7. ESTIMATE OF FUTURE AIR QUALITY WITHOUT COUNTERMEASURES

7.1 Future Socio-economic Frameworks

In order to predict the air pollution level in the Jabotabek region, the Team proposed future scenarios by setting socio-economic frameworks as described below.

(1) Future Scenarios

Four (4) parameters which are most likely concerned with air pollution were selected to delineate future socio-economic conditions of Jabotabek. These are population, per capita gross regional domestic product (GRDP), net commuter population, and industrial area. Based on those, the following three scenarios towards the study target year of 2010 were proposed to BAPEDAL.

- Future low-growth scenario,
- Future high-growth scenario, and
- Future medium-growth scenario.

Considering survey reports and forecast documents concerned, it is expected that the future socio-economic conditions of the Jabotabek region would be mostly between the low- and high-growth levels. Thus, the future medium-growth scenario was applied to this Study, according to an agreement between the Indonesian and Japanese sides.

(2) Finalized Development Framework for the Jabotabek Region in the Future

In selecting the future medium-growth scenario, 2 other parameters - mobile fuel consumption and person-trip generation - were added to the above-mentioned 4 parameters, as they were needed to predict air pollutant emission from mobile sources. Table 7.1 shows the finalized future scenario for the Jabotabek region, together with past and present levels of parameters.

Table 7.1 Finalized Future Scenario for Jabotabek

Factor/Area	1990	1993	1995	2000	2008	2010
Population in Jabotabek (Unit : persons)						
DKI Jakarta	8,235,000	---	9,062,500	9,892,500	---	11,339,000
Bekasi	2,099.000	---	2,738,500	3,468,500	---	4,434,000
Tangerang	2,757,500	---	3,595,000	4,568,500	---	6,013,500
Bogor	3,990,500	---	4,764,500	5,571,500	---	6,970,000
Botabek	8,847,000	---	11,098,000	13,608,500	---	17,417,500
Total (Jabotabek)	17,082,000	---	20,160,500	23,501,000	---	28,756,500
Per Capita Gross Regional Domestic Product (GRDP) in Jabotabek (Unit : Rp/year)						
DKI Jakarta	---	---	1,697,500	2,542,500	---	4,593,000
Botabek	---	---	1,337,500	1,697,500	---	4,504,000
Average (Jabotabek)	---	---	1,517,500	2,052,400	---	4,538,710
Net In-Commuter Population from Botabek to Jakarta (Unit : persons)						
from Bekasi	---	72,200	---	91,450	---	172,859
from Tangerang	---	44,900	---	57,550	---	110,663
from Bogor	---	70,400	---	85,150	---	142,040
Total (from Botabek)	---	187,500	---	234,150	---	425,562
Industrial Land in Jabotabek (Unit : ha)						
DKI Jakarta	4,519	---	---	5,689	---	7,979
Botabek	10,662	---	---	13,402	---	19,492
Total (Jabotabek)	15,181	---	---	19,091	---	27,471
Fuel Consumption by Road Transport in DKI Jakarta (Unit : mil.kl)						
Gasoline	1.1	---	---	---	3.7	---
ADO	0.3	---	---	---	1.1	---
Total (Jakarta)	1.4	---	---	---	4.8	---
Person-trip Generation (Unit : 1,000 trips)						
DKI Jakarta	---	16,435	---	---	---	22,782
Botabek	---	16,175	---	---	---	33,932
Total (Jabotabek)	---	32,610	---	---	---	56,714

Note: ADO: automotive diesel oil

7.2 Estimate of Future Air Pollutant Emissions from Stationary Sources

(1) Factories

In the Jabotabek area, the average annual growth rate of total electricity generation between 1990/91 and 1994/95 was 19%, that of cement production between 1988 and 1995 was 8.7%, and that of consumption of HSD, IDO and natural gas by caloric excluding the consumption by the electric power supply industry from 1986 to 1994 was 11%.

The estimated total emission load of each pollutant in 2010 is 4.32 times that in 1995 (184,000 tons for SOx, 159,000 tons for NOx, and 59,000 tons for PM) as shown in Table 7.2.

Table 7.2 Future Air Pollutant Emission Loads from Factories (Jabotabek)

Year	Industry	GRDP (ratio to 1995)	(ton/year)		
			SOx	NOx	PM
1995	Electricity	1.00	15,096	20,088	760
	Cement		6,379	5,740	2,009
	Other		21,222	11,004	10,812
	Total		42,697	36,832	13,581
2000	Electricity	1.60	24,153	32,141	1,215
	Cement		10,206	9,185	3,215
	Other		33,955	17,606	17,299
	Total		68,314	58,932	21,729
2010	Electricity	4.32	65,215	86,781	3,281
	Cement		27,557	24,799	8,680
	Other		91,679	47,537	46,708
	Total		184,450	159,117	58,669

(2) Households

The future air pollutant emission load from households was estimated based on population growth. Total population in Jabotabek is expected to grow from 20 million in 1995 to 24 million in 2000 and 29 million in 2010. Total annual emission load from 1995 to 2010 will increase from 4,000 tons to 6,000 tons for SOx, 5,000 tons to 7,000 tons for NOx, and 600 tons to 900 tons for PM as shown in Table 7.3.

Table 7.3 Air Pollutant Emissions from Households (Jabotabek)

(Unit : ton/year)

District	SOx			NOx			PM		
	1995	2000	2010	1995	2000	2010	1995	2000	2010
Jakarta	1,897	2,071	2,374	2,230	2,435	2,791	288	315	361
Bogor	997	1,166	1,459	1,173	1,371	1,715	152	177	222
Tangerang	753	956	1,259	885	1,124	1,480	114	145	191
Bekasi	573	726	928	674	854	1,091	87	110	141
Jabotabek Total	4,220	4,920	6,020	4,962	5,784	7,077	642	748	915

7.3 Estimate of Future Air Pollutant Emissions from Mobile Sources

(1) Automobiles

Considering the increase rate of fuel consumption of 7.1% between 1990 and 2008, the growth rate of person-trip generation was set at 5.2%. The total trip ends in 2010 would be 2.139 times that in 1995.

Based on future traffic and subsequent growth rates of various vehicle types, area distribution, and future public transport mode (like MRT), the running kilometers and pollution load were calculated as shown in Table 7.4.

Table 7.4 Future Air Pollution Loads from Automobiles

(Unit Pollutant: Ton/Year, Running Km: 10^6km/Year)

	CO	HC	NOx	SOx	PM	Running Km
Year 2010	1,154,492.8	196,879.5	223,913.0	18,991.5	21,964.3	80,286.7
Year 1995	564,292.0	97,970.6	98,738.3	8,142.3	9,563.0	38,576.6
2010/1995	2.05	2.01	2.27	2.33	2.30	2.08

(2) Ships and Aircraft

The trip number of ships in 1995 - 2010 was estimated at 1.318 times that in 1995. Future air pollutant emission at the port was predicted based on this growth rate. It was estimated that the total SOx and NOx emission loads from ships in 2010 would be 1,065 tons/year and 2,583 tons/year, respectively.

The trip number of aircraft in 2010/1995 was estimated at 4.192 times that in 1995 for Soekarno-Hatta airport and 3.142 times for Halim airport. Future air pollutant emission load at the airport was predicted based on those growth rates. It was estimated that the total emission loads from aircraft in 2010 would be 437 tons/year for SOx and 4,946 tons/year for NOx.

7.4 Simulation of Air Quality without Countermeasures in 2010

Simulation of air quality in Jabotabek area was carried out for the case without countermeasure in 2010. Concentration maps of SO_2, NO_2 and CO are shown in Figures 7.1 to 7.3.

The areas with high SO_2 concentration exceeding the standards widely spread in Jakarta Utara, Jakarta Pusat, Jakarta Barat to Kota Tangerang, Jakarta Timur to Kota Bekasi, and Cibinong. Total number of the grids exceeding the standards is 441 and 20 grids show very high SO_2 concentration (two times higher than the standards). All of DKI Jakarta, Kota Tangerang, and Kota Bekasi were covered with relatively high SO_2 (more than 10 ppb). The main cause of the high SO_2 concentrations is the factories like power plants, cements, and so on. The impacts from automobiles and ships are limited in certain local spots.

The grids with high NO_2 concentration exceeding the standards mainly appear in DKI Jakarta, Kota Tangerang, and Kota Bekasi. Total number of the grids exceeding the standards is 47 and two grids show very high NO_2 concentration (two times higher than the standards). The main cause of the high NO_2 concentrations is the automobiles at heavy traffic roads. The impacts from factories are not so high NO_2.

CO concentrations are below the standard even in 2010.

Future Condition (2010)

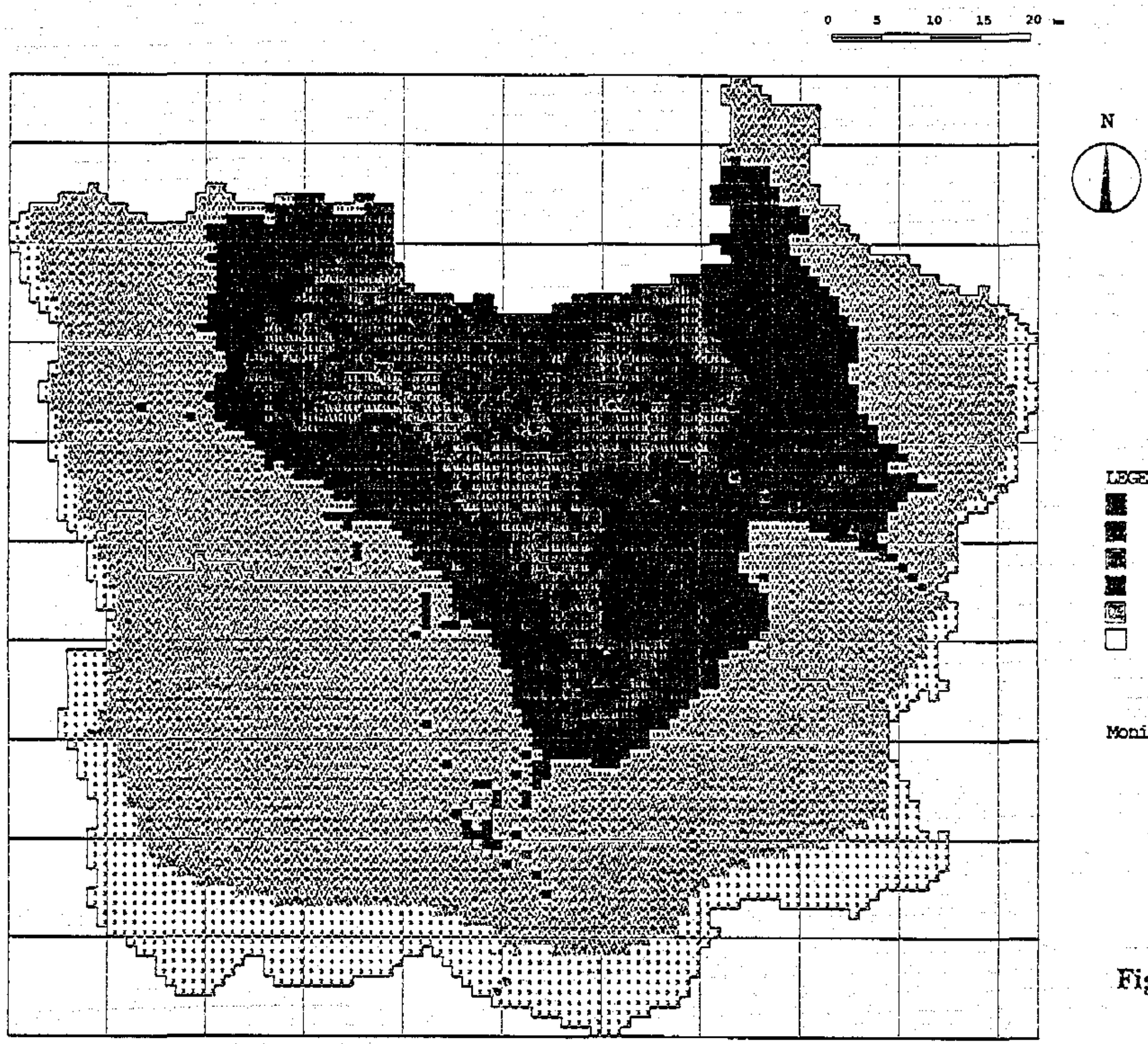


Figure 7.1 Concentration Map of SO_2 from All Sources in 2010

SO2 ppb Annual Average

C MAX= 51.9ppb
Background Concentration: 0.ppb

Future Condition (2010)

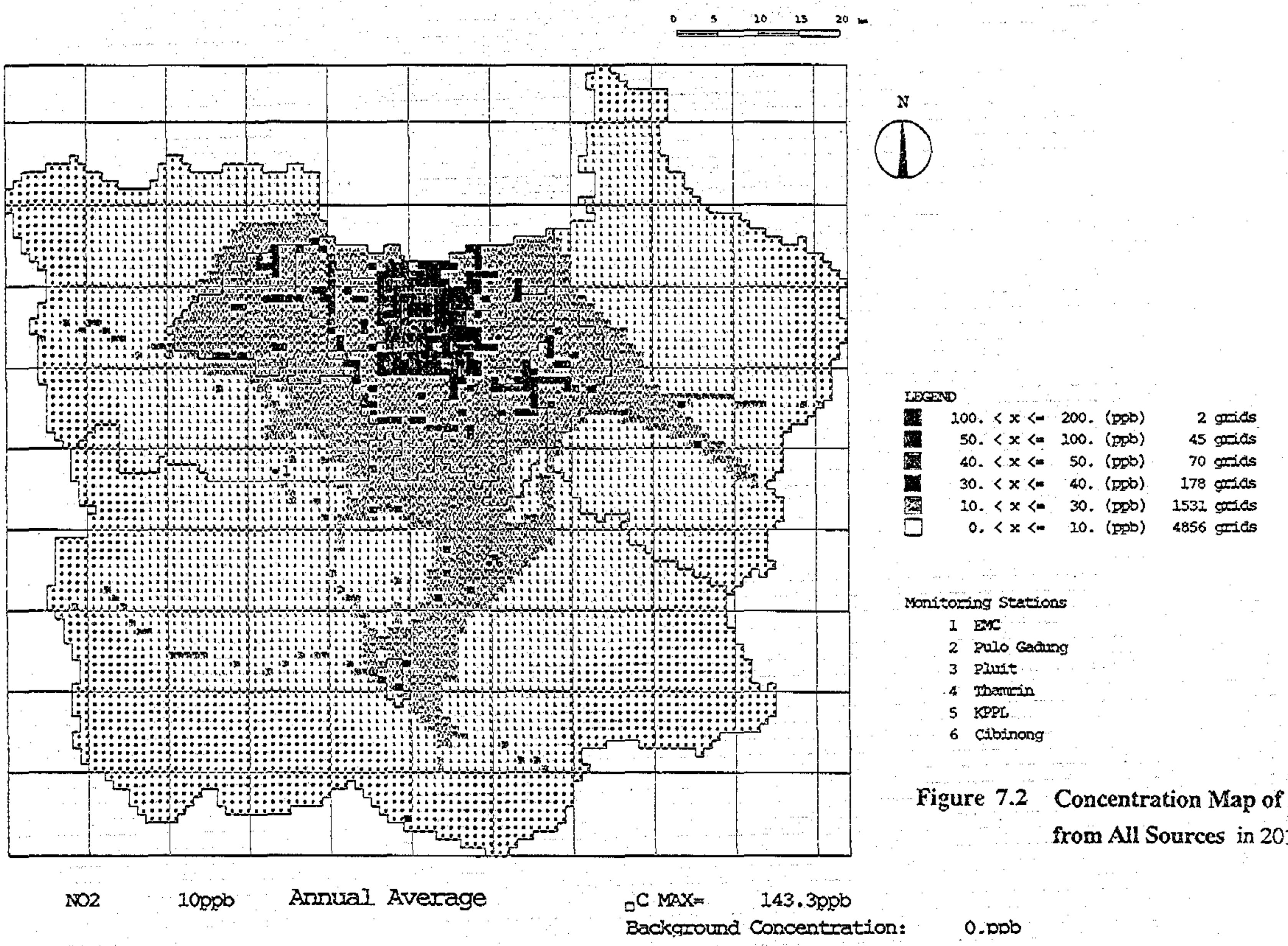
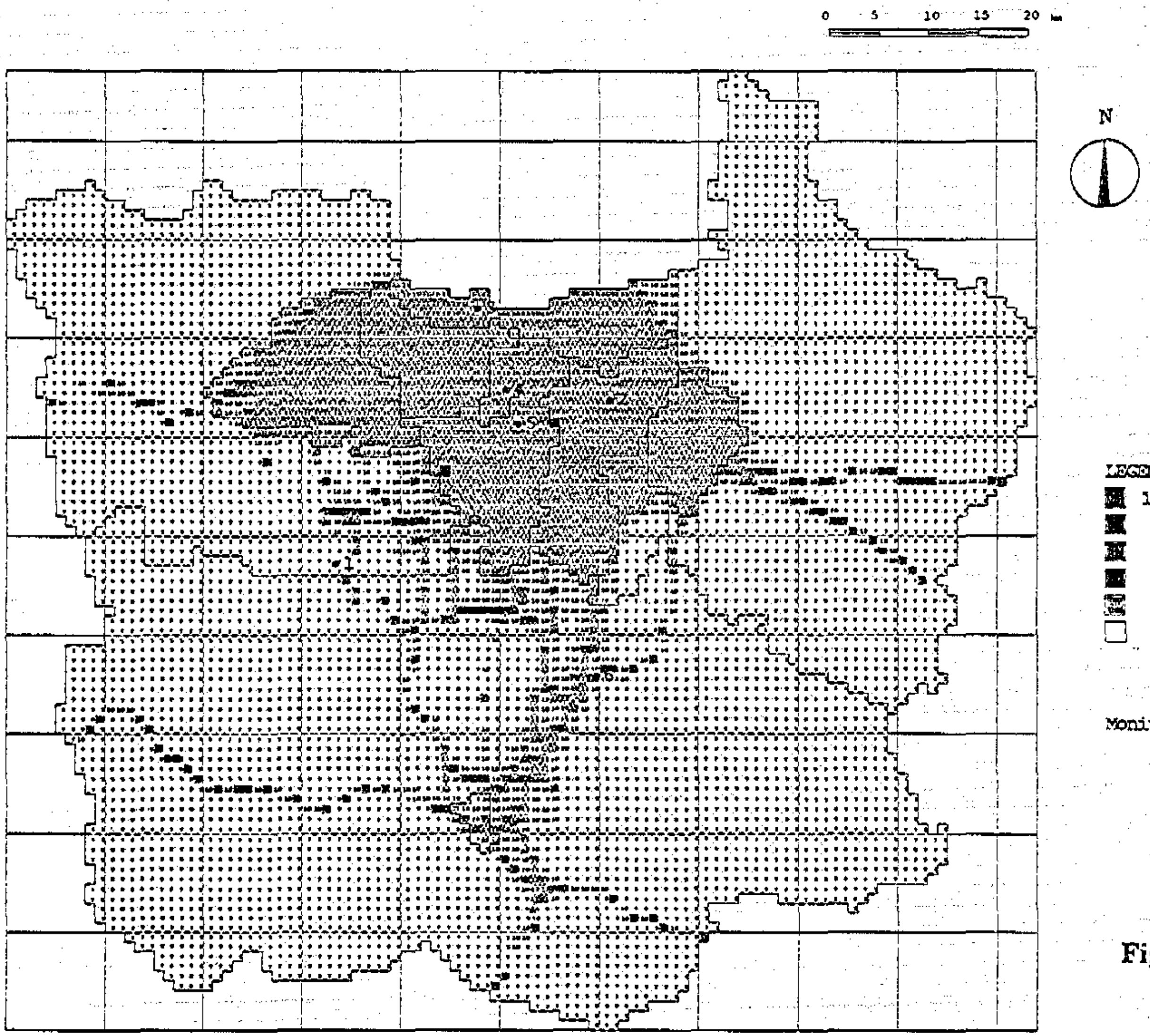


Figure 7.2 Concentration Map of NO_2 from All Sources in 2010

Future Condition (2010)



LEGEND

16200. < x <=32400. (ppb)	0 grids
8100. < x <=16200. (ppb)	0 grids
6000. < x <= 8100. (ppb)	0 grids
4000. < x <= 6000. (ppb)	2 grids
1000. < x <= 4000. (ppb)	1199 grids
0. < x <= 1000. (ppb)	5481 grids

Monitoring Stations
1 EMC
2 Pulo Gadung
3 Pluit
4 Thamrin
5 KPPL
6 Cibinong

CO 100ppb Annual Average

C MAX= 4098.1ppb
Background Concentration: 860.ppb

Figure 7.3 Concentration Map of CO from All Sources in 2010

8. BASIC PRINCIPLES FOR PLANNING OF COUNTERMEASURES

8.1 Issues and Focal Points for Planning of Countermeasures

(1) Air Pollution Aspects

Current air quality

According to the result of air quality monitoring, studies of fuel and emissions from stationary and mobile sources, and analysis of air pollution mechanism, characteristics of current air quality are summarized as follows.

1) With regard to ambient air quality, the concentrations of SPM, Non-Methane Hydrocarbon and TSP exceed the Draft National or DKI Jakarta Ambient Air Quality Standards at least in some instances in some stations, but the concentrations of SO_2, NO_2 and CO satisfy the standards in all instances and in all stations.

2) As for stationary sources, electric supply industry is the biggest producer of SOx and NOx. For PM, cement, iron and steel, and textile industries are the main contributors. In the case of emission from factories by area, the share of DKI Jakarta is the highest for SOx and NOx. For PM, Bogor's share is the highest in the region.

3) As for mobile sources, more than 50% of CO and NOx are emitted from the passenger car group. SOx and PM emissions are almost equally shared by the passenger car group, bus and truck group with similar values. For HC emission load, passenger car and motorcycle group each occupies around 40%.

4) As for all emission loads from stationary and mobile sources, the highest share of SOx emission is from factories and NOx emission from automobiles. For PM, the highest share is from factories.

5) Correlation coefficients of simulated results and actual measurement at monitoring stations are 0.67 for SO_2, 0.92 for NO_2, and 0.94 for CO. So, the simulation model can be used for the present and future predictions of these pollutants. On the other hand, correlation coefficient of SPM simulation is 0.15 and background value is high with 73 ppb, therefore the model should not be used for SPM prediction.

Future trend (2010)

The results of simulation of air quality without countermeasures in 2010 are summarized as follows.

1) Total emission load of air pollutants in 2010 compared with 1995 will be 4.3 times for factories, about 1.4 times for households, and 2.0 to 2.3 times for automobiles.

2) As for the ambient air quality in 2010, SO_2 will exceed the standards in the northern part of DKI Jakarta, Tangerang, Cibinong, and Bekasi. NO_2 also will exceed the standards in the central areas of DKI Jakarta and along major roads, but CO will satisfy the standards.

(2) Technical Aspects

1) There is a serious shortage of continuous monitoring stations to monitor the ambient air quality in the whole Jabotabek area. Only part of DKI Jakarta is monitored now.

2) Technical know-how on basic operation of various kinds of monitoring equipment, check of accuracy and classification of monitoring data is not enough.

3) Due to the lack of technical know-how to grasp working conditions and fluctuations of combustion facilities, assessment of measured data is not so reliable.

4) Technical know-how on analysis of the exhaust gas investigation results is not enough.

5) Larger-scale boiler facilities have significant adverse impacts on ambient air, since they usually use a great extent of MFO containing much sulfur.

6) High dust and NOx concentrations are found in the facilities with diesel generators, even though they use HSD as fuel.

(3) Institutional aspects

1) BAPEDAL has institutional weak points such as lack of working staff, financial and functional capabilities since its establishment in 1990.

2) Air pollution countermeasures are carried out by various agencies such as the Ministry of Health, Ministry of Industry and Trade, Ministry of Mining & Energy, Ministry of Public Works, Ministry of Transportation and so on, but BAPEDAL performance is lacking adjustment and coordination on policies with those agencies.

3) Although KPPL is under the direct control of the Governor of DKI, it is only a local research institute in character, lacking competence in planning and coordinating DKI's environmental policies.

4) All local government agencies are lacking staff, analysis facilities and institutional strength.

5) Factories hardly have exclusive organization on environmental management and carry out environmental countermeasures as an additional work.

(4) Financial Aspects

1) Budget allocation for environmental management is given third priority in the Five-year Development Plan of the Government, i.e., in fact, of lower priority.

2) The Resources & Environmental Division of BAPPEDA (Regional Planning Agency, DKI Jakarta), which is in charge of budgetary planning for resources and environment for the local government, reportedly gives lower priority to environmental management.

3) Financial support from the Government for the AMDAL training courses is too small to train an enough number of environmental experts.

8.2 Basic Principles for Planning of Countermeasures

(1) Characteristics of the Control Plan

The plan integrates countermeasures to manage air quality for the Jakarta metropolitan area, in a well organized and systematic form. It consists of an air-pollution control strategy which shows long-term directions towards the year 2010, and action plans clarifying detailed activities to be implemented by 2000.

(2) Goal of the Control Plan

The plan aims at overall compliance with the draft ambient air-quality standards on a national level, within the Jabotabek area.

(3) Concept for Planning of Countermeasures

The air-pollution control strategy was formulated in order to accomplish the above goal, by taking the following study steps :

1) Establishment of a baseline from the results of air-quality simulation for 2010 without countermeasures,

2) Review and analysis of the on-going "Blue Sky Program" to identify its present situation and back-up necessity, then

3) Evaluation of the proposed countermeasures by means of air-quality simulation for 2010 with such countermeasures.

Individual countermeasures were evaluated only qualitatively, since actual methods for implementation of some measures are subject to governmental policies and/or private-sectors' directions.

Action plans were formulated for countermeasures feasible by 2000 with high urgency, taking due consideration of the present progress of the Blue Sky Program.

(4) Target Pollutants and Polluters

Countermeasures under the plan are targeted for stationary and mobile emission source controls as well as other control measures, and they aim at emission reduction of sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and carbon monoxide (CO).

Only emission load was calculated for suspended particulate matter (SPM) because its simulation model could not be designed due to a severe influence from background concentration. Future quality of hydro-carbon (HC) was also not simulated due to unknown specific sources. But countermeasures related to HC were classified as other control measures since HC quality is largely exceeding the draft standards at present.

9. Source Control Strategy

9.1 Measures for Emission Source Control

The Team proposed the measures for stationary and mobile emission source control based on the air quality monitoring, emission measurement, simulation of air quality without countermeasures in 2010, and the Blue Sky Program.

Simulation of air quality was carried out by two steps, with existing and planned countermeasures by BAPEDAL (Case 1) as the first step, and together with additional countermeasures (Case 2) as the second step.

Based on the result of simulation, a source control strategy was proposed, showing competent authorities, control items, time of implementation, and cost. Countermeasures with high priority for action plans were selected by the viewpoint of grasping of the most important and basic data in order to manage the air quality effectively.

(1) Measures for Common to Stationary and Mobile Sources

1) Monitoring of Hydrocarbon Concentration in Ambient Air

The air quality monitoring conducted in this Study shows that quality levels at all of the monitoring stations do not comply with the Draft National Ambient Air Quality Standard on hydrocarbon. Due to the lack of data on emission loads, it is necessary to carry out a survey on emissions of hydrocarbon from stationary and mobile sources in addition to continuous monitoring.

2) Reduction of Hydrocarbon Emissions

Since HC emission load from stationary sources is not specified, survey for inventory, countermeasures against major sources, comparison of alternative measures and recommendation of potential control strategy should be carried out for reduction of HC emission.

3) Reduction of Particulate Matter in Ambient Air

TSP and SPM in Jakarta exceed the DKI Jakarta's environmental standard. Sources of particulate matter are likely to be diesel smoke for SPM and diesel smoke as well as soil dust for TSP. So it is necessary to survey on specific sources to reduce particulate matter.

4) Strengthening of Ambient Air Monitoring System

High SO_2 concentrations are predicted in Tangerang, Cibinong and Bekasi, in addition to the northern part of DKI Jakarta in future. New monitoring stations should be established in those areas for the implementation of proper measures and confirmation of their effect.

(2) Measures for Stationary Emission Source Control

According to the result of simulation of air quality without countermeasures in 2010, SO_2 concentrations are very high in the northern part of DKI Jakarta, Tangerang, Cibinong and Bekasi. NO_2 concentrations also are high in the central area of DKI Jakarta. So, it is necessary to implement the measures for stationary emission source control.

1) Stationary Source Inventory

Under the Blue Sky Program, BAPEDAL is considering strengthening the emission standards of stationary sources by introducing additional kinds of industry to the current ones, and also to implement arbitrary on-the-spot stack gas monitoring. BAPEDAL needs the whole picture of stationary sources in Jabotabek, utilizing the inventory guideline provided by the Team.

2) Enforcement of Emission Standard Decree

The Decree of State Minister (KEP-13/MENLH/3/1995) on Emission Standards for stationary emission sources regulates emissions from 4 prime industries (iron & steel, pulp & paper, cement, and coal fired steam power plants) and all other industries. The standards are effective in 2 target years of 1995 and 2000 . According to the result of emission gas measurement of the 36 facilities in 31 factories, the 1995 standard emission level of stationary emission sources were exceeded in several facilities. It is therefore necessary to impose penalty and fine on entrepreneurs who violate regulations on emission gas.

In order to strengthen the regulations on emission gas from factories, an inspection system should be established by local governments. Inspection and monitoring of the emission gas from factories under the law and decrees are a duty of the local government.

3) Total Emission Reduction Plan

Emission control is applicable to areas where factories and businesses are concentrated, and thus it is difficult to maintain the levels required by the Draft National Ambient Air Quality Standard by applying only the emission standard applicable to unit facilities. Such areas are designated by the Government as areas to which the standard for total emission control should be applied. The local governor of such a designated area should apply the total emission control standard to the designated factories whose scales are larger than a certain standard, and the fuel use control standard to factories other than designated factories.

4) Emission Management System

In order to meet the emission standards for stationary sources in each industry, managers with the technical knowledge on the air pollution control measures, should be more effective in carrying out daily inspection and monitoring. As for the selection of managers, employment of certificate holders under the AMDAL system should be considered.

5) Combustion Control System

Appropriate design of the heating system is now an important factor. Its aim is only to make operation of the heating system efficient, in a narrow sense. Yet combustion control in a wider sense, including the use of proper fuel and regular maintenance of the entire heating system and control equipment used, is still important.

6) Fuel Conversion

The concentration of SO_2 in the exhaust gas is in direct proportion to the sulfur content in the fuel. Therefore a direct effect of strengthening of regulations on emission gas and introduction of total emission control can be expected by promoting the conversion of fuel use from petroleum fuel to natural gas. Also, for the air pollution control in Jabotabek, utilization of coal should not be allowed because of its high sulfur content.

7) District Stack Gas Control

Installation of stack gas desulfurization, stack gas denigration and dust separation system in combustion facilities is effective for stack gas control in high stack gas concentration areas determined by air quality simulation.

(3) Measures for Mobile Emission Source Control

The results of simulation of air quality without countermeasures in 2010 show that SO_2 and NO_2 concentrations along major roads are high due to the increased traffic volume which is estimated to be more than twice that in 1995. So, implementation of the measures for mobile emission source control is required.

As for traffic flow control and traffic volume control, improvement of the road network and introduction of a new transportation system (subway) have been planned and executed, and those measures have been considered in the simulation of air quality without countermeasures in 2010. Therefore, they are not included here.

1) Preparation of Mobile Source Inventory in Jabotabek

Emission gas from vehicles largely contributes air pollution in Jabotabek. BAPEDAL needs to conduct fact-finding on emission gas level from mobile sources in Jabotabek by using the guidelines for preparation of mobile source inventory prepared by the Team in order to control emission gas from mobile sources.

2) Introduction of New Regulations on Vehicle Emission Gas

Besides idling emission gas control, new regulations are needed with stricter standards requiring, for instance, the installation of emission gas control equipment such as catalytic converters introduced in Japan and Europe. BAPEDAL considers to apply UN-ECE standards under the Blue Sky Program. The standards would be established for each car type, and their measurement is carried out using the chassis dynamometer under actual vehicle driving patterns.

3) Strengthening of Vehicle's Inspection and Maintenance Program

Half-yearly inspection and maintenance are compulsory for all commercial vehicles, but they are not satisfactory due to the lack of inspection facilities such as vehicle gas meter for CO and HC, and diesel smoke meter for black smoke.

The results of emission gas tests on present used cars conducted under this Study show that the idling emission standards are not well observed. Measures such as reinforced inspection of emission gas concentration, penalization of vehicles in poor repair condition, and increase of inspection centers are needed.

4) Promotion of Unleaded Gasoline Usage

Extension of the use of unleaded gasoline is needed not only for the benefit of health, but also due to the introduction of new regulations including the installation of catalytic converters. The amount of Super TT (unleaded gasoline) sold is very small due to its higher price and because there are only 6 refueling stations in DKI Jakarta. In order to promote the utilization of unleaded gasoline, heavier taxation on leaded gasoline and increase of unleaded gasoline filling stations should be further considered. In the period of transition from leaded gasoline to unleaded gasoline in Japan, the transition was conducted smoothly by a policy, that is Premium was conducted into unleaded at first, and Premix was kept leaded for a while with high price.

5) Acceleration of Turnover Rate of Aged Vehicles

If new regulations on vehicle emission gas are introduced, their effect is limited due to the continued use of old and polluting vehicles. It is necessary to establish measures to accelerate the turnover rate of current vehicle fleet, such as new taxation system which gives old car higher tax rate than that of new cars as an incentive not to keep old car.

6) Promotion of Low-pollution Vehicles

It is necessary to introduce and promote the use of CNG, LPG and electric vehicles in the public transportation system. Government support is needed for the introduction of these low-pollution vehicles.

7) Suppression of Diesel Use in Vehicles

Current motor vehicle fuels are favor to diesel by almost half of gasoline. If this difference continue in the coming years, it will promote usage of diesel vehicles greatly which emit more Nox and SPM than gasoline vehicles. Strengthening of regulatory standards on sulfur content in diesel fuel would be effective for the reduction of SO_2 emission load in the same way as the control of diesel fuel vehicle. Also low sulfur diesel fuel is a prerequisite for catalytic converter technology for diesel vehicles.

9.2 Air Quality with Countermeasures in 2010

(1) Air Quality with Existing and Planned Countermeasures by BAPEDAL (Case 1)

1) Estimate of Emissions from Factories

BAPEDAL enforced air pollutant emission regulation against stationary sources in 1995. It has two target years of 1995 and 2000. To evaluate the emission regulation, the amount of emission reduction from factories in 2010 was estimated. To estimate the effect of the regulation the following three assumptions were made.

- No new facility will be introduced before 2000.
- Old (existing) facilities will continue to work in 2010.
- Emissions from unsurveyed sources (factories) will not change regardless of the regulation.

Air pollution emissions from factories with countermeasures were estimated as shown in Table 9.1.

Table 9.1 Emission Reduction from Factories (2010)

Pollutant	No regulation (ton/year)	Regulation (ton/year)	Reduction (ton/year)	Reduction rate (%)
SOx	184,450	117,314	67,136	36.4
NOx	159,117	159,117	0	0.0

2) Estimate of Emissions from Automobiles

BAPEDAL will apply ECE83/01 Standards according to the Blue Sky Program. The mobile emission standard is assumed to start from January 1st, 2001, and running vehicle types targeted by the standard to be passenger car, taxi, van, and small truck based on vehicle weight.

BAPEDAL has plan of 'Introduction of Low Emission Vehicles'. The low emission vehicles assumed were LPG vehicle for taxi and CNG vehicle for bus, and it was estimated that all taxies and 50% of buses (excluding microbus) are converted to low emission vehicles in the year 2010.

Air pollution emissions from automobiles with countermeasures were estimated as shown in Table 9.2.

Table 9.2 Emission Reduction from Automobiles (2010)

(Unit : ton/year)

	CO	NOx	SOx
Year 1995	564,292.0	98,738.3	8,142.3
Year 2010	1,154,492.8	223,913.0	18,991.5
With Control	964,535.8	178,135.1	16,041.2
Reduction	189,957.0	45,777.9	2,950.3
(%)	16.5	20.4	15.5

3) Simulation of Air Quality (Case 1)

SO_2, NO_2 and CO concentration maps are shown in Figures 9.1 to 9.2.

SO_2 concentrations decrease with the planned countermeasures. Number of grids with high SO_2 concentrations exceeding the standards decreases from 441 to 107, but more than one hundreds of grids remain exceeding the standards.

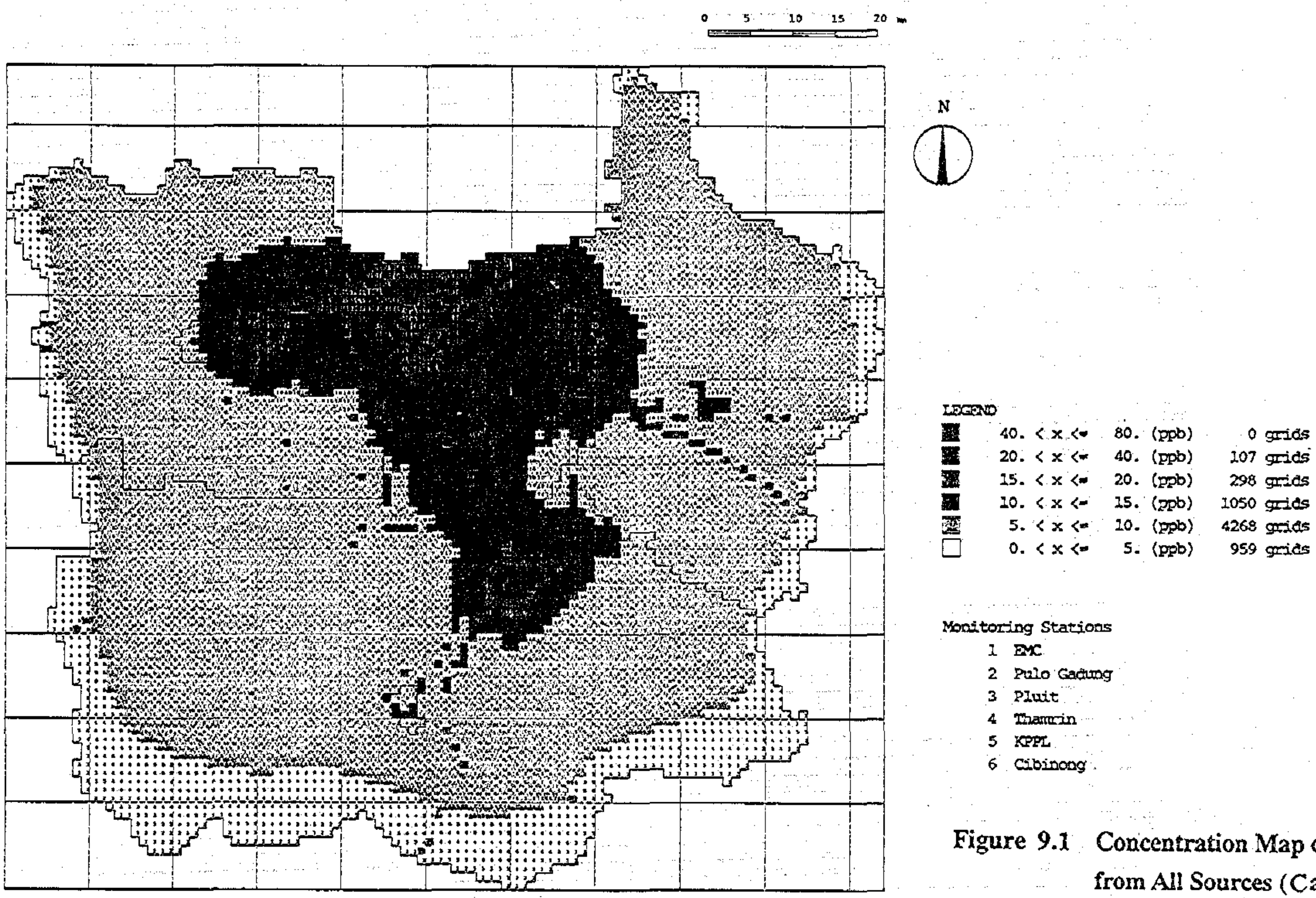
The contributions from the factories are reduced by regulation and severe concentrations (two times higher than the standards) are extinguished. However, the reductions by the regulation are not enough to satisfy the standards.

SO_x emission is reduced by the introduction of LEVs, but no limit for SO_x in the planned regulation. More reduction of SO_x from automobiles is necessary to satisfy the standards beside heavy traffic road and low sulfur diesel oil is the preferable option.

NO_2 concentrations decrease with the planned countermeasures and number of grids with high NO_2 concentrations exceeding the standards decrease from 47 to 16. However, the countermeasures are not sufficient to solve the NO_2 problem perfectly at heavy traffic roads.

CO concentrations are below the standard even without the planned countermeasures and reduced by the regulation.

Future Condition with Selected Countermeasures (2010)



SO2 ppb Annual Average

C MAX= 39.2ppb
Background Concentration: 0.ppb

Figure 9.1 Concentration Map of SO_2 from All Sources (Case1)

Future Condition with Selected Countermeasures (2010)

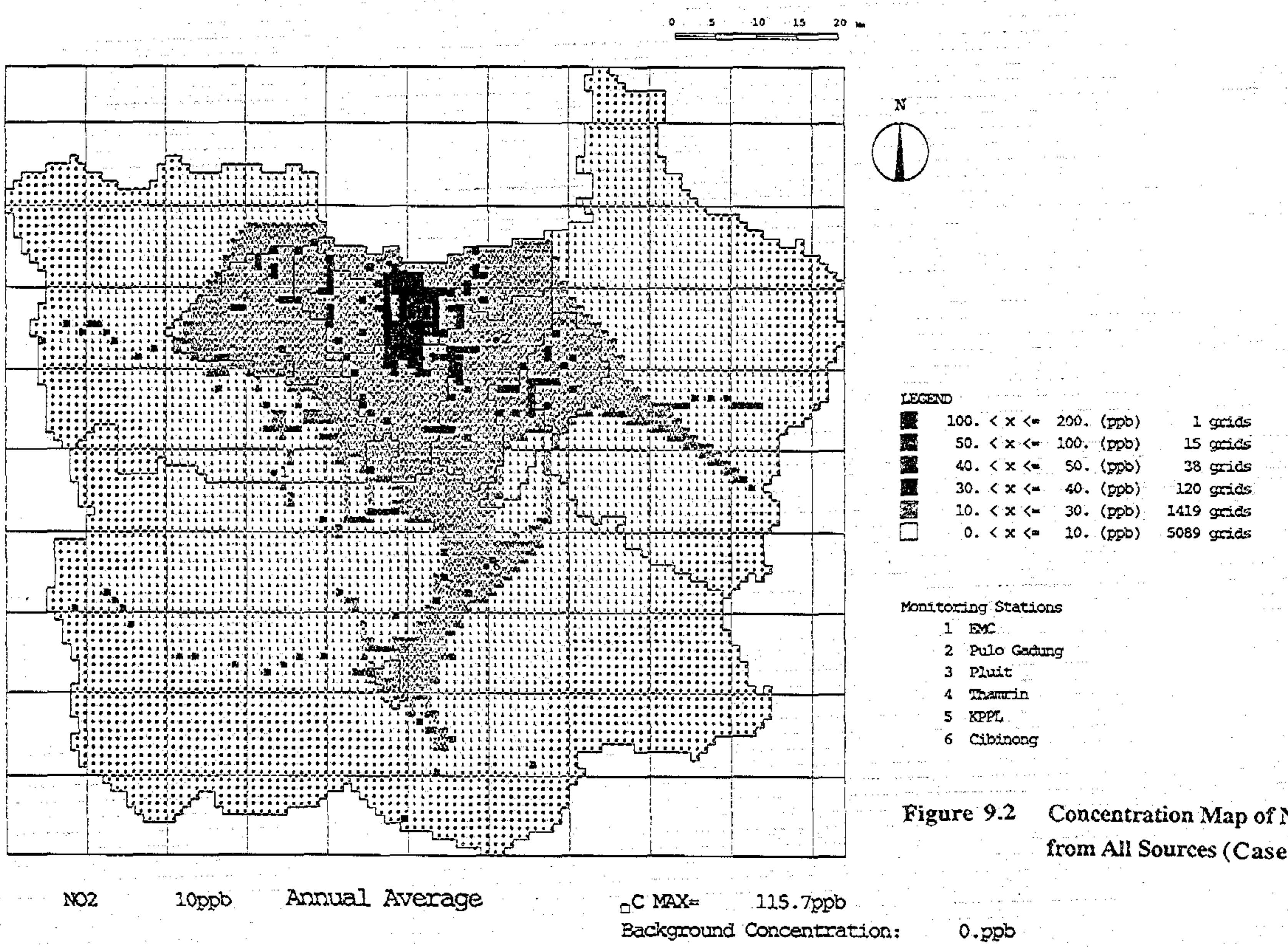


Figure 9.2 Concentration Map of NO_2 from All Sources (Case1)

(2) Air Quality with Additional Countermeasures (Case 2)

In this section countermeasures necessary to satisfy the proposed air quality standards for SO_2 and NO_2 for the whole Jabotabek area are examined.

1) Additional Measures against Factories

SO_2 concentrations, mainly affected by the factories, in Cibinong area in Bogor, East area in Tangerang, and Bekasi near DKI Jakarta exceed the proposed air quality standard. Therefore, the following additional measures were evaluated.

(1) Regional total SOx reduction by fuel change and introduction of desulfurization
(2) Installing high stack

Total SOx emission is reduced to 94,562 tons/year by implementing the additional measures and about 51% reduction of SOx is achieved as shown in Table 9.3.

Table 9.3. SOx Emission Change from Factories by Additional Countermeasures

(Unit : ton/year)

Countermeasures	No measure	Emission regulation	Additional measures
SOx emission	184,450	117,314	94,562
Ratio	1.0	0.64	0.51

2) Additional Countermeasures against Automobiles and Ships

Even if the planned countermeasures by BAPEDAL are implemented, there remain some points with high concentrations of SO_2 and NO_2 caused by mobile sources, which exceed the standards.

Then, the following additional measures were evaluated:

NO_2; - Accelerating change to new vehicles (100 % changed to regulated vehicles)

SO_2; - Reduction of sulfur content in diesel from around 0.4 % to 0.1 %
- Reduction of sulfur contents for ships from around 0.6 % to 0.4 %

As a result of these additional countermeasures, NOx and SOx emissions from mobile sources will be reduced to 51 % and 26 % respectively compared without countermeasures case in 2010 as shown in Table 9.4.

Table 9.4 Emission Change from Mobile Sources by Additional Countermeasures

(Unit : ton/year)

Countermeasures	No measure	Planned measures	Additional measures
NOx emission	223,913	178,135	113,865
Ratio	1.0	0.80	0.51
SOx emission	18,992	16,041	4,927
Ratio	1.0	0.84	0.26

3) Simulation of Air Quality

SO_2 and NO_2 concentration maps are shown in Figures 9.3 and 9.4. As a result of application of full countermeasures, the standards will be satisfied in the whole Jabotabek area. In a sense, the full countermeasures are considered ideal. A detailed feasibility study will be necessary for implementation of each countermeasure, and detailed specifications like reduction rate, sulfur content, etc. could be changed in the future.

9.3 Evaluation of Applied Countermeasures

(1) Evaluation from Institutional and Legislative Points of View

1) Countermeasures common for Stationary and Mobile Emission Source Controls

It is necessary to reinforce BAPEDAL, L-BLH, BLK, etc., and to enact 'Air Pollution Control Law'.

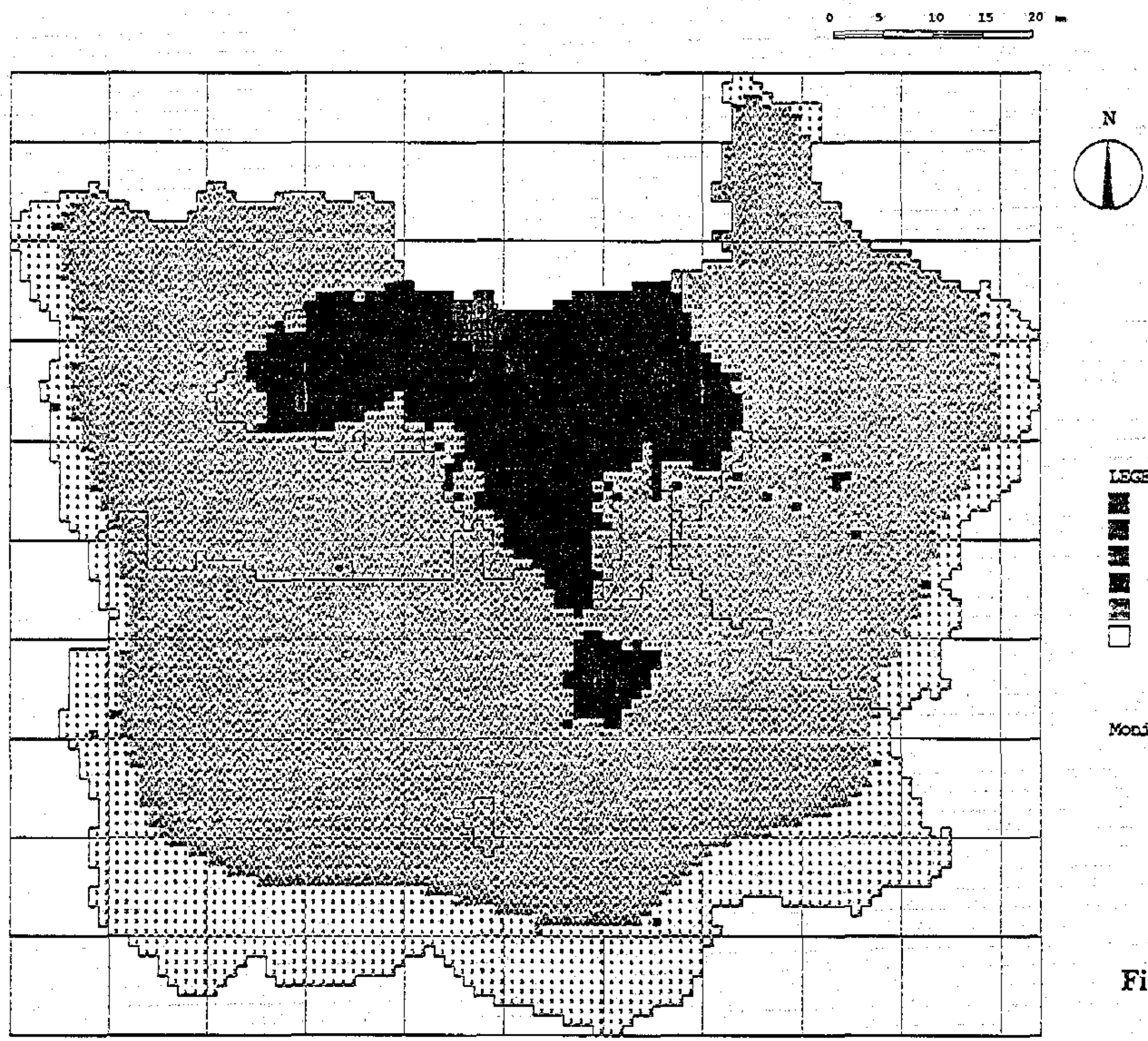
2) Countermeasures for Stationary Emission Source Control

It is necessary to reinforce BAPEDAL, L-BLH and BPPI, and to enact 'Air Pollution Control Law', 'Act of Pollution Control Manager System' and 'Energy Saving Act'.

3) Countermeasures for Mobile Emission Source Control

It is necessary to reinforce BAPEDAL, DLLAJK and L-BLH, and to enact 'Air Pollution Control Law' and 'Road Transport & Motor Vehicle Law'.

Future Condition with Full Countermeasures (2010)



LEGEND

40. < x <=	80. (ppb)	0 grids
20. < x <=	40. (ppb)	0 grids
15. < x <=	20. (ppb)	54 grids
10. < x <=	15. (ppb)	852 grids
5. < x <=	10. (ppb)	4541 grids
0. < x <=	5. (ppb)	1235 grids

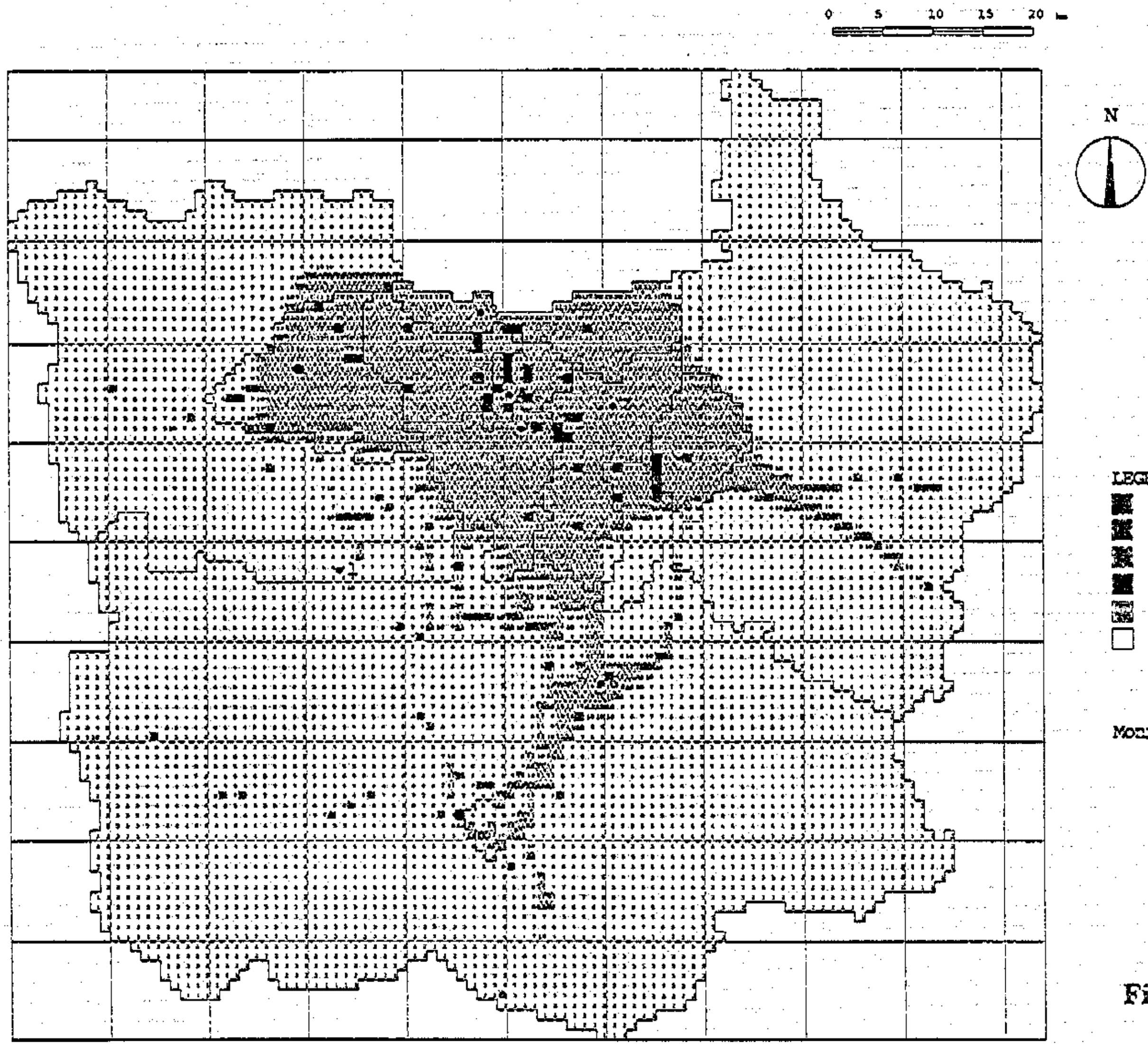
Monitoring Stations
1 EMC
2 Pulo Gadung
3 Pluit
4 Thamrin
5 KPPL
6 Cibinong

Figure 9.3 Concentration Map of SO_2 from All Sources (Case2)

SO2 ppb Annual Average

C MAX= 19.5ppb
Background Concentration: 0.ppb

Future Condition with Full Countermeasures (2010)



LEGEND

▩	100. < x <= 200.	(ppb)	0 grids
▩	50. < x <= 100.	(ppb)	0 grids
▩	40. < x <= 50.	(ppb)	7 grids
▩	30. < x <= 40.	(ppb)	42 grids
▩	10. < x <= 30.	(ppb)	1195 grids
□	0. < x <= 10.	(ppb)	5438 grids

Monitoring Stations
1 EMC
2 Pulo Gadung
3 Pluit
4 Thamrin
5 KPPL
6 Cibinong

Figure 9.4 Concentration Map of NO_2 from All Sources (Case2)

NO2 ppb Annual Average

C MAX= 48.4ppb
Background Concentration: 0.ppb

(2) Evaluation from Financial Point of View

Potential financial sources to carry out the proposed countermeasures are 1) the Government of Indonesia itself, 2) the private sector, 3) multilateral or bilateral grant funds, and 4) international loans.

Implementation of the countermeasures included in the proposed strategy is financially feasible, when national and international trend of increasing stress on financial support to pollution control is taken into due consideration.

(3) Evaluation from Social Point of View

Indonesia is one of the most rapidly developing nations in Asia. In particular, development within the Jabotabek region including Jakarta is remarkable. But this development phenomenon concurrently has brought and will bring about air pollution in the Jabotabek area. The Indonesian Government has put a high priority on environmental conservation including air quality upon the 1992 UN Environmental Development Conference. This prioritization trend of the Government have been reflected on the national budget allocated to BAPEDAL and the local budget for environmental activities of provinces.

There is no social objection against the anti-air-pollution projects, rather because local people have been very afraid of future air pollution associated with the increasing traffic volume. Therefore, the proposed strategy can be regarded as acceptable to the local society of the Jabotabek region.

(4) Evaluation from Environmental Point of View

The proposed strategy consisting of the various countermeasures for both stationary and mobile emission source control is undoubtedly improvement-oriented for environment, especially for air-pollution abatement. Therefore, all the countermeasures could be evaluated as environmentally acceptable. And any negative environmental impacts of the proposed countermeasures is not predicted at present.

(5) Countermeasures with High Priority

The final goal of the proposed strategy and countermeasures is to comply the draft ambient air quality standards by 2010 within the Jabotabek region.

In order to accomplish this goal, it was clarified through the air-quality simulation works that all the proposed countermeasures for stationary, mobile and the both emission sources should be implemented.

Those countermeasures should be implemented organically and effectively. So the following characteristics of individual countermeasures were analyzed to prioritize the countermeasures:

1) Existing organizations like agencies, institutes, etc. concerned with preparation and implementation of the countermeasures,

2) Existing legislations and programs covering activities proposed under each countermeasures,

3) Institutional systems or legislations necessary to implement the countermeasures,

4) Estimated annual cost on average for preparing and implementing the countermeasures, and

5) Proposed years to commence the preparatory and implementation stages of the countermeasures

In order to put priority for implementation on the proposed countermeasures, the two(2) aspects, i.e. "institutional / legislative necessity" and "commencement year for preparation" of each countermeasures, were taken into consideration. The more institutional / legislative-capacity building or the earlier commencement for preparation is required, the higher priority the countermeasures has. Countermeasures already going on were regarded as with low priority, since they have been anyway commenced by certain organizations in duty. Figure 9.5 shows priority position of each countermeasures, largely divided into three(3) groups; "high priority", "medium priority" and "low priority".

Table 9.5 summarizes various characteristics and priority of each countermeasures.

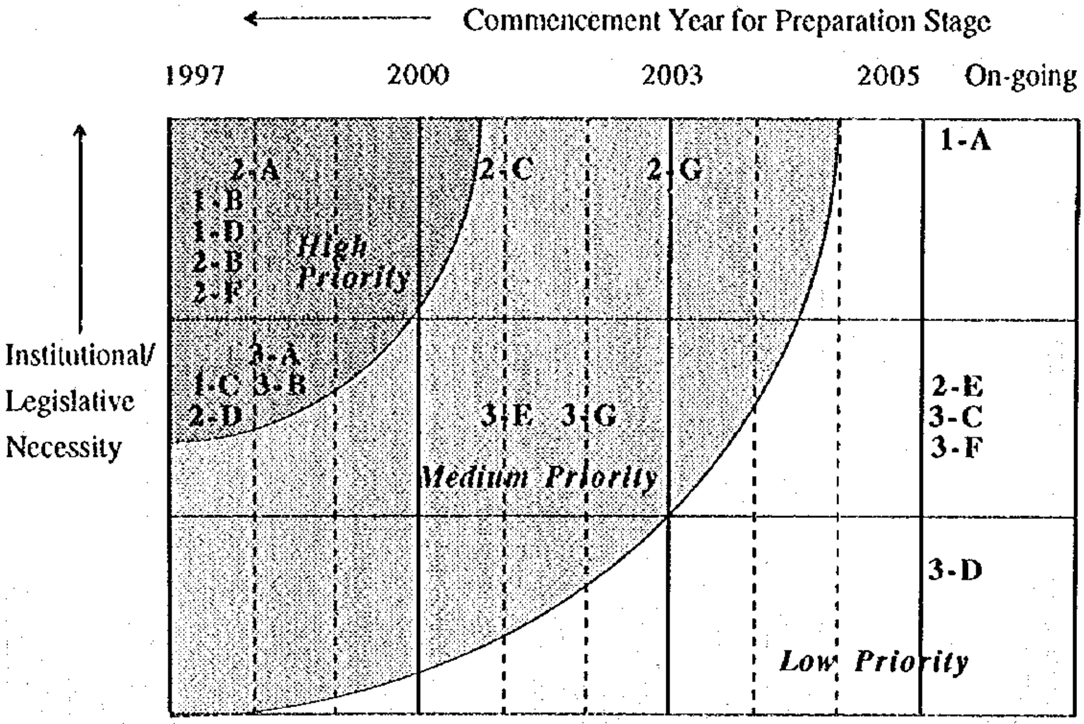


Figure 9.5 Priority of Countermeasures

<u>High-Priority Group</u>

1-B. Reduction of Hydrocarbon Emissions
1-C. Reduction of Particulate Matter in Ambient Air
1-D. Strengthening of Ambient Air Monitoring System
2-A. Preparation of Stationary Source Inventory
2-B. Enforcement of Emission Standards Decree
2-D. Emission Management System
2-F. Fuel Conversion
3-A. Preparation of Mobile Source Inventory in Jabotabek
3-B. Introduction of New Regulations on Vehicle Emission Gas

<u>Medium-Priority Group</u>

2-C. Total Emission Reduction Plan
2-G. Direct Stack Gas Control
3-E. Acceleration of Turn-over Rate of Aged Vehicles
3-G. Suppression of Diesel Use in Vehicles

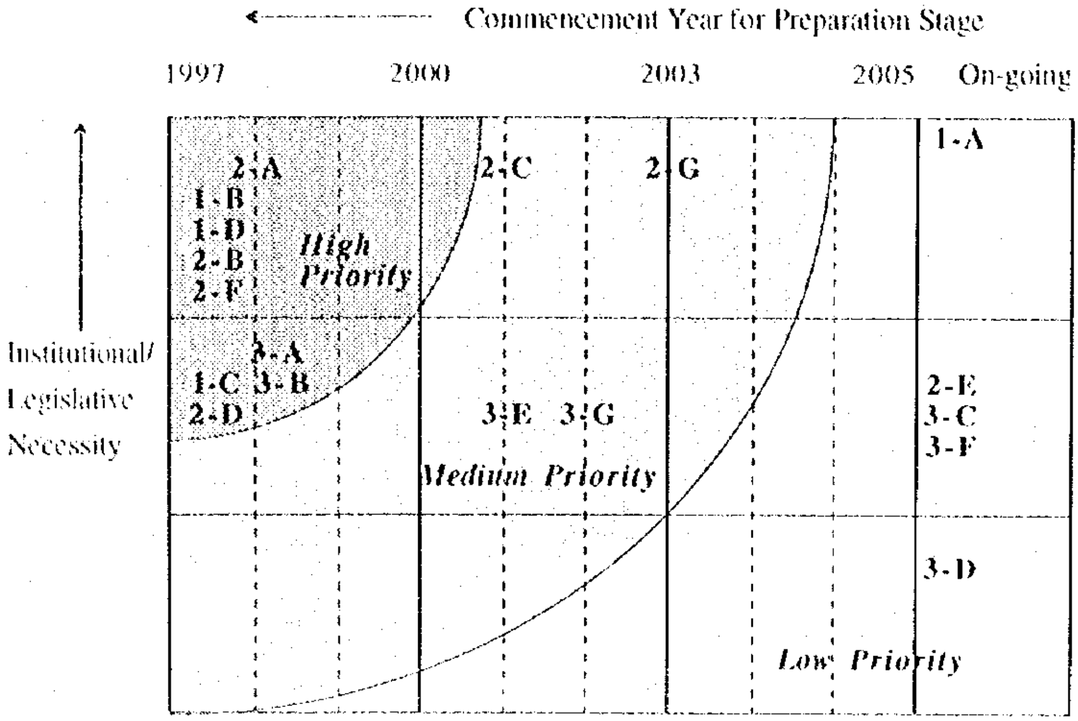


Figure 9.5 Priority of Countermeasures

<u>High-Priority Group</u>

1-B. Reduction of Hydrocarbon Emissions

1-C. Reduction of Particulate Matter in Ambient Air

1-D. Strengthening of Ambient Air Monitoring System

2-A. Preparation of Stationary Source Inventory

2-B. Enforcement of Emission Standards Decree

2-D. Emission Management System

2-F. Fuel Conversion

3-A. Preparation of Mobile Source Inventory in Jabotabek

3-B. Introduction of New Regulations on Vehicle Emission Gas

<u>Medium-Priority Group</u>

2-C. Total Emission Reduction Plan

2-G. Direct Stack Gas Control

3-E. Acceleration of Turn-over Rate of Aged Vehicles

3-G. Suppression of Diesel Use in Vehicles

Low-Priority Group

1-A. Monitoring of Hydrocarbon Concentration in Ambient Air

2-E. Combustion Control System

3-C. Strengthening of Vehicle Inspection Program

3-D. Promotion of Unleaded Gasoline Usage

3-F. Promotion of Low-pollution Vehicles

Table 9.5 Result of Evaluation of Countermeasures

Control Measures		Institutions & Legislations					Commencement Year		Average Annual	Priority
		Existing Bodies for Preparation	Existing Bodies for Implementation	Existing Legislations and Programs	Reinforcement of staff in charge	Enactment	Preparation	Implementation	Cost from 1997 to 2000 (million Rp.)	
(1) Common to Stationary & Mobile Sources	1-A. Monitoring of Hydrocarbon Concentration in Ambient Air	BAPEDAL	BAPEDAL, L-BLH	• Industrial Act • AMDAL	BAPEDAL and L-BLH	Air Pollution Control Law	—	already commenced	—	Low
	1-B Reduction of Hydrocarbon Emissions	BAPEDAL	BAPEDAL, L-BLH	• Industrial Act • AMDAL	BAPEDAL and L-BLH	Air Pollution Control Law	1997	1998	2,370	High
	1-C. Reduction of Particulate Matter in Ambient Air	MOH, BAPEDAL	L-BLH	• Waste Act • Revised Environment Act	L-BLH	—	1997	1997	1,060	High
	1-D. Strengthening of Ambient Air Monitoring System	BAPEDAL	BAPEDAL, L-BLH, BLK, BMG, L-PU	• Revised Environment Act	L-BLH, BPPI and L-PU	Air Pollution Control Law	1997	1999	150 (17,310)	High
(2) Stationary Sources	2-A. Preparation of Stationary Source Inventory	BAPEDAL	BAPEDAL, L-BLH	• Industrial Act • AMDAL	BAPEDAL and L-BLH	Air Pollution Control Law	1998	2001	70 (1,420)	High
	2-B. Enforcement of Emission Standards Decree	BAPEDAL	BAPEDAL, L-BLH, BPPI	• Industrial Act • Blue Sky Program • Emission Gas Standard, • Revised Environment Act	L-BLH	Air Pollution Control Law	1997	2002	40	High
	2-C. Total Emission Reduction Plan	BAPEDAL, L-BLH	L-BLH	• Industrial Act, • Revised Environment Act	BAPEDAL and L-BLH	Air Pollution Control Law	2001	2006	No cost up to 2000	Medium
	2-D. Emission Management System	BAPEDAL, PERIND	BAPEDAL, PERIND	• AMDAL • Industrial Act • Blue Sky Program	—	Pollution Control Manager System	1997	2002	—	High
	2-E. Combustion Control System	BAPEDAL, BAKOREN	BPPI, L-BLH, PELAKSANA, Indonesia Bank	• Industrial Act • Environmental Soft Loan Program	BAPEDAL, BPPI and L-BLH	Energy Saving Act	—	already commenced	—	Low
	2-F. Fuel Conversion	TAM, BAPEDAL	L-BLH, BPPI, PERTAMINA	—	L-BLH and BPPI	Air Pollution Control Law	1997	2006	— (136,000)	High
	2-G. Direct Stack Gas Control	BAPEDAL	BAPEDAL, PELAKSANA, Indonesia Bank	• Soft Loan Program	BAPEDAL	Air Pollution Control Law	2003	2006	No cost up to 2002	Medium
(3) Mobile Sources	3-A. Preparation of Mobile Source Inventory in Jabotabek	BAPEDAL	BAPEDAL	—	BAPEDAL	—	1998	2000	30 (10,210)	High
	3-B. Introduction of New Regulations for Vehicle Emission Gas	BAPEDAL	HUB	• Industrial Act • Blue Sky Program	—	Road Transport & Motor Vehicle Law	1998	2001	700 (11,300)	High
	3-C. Strengthening of Vehicle Inspection Program	HUB, BAPEDAL	DLLAJK, L-BLH	• Road Traffic Law • Blue Sky Program • Automobile Exhaust Standard	DLLAJK and L-BLH	—	—	already commenced	—	Low
	3-D. Promotion of Unleaded Gasoline Usage	BAPENAS, BAPEDAL, HUB	BAPEDAL, PERTAMINA	• Blue Sky Program	—	—	—	already commenced	500 (350,000)	Low
	3-E. Acceleration of Turn-over Rate of Aged Vehicles	BAPENAS, BAPEDAL	DLLAJK, L-BLH	• Road Traffic Law	DLLAJK and L-BLH	—	2001	2006	No cost up to 2000	Medium
	3-F. Promotion of Low-pollution Vehicles	BAPEDAL	DLLAJK, L-BLH, BAPEDAL, PELAKSANA, Indonesia Bank	• Blue Sky Program • Soft Loan Program	BAPEDAL	—	—	already commenced	—	Low
	3-G. Suppression of Diesel Use in Vehicles	BAPEDAL	PERTAMINA	—	—	Air Pollution Control Law	1998	2006	No cost up to 2001	Medium

Notes: 1) Prioritization is only among the countermeasures proposed here by the JICA Study Team in addition to the on-going projects. (But all these proposed countermeasures should be implemented to reach the 2010 goals.) Therefore, remaining potential countermeasures are not subject to the prioritization here.
2) Average annual cost shows wage including PR cost. ( ) shows equipment/facilities initial investment cost and foreign consultant fee.

10 ACTION PLANS

10.1 Introduction

The proposed strategy consists of 18 countermeasures (4 common to stationary and mobile sources, 7 for stationary sources, and 7 for mobile sources). All these countermeasures have to be prepared and implemented from now on in order to attain the strategic goal of compliance with air-quality standards in the Jabotabek region by 2010. Out of the 18 countermeasures, 9 were classified into the 'high priority' group as shown in Figure 9.5.

From these 8 countermeasures with high level of priority, the next three (3) were selected from the viewpoint of grasping of the most important and basic data in order to manage the air quality in Jabotabek area effectively. And these countermeasures will be formulated in detail as action plans from the section 10.2. This selection simply reflects current lacking situation of basic data, which will be essentially important to accelerate the other proposed countermeasures.

- 1-D. Strengthening of Ambient Air Monitoring System
- 2-A. Preparation of Stationary Source Inventory
- 3-A. Preparation of Mobile Source Inventory in Jabotabek

Action plan for '1-D. Strengthening of Ambient Air Monitoring System' is for general purpose to collect data continuously. Action plan for '2-A. Stationary Source Inventory' is to collect data of stationary sources and to support '2-B. Enforcement of Emission Standards Decree' and other measures related to stationary sources. Finally action plan for '3-A. Preparation of Mobile Source Inventory in Jabotabek' is necessary to collect essential data for establishment of emission factors of running vehicles in Jabotabek.

10.2 Strengthening of Ambient Air Monitoring System (1-D)

(1) Action Justification

Ambient air quality has been changed always, cyclically or not, by meteorological conditions, socio-economic activities, and so on. An air quality monitoring system should be able to collect data including those changes for comprehension of long term air quality and for implementation of proper measures. The air quality standards usually use the time span of average value. Moreover, as long term exposure to air pollutants is serious and as the long term average value is applied to evaluate the degree of exposure to their receptors, continuous monitoring is essential.

(2) Objectives

By implementing the action plan, a system of 25 full scale stations will be completed. In addition, the project will accomplish following objectives:

- Improvement of monitoring and evaluation system in Kabupatens in Jabotabek;
- Development of environmental impact management process in BAPEDAL and others;
- Centralization of air quality data in Jabotabek; and
- Pilot project of similar ones needed for other industrial regions in Indonesia

(3) Scope

Important tasks are as follows:

1 : Determination of Sites of Monitoring Stations
2 : Arrangement for Legal Support
3 : Installation of Monitoring System
4 : Organization of Human Resources
5 : Preparation for Operation and Maintenance

(4) Time Schedule

Table 10.1 shows the necessary time schedule targeting the year 2000 to start commissioning the monitoring system.

Table 10.1 Time Schedule for Strengthening of Ambient Air Monitoring System

Task		1997			1998			1999			2000		
1	Sites			——→									
2	Legal Sup			——→									
3	Equip.			———	———	———	———	———	——→				
4	Training							———	——→				
5	Preparation				———	——→			——→				
	Operation									———	———	———	———

(5) Cost

Investment cost for the monitoring equipment is Rp. 17,270,000,000. This amount is allocated from the budget of BAPEDAL, 2/3 in 1998 and 1/3 in 1999. Annual budgets including wages to be provided by each organization involved are shown in Table 10.2 below.

The budget in 2000 includes maintenance fees in 2000 and purchasing of spare and consumable parts for 2001.

Table 10.2 Annual Budget to be Provided by Each Agency

Unit: Rp.

	1997	1998	1999	2000
BAPEDAL	12,080,000	11,524,911,000	5,827,180,000	21,450,000
DKI	1,980,000	2,845,000	230,635,000	440,760,000
Bogor	1,570,000	2,285,000	50,165,000	270,880,000
Tangerang	1,570,000	2,285,000	47,058,000	230,845,000
Bekasi	1,570,000	2,285,000	44,300,000	191,510,000
Total	18,770,000	11,534,611,000	6,199,338,000	1,155,445,000

(6) Institutional Necessity

The following preparations are necessary :

- Reinforcement of staff in duty in BAPEDALDA, L-BLH, BLK, BPPI and L-PU, and
- Enactment of 'Air Pollution Control Law'

To operate and maintain this system, 3 officers from BAPEDAL, 8 from DKI, and 5 each from individual Kabupatens are required except clerks and trainers and those required temporarily.

(7) Evaluation

As the cost is beyond BAPEDAL's and local governments' regular budget, their deficiency is to be covered by raising the additional funds.

10.3 Preparation of Stationary Source Inventory (2-A)

(1) Action Justification

More than 80% of SOx, nearly 30% of NOx, and over 50% of SPM are emitted from stationary pollution sources in Jabotabek. Although current air quality satisfies almost national and local standards, increases of industrial activities in the area warn that pollutant emissions will violate the standards in the future if no countermeasures are implemented.

Therefore, preparation of stationary source inventory is mandatory to inspect factories and to decide kinds of industries to be specified by the emission standard decree.

The information for the preparation of stationary source inventory should include locations, kinds of pollutants, their emission rates and patterns. The information should be renewed occasionally since it is varying frequently by increasing or reducing production capacity, converting a type of fuel, changing operation patterns, or else.

Air pollution is a wide spread phenomena. It can not be contained in one single region. As BAPEDAL is in the position above the both local governments and has function to implement pollution control measures, BAPEDAL is the best agency to implement this action plan with the cooperation of Kabupatens of Bogor, Tangerang, and Bekasi, and DKI Jakarta.

(2) Objectives

By implementing the action plan, the project will accomplish following objectives, besides the original purpose of preparation of stationary source inventory:

- Strengthening of cooperation and coordination between BAPEDAL and L-BLHs
- Development of environmental impact management process in BAPEDAL
- Development of the partnership of officials with the industrial community
- Centralization of the pollutant emission information possessed by other agencies
- Pilot project of similar ones needed for industrial regions in Indonesia.

(3) Scope:

It is divided into eight tasks as described in below.

1 : Review of Previous Studies
2 : Identification of Stationary Sources
3 : Arrangement for Legal Support
4 : Implementation of Questionnaire Survey
5 : Training Technicians for Emission Measurement
6 : Procurement of Measurement Equipment
7 : Measurement of Pollutant Emissions at Sites
8 : Compilation of Stationary Source Inventory

(4) Time Schedule

The necessary time schedule is shown in Table 10.3.

Table 10.3 Time Schedule for Preparation of Stationary Source Inventory

Task	1997	1998			1999			2000			2001		
1	Review	→											
2	Identification	—	—	—	—	—	—	→					
3	Legal	—	→										
4	Question.			—	—	—	—	—	→				
5	Training							→					
6	Equip.				—	—	→						
7	Measure								—	—	→		
8	Compile				—	—	—	—	—	—	—	→	

(5) Cost

The total cost estimated as Rp. 1,767,500,000 including wages and 5 sets of equipment (Rp. 1,425,000,000).

(6) Institutional Necessity

The following preparations are definitely essential in order to implement this countermeasures :

- Reinforcement of staff in duty in BAPEDAL and L-BLH, and
- Enactment of 'Air Pollution Control Law'

BAPEDAL shall compose a project team to implement this action plan, when it is authorized. The team needs two core project officers from BAPEDAL to manage the project.

Besides, two EMC experts will be in charge of equipment specification and training while 5 officials from DKI Jakarta, three officials from Tangerang, and two officials respectively from Bogor and Bekasi shall be exclusively involved in implementation.

(7) Evaluation

BAPEDAL has to allocate over Rp. 1,400 million as the initial investment cost and the foreign consultant fee. But this amount can be recovered by raising the additional funds, fuel taxation, etc.

10.4 Preparation of Mobile Source Inventory in Jabotabek (3-A)

(1) Action Justification:

Emission gas from running vehicles has largely contributed to air pollution in Jakarta metropolitan area. It is thus essential for BAPEDAL to analyze mobile emission gas and estimate its future trend. Since BAPEDAL has no chassis dynamometer system to be used for clarification of emission gas situation of running vehicles, introduction of a new set of this system is necessary. By means of the introduction, emission factors for Jakarta metropolitan area can be established, leading to effective air pollution control in the future.

(2) Objective:

In addition to the main purpose to formulate inventory of mobile source emissions in Jabotabek, the purposes below are envisaged:

- Strengthening of cooperation and coordination among BAPEDAL, HUB and DLLAJK,
- Development of the partnership among BAPEDAL, GAIKINDO and PASMI, and
- Centralization of the pollutant emission information possessed by various agencies

(3) Scope:

Important tasks consist of the following 13 ones:

1 : Organization of a Task Force Team
2 : Update of Vehicle Market Information
3 : Monitoring of Traffic Volume
4 : Preparation of a Test Plan for Drive Cycle Establishment
5 : Road Test
6 : Development of Jabotabek Test Cycle Modes
7 : Purchase of Chassis Dynamometer (C.D.)
8 : Installation of C.D.
9 : Operator Training of C.D.
10 : Calculation of Major Emission Factors
11 : Estimation of Other Emission Factors
12 : Determination of Average Emission Factors
13 : Assessment of Mobile Source Inventory

(4) Time Schedule:

Table 10.4 indicates the time schedule required for implementation of the plan.

Table 10.4 Time Schedule for Preparation of Mobile Source Inventory in Jabotabek

Task		1998	1999	2000	2001	2002	2003	2004
1	Task Force Team	→	→					
2	Market Information	→	→					
3	Monitoring of Traffic	→	→					
4	Test Plan			→				
5	Road Test			→				
6	Test Cycle Modes				→			
7	Purchase of C.D.		→	→				
8	Installation of C.D.				→			
9	Operator Training				→			
10	Major Factors					→	→	
11	Other Factors					→	→	
12	Average Factors							→
13	Assessment							→

(5) Cost

Table 10.5 shows the cost for implementation. The cost for initial investment for Chassis Dynamometer as well as construction was estimated to be Rp. 8.85 billion.

Table 10.5 Fiscal Budget Required for BAPEDAL

	1998	1999	2000	2001	2002	2003	2004
Staff Fee	10.5	10.5	10.5	10.5	1.8	1.8	14.0
Task Force Meeting	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Chassis Dynamometer		3,850	2,500	2,554.1	361	361	
Road Test		28	28.1				
Consultant Fee			344	674	337		
Total	11.1	3,889.1	2,883.2	3,239.2	700.4	363.4	14.6

(6) Institutional Necessity

Enforcement of BAPEDAL is needed. Two BAPEDAL staff should be exclusively involved in formulation work of the inventory. Besides, upon introduction of Chassis Dynamometer, 2 chief engineers, 1 emission gas analyst and 6 operators of Chassis Dynamometer should be hired on a full-working basis.

(7) Evaluation

It is necessary to make special arrangement for cost recovery measures when BAPEDAL as an agency in duty cannot procure appropriate budget internally. The mobile source inventory will be also revised according to the change of vehicle compositions of Jabotabek in the future, probably in 3 or 5 years interval using chassisdynamometer system.

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