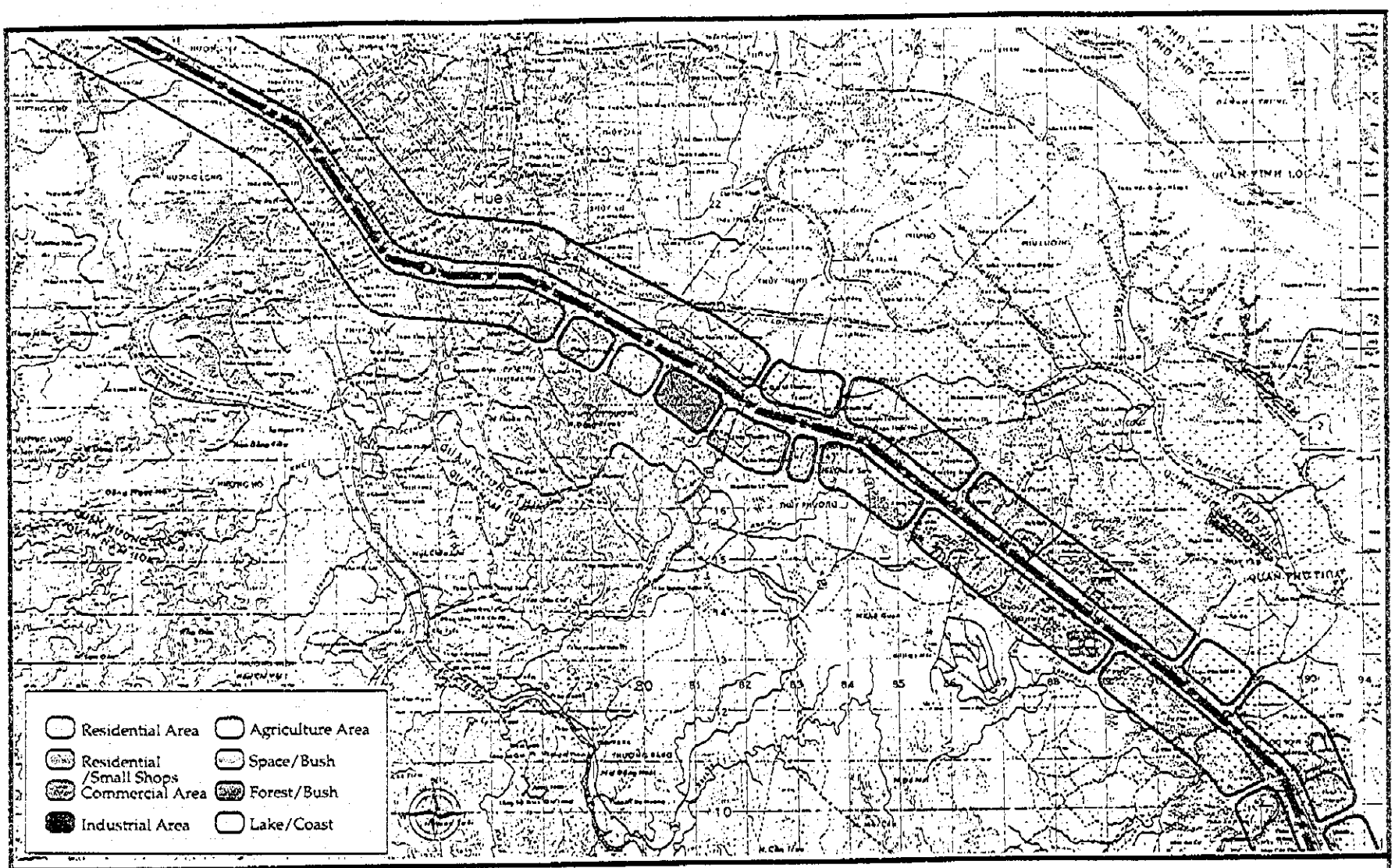


Fig. 8.16.6 (8) Land Use along Railway on Hanoi - Ho Chi Minh Line (Hue - Da Nang)

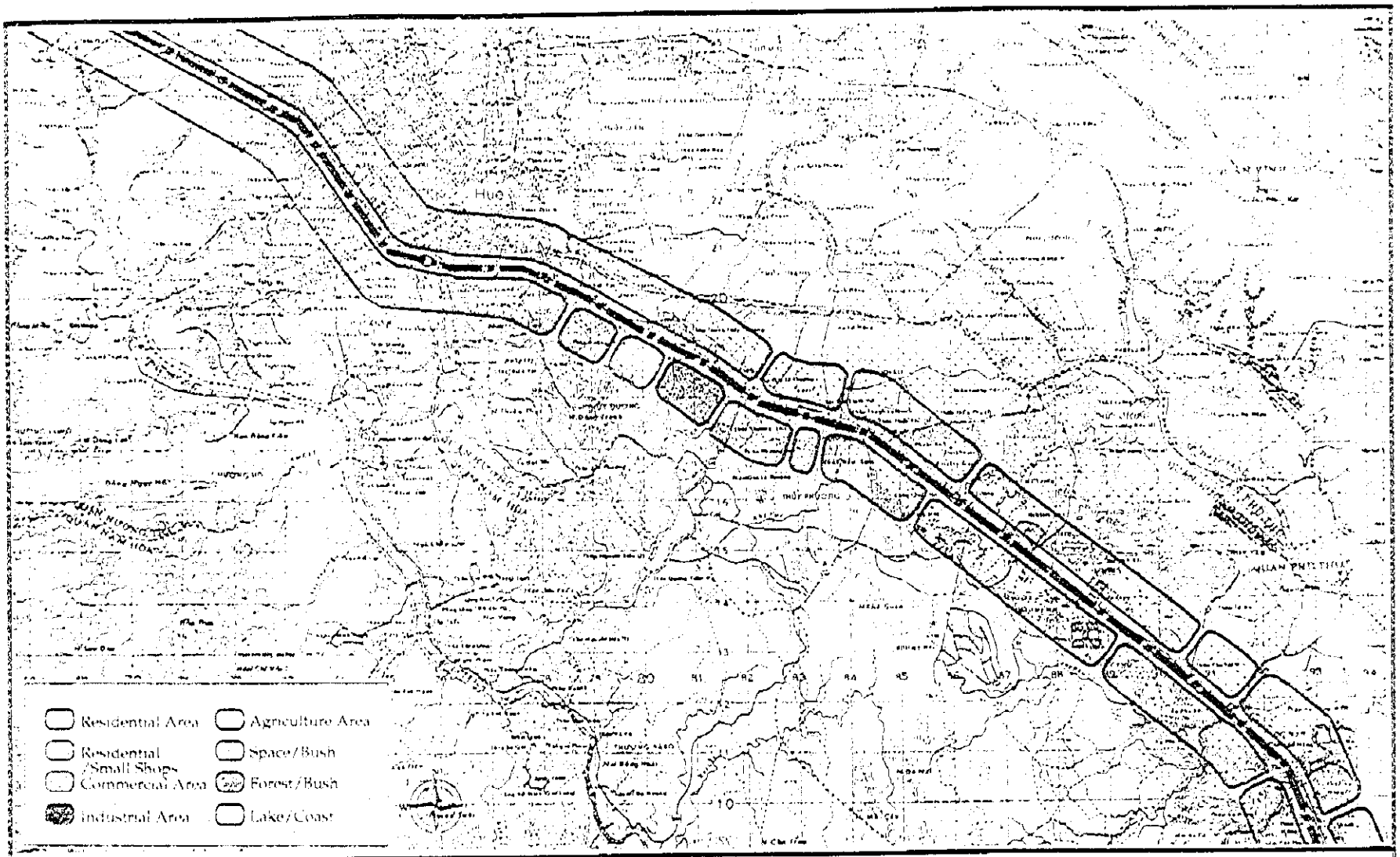


Fig. 8.16.6 (8) Land Use along Railway on Hanoi - Ho Chi Minh Line (Hue - Da Nang)

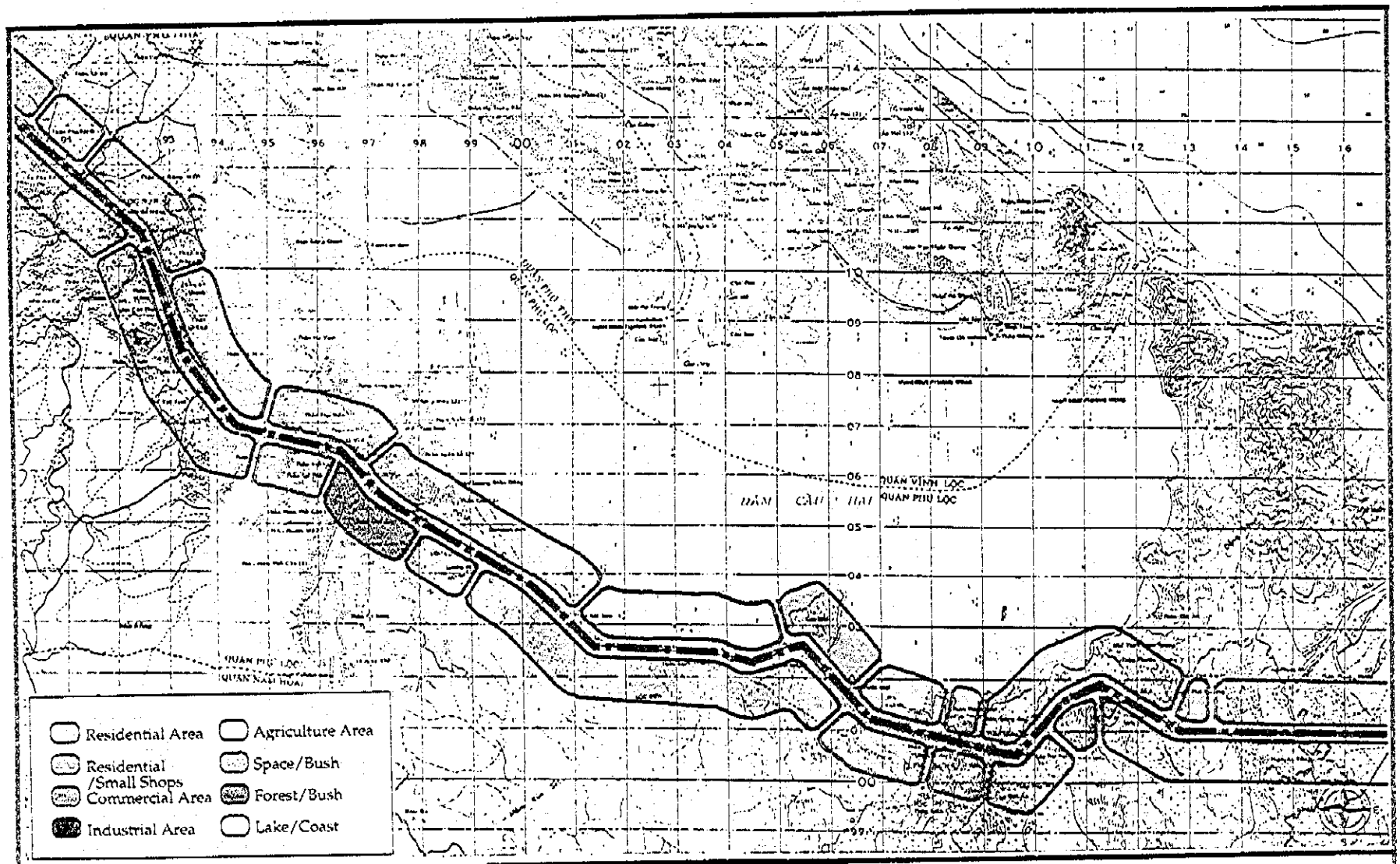


Fig. 8.16.6 (9) Land Use along Railway on Hanoi - Ho Chi Minh Line (Hue - Da Nang)

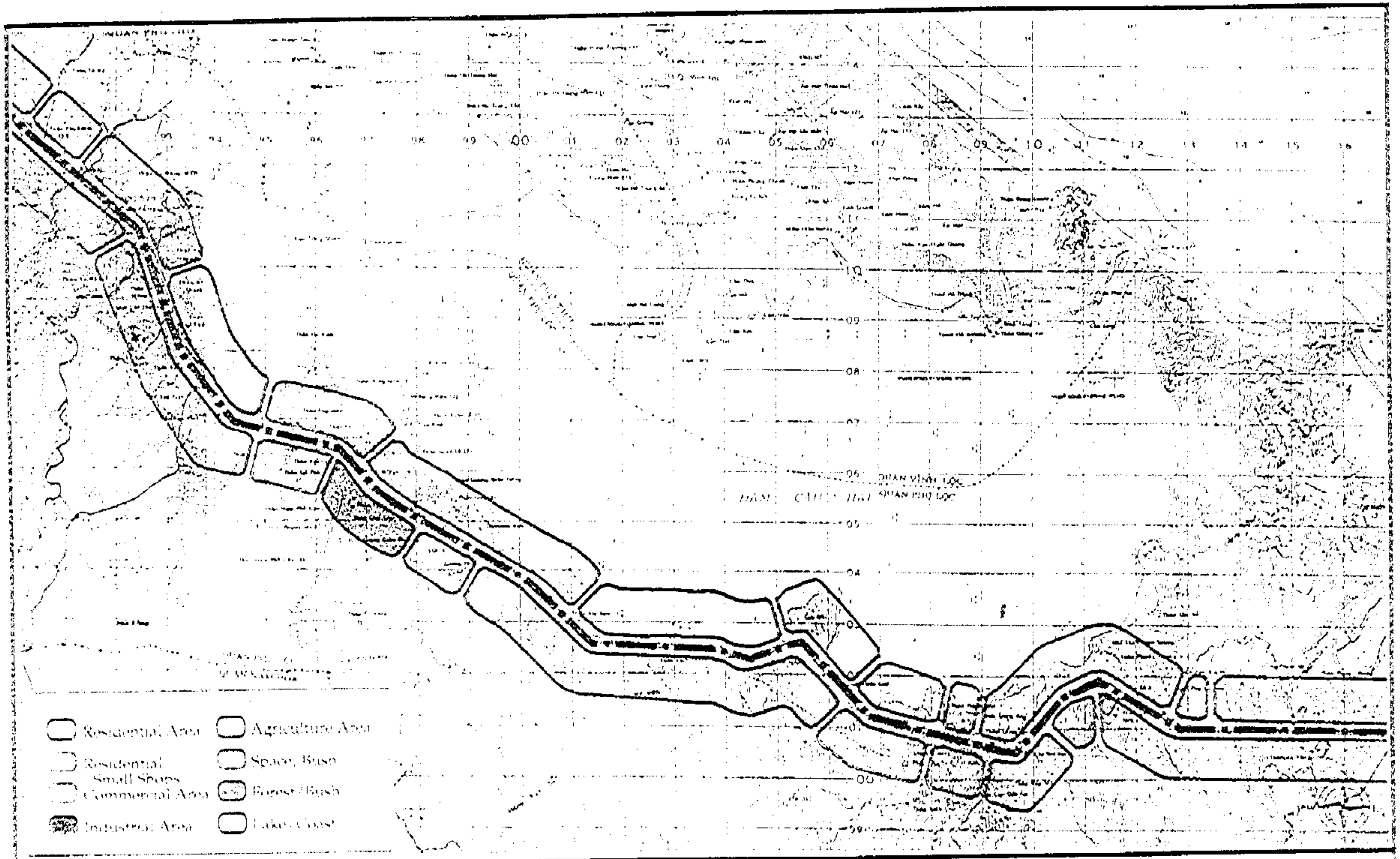


Fig. 8.16.6 (9) Land Use along Railway on Hanoi - Ho Chi Minh Line (Hue - Da Nang)

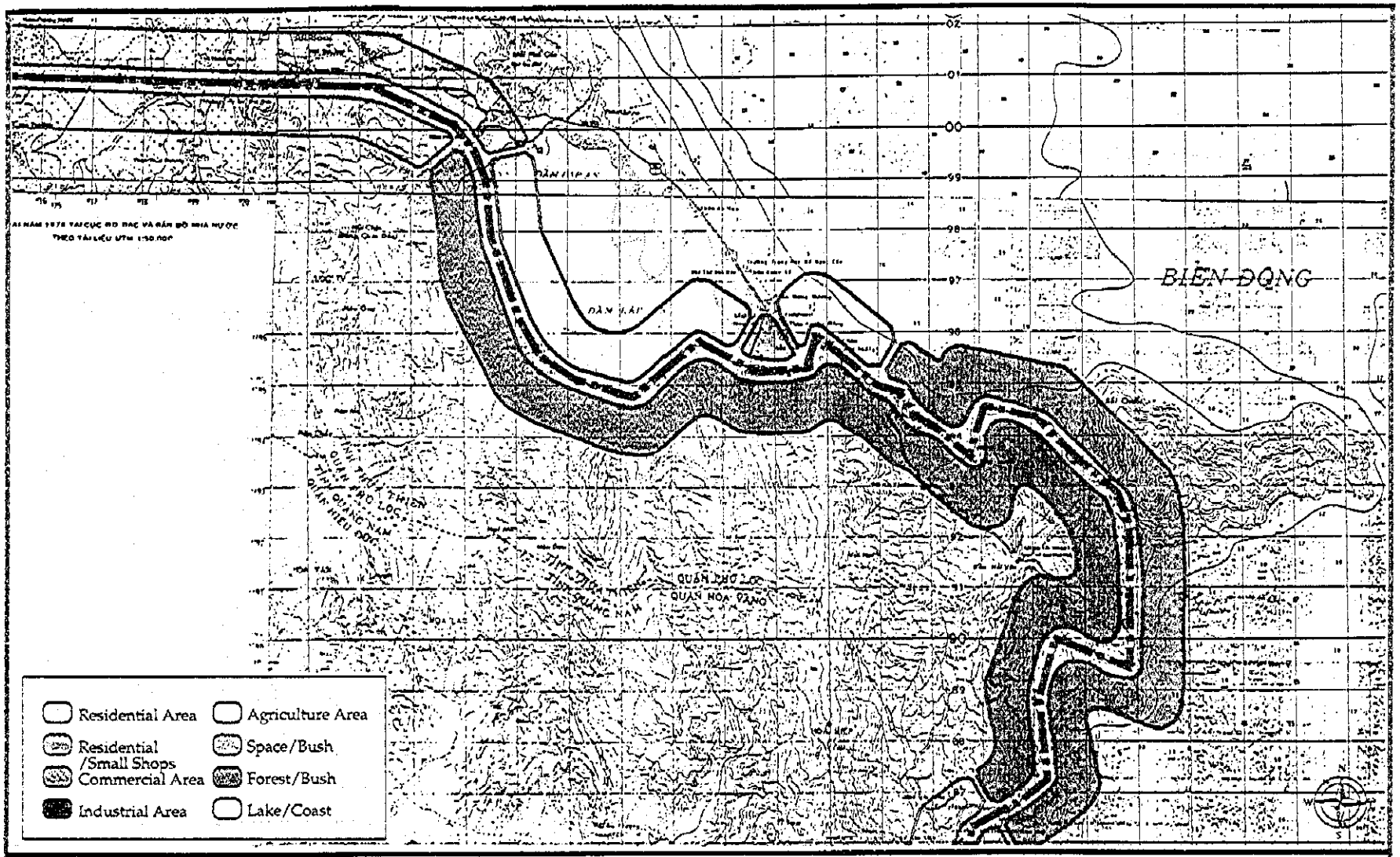


Fig. 8.16.6 (10) Land Use along Railway on Hanoi - Ho Chi Minh Line (Hue - Da Nang)

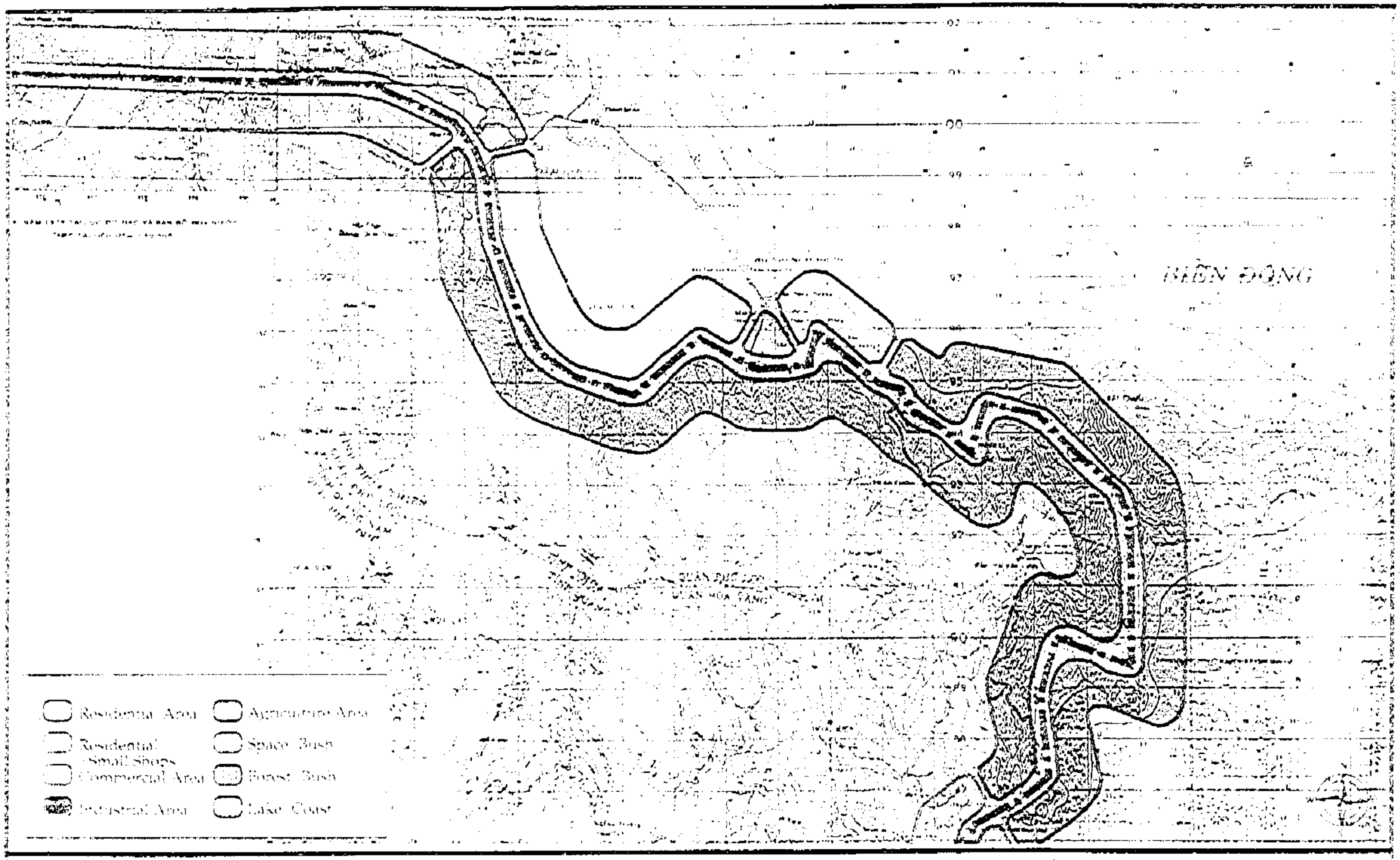


Fig. 8.16.6-10. Land Use along Railway on Hanoi - Ho Chi Minh Line (Hue - Da Nang)

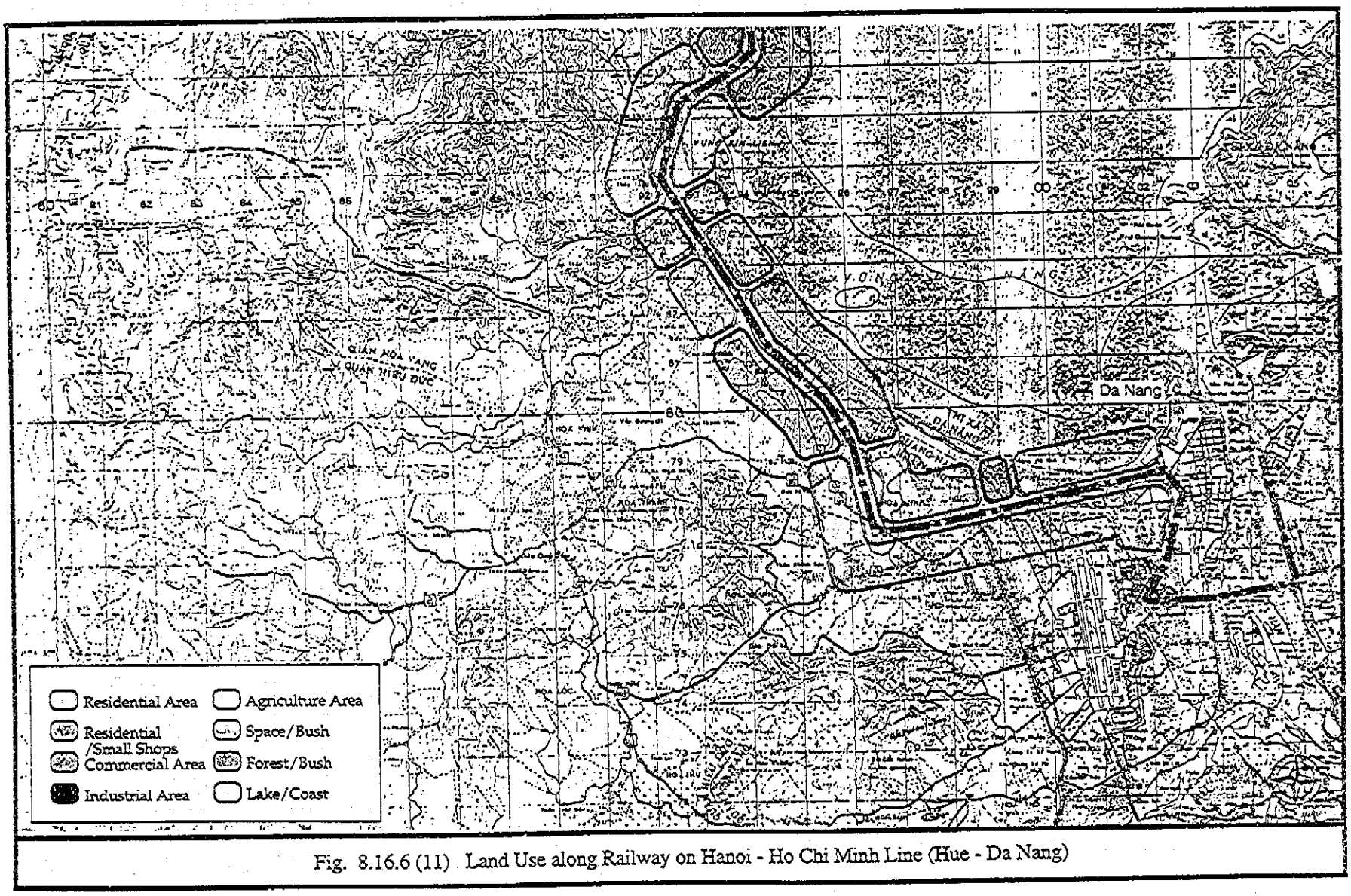


Fig. 8.16.6 (11) Land Use along Railway on Hanoi - Ho Chi Minh Line (Hue - Da Nang)