3.5 UTILITIES SYSTEM

3.5.1 Water Supply System

Currently, the service ratio of water supply in the Study Area reaches 100%. In the master plan of BMA, the water demand in Din Daeng district in 2015 is estimated at almost the same level of 1990. The existing water supply system, therefore, is sufficient for the demand in 2015, as tabulated in the following.

Table 3.12: Water Demand Estimation

Year	Unit Daily Water Demand (litter/capita/day)	Population (1,000 pop.)	Avg. Daily Water Demand (m^3/day)
1990	365	255.2	93,196
2000	374	228.9	85,609
2005	374	239.0	89,394
2010	375	246.3	92,256
2015	376	251.2	94,359

Source: The MWA master plan for unit daily water demand.
NESDB's plan for population.

Drinking water is supplied from Bang Khen WTP with a capacity of 3,200,000 m^3/day and Sam Sen WTP with 700,000 m^3/day. Raw water of both WTPs is abstracted at Sam Lae, 96 km upstream on the Chao Phraya River.

Phahon Yothin PS is the nearest pumping station to the Study Area and is located on the west side of the Study Area across the highway and along Sutthisan road. Trunk pipelines serving the Study Area are laid along Sutti San road, Ratchadaphisek road, Din Daeng road, and Vibhavadi Rangsit road as shown in Figure 3.12. Pipes on these trunk routes are made of steel and have 1,200 mm diameter.

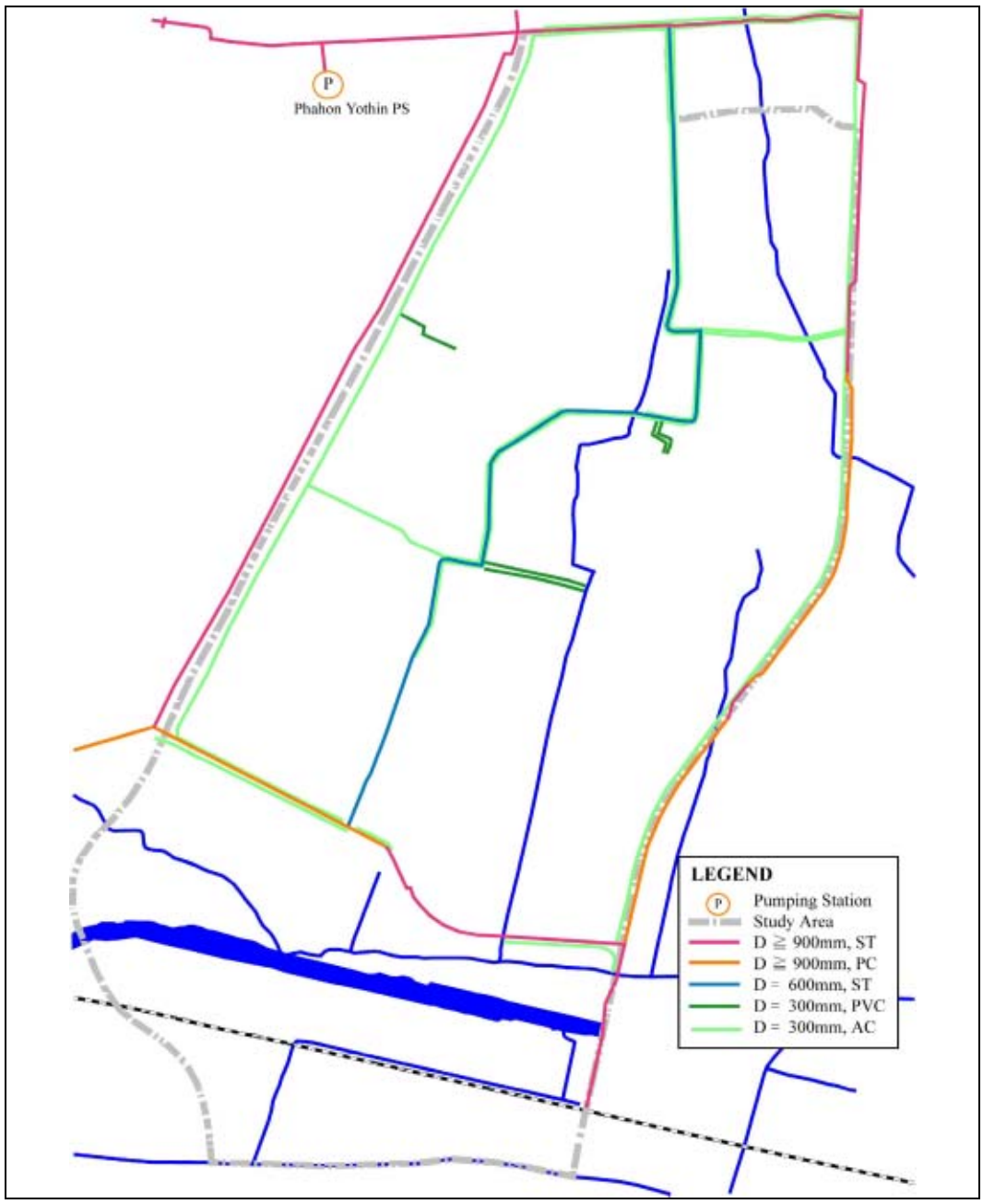
Sub-main distribution pipeline runs through the Study Area along Pracha Songkhro road from north to south, made of steel with a 600 mm diameter.(combine the previous two sentences)

Tertiary distribution pipelines made of polyvinyl chloride (PVC) and/or asbestos cement (AC) pipe are laid along the sois. They have 300 mm diameter, and connect to pipelines of 100-250 mm diameter to individual customers.

(3) Leakage of water

As many AC pipes are still in use, high leakage of 34% is recorded. A leakage improvement program has not yet been implemented in the Study Area, due largely to congested narrow roads constraining replacement works.

Figure 3.11: Water Supply System



3.5.2 Sewerage System

At present, there is no operational central WWTP in the Study Area. Apart from the central WWTPs, there are two community plants: one at Huai Khwang Community which has been transferred from NHA to BMA, and another at Din Daeng Housing Community, which is operated by NHA. The capacity is 2,400 m^3/day for 16,800 people in Huai Khwang and 1,000 m^3/day for a population of 5,100 in Din Daeng.

Private properties have their own wastewater treatment facilities as required by regulations. It is assumed that operation of these private facilities is not good, and effluent water is discharged to *khlongs* without proper treatment process as mentioned in Chapter 2.

Due to improper wastewater treatment, khlong water has been heavily polluted. BMA introduces water from the Chao Phraya River to Khlong Sam Sen in line with water circulation program for major khlongs during the dry season. The water flows to Khlong Saen Saep and down to Khlong Phra Khanong. BMA also installed an aeration system in Makkasan Pond to improve Khlong Saen Saep in 1996. However, significant improvement has not been witnessed as indicated in the result of water quality monitoring by DDS. Average BOD value is 46.0 mg/l at the nearest monitoring point (No. 83) with a maximum value of 80.0 mg/l in 2000.

The water quality in Makkasan Pond seems more contaminated than the *khlongs*, as water in the pond does not flow actively.

BMA is constructing Din Daeng Central WWTP, which will cover most of the Study Area as well as seven other districts except the southern part of the Makkasan Pond. The WWTP will be operated in December, 2002 and its features are summarized in the following table.

Table 3.13: Outline of the Din Daeng Central WWTP

Phase	Design Population (pop.)	Design Capacity (m^3/day)	Population in Service Area (mil. pop.)	Service Ratio (%)
Phase 1	697,000	341,000	1.25 million (2001)	56
Phase 2	1,080,000	463,000	1.41 million (2020)	77

Source: The Study for the Master Plan on Sewage Sludge Treatment/Disposal and Reclaimed Wastewater Reuse in Bangkok 1999, JICA

After treatment to the required effluent quality of 20:30 BOD:SS (mg/l), the treated water will be discharged to Makkasan Pond. The treatment plant has been already

constructed, but small sections of the sewage collection system still remain incomplete.

The Din Daeng central WWTP adopted interceptor system in which wastewater is conducted to the interceptor sewer before discharge to the khlongs. The interceptor and diversion chambers are hydraulically designed to accept five times the dry weather flow (DWF) and to allow excess flows to the khlongs. The interceptor pipeline is installed several tens of meters below the ground.

Figure 3.12: Wastewater Discharge System

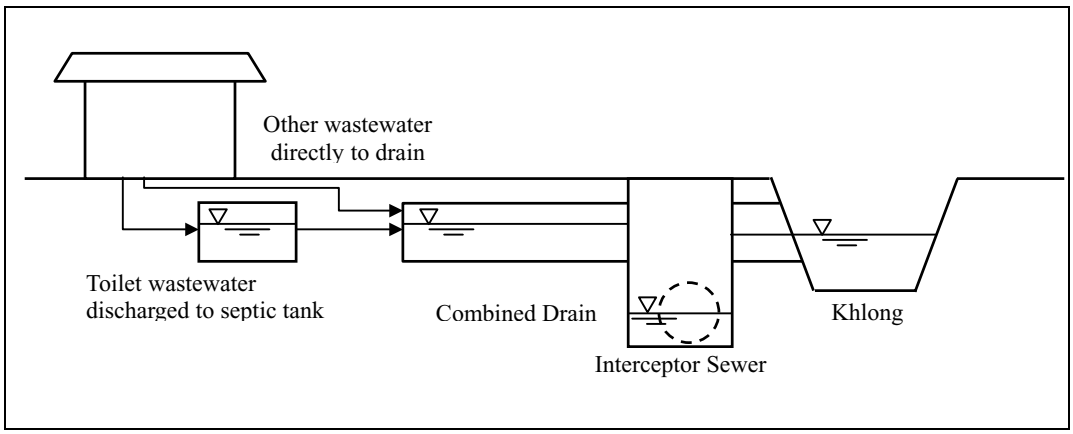
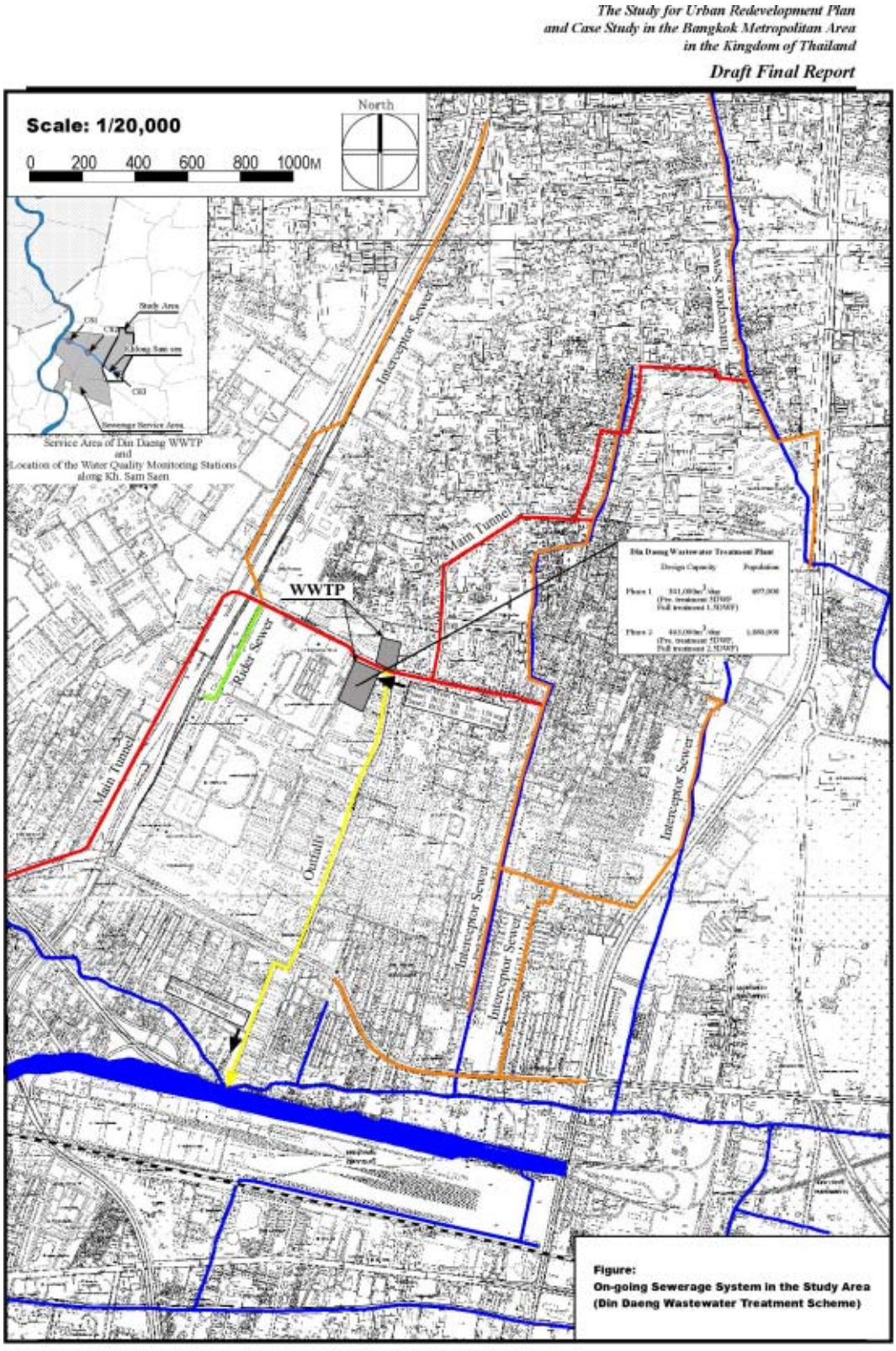


Figure 3.13: Sewerage System in the Study Area



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3.5.3 Storm Drainage System

The drainage system of the Study Area is mostly included in Din Daeng polder, which belongs to the East Sub-Urban District defined in the master plan. The southern part beyond the Makkasan Pond is included in the Sukhumvit polder of the City Core section. According to the master plan, both polders have sufficient drainage capacity for a rainfall of 2-year return period.

According to the Din Daeng district office, Din Daeng district has not experienced severe flood problems in recent years. Flood protection programs had been eagerly conducted in the past, because the district is located in the central part of BMA. At present, there is no flood protection project in the district and the main target has shifted to cleaning and maintenance of drainage facilities.

An inundation report by DDS shows that potential inundation areas are limited to the southeast part along Khlong Na Song in the Study Area. The district office has also recorded some inundation in housing compounds of NHA and private areas where old planning standards had been adopted.

Concrete pipes and culverts have been installed to collect storm water from roadside gullies combined with wastewater. Storm water is drained to Khlong Huai Khwang, canals along Vibhvadi Rangsit road, and Khlong Sam Sen. The Makkasan Pond has a retention capacity of 350,000m^3 to receive the storm water of 326,000m^3 from Khlong Sam Sen in a 2-year rainfall.

Being flat terrain, the storm water is pumped out to the major khlongs mentioned above. The existing pumping capacity regulates the average water depth to be less than 20mm for a 2-year rainfall. The following table shows an outline of pumping stations located in the Study Area.

Table 3.14: Outline of the Existing Pumping Stations in the Study Area

Name of P.S.s	Pumping Capacity (m^3/s)	Area for Discharge
P1:Khlong Na Song along Asok-Din Daeng Rd.	14	To Khlong Sam Sen
P2: Mae Phra Fatima	9	To Khlong Sam Sen
P3: Khlong Na Song along Soi Phrom Phan		To Khlong Huai Khwang
P4: Khlong Huai Khwang, Soi Jip Damri	8	To Khlong Huai Khwang
P5-1: Bueng Makkasan	12	From Kh. Sam Sen to Makkasan Pond
P5-2: Bueng Makkasan		From Makkasan Pond to Kh. Sam Sen
P6: Sutthisan	2	
P7: Din Daeng	6	

Source: BMA

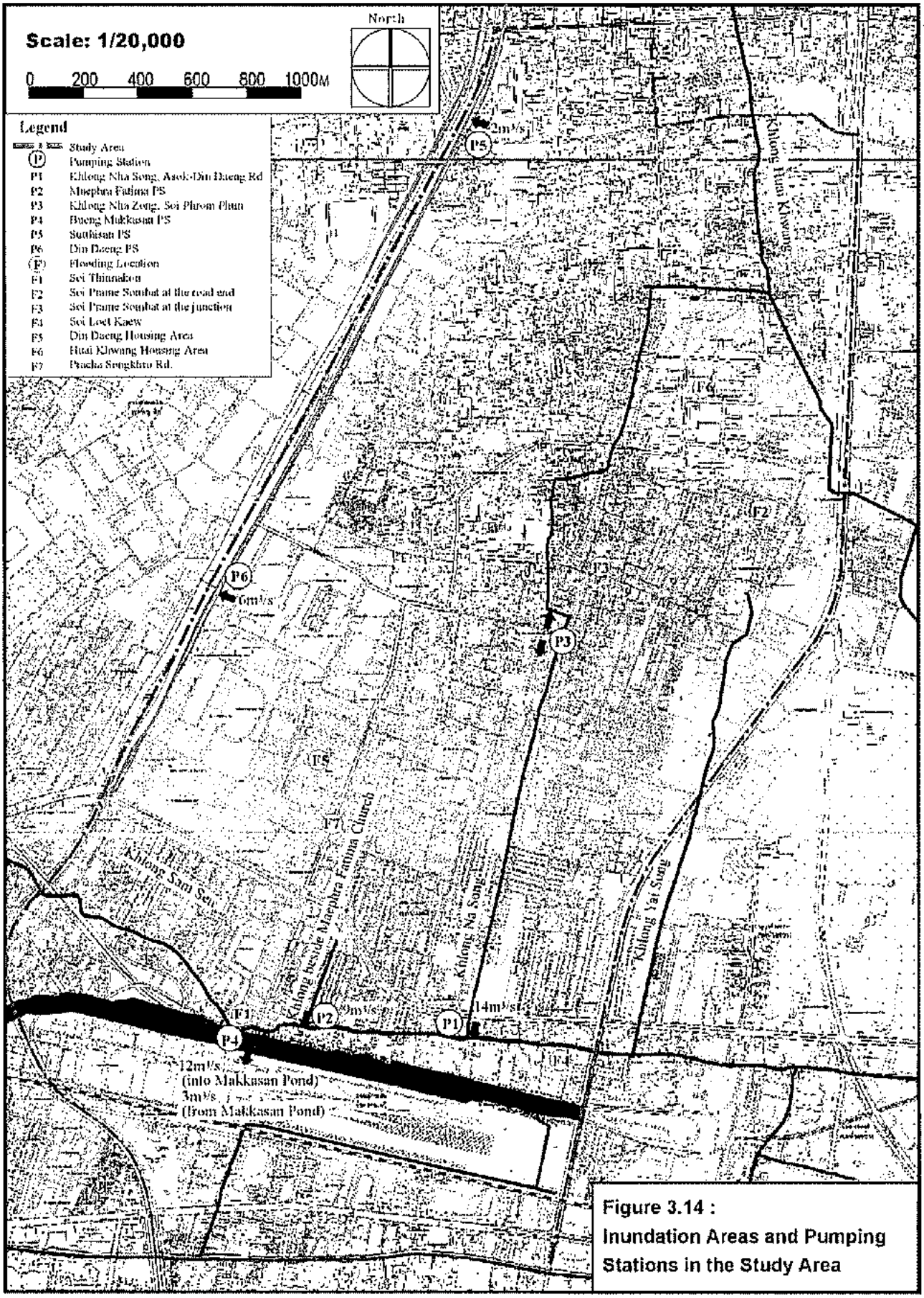

Figure 3.14 :
Inundation Areas and Pumping Stations in the Study Area

3.5.4 Electric Power System

Primary power supply substation for the Study Area is Saen Saep substation with capacity of 3X40MVA, which receives electric power from Ratchadaphisek terminal station (2X300MVA). The maximum electricity demand of each station is 37.1 MW and 309.1 MW in 2000, respectively.

The capacity of the Saen Saep substation is sufficient for the electricity demand in 2015 as tabulated in the following table.

Table 3.15: Electricity Demand in the Study Area

Items	Unit	2000	2001	2005	2010	2015
Max. Electricity Demand	MW	37.1	39.4	47.5	58.9	73.7
Increasing Ratio	%	-	6.16	4.34	4.27	4.68
Max. Load of Substation	MVA	43.7	46.4	55.9	69.4	86.8
Max. Capacity of Substation (Saen Saep S.S.)	MVA	96.0				

Note: 1) Max. electricity demand and load is actual record of MEA.
2) Capacity of San Saep S.S. is 120 MVA (3 × 40 MVA) and the max. loading ratio for 3 bays S.S. is limited to 80 %, according to the JICA F/S Report in 1995.
3) Increasing ratio until 2011 follows the ratio of MEA's electricity demand master plan and after 2012 adopts average ratio from 2001 to 2011.

MEA plans to improve the power supply system covering the Study Area. It consists of i) construction of Vibhavadi terminal station (2X300MVA) to start operation in 2002; ii) construction of Din Daeng substation (2X60MVA) in 2004, and iii) upgrading of high voltage line from 12kV to 24kV to be implemented in 2002. The current major problem is intricate overhead power lines, which disturb the cityscape and are difficult to maintain.

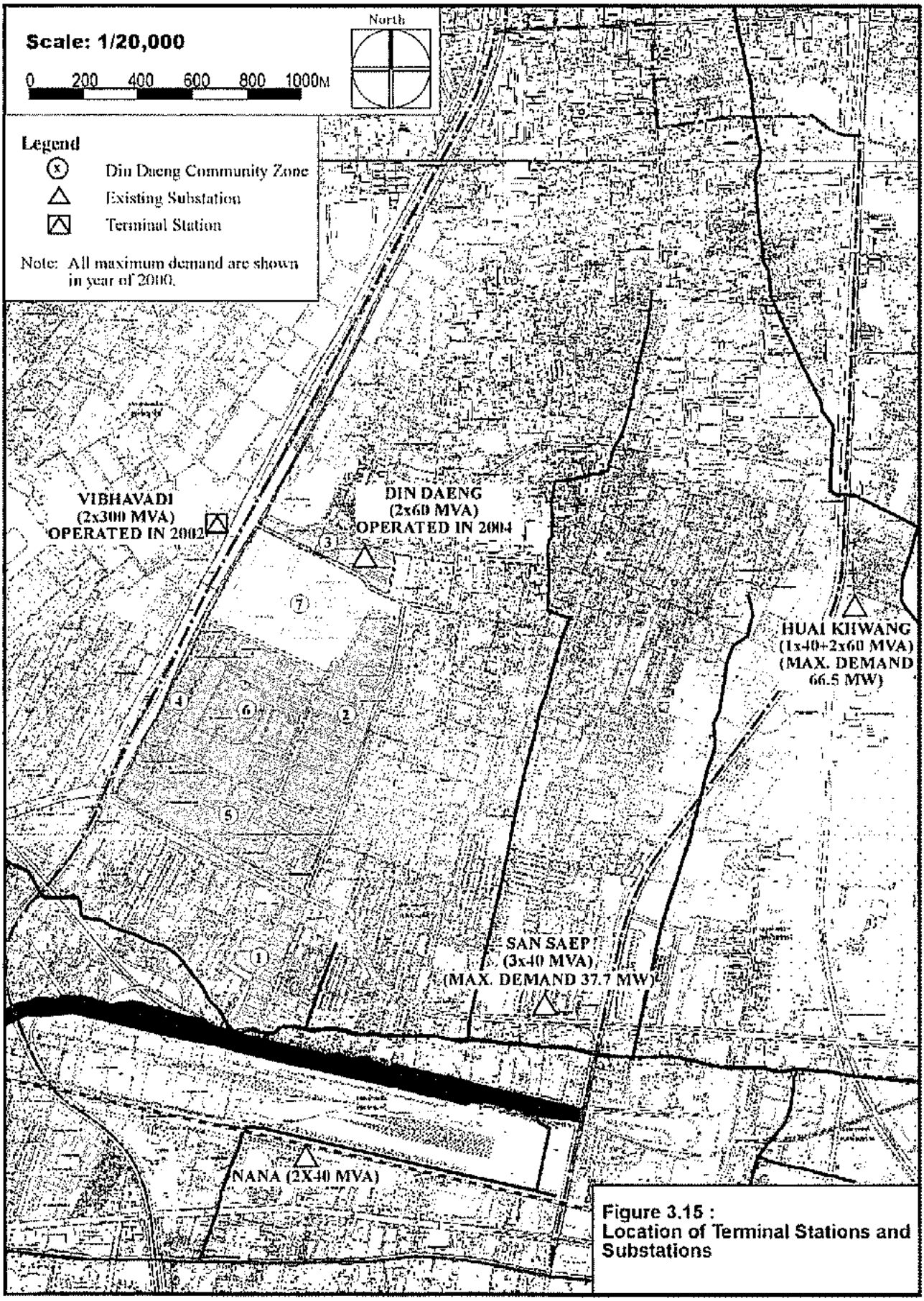

Figure 3.15 :
Location of Terminal Stations and Substations

3.5.5 Telecommunication System

The Study Area belongs to service areas of three switching stations (S.S.), namely, Inthamara S.S., Asok-Din Daeng S.S., and Phloen Chit S.S. The diffusion ratio is at a low level of 131 persons per connected line in 1999, and it will be 97 persons per connected line in 2010, according to Telephone Organization of Thailand's estimation. However there are 113 distribution cabinets already located in the Study Area, which can provide a high diffusion ratio of 2 persons/line as shown in the following table.

Table 3.16: Diffusion Ratio in the Study Area

Description		Service Area of Switching Station			Total
		Inthamara S.S.	Asok-Din Daeng S.S.	Phloen Chit S.S.	
No. of Distri. Cabinets	Overall	45	93	12	150
	Data available	8	93	12	113
No. of Connected Lines (cabinets)	1999	1,742	16,269	1,633	21,643
	2005	2,285	21,601	2,338	28,229
	2010	2,545	27,765	2,902	35,222
Diffusion Ratio of Connected Lines (pop/ line)	2000	-	-	-	131
	2005	-	-	-	105
	2010	-	-	-	97
Diffusion Ratio of Cabinet Capacity (pop/line)	2000	-	-	-	2.3
	2005	-	-	-	2.4
	2010	-	-	-	2.4
	2015	-	-	-	2.5

Note: 1) Connected line is estimation by TOT.
2) Diffusion ratio is based on NESDB population forecast in Din Daeng District.
3) Diffusion ratio of cabinet capacity is based on the max. capacity of 900 lines/cabinet.

Asok-Din Daeng S.S., covering most of the Study Area, has 40,000 channels and 25,000 lines are currently connected. It also has 152 distribution cabinets related by 24 main cable lines, which are sufficient for the total cabinet capacity. BMA's branch city hall and other large facilities are connected by special lines or optical fibers, separate from the system mentioned above.

The current problems include, i) congested overhead telephone cables which make the cityscape unseemly, and ii) difficulty of securing space for setting up exchange stations due to high density of urbanization and high land price.

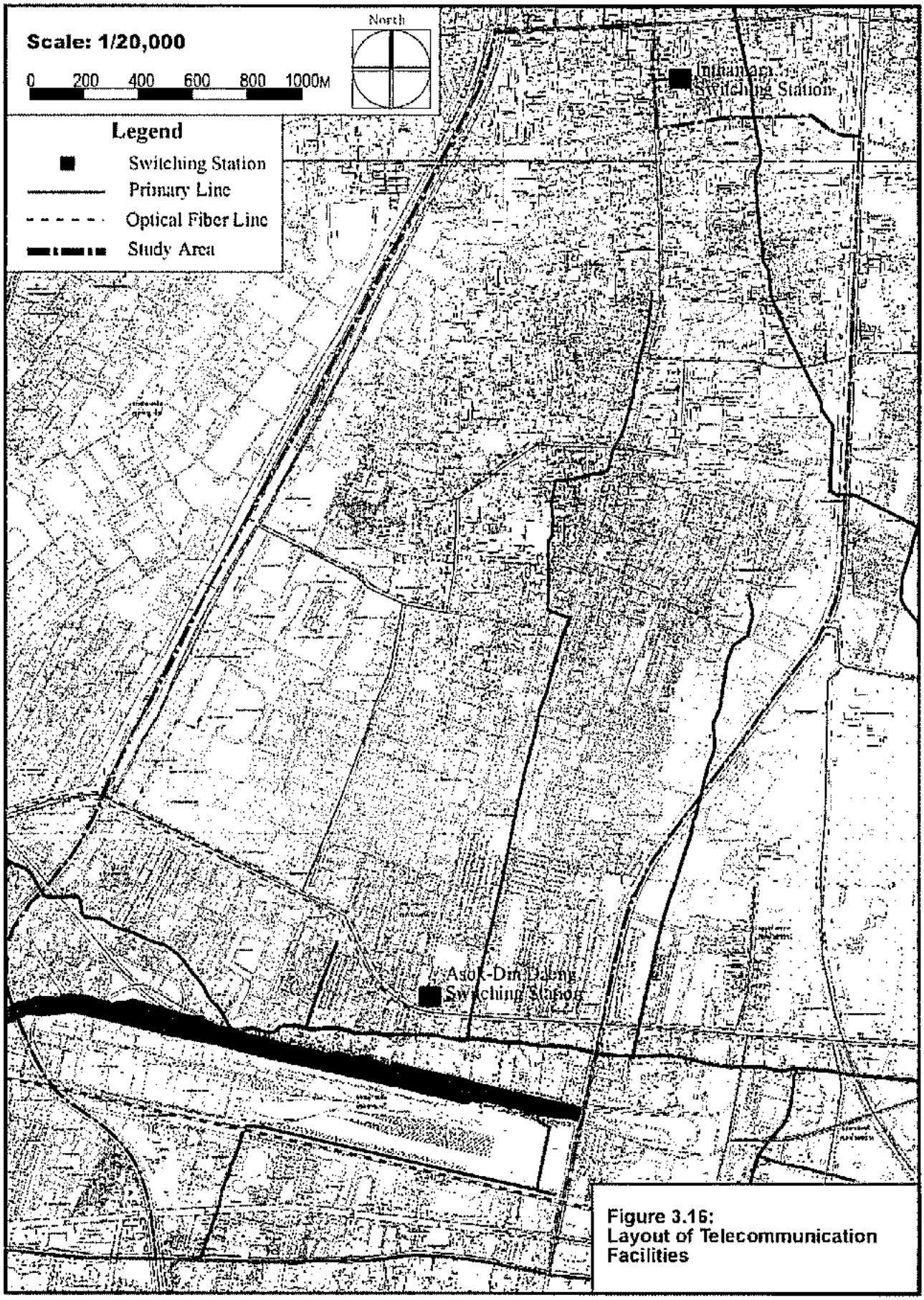

Figure 3.16:
Layout of Telecommunication Facilities

3.5.6 Solid Waste Disposal System

The amount of solid waste has increased from 206.5 ton/day in 1995 to 304.7 ton/day in 2000 in Din Daeng district. The solid waste generation ratio is almost the same as the average for BMA (1,642 gram/person/day).

The Din Daeng district office has 73 collection vehicles, with a total capacity of 266 ton, which will be sufficient to collect the projected solid waste generation to the year 2015. According to DPC's master plan, the average collection time is about 2 hours, and therefore, the required number of trips is assumed to be less than 2 trips/day.

Table 3.17: Outline of Solid Waste Collection Capacity

Year	Unit Solid Waste Generation (g/p/d)	Population (pop)	SW Generation (ton/day)	Capacity of Collection Vehicles (ton/trip)	Required Trip (trip/day)
2000	1,643	185,500	304.8	266	1.1
2005	1,715	193,700	332.2	(73 vehicles)	1.2
2010	1,817	199,600	362.7		1.4
2015	1,918	203,600	390.5		1.5

Note: 1) Population is based on NESDB population forecast in Din Daeng District
2) Capacity of collection vehicles is based on the data from Din Daeng District office, BMA.
3) Unit solid waste generation after 2005 adopts the rate of Master Plan by PCD, BMA.

Operation of solid waste collection works is as follows:

- 3 times a day at main roads;
- 1 time per every two days at soi roads;
- 2 or 3 times a week at housing area; and
- 1 time a day at markets and schools by, 4 m^3 or 8 m^3 containers.

Tha Raeng transfer station and On-nut transfer station receive 75% and 25% of collected solid waste in the district respectively, and transfer them to Kamphang Saen landfill site and Rachathewa landfill site.

Currently, solid waste illegally dumped in slum areas and/or public parks are collected by BMA, which amounts to 10% of the total collected waste. There are complaints from people living around the spots about bad odor from discharge spots and illegal dumping.

3.6 PUBLIC POLLUTION

3.6.1 Ground Water

Although there is no record of wells in the Study Area, the rate of land subsidence was about 1-3 cm/year and the fall in ground water level was about 2-3 m/year.

3.6.2 Surface Water

Wastewater generated from the Study Area is normally discharged to the khlongs without treatment at wastewater treatment plants. It causes water pollution and is unsuitable for aquatic life and hazardous to human health. NHA's Huai Khwang and Din Daeng Housing Complexes have community sewerage treatment plants with capacities of 2,400 and 1,000m^3/day respectively and the former is receiving only 1,400 m^3/day of wastewater generated in the surrounding residential areas. Therefore its remaining capacity of 1,000 m^3/day should be utilized to reduce the pollution load in the nearby waterways.

Since a new plant with capacity of 341,000 m^3/day is being constructed near the BMA's city hall and planned to be completed in December 2002, sewerage system of the Study Area should be connected to the new plant in the future.

The major khlongs of the Study Area during 1997-2000 were highly polluted with low DO (0-0.7 mg/l), high concentration of BOD (12-70.7 mg/l), and total coliform bacteria (2.3×10^6-6.8×10^7 MPN/100 ml). The water was green to black color with bad odors, which clearly is unsuitable for aquatic life and human consumption.

Table 3.18: Khlong Water Quality in the Study Area (1997 - 2000)

	Khlong Bang Sue*1				Khlong Huai Khwang*2				Khlong Sam Saen*3				Standard*4
	1997	1998	1999	2000	1997	1998	1999	2000	1997	1998	1999	2000	
DO	1.2	0.4	0.1	0.3	0.7	0	0	0.1	0.2	0.1	0.1	0	<2
H_2S	0.5	1.7	0.4	0.7	0.2	1.9	1.5	0.8	0.4	1.9	2.6	0.5	-
BOD	18	12	16.4	20.2	47	62	70.7	61.8	40	49	48.5	39	<4
SS	24	25	34	112	35	63	22	29	53	31	23	146	-
TKN	6.3	7	7.4	8.3	12.6	12.1	17	18.3	9.9	10.3	14.5	17.2	-
NH3-N	2.9	2.5	4	5.1	4.4	6.8	12.1	14.5	4.1	6.4	11.6	12.4	>0.5
Total-P	0.1	0.2	0.2	0.8	0.3	0.3	0.3	1	0.2	0.2	0.3	1.1	-
TCB	$7.7*10^6$	$6.4*10^6$	$3.1*10^7$	$1.1*10^7$	$1.9*10^7$	$5.2*10^7$	$6.8*10^7$	$2.1*10^7$	$8.0*10^6$	$4.1*10^6$	$2.3*10^6$	$3.9*10^7$	-

Remark: DO=Dissolved Oxygen, BOD=Bio-chemical Oxygen Demand, SS=Suspended Solid, TKN=Total Kjeldahl Nitrogen, Total Coliform Bacteria
*1 At Chao Phraya Park Hotel, Ratchadaphisek Road.
*2 At Huai Khwang Community
*3 Behind Din Daeng Flat
*4 Surface Water Quality Standard class 4, According to Notification of MOSTE (1985)
The unit of all parameters are mg/l, except for total coliform bacteria which is MPN/100 ml.
Source: Water Quality Management Division, Dept. of Drainage and Sawerage, BMA.

3.6.3 Air Quality and Noise Level

Traffic congestion is one of the major causes of air pollution (in terms of TSP and PM-10) and high noise level (in terms of Leq (24)) along the roadsides. The Study Area is located in the inner city area of BMA, thus the traffic congestion problem is quite a complicated matter. To solve the problem, it is necessary to establish the community level transportation system integral with the development of arterial roads and mass transit.

The air quality records indicate that concentration of Pb and SO_2 is within the MOSTE Standard except for TSP and PM-10. The PM-10 values range from 107-304 $\mu g/m^3$ and most of their values exceed the ambient air standard (120 $\mu g/m^3$). The maximum value of PM-10 is about 2.5 times larger than the standard and is observed at the police camp on Rama IX road (A15). The TSP values range from 0.02-0.67 mg/m^3. The maximum TSP value is about 2 times the standard and is observed at the Police Camp, Pratu Nam (A5) and junction at the Mass Communication Organization of Thailand (A1).

Regarding the noise level, the Leq (24) ranges from 70.8-83.5 dB(A) which exceeds the ambient noise standard (70 dB(A)). The Leq(24) is particularly high at the Police camp, Pratu Nam (N5), Department of Livestock Development (N16), Police camp at Rama IX junction (N17) and Victory Monument (N13 and N14). The Leq (1-hr) ranges from 81.60-60.1 dB(A). The standard value of Leq (1-hr) has not been established in Thailand.

Table 3.19: Air Quality around the Study Area

Measuring Station	Period	Pollutant						Source
		TSP	PM-10	SO2	Pb	CO (ppm)		
		(mg/m3)	(mg/m3)	(mg/m3)	(mg/m3)	Avg. 1-hr	Avg. 8-hr	
A1 MCOT Junction	Mar-99	0.6110		<0.001	0.0078			
	Jul-99	0.1030	0.00	0.0130	0.0036	0.00	0.00	HK
	Feb-00	0.0260		<0.001	0.1000			
A2 Wat Rama IX Kachanaphisek	Mar-99	0.2070		<0.001	0.0042			
	Jul-99	0.0620	0.00	0.0270	0.0035	0.00	0.00	HK
	Feb-00	0.2100		<0.001	0.7000			
A3 Yu Charoen Real Estate	Mar-99	0.1240		<0.001	0.0067			
	Jul-99	0.0620	0.00	0.0130	0.0035	0.00	0.00	HK
	Feb-00	0.1380		0.0030	0.7000			
A4 Victory Monument	Feb-00	0.1990	0.00	<0.001	0.1000	0.00	0.00	RT
A5 Pratu Nam, Police Camp	Feb-Mar 97	0.6700	281.00	-	0.1400	7.17	7.13	PCD
	Mar-98	0.3600	179.00	-	0.1000	3.30	3.30	PCD
	Mar-99	0.0550	-	0.0320	0.0013	0.00	0.00	RT
	Apr-99	0.2400	142.00	-	0.0700	3.62	3.57	PCD
	Jul-99	0.2580	-	0.0186	0.0036	0.00	0.00	RT
A6 Rang Nam Road (Suntiphap Park)	Mar-99	0.0810	0.00	0.0510	0.0007	0.00	0.00	RT
	Jul-99	0.0700		0.0100	0.3550			
A7 Si Ayutthaya Road	Mar-99	0.2710	0.00	0.0190	0.0016	0.00	0.00	RT
	Jul-99	0.1310		0.0060	0.0038			
	Feb-00	0.2790		<0.001	0.2000			
A8 Yothi Road	Feb-00	0.3410	0.00	<0.001	0.1000	0.00	0.00	RT
A9 Fortune Tower, Ratchadaphisek Road	Feb-00	0.2450	0.00	0.0050	0.1000	0.00	0.00	DD
A10 Din Daeng Flat	Mar-99	0.1560	0.00	<0.001	0.0015	0.00	0.00	DD
	Jul-99	0.149		0.0260	0.0037			
A11 Sutthisan Vibhavadi Junction	Mar-99	0.0190	0.00	<0.001	0.0081	0.00	0.00	DD
	Jul-99	0.089		0.1500	0.0040			
	Feb-00	0.237		0.0080	0.1000			
A12 Vibhavadi Park (Infornt of Din Daeng District Office)	Mar-99	0.1250	0.00	0.0040	0.0116	0.00	0.00	DD
	Jul-99	0.0810		0.01	0.0037			
	Feb-00	0.0410		0.00	0.2000			
A13 Department of Livestock Development	Jan-Feb 97	0.4700	207.00	-	0.1100	7.10	7.11	PCD
A14 Victory Monument, Police Camp	Sep-Oct 97	0.2800	144.00	-	0.1000	1.99	1.95	PCD
	Oct-98	0.26	161.0000	-	0.0800	1.8000	1.80	PCD
	Nov-Dec 99	0.17	107.0000	-	0.1000	0.1700	1.67	PCD
A15 Rama IX, Police Camp	Jan-98	0.6800	304.00	-	0.1020	2.30	2.20	PCD
	Jan-99	0.24	180.0000	-	0.0400	4.0100	3.91	PCD
Standard Value		0.33	120	0.7800	1.50	30.0000	0.00	-

Remark: PCD = Pollution Control Department, MOSTE
HK = The District Office at Huai Khwang
RT = The District Office at Ratchathewi
DD = The District Office at Din Daeng
Standard Value = Ambient Air Standards of Thailand, According to Ministry of Science, Technology and Environment
Source:Data derived from - the District Offices at Huai Khwang, Ratchathewi and Din Daeng.
PCD = Pollution Control Department, Ministry of Science, Technology and Energy.

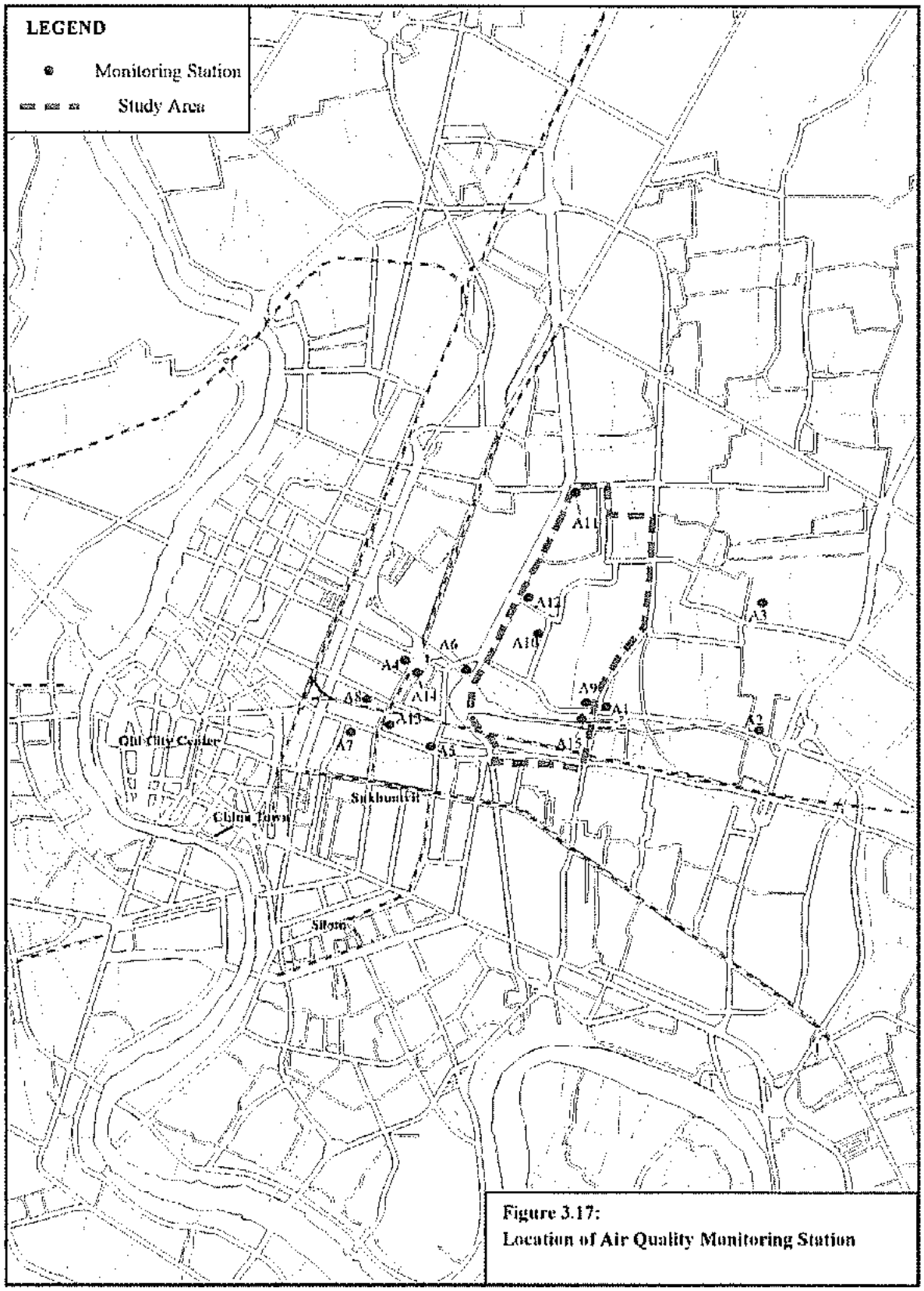

Figure 3.17:
Location of Air Quality Monitoring Station

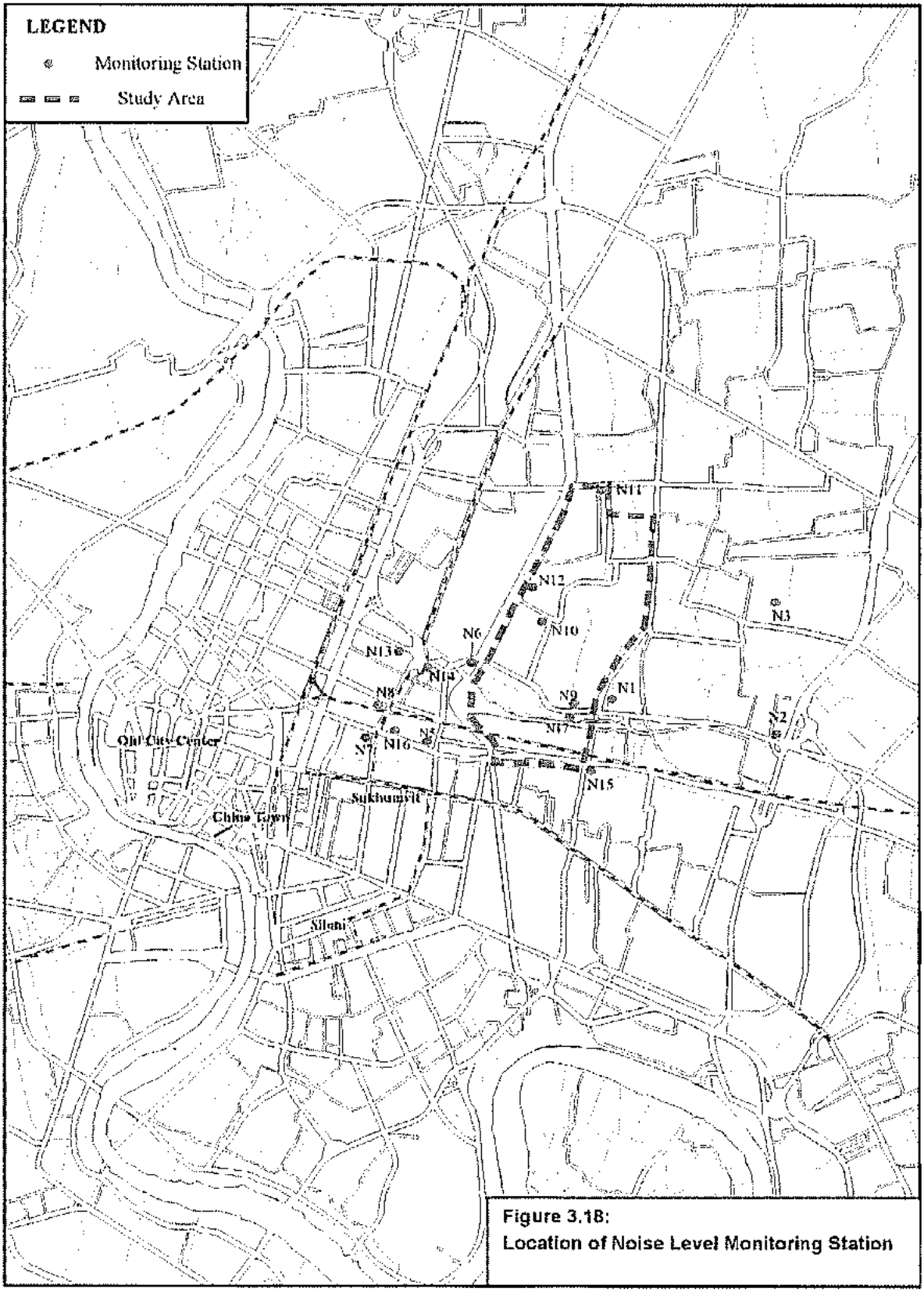

Figure 3.18:
Location of Noise Level Monitoring Station

Table 3.20: Noise Level around the Study Area

	Measuring Station	Period	Noise Level (dB(A))		Source
			Leq 24-hr	Leq 1-hr	
N1	MCOT Junction	Mar-99		79.2	HK
		Jul-99		76.4	
		Feb-00		64.2 - 74.9	
N2	Wat Rama IX Kanjanaphisek	Mar-99		60.5	HK
		Jul-99		63.3	
		Feb-00		59.0-66.1	
N3	Yu Charoen Real Estate	Mar-99		67.4	HK
		Jul-99		66.3	
		Feb-00		60.1-70.1	
N4	Victory Monument	Feb-00		63.6-78.3	RT
N5	Pratu Nam, Police Camp	Mar-97	83.0-83.5		PCD
		Mar-98	80.6-81.9		PCD
		Mar-99		80.2	RT
		Jul-99		81.2	RT
		Apr-99	80.6-81.0		PCD
N6	Rang Nam Road	Mar-99		63.4	RT
	(Suntiphap Park)	Jul-99		68.4	
N7	Si Ayutthaya Road	Mar-99		76.2	RT
		Jul-99		77.9	
		Feb-00		60.1-73.8	
N8	Yothi Road	Feb-00		60.4-72.9	RT
N9	Fortune Tower, Ratchadaphisek Road	Feb-00		64.3-72.3	DD
N10	Din Daeng Flat	Mar-99		78	DD
		Jul-99		81.6	
N11	Sutthisan Vibhavadi Junction	Mar-99		80.2	DD
		Jul-99		80.9	
		Feb-00		72.3-81.5	
N12	Vibhavadi Park (Infornt of	Mar-99		79.9	DD
	Din Daeng District Office)	Jul-99		75.9	
		Feb-00		52.0-62.7	
N13	Ratchawithi Hospital, Victory Monument	Jun-97	70.6-71.0		PCD
		June-July 1998	73.7-74.2		
		Sep-99	73.7-74.0		
N14	Dokya Bookstore, Victory Monument	June-July 1997	76.9-79.2		PCD
N15	Asok-Petchaburi Junction	Sep-97	70.8-71.5		PCD
N16	Department of Livestock Development	Feb-97	77.4-78.1		PCD
		Sep-98	75.6-76.0		PCD
		Feb-97	75.5-76.4		PCD
N17	Rama IX Junction, Police Camp	September - Oct-99	77.2-78.1		PCD
Standard Value			70		

Remark: PCD = Pollution Control Department, MOSTE.
HK = The District Office at Huai Khwang
RT = The District Office at Ratchathewi
DD = The District Office at Din Daeng
Standard Value = Ambient Air Standards of Thailand, According to MOSTE

Source: Data derived from
- the District Offices at Huai Khwang, Ratchathewi and Din Daeng.
- Pollution Control Deprtment, MOSTE

3.6.4 Businesses with Potential Health Impact

The Public Health Act (1982) classifies 130 categories of businesses detrimental to human health. Among them, the 20 most commonly found in Din Daeng district are summarized in the following table in order of the numbers of businesses

Although all of these businesses are small-scale enterprises and the processing methods are rather simple, they could cause environmental impact by means of air pollution, nuisance from noise, and disposal of solid waste and wastewater.

Table 3.21: Businesses with Potential of Hazard to Health Impact in the Study Area

Business Type	No.
Manufactures of metal container or tool	74
Reparation of air conditional apparatus, parts of motor vehicle or machine	103
Manufactures and enameling of plastic, celluloid, bakelite or similar material	41
Sewing by sewing machines more than 5 machines	91
Painting and spray	49
Manufactures of wood and rattan by machine	31
Printing or similar activity with machine	46
Manufactures of storage petroleum product	24
Making of tools or other products from shell, bone, or other animal product	10
Storages of used material	16
Printing and finishing cloth and other textile	13
Paper product or stationary	8
Manufacture of bread and biscuit	22
Producing food by packing in can, bottle or other containers	11
Wash machines and vacuum cleaner	11
Storage of gas	19
Film developing	21
Patching or welding of rubber	12
Spinning and weaving by machines or by loom (more than 4 loom)	6
Metal welding with gas, electricity or machine	6
Total	614

Source: Public Health and Environmental Department, Din Daeng District.

3.6.5 Others

The immediate problem is poor waste collection services especially in the alleys and congested residential area. In addition, illegal waste dumping are rampant in many places of BMA. These activities result in bad odor and pose health hazard.

To solve this problem, the following measures are necessary:

The immediate problem is poor waste collection services especially in the alleys and congested residential areas. In addition, illegal waste dumping is rampant in many places of BMA. These activities result in bad odor and pose a health hazard.

To solve this problem, the following measures are necessary:

- watching of regulations for garbage dumping and collection among residents;
- strengthening and improvement in garbage collection system; and
- application of punitive regulation.

CHAPTER FOUR:

BASIC POLICIES ON URBAN REDEVELOPMENT

IN THE STUDY AREA

4.1 CHARACTERISTICS OF THE STUDY AREA SUMMARIZED

4.1.1 Locational Characteristics

The location of the Study Area can be characterized by the following:

- Located at the junction of the north-south and east-west urban axes;
- Located at the gravity center of population in BMR after recent sub-urbanization toward north-east; and
- Although adjacent to the urban cores, access to them is hindered especially by Vibhavadi Rangsit road on the west and the railway and marshalling yard of SRT and Saen Saep canal on the south.

4.1.2 Characteristics in Land Use

The land use in the Study Area can be characterized by the following:

- One of the old urban districts triggered by construction of welfare housing by the Department of Public Welfare, in the 1950s;
- It comprises two mega-project areas, namely: Din Daeng Community Development Area and Makkasan SRT Marshalling Yard Development Area;
- Large-scale public land use dominates along Vibhavadi Rangsit road, while large-scale commercial and recreational facilities along Ratchadaphisek road that has developed in recent years;
- The southern part of the district has a very high population density with many shop houses, most of them relatively old; and
- The northern part is formed by detached houses with some higher grade residential estates.

4.1.3 Social Characteristics

Due to the historical background of urbanization as initiated by the Department of Public Welfare's housing development, and followed by public rent apartments by NHA in Din Daeng and Huai Khwang, the Study Area is inhabited by low income dwellers.

A large proportion of these people is engaged in the service sector and provides various services for the entire city with relatively low reward for their work. It is, therefore, very important for the area to remain as a livable place for these people.

There are several dense communities (slums and squatters) situated in the Study Area. These dense communities generally have rent contract for the land and/or houses occupied by them, and therefore have access to social services provided by the public sector. At the same time, there are several communities that have no contract for their use of land and/or houses, particularly around Makkasan Lake and SRT Makkasan Marshalling Yard. People in these communities tend to be engaged in the informal sector and, therefore, are economically unstable. For those people, stable housing and opportunities for education and training are desired.

4.1.4 Weakness of the Study Area

In spite of the advantageous location, urban renewal had not significantly taken place in the Study Area, during the last urban development boom period, except along Ratchadaphisek road. The population in the Area has been decreasing. This stagnation can be attributable to the following factors:

- Poor access to the existing urban cores;
- Notorious traffic congestion at the intersection of Vibhavadi Rangsit and Din Daeng Asok roads;
- Lack of convenient transport due to absence of secondary arterial roads and infiltration of passing-by traffic through the area;
- Poor level of urban amenity such as bad smell of canals and flood retention pond, scarce open space and greenery; and
- Difficulty in land acquisition and/or adjustment of right holders due to highly built-up area with many people to be affected by projects.

4.2 POSITION OF THE STUDY AREA IN WIDER CONTEXT

4.2.1 Locational Advantages and Opportunities of the Study Area

The Study Area is judged to be suitable for restructuring its urban structure for the following reasons:

- Situated at the junction of two existing major urban axes, it is in a strategically important position;
- It may be possible to develop a compact and spatially balanced urban core due to proximity to the existing urban cores on three sides;
- As it is located inside the inner ring road, it is possible to utilize well developed existing infrastructure;
- The proposed station of the Blue Line, together with planned Orange Line, will make it possible to establish mass transit oriented transport system; and
- Located on the north east of the existing urban cores, it has better access for the large number of citizens residing in north-eastern area of BMA.

4.2.2 Desired Role of the Study Area

Based upon the discussion so far above, the role to be played by the Study Area can be "The Fourth Urban Core of Bangkok" along with existing cores of Rattanakosin, Silom and Dusit areas. Specifically, following urban functions are expected:

(1) International Gateway and Associated Business Center

As SRT's Makkasan Marshalling Yard is strategically located at the junction of the two urban axes, this area is strongly expected to play the role of an international gateway via the Second Bangkok International Airport (SBIA) upon its opening. A plan is being worked out to set up a City Air Terminal herein. Excellent access is to be established, and will no doubt afford an advantageous base for some specific business fields, such as international financing, international trade, and insurance businesses.

(2) Civic Center for the Citizens of BMA Area

Din Daeng Community Area (100 ha) contains a variety of public facilities and services citywide, as represented by the branch city hall of BMA, specialty hospital

of MOPH, elders' welfare facility of MOL, schools of MOE and BMA. It therefore can be defined as a civic center serving the citizens of the entire BMA area. The projected new city hall of BMA will further enhance this function.

(3) Urban Central Residence

Being close to the CBD and other urban cores, the Study Area can be a residential area with short commuting time for workers. In the southern part of the Study Area, there are a significant number of people living and engaged in a variety of inexpensive urban services for the entire city. Since they embody one of the truly Bangkok-like urban features, the Study Area should continue to accommodate these people.

(4) Urban Recreation

There exists a number of public open spaces such as the Thai-Japan Youth Center and Makkasan Lake. As the opening of the new city hall will enhance symbolic status, the Study Area can offer a variety of urban recreational functions for citizens citywide.

Figure 4.1: Position and Role of the Study Area