

# Malaysia Environmental Quality Report 2007



**Department of Environment**  
Ministry of Natural Resources and Environment  
Malaysia

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# Department of Environment, Malaysia

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“Compared to 2006, due to increased effort in enforcement, awareness programmes and activities as well as favourable weather conditions experienced in the country, the overall air quality in 2007 remained good and moderate most of the times. There was also no transboundary haze pollution observed during the year.”



## Foreword

The Environmental Quality Report 2007 is hereby presented in compliance with Section 3(1)(i) of the Environmental Quality Act 1974.

It is indeed my pleasure to report that the quality of the environment with respect to river and marine water quality continued to improve. The number of clean river basins has increased from 80 to 91 rivers while slightly polluted river basins have decreased from 59 to 45. Main contaminants of coastal waters namely suspended solids, *Escherichia coli*, oil and grease have decreased substantially.

Compared to 2006, due to increased effort in enforcement, awareness programmes and activities as well as favourable weather conditions experienced in the country, the overall air quality in 2007 remained good and moderate most of the times. There was also no transboundary haze pollution observed during the year.

With respect to scheduled wastes management, a new set of e-waste guidelines was formulated to ascertain identification and classification of e-waste enabling parties concerned to determine waste categorization under the Environmental Quality (Scheduled Wastes) Regulations 2005. Through the gazetted amendment of the Environmental Quality Act 1974, notably under Section 34B and Section 43, stiffer penalties were imposed on individuals and companies found liable for the offence of illegally disposing toxic and hazardous wastes. As a result, incidents of illegal dumping were significantly reduced. On the other hand, increased number of licences issued for scheduled waste facilities showed the determination of the department to encourage industries to put into practice the 3R (Reduce, Reuse and Recycle) programmes.

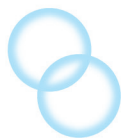
The Department of Environment will continue to strengthen and implement its strategies and measures effectively in managing the environment sustainably. However the department alone cannot totally safeguard the environment without the cooperation and commitment from various stakeholders including the private sector as well as the non-governmental organizations (NGOs).

“Environmental Conservation, Our Shared Responsibility”

With best wishes,

**Dato' Hajah Rosnani Ibarahim**  
Director General Of Environmental Quality  
Malaysia

30 April 2008



## CHAPTER 1

# AIR QUALITY

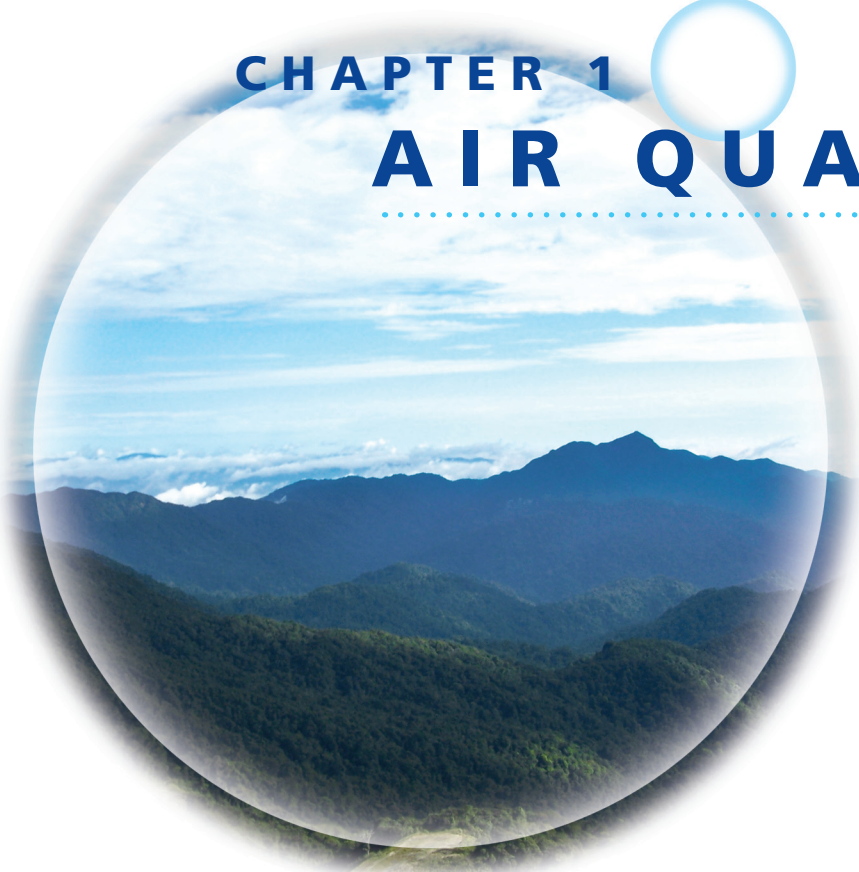
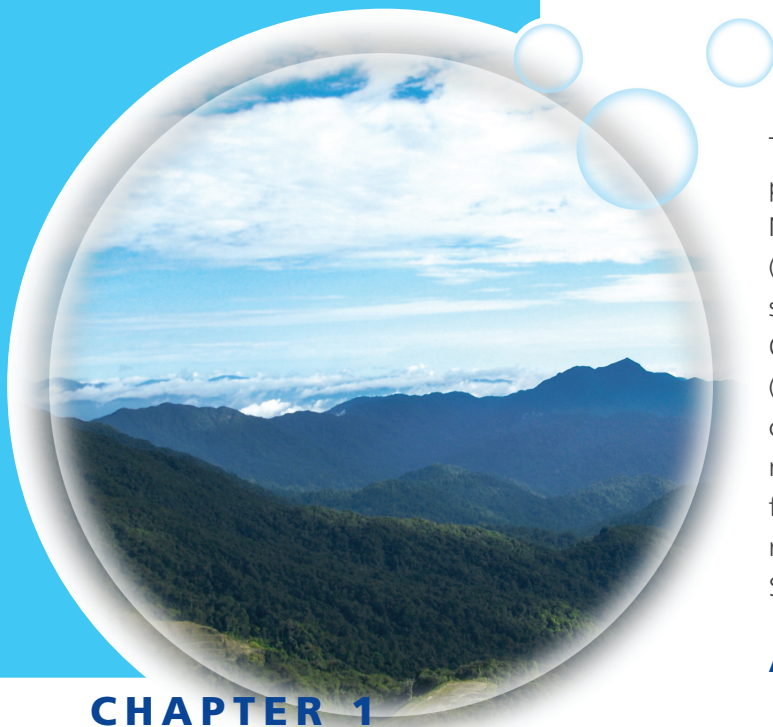


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## CHAPTER 1 AIR QUALITY

### AIR QUALITY MONITORING

As in the previous year, the Department of Environment (DOE) continues to monitor the country's ambient air quality through a network of 51 stations (**Map 1.1 and Map 1.2**). These monitoring stations are strategically located in residential, urban and industrial areas to detect any significant change in the air quality which may be harmful to human health and the environment.

Other than the 51 stations in the National Air Quality Monitoring Network, manual air quality monitoring stations using High Volume Samplers were also established at 20 other sites. The pollutants measured were total suspended particulates, particulate matter (PM<sub>10</sub>) and heavy metals such as lead.

### AIR QUALITY STATUS

Based on the Air Pollutant Index (API), the overall air quality for Malaysia in 2007 improved significantly compared to the previous year. This was due to the favorable weather conditions (neutral to weak La Nina) experienced in the region in the later months of 2007 which resulted in a decreased number of hotspots detected. As a result no transboundary haze pollution was observed.

The annual average concentrations of criteria pollutants measured namely Carbon Monoxide (CO), Nitrogen Dioxide (NO<sub>2</sub>), Ozone (O<sub>3</sub>), Sulphur Dioxide (SO<sub>2</sub>) and Particulate Matter (PM10) were below the stipulated levels under the Malaysian Ambient Air Quality Guidelines. However ground level Ozone (O<sub>3</sub>) remained the pollutant of concern due to the conducive atmospheric condition and emission from motor vehicles especially in urban areas that enhance its formation. This has resulted in several unhealthy days recorded at various locations in Klang Valley, Negeri Sembilan, Perak, Kedah, Pulau Pinang and Johor.

### Air Quality Status in the West Coast

#### Klang Valley

In 2007, the air quality in the Klang Valley was good 34 percent of the time, moderate 63 per cent and the remaining 3 percent at an unhealthy level. The highest number of unhealthy days was recorded in Kajang (24 days) (**Figure 1.1**), compared to 48 days in Gombak in 2006. The main pollutant was ground level Ozone (O<sub>3</sub>). The overall air quality status in Klang Valley is shown in **Figure 1.2**.

Table 1.1 Malaysia : Air Pollutant Index (API)

API	AIR QUALITY STATUS
0 – 50	Good
51 – 100	Moderate
101 – 200	Unhealthy
201 – 300	Very Unhealthy
> 300	Hazardous

#### Northern Region

As in the previous year, the overall air quality of the northern region of the West Coast of Peninsular Malaysia (Perlis, Kedah, Pulau Pinang and Perak), was between good and moderate most of the time. However, Tanjung Malim recorded 3 unhealthy days while Seberang Jaya and Sungai Petani each recorded 1 unhealthy day. The pollutants of concern were Particulate Matter (PM<sub>10</sub>) and ground level Ozone (O<sub>3</sub>).



Map 1.1 Malaysia : Location of Continuous Air Quality Monitoring Stations, Peninsular Malaysia



Map 1.2 Malaysia : Location of Continuous Air Quality Monitoring Stations, East Malaysia, 2007

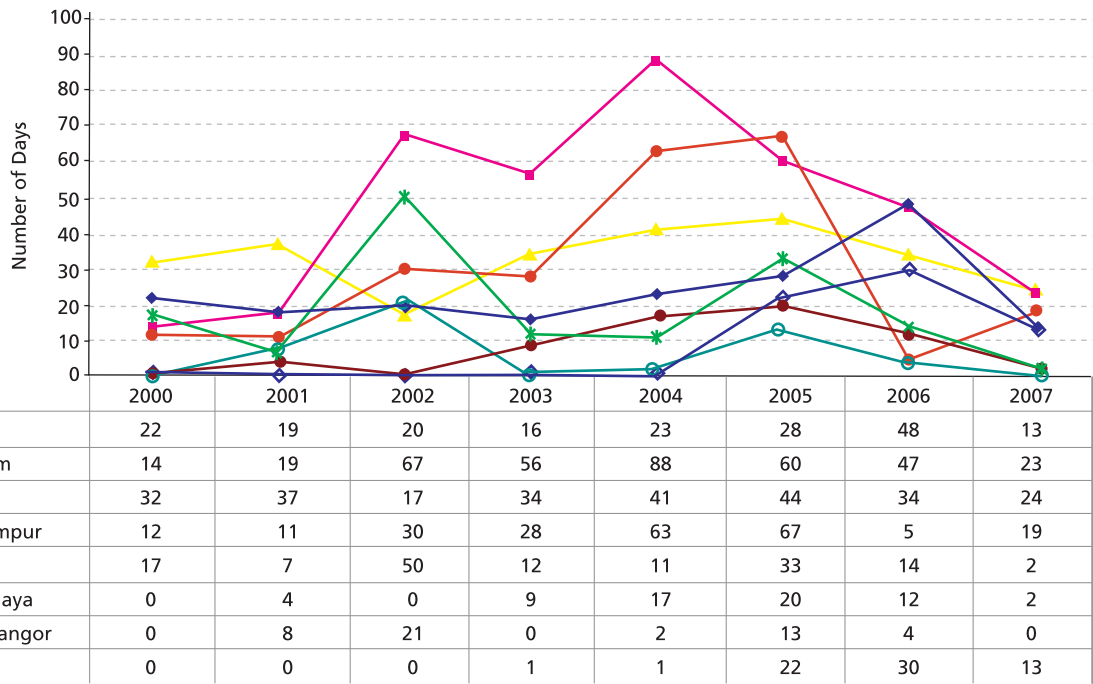


Figure 1.1 Malaysia : Number of Unhealthy Days, Klang Valley, 2000 - 2007

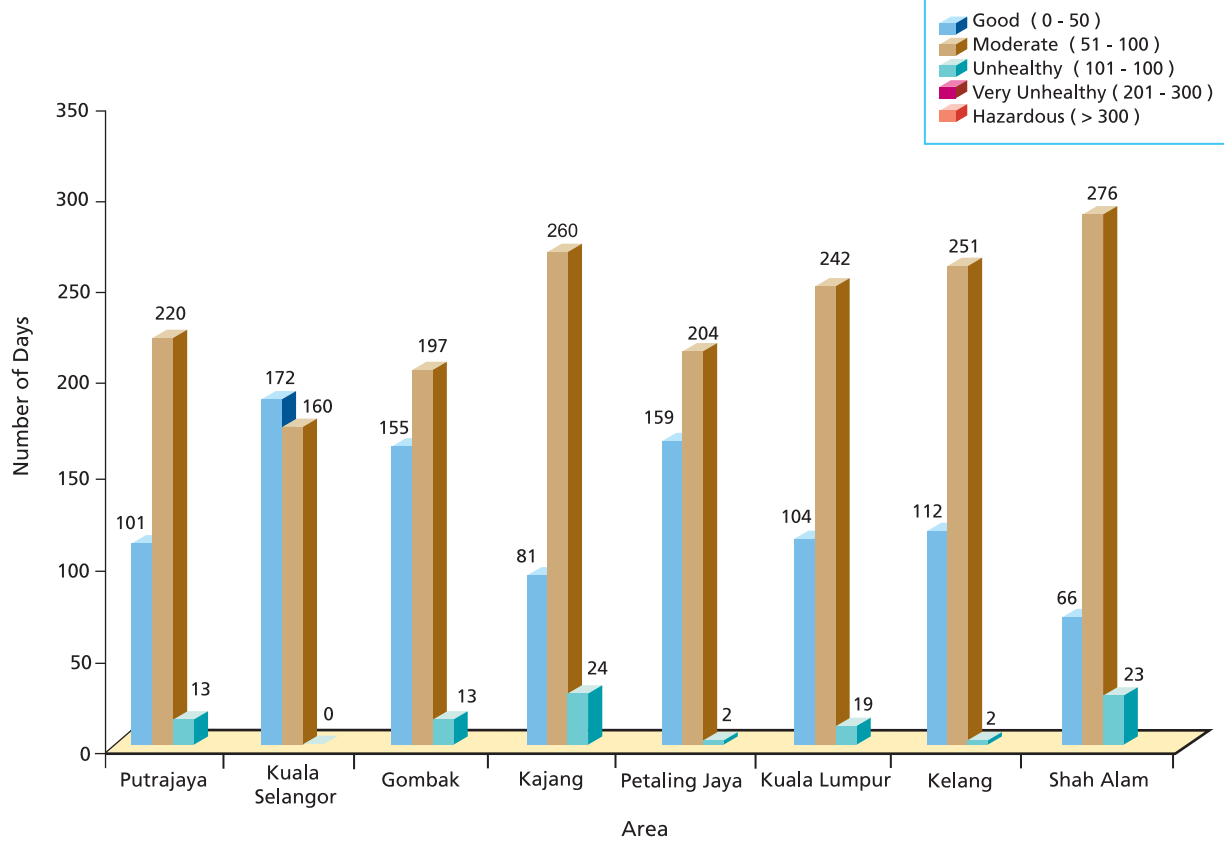


Figure 1.2 Malaysia : Klang Valley Air Quality Status, 2007

## Southern Region

In the southern region of the West Coast of Peninsular Malaysia (Negeri Sembilan, Melaka and Johor) the air quality was also between good to moderate most of the time, with the exception of a few unhealthy days. The unhealthy days were recorded in Seremban (1 day), Nilai (2 days), Larkin (4 days), Johor Bahru (2 days) and Pasir Gudang (2 days). The pollutant of concerned was ground level Ozone (O<sub>3</sub>). **Figure 1.3** shows the overall air quality status for the West Coast of Peninsular Malaysia.

## Air Quality Status in the East Coast

In the East Coast of Peninsular Malaysia (Pahang, Terengganu and Kelantan) the air quality remained good most of the time and occasionally moderate. No unhealthy day was recorded. The overall air quality status in the East Coast is shown in **Figure 1.4**.

## Air Quality Status in Sabah, Labuan and Sarawak

The air quality in Sabah, Labuan and Sarawak was generally good and moderate. There was significant

improvement compared to 2006 especially for the State of Sarawak where there was no unhealthy day recorded in 2007.

## AIR QUALITY TREND

Six criteria pollutants, namely Carbon Monoxide (CO), Nitrogen Dioxide (NO<sub>2</sub>), Ozone (O<sub>3</sub>), Sulphur Dioxide (SO<sub>2</sub>) and Particulate Matter (PM<sub>10</sub>) were monitored continuously at 51 locations, while lead (Pb) concentration was measured once in every six days at two locations. The air quality trend for the period 1998 to 2007 was computed by averaging direct measurements from the monitoring sites on a yearly basis and cross-reference with the Malaysian Ambient Air Quality Guidelines shown in **Table 1.2**.

## Particulate Matter (PM<sub>10</sub>)

Particulate Matter is the general term used to describe respirable particles of less than 10 microns in size. They may be from motor vehicle exhaust, heat and power generation, industrial processes and open burning activities. PM<sub>10</sub> may also form in the atmosphere by the transformation of precursor emissions such as SO<sub>2</sub>

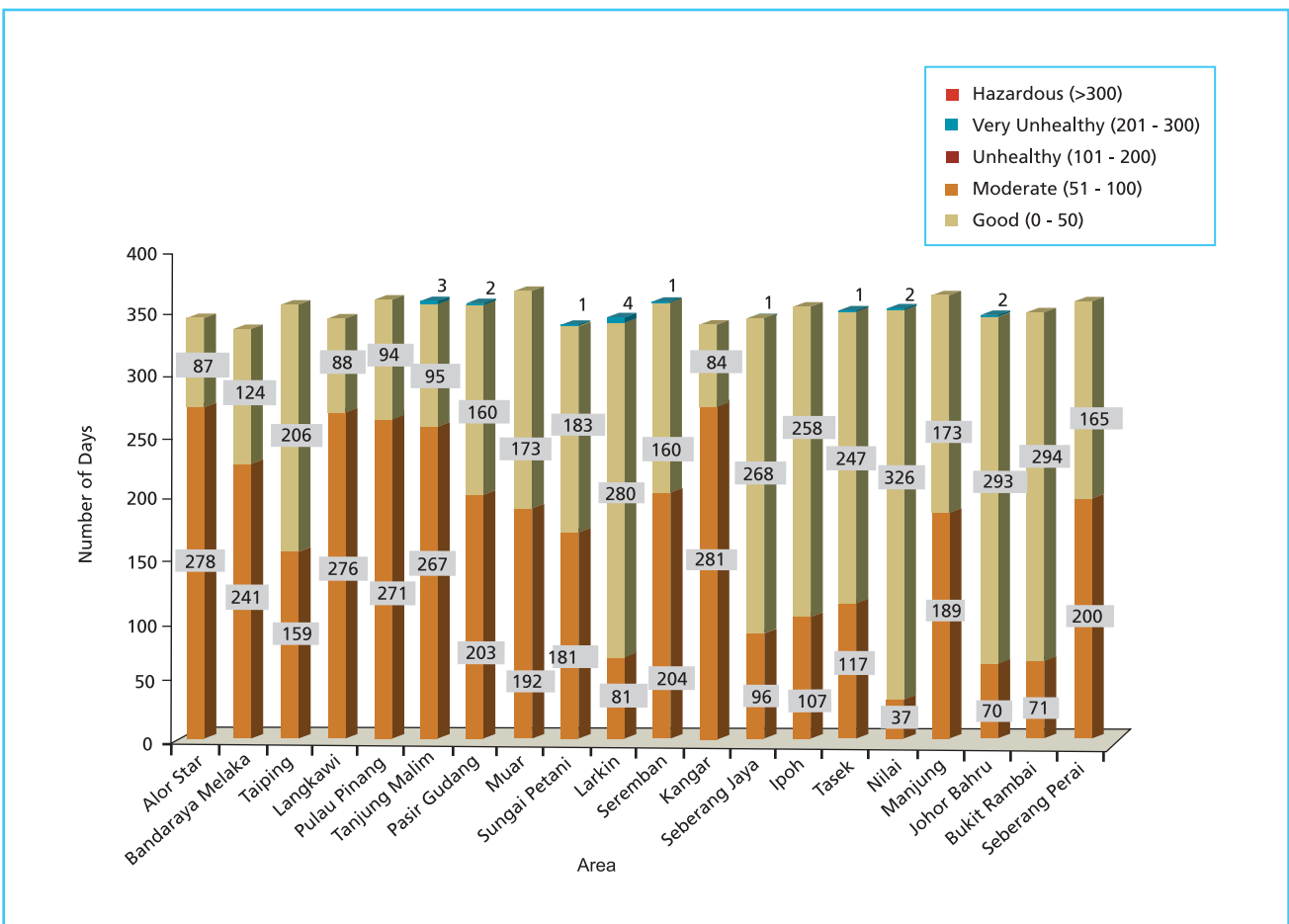


Figure 1.3 Malaysia : Air Quality Status, West Coast Peninsular Malaysia, 2007

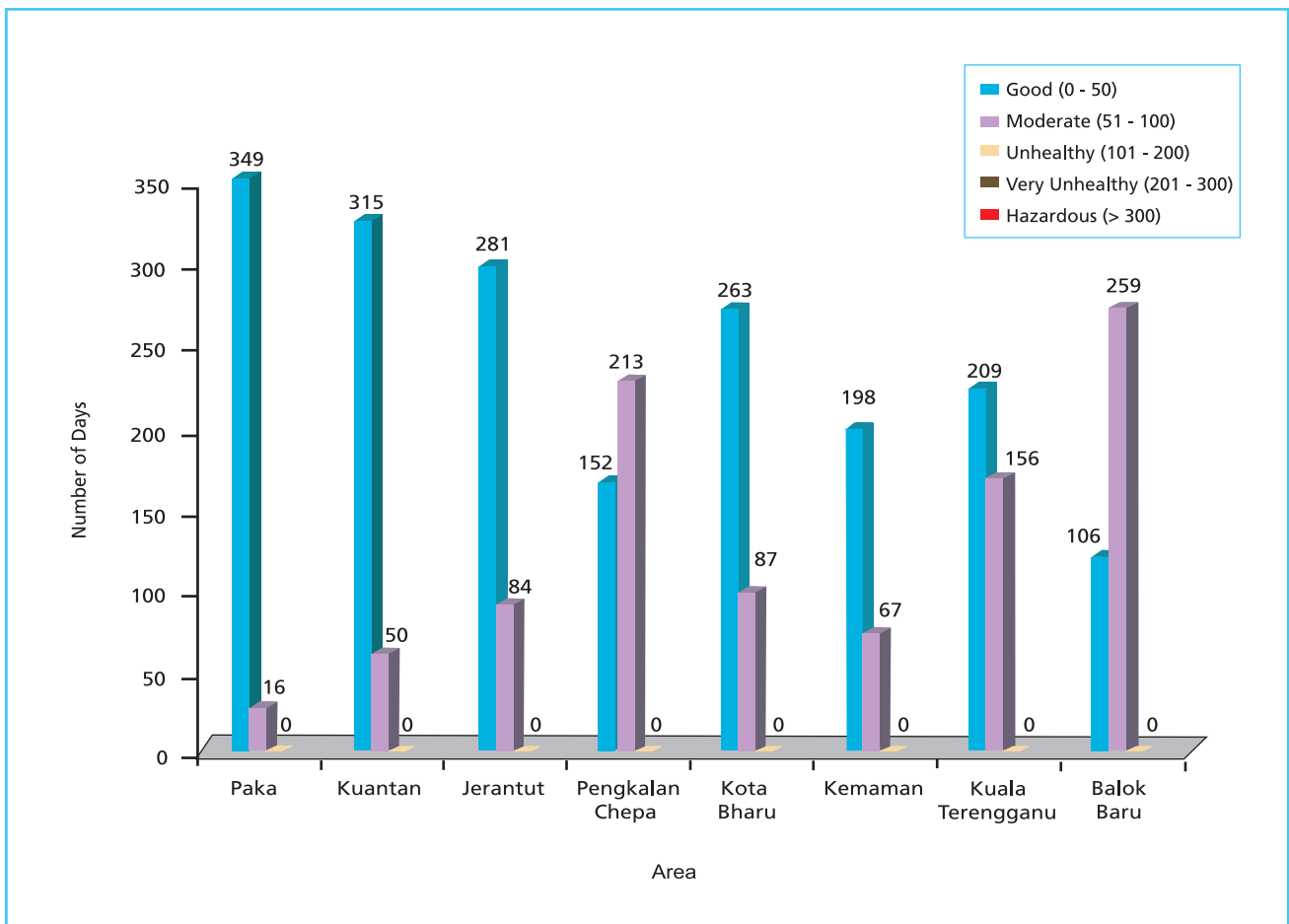


Figure 1.4 Malaysia : Air Quality Status, East Coast Peninsular Malaysia, 2007

Table 1.2 Malaysia : Ambient Air Quality Guidelines

Pollutant	Averaging Time	Malaysia Guidelines	
		ppm	( $\mu\text{g}/\text{m}^3$ )
Ozone	1 Hour	0.10	200
	8 Hour	0.06	120
Carbon Monoxide**	1 Hour	30.0	35
	8 Hour	9.0	10
Nitrogen Dioxide	1 Hour	0.17	320
	24 hour	0.04	10
Sulphur Dioxide	1 hour	0.13	350
	24 Hour	0.04	105
Particulate Matter (PM10)	24 Hour		150
	12 Month		50
Total Suspended Particulate (TSP)	24 Hour		260
	12 Month		90
Lead	3 Month		1.5

Note : \*\*( $\text{mg}/\text{m}^3$ )

and NO<sub>x</sub> (to form Sulphates and Nitrates). In addition, significant amount of fine particulates can also arise from uncontrolled biomass burning activities either within or from outside the country (transboundary pollution).

PM<sub>10</sub> can cause eye and throat irritation, and its accumulation in the respiratory system is associated with numerous respiratory problems such as decreased lung function. High levels of PM<sub>10</sub> can also pose health risk to sensitive groups such as children, the elderly and individuals with asthma or cardiopulmonary diseases.

PM<sub>10</sub> can also cause undesirable impact on the environment. The presence of high levels of PM<sub>10</sub> in the atmosphere is a major cause of reduced visibility, resulting in hazy conditions especially during the dry season. Other environmental impacts can occur when PM<sub>10</sub> is deposited onto soil, plants, water or other materials. Depending on the chemical composition of these substances, when PM<sub>10</sub> is deposited in sufficient quantities, it may change the nutrient balance and acidity in soil, interfere with plant metabolism and change the composition of materials.

In 2007 the annual average value of PM<sub>10</sub> was 43 ug/m<sup>3</sup>, below the Malaysian Ambient Air Quality Guidelines value of 50 ug/m<sup>3</sup>. This was a decreased of 14 percent compared to 2006. The trend of the annual average levels of PM<sub>10</sub> concentration in the ambient air between 1998 and 2007 is shown in **Figure 1.6**. Based on land use categories, PM<sub>10</sub> concentration was also below the guidelines value as shown in **Figure 1.6(a)**.

### Sulphur Dioxide (SO<sub>2</sub>)

Sulphur dioxide is a colourless, pungent, irritating, water-soluble reactive gas. This gas is formed during the combustion process of fuel containing sulphur (e.g. oil and coal) mainly from industrial activities. High concentrations of SO<sub>2</sub> in the atmosphere increase the risk of adverse symptoms in asthmatic patients and irritate the respiratory system. Other effects associated with long-term exposure to high concentrations of SO<sub>2</sub> include respiratory illnesses, alterations in lung function and aggravation of existing cardiovascular diseases.

There are also environmental concerns associated with high concentrations of SO<sub>2</sub>. SO<sub>2</sub> along with NO<sub>x</sub> is a major precursor to acidic deposition, which contributes

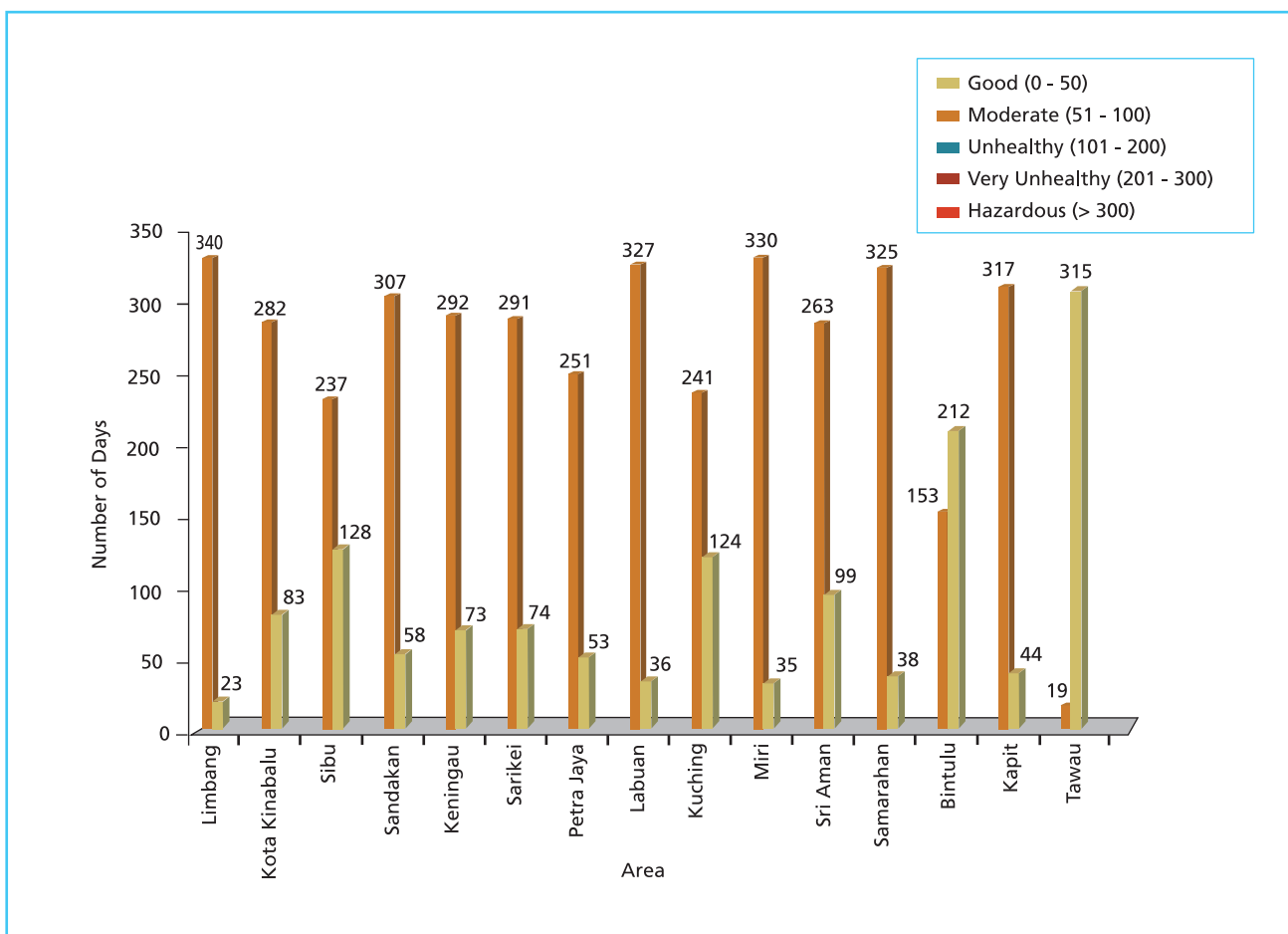


Figure 1.5 Malaysia : Air Quality Status in Sabah and Sarawak, 2007

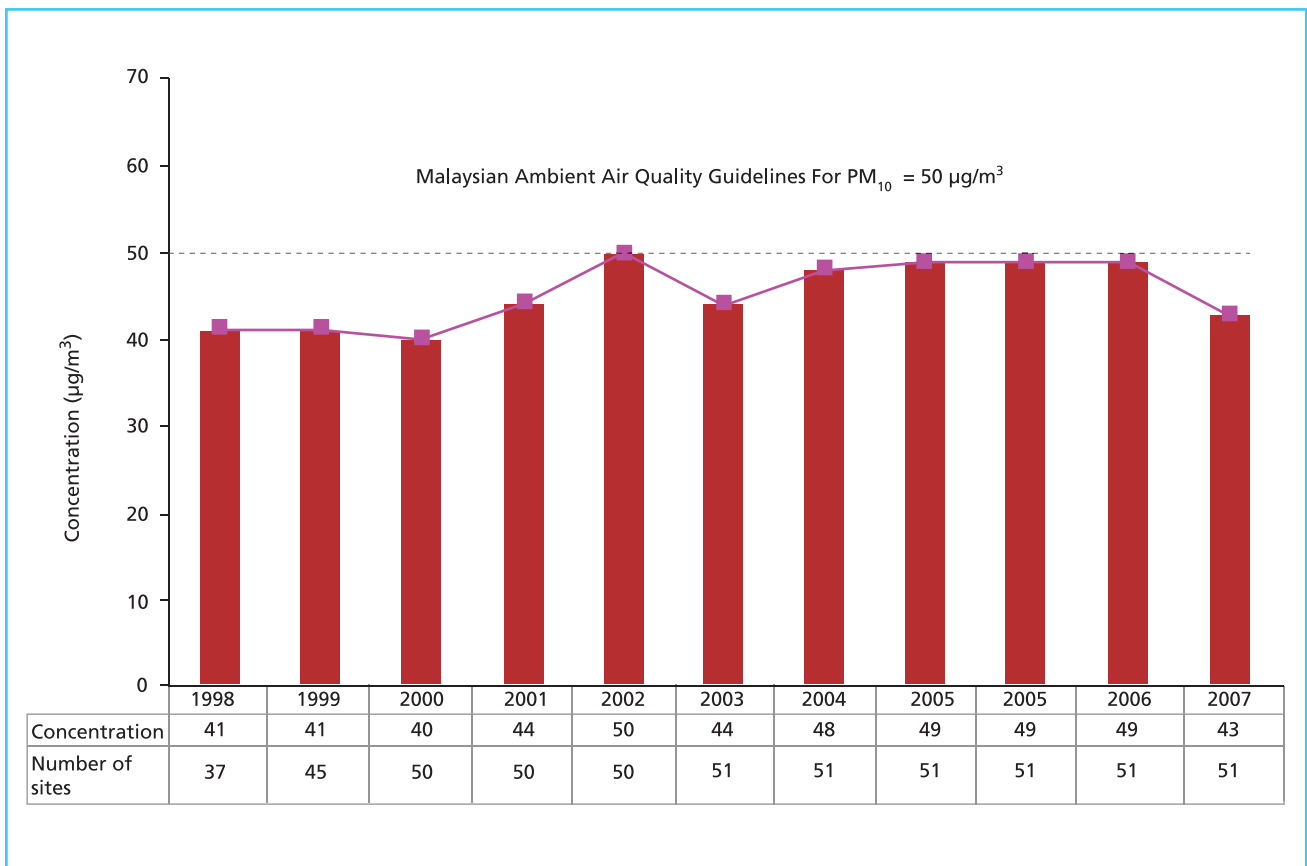


Figure 1.6 Malaysia : Annual Average Concentration of  $PM_{10}$ , 1998-2007

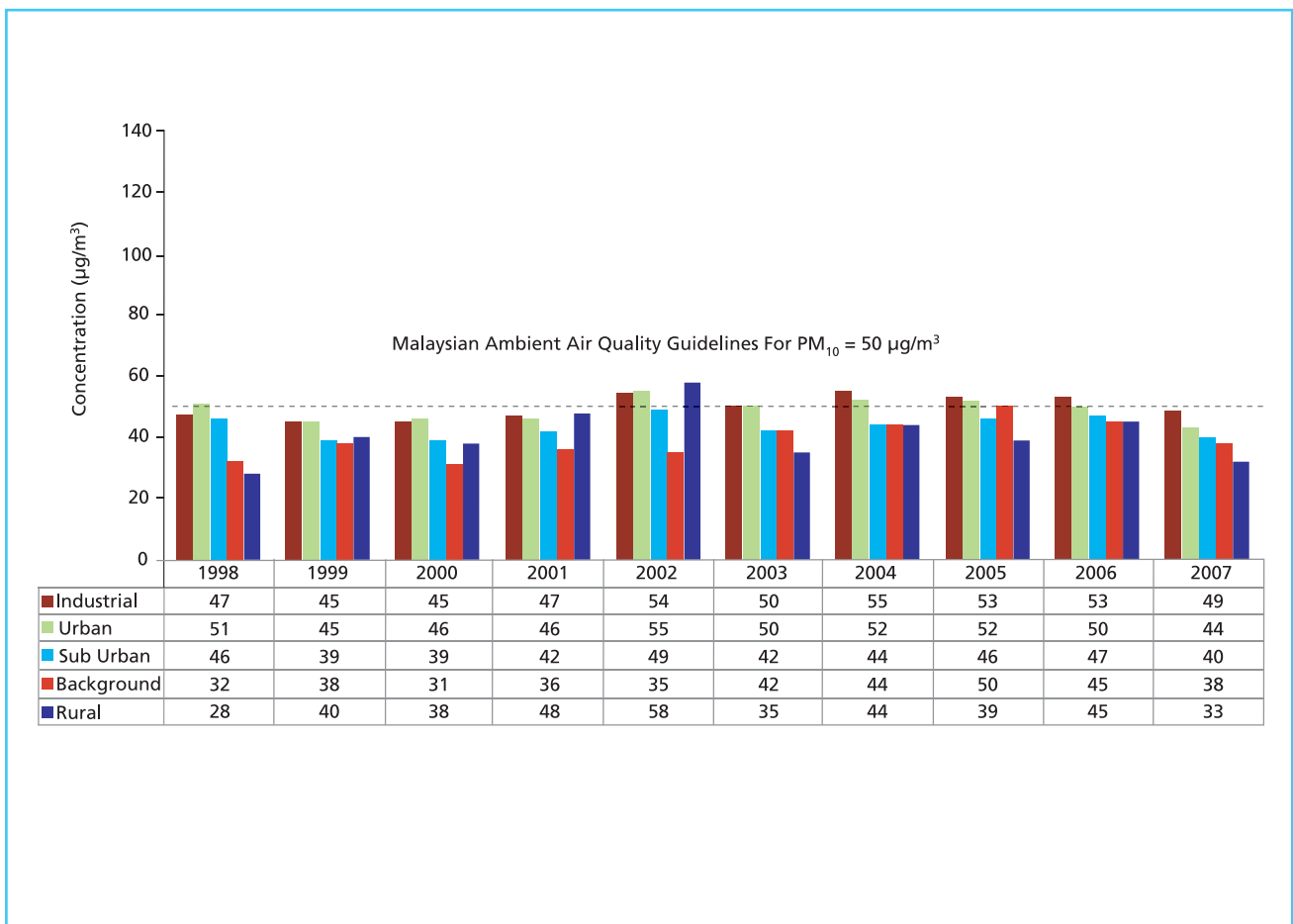


Figure 1.6(a) Malaysia : Annual Average Concentration of  $PM_{10}$  by Land Use , 1998 - 2007



Air Emissions from Oil Refinery Plant (DOE Photo Library)

to the acidification of soils, lakes and streams resulting in adverse impact on the ecosystem.  $\text{SO}_2$  can also be harmful to plant life and accelerates the corrosion of buildings and monuments.

Generally the annual average  $\text{SO}_2$  concentration shows a declining trend between 1998 and 2007 (**Figure 1.7**) and were well below the Malaysian Ambient Air Quality Guidelines. This could be attributed to more widely use of natural gas for industrial combustion processes and vehicles. However the concentrations of  $\text{SO}_2$  were higher in industrial areas where the main emission sources were located. **Figure 1.7(a)** shows the annual average concentrations of  $\text{SO}_2$  for different categories of land use.

### Nitrogen Dioxide ( $\text{NO}_2$ )

Nitrogen dioxide is a reddish brown, highly reactive gas that is formed in the ambient air through the oxidation of  $\text{NO}$ . Nitrogen oxides ( $\text{NO}_x$ ) is the term used to describe the total sum of  $\text{NO}$ ,  $\text{NO}_2$  and other oxides of nitrogen. The major sources of man-made  $\text{NO}_x$  emissions are

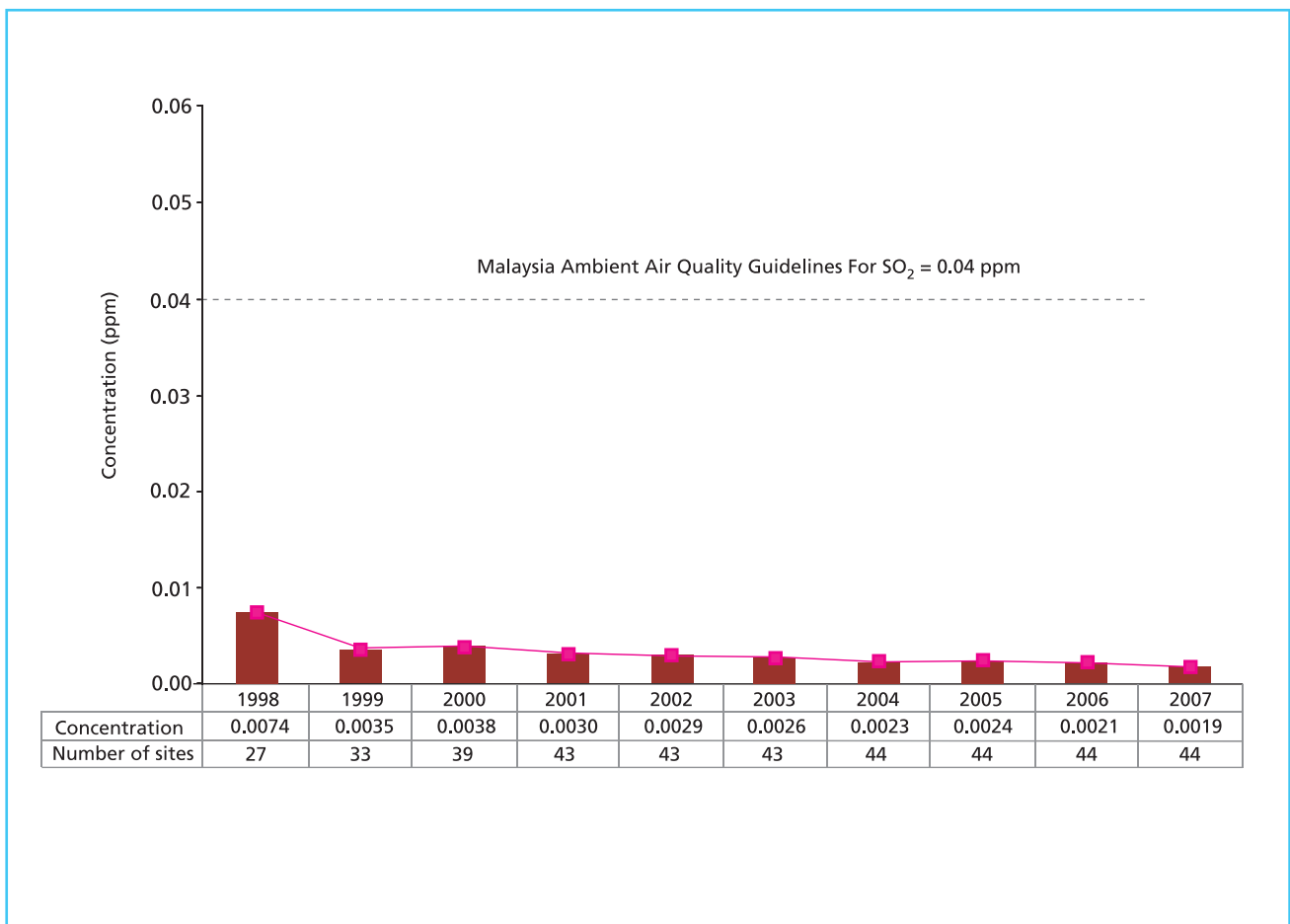


Figure 1.7 Malaysia : Annual Average Concentration of  $\text{SO}_2$ , 1998 - 2007

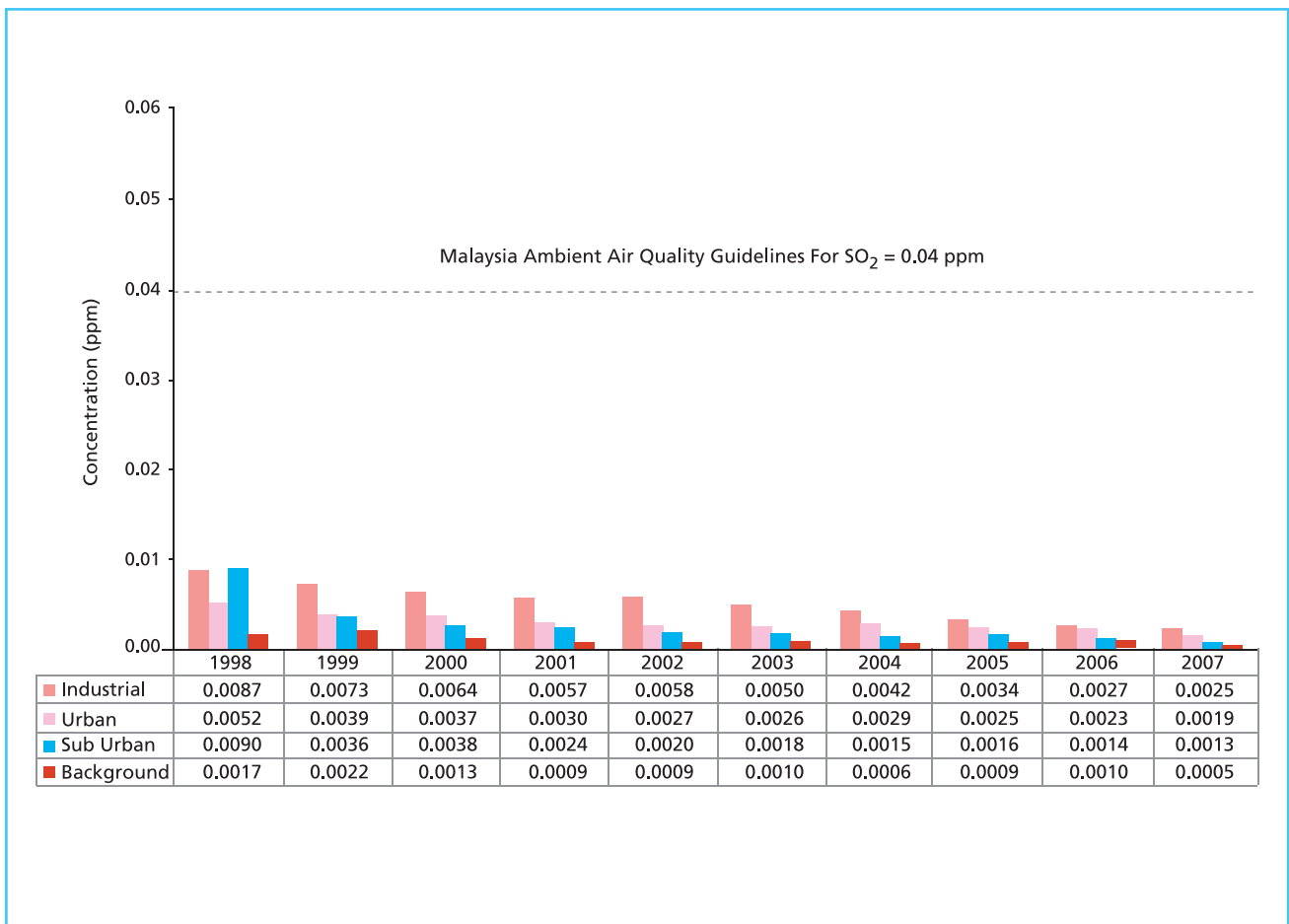


Figure 1.7 (a) Malaysia : Annual Average Concentration of SO<sub>2</sub> by Land Use, 1998 - 2007

high-temperature combustion processes, such as those occurring in automobiles and power plants. Most of the NO<sub>x</sub> (95%) from combustion processes are emitted as NO and the rest as NO<sub>2</sub>. NO is readily converted to NO<sub>2</sub> in the environment.

Short term exposure to NO<sub>2</sub> may lead to changes in airway responsiveness and lung function in individuals with pre-existing respiratory illnesses and increases respiratory illness in children. Long term exposure may increase susceptibility to respiratory infection and cause alteration in lung function. Nitrogen oxides also react in the air to form ground-level ozone and fine particle pollution, both of which are associated with adverse health impacts.

NO<sub>x</sub> contribute to a wide range of environmental effects, including the formation of acid rain and potential changes in the composition and competition of some species of vegetation in wetland and terrestrial systems, visibility impairment, acidification of freshwater bodies, eutrophication of estuarine and coastal waters and increase in levels of toxins harmful to aquatic life.

In 2007, the NO<sub>2</sub> concentration decreased by two percent from the 2006 levels. However NO<sub>2</sub> concentrations remain high in urban and industrial areas mainly due to emissions from motor vehicles and combustion processes. The annual average concentrations of NO<sub>2</sub> in the ambient air from 1998 to 2007 remains almost constant but well below the Malaysian Ambient Air Quality Guidelines as shown in **Figure 1.8** and **Figure 1.8(a)**.

### Ground Level Ozone (O<sub>3</sub>)

Ozone is not emitted directly into the air but is formed by the reaction of volatile organic compounds (VOCs) and NO<sub>x</sub> in the presence of heat and sunlight. O<sub>3</sub> forms readily in the atmosphere, usually in the warm sunny urban atmosphere. VOCs are emitted from various sources, including motor vehicles, chemical plants, refineries, factories, consumer and commercial products, and other industrial sources. NO<sub>x</sub> are emitted from motor vehicles, power plants and combustion sources. Changes in weather patterns contribute to yearly differences in O<sub>3</sub> concentrations. O<sub>3</sub> and the precursor pollutants that form O<sub>3</sub> can also be

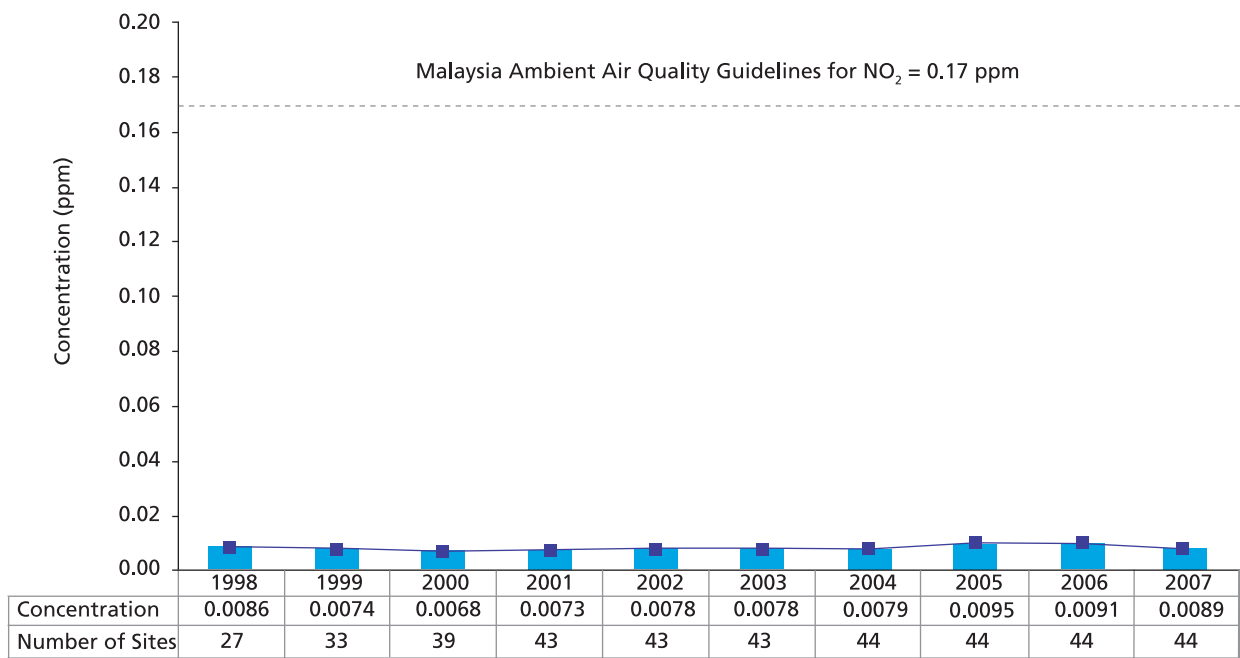


Figure 1.8 Malaysia : Annual Average Concentration of NO<sub>2</sub>, 1998 - 2007

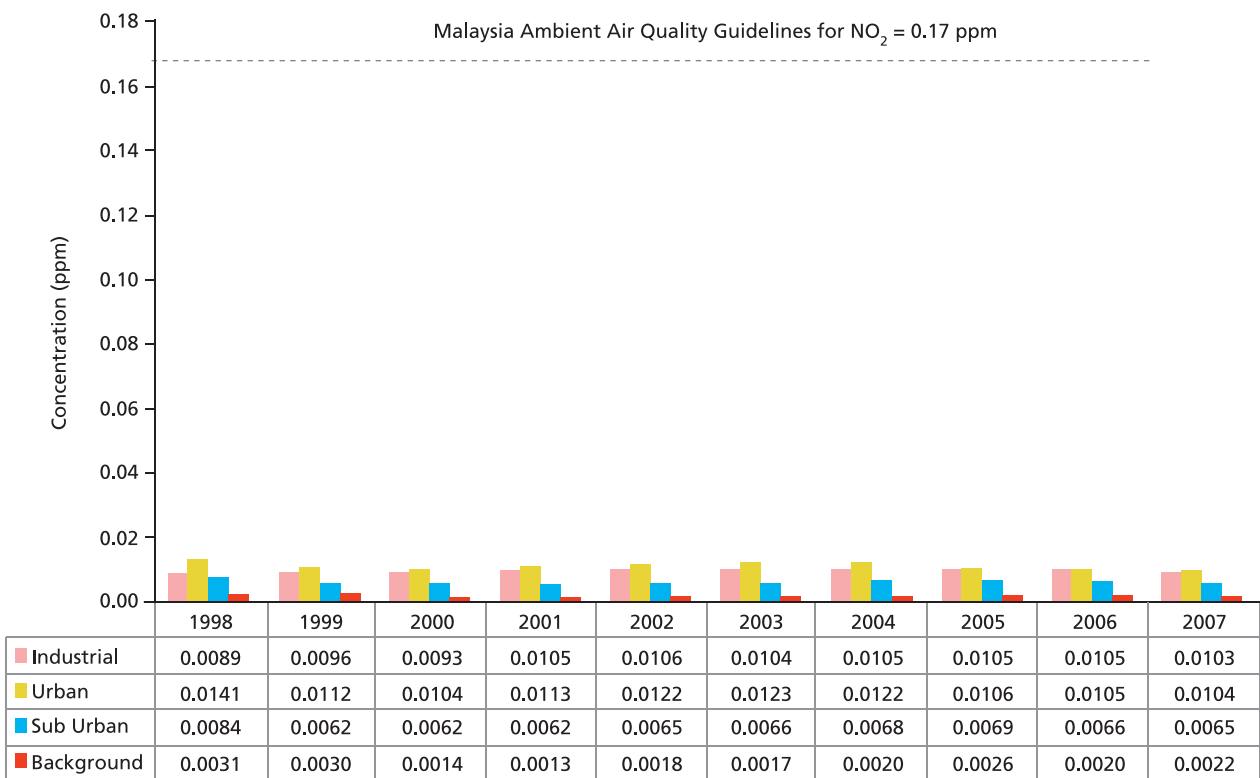


Figure 1.8(a) Malaysia : Annual Average Concentration of NO<sub>2</sub> by Land Use , 1998 - 2007

transported hundreds of kilometers away depending on wind direction.

Exposure to high concentrations of O<sub>3</sub> has been linked to numerous health effects. Repeated exposures to O<sub>3</sub> can make people more susceptible to respiratory infections resulting in lung inflammation and aggravate pre-existing respiratory diseases such as asthma. O<sub>3</sub> also affects vegetation and ecosystems, leading to reduction in agricultural and commercial forest yields, reduced growth and survivability of tree seedlings, and increase plant susceptibility to diseases, pests, and other environmental stresses. In long lived species, these effects may become evident only after several years or decades. Thus, O<sub>3</sub> has the potential for long-term effect on forest ecosystems.

In 2007, the annual average daily maximum one-hour O<sub>3</sub> concentrations decreased by four percent compared to 2006. The annual average daily maximum one-hour O<sub>3</sub> concentrations in ambient air for 1998 to 2007 remain almost constant but well below the Malaysia Ambient Quality Guidelines value of 0.1ppm as shown in **Figure**

**1.9. Figure 1.9(a)** describes the O<sub>3</sub> concentration for various land use categories between 1998 and 2007. Urban areas recorded higher levels of O<sub>3</sub> due to the greater number of motor vehicles and the conducive atmospheric conditions resulting in its formation.

### Carbon Monoxide (CO)

Carbon monoxide is a colourless, odourless and at high concentration, a poisonous gas. CO is formed when the carbon present in fuel is not burnt completely. CO is emitted mainly from motor vehicle exhaust. Other sources of CO emissions include industrial processes and open burning activities.

CO enters the bloodstream through the lungs and reduces oxygen delivery to organs and tissues. The health threat from exposure to CO is most serious to those who suffer from cardiovascular diseases. At high levels of exposure, CO can be poisonous even to healthy people. Visual impairment, reduced work capability and poor learning ability are among the health effects associated with exposure to elevated CO levels.

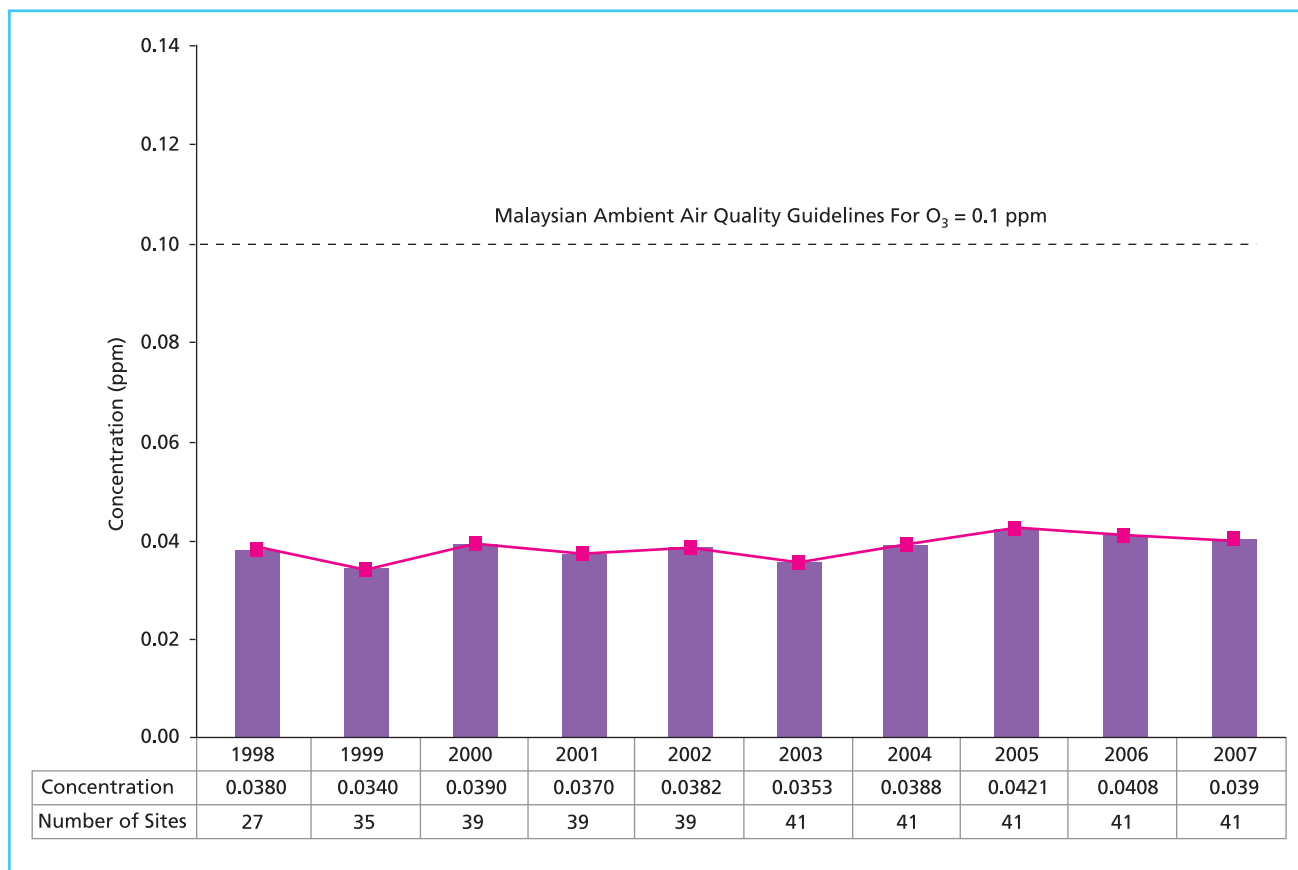


Figure 1.9 Malaysia : Annual Average Daily Maximum 1 Hour Concentration of O<sub>3</sub>, 1998 - 2007

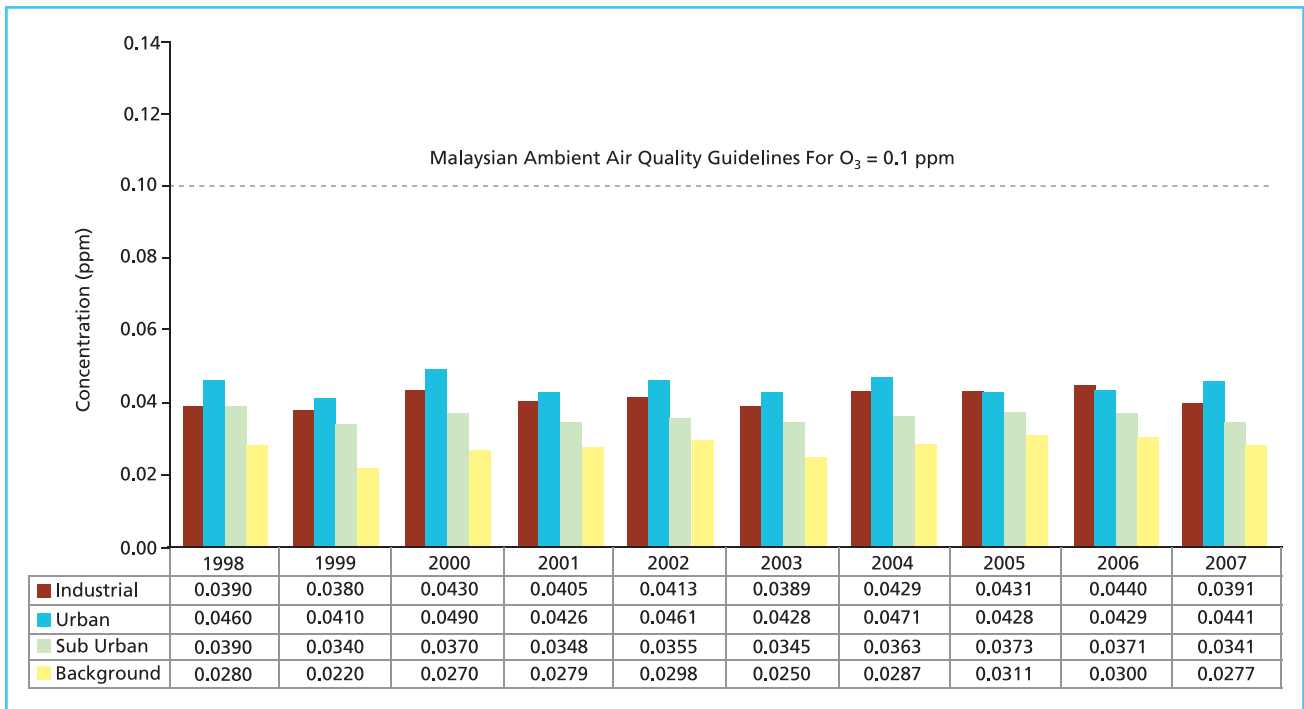


Figure 1.9(a) Malaysia : Annual Average Daily Maximum 1 Hour Concentration of O<sub>3</sub> by Land Use, 1998 - 2007

There was an almost nine percent decreased in CO levels in 2007 compared to 2006. However the trend of CO concentration from 1998 to 2007 remains almost constant. The levels recorded were well below the Malaysian Ambient Air Quality Guidelines (**Figure 1.10**). In urban areas the concentration of CO was higher where the main sources of emission were motor vehicles. **Figure 1.10(a)** shows CO concentrations for various categories of land use.

### Lead (Pb) Concentration

Excessive exposure to lead may cause neurological

impairment such as mental retardation and behavioural disorders. Even at low dosage, lead exposure is associated with damage in foetus nervous system and in young children resulting in learning deficiency and lowered IQ.

Generally Pb levels remain low after unleaded petrol was introduced in 1991 and the full implementation of unleaded petrol in 1998. Pb levels have remained low since then as shown in the average level of atmospheric Pb monitored in the Klang Valley in 2007 (**Figure 1.11**).



Haze Free (DOE Photo Library)

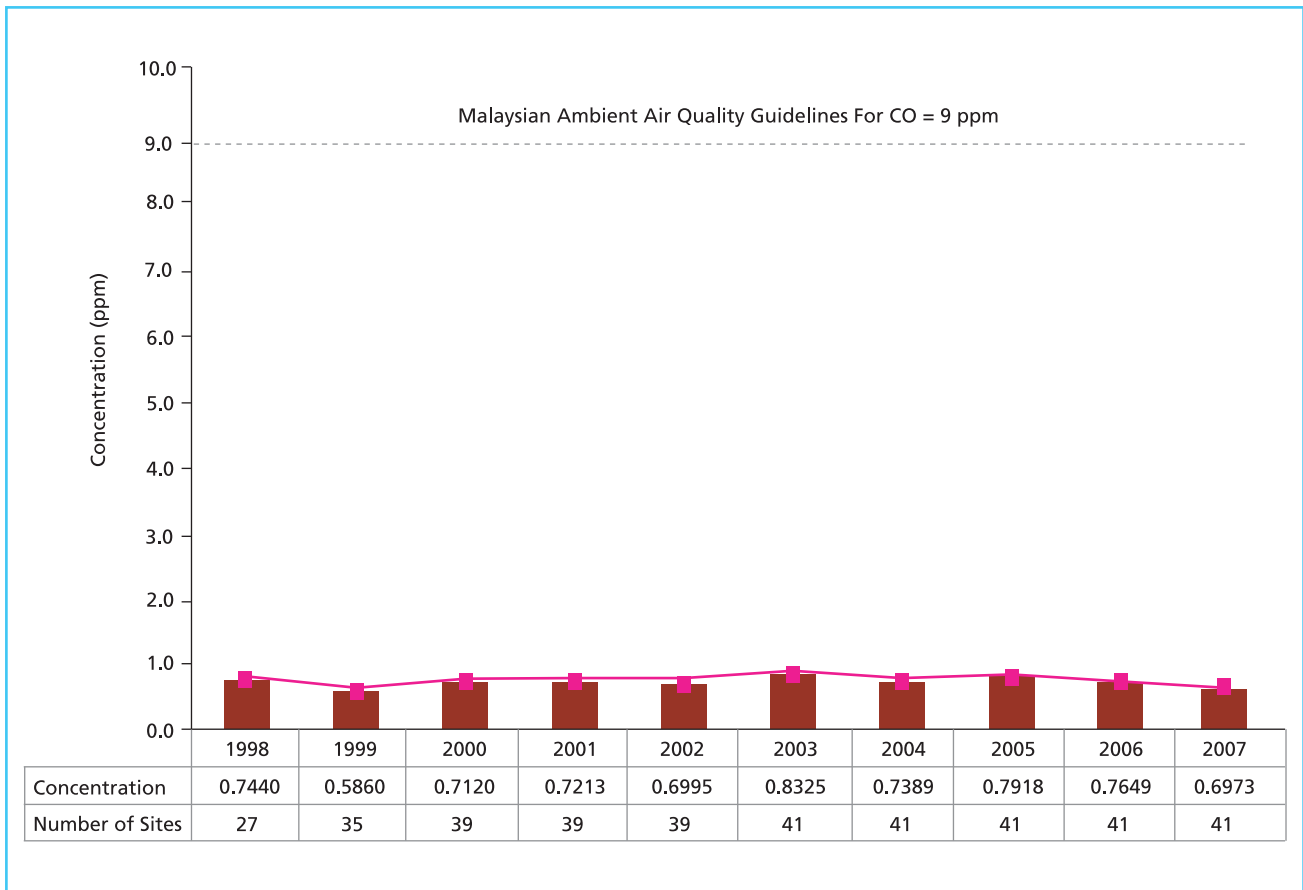


Figure 1.10 Malaysia : Annual Average Concentration of CO, 1998 - 2007

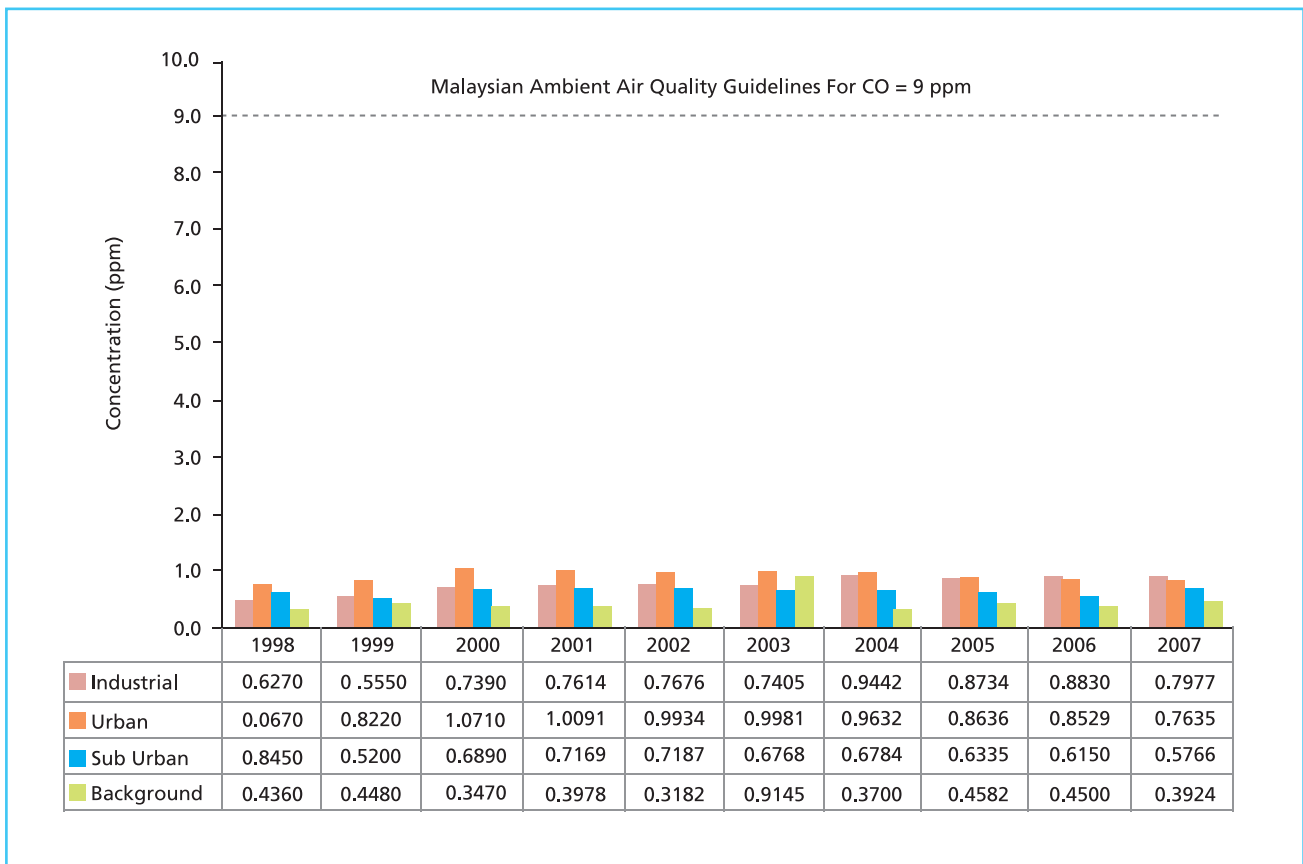


Figure 1.10(a) Malaysia : Annual Average Concentration of CO by Land Use, 1998 - 2007

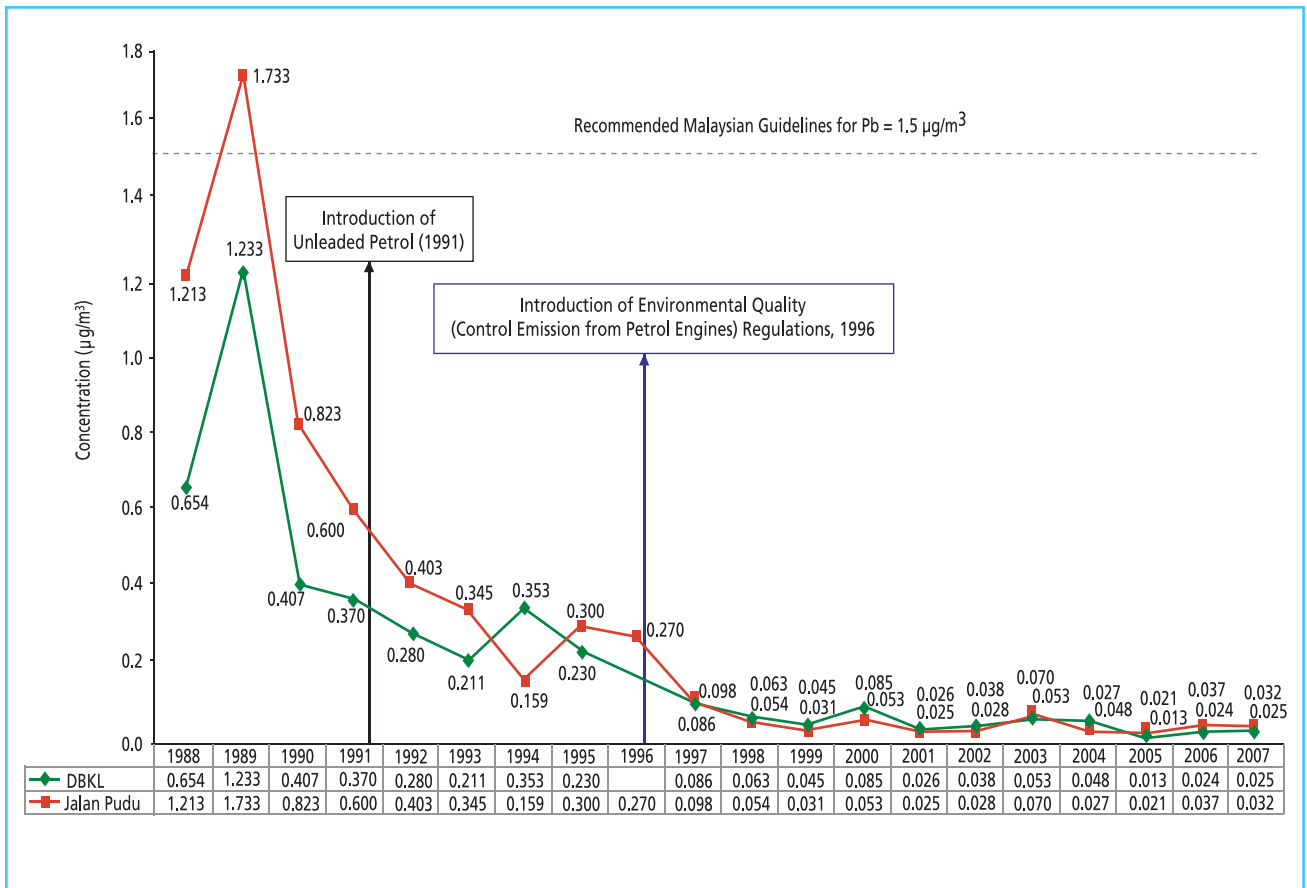


Figure 1.11 Malaysia : Air Quality Trend : Ambient Pb Concentration in Klang Valley, 1988 - 2007



Black smoke emissions : Facility without air pollution control equipment (DOE Photo Library)

# CHAPTER 2

# NOISE MONITORING



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## NATIONAL AMBIENT NOISE MONITORING PROGRAMME

Under the National Ambient Noise Monitoring Programme more intensive noise monitoring was carried out in 2007. Noise levels were monitored in four (4) types of areas namely Industrial Areas, Traffic Areas, Sensitive Areas – Schools and Hospitals and Construction Areas. The noise levels for day time (7:00 a.m. to 10:00 p.m.) and night time (10:00 p.m. to 7:00 a.m.) were measured. In addition, noise levels in the morning, afternoon and evening ( $L_{Aeq}$  for one hour) were also measured. The  $L_{Aeq}$  calculated represented the existing noise levels in those areas.

## CHAPTER 2

# NOISE MONITORING

Figure 2.1, Figure 2.2, Figure 2.3, Figure 2.4 and Figure 2.5 show the  $L_{Aeq}$  noise levels for the various areas recorded. The readings from this National Ambient Noise Monitoring Programme would be beneficial as a baseline data for planning purposes and new development in the future.

The Planning Guidelines for Environmental Noise Limits and Control 2004 specify maximum permissible sound levels for different category of receiving land use as shown in **Schedule 1 and Schedule 2** for any new development and **Schedule 3** for road traffic.

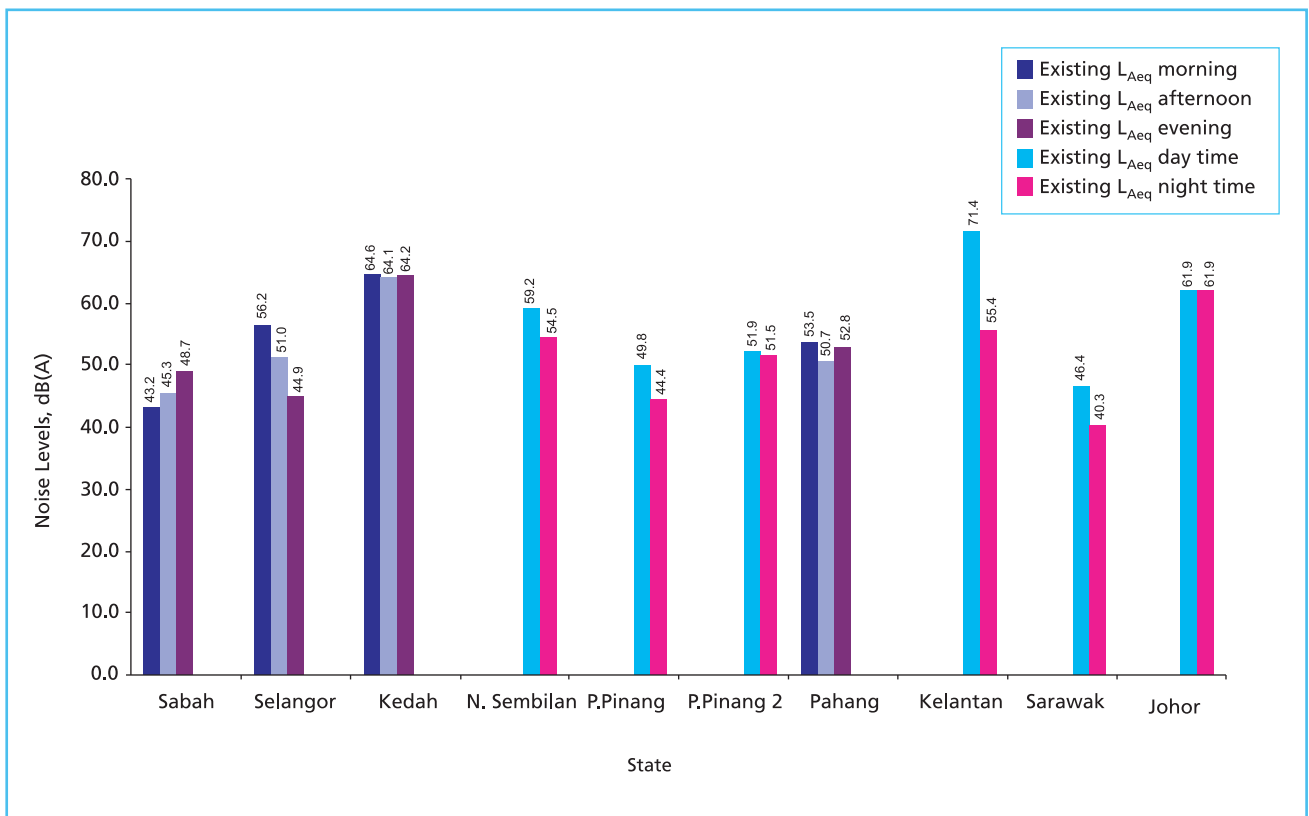


Figure 2.1 Malaysia : Noise Level in Certain Areas For Industrial Areas By States

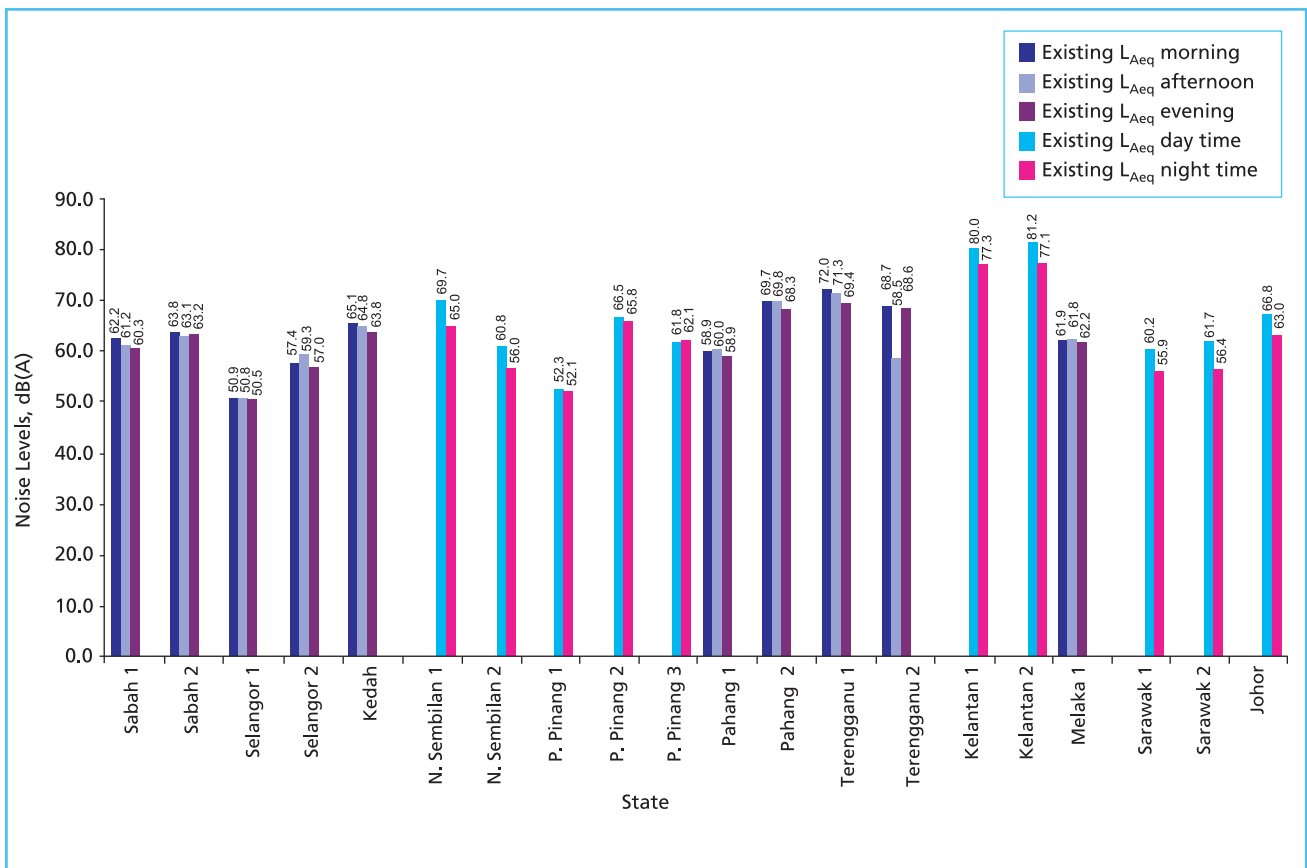


Figure 2.2 Malaysia : Noise Level in Certain Areas For Traffic By States

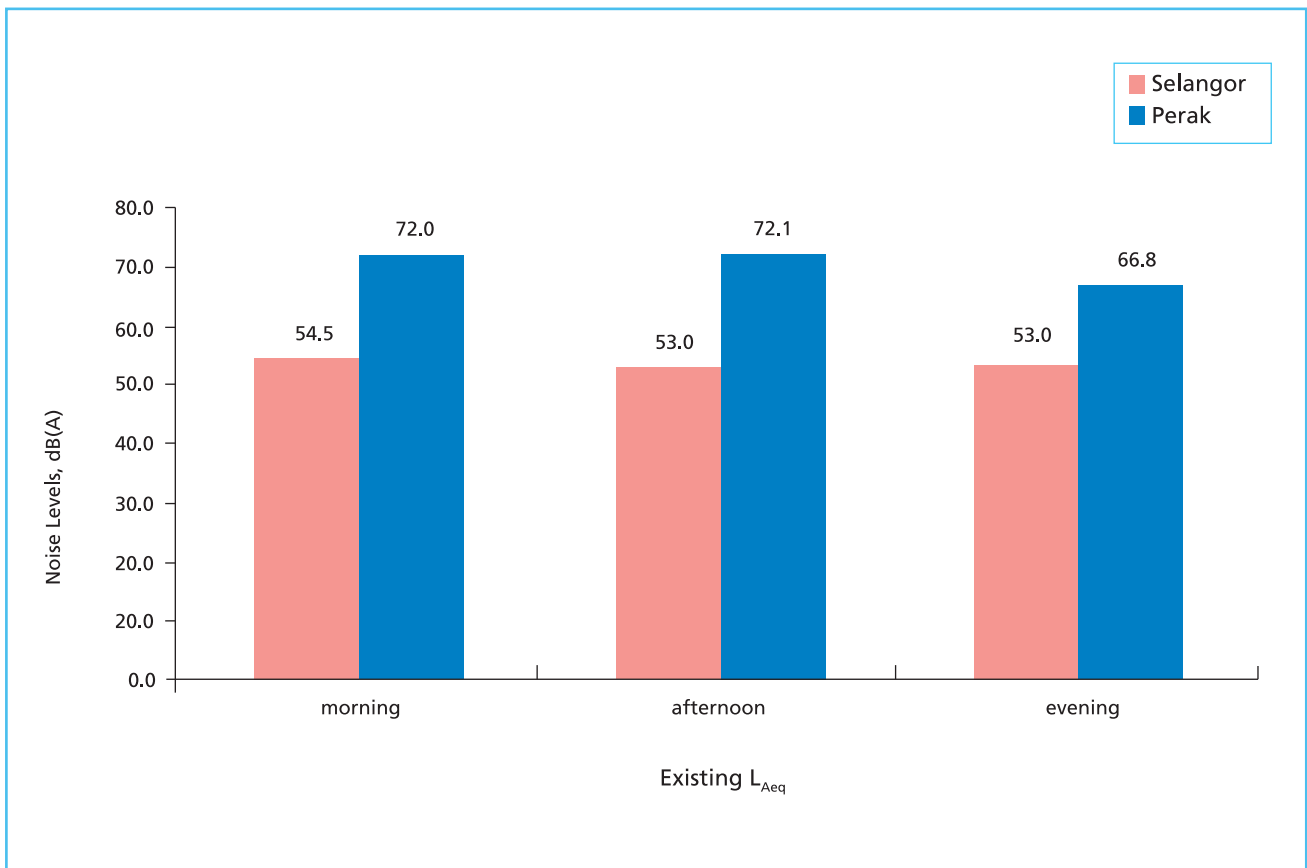


Figure 2.3 Malaysia : Noise Level For Sensitive Areas - Hospitals

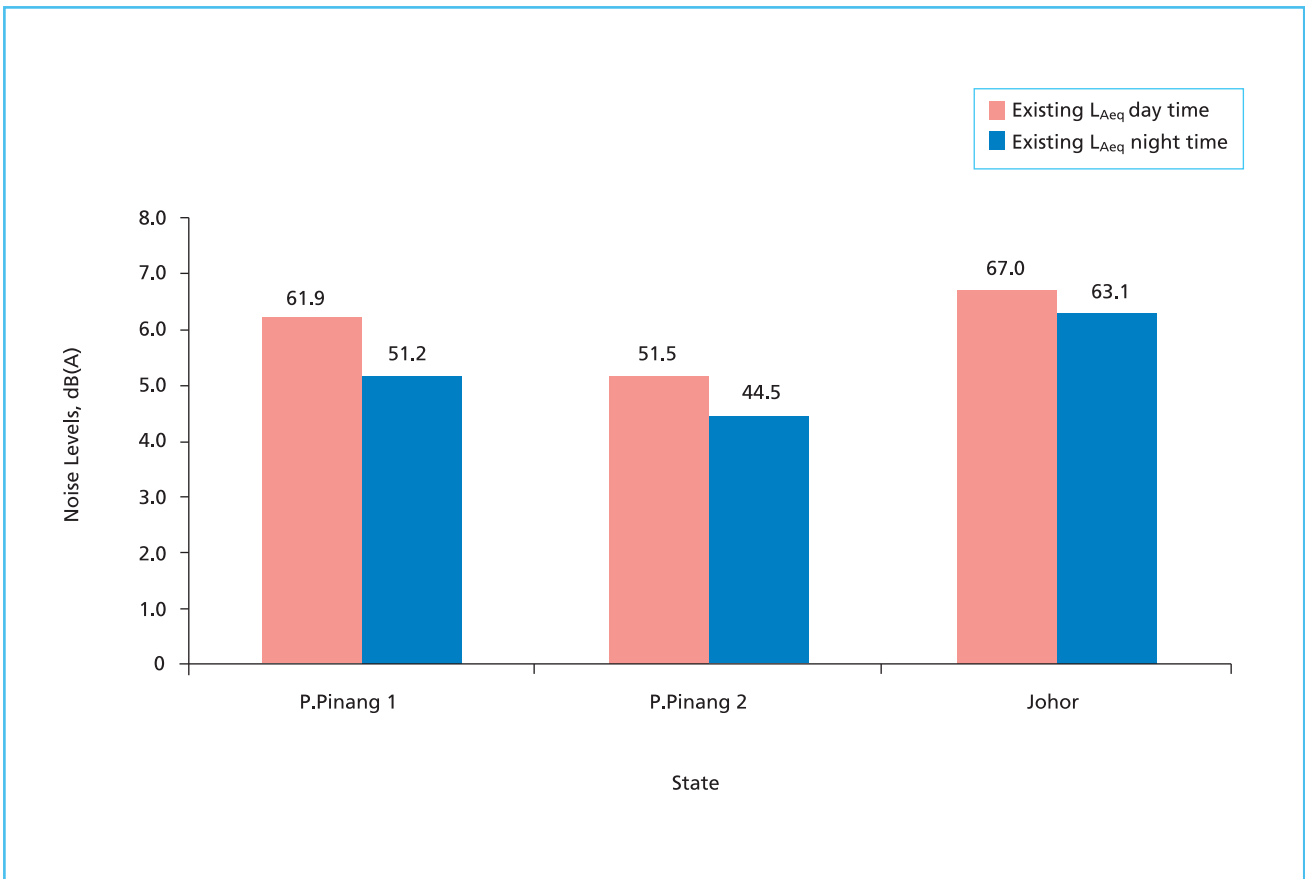


Figure 2.4 Malaysia : Noise Level For Sensitive Areas - Schools

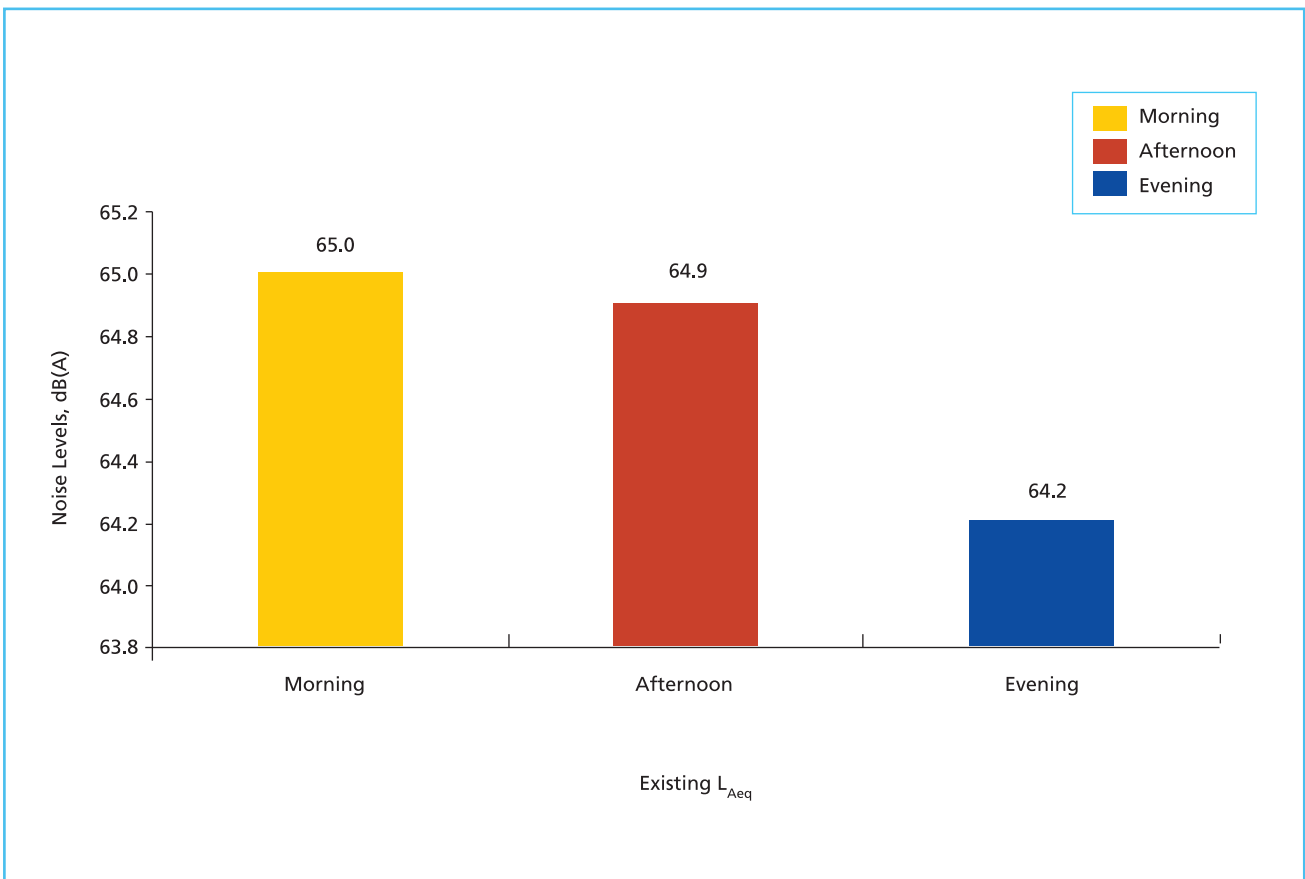


Figure 2.5 Malaysia : Noise Level For Construction Area



Noise pollution : Hydraulic piling activities (DOE Photo Library)

SCHEDULE 1  
 MAXIMUM PERMISSIBLE SOUND LEVEL ( $L_{Aeq}$ ) OF RECEIVING LAND USE FOR PLANNING AND NEW DEVELOPMENT

Receiving Land Use Category	Day Time 7:00 a.m. – 10:00 p.m.	Night Time 10:00 p.m. – 7:00 a.m.
Noise Sensitive Areas, Low Density Residential, Institutional (School, Hospital) and Worship Areas	50 dB(A)	40 dB(A)
Suburban Residential (Medium Density) Areas, Public Spaces, Parks and Recreational Areas	55 dB(A)	45 dB(A)
Urban Residential (High Density) Areas and Designated Mixed Development Areas (Residential - Commercial)	60 dB(A)	50 dB(A)
Commercial Business Zones	65 dB(A)	55 dB(A)
Designated Industrial Zones	70 dB(A)	60 dB(A)

Source : The Planning Guidelines for Environmental Noise Limits and Control, 2004.



Noise isolating barrier walls installed along the highway (DOE Photo Library)

SCHEDULE 2

MAXIMUM PERMISSIBLE SOUND LEVEL ( $L_{Aeq}$ ) OF NEW DEVELOPMENT (ROADS, RAILS AND INDUSTRIAL) IN AREAS OF EXISTING HIGH ENVIRONMENTAL NOISE CLIMATE

Receiving Land Use Category	Day Time 7:00 a.m. – 10:00 p.m.	Night Time 10:00 p.m. – 7:00 a.m.
Noise Sensitive Areas and Low Density Residential Areas	$L_{90} + 10$ dB(A)	$L_{90} + 5$ dB(A)
Suburban and Urban Residential Areas	$L_{90} + 10$ dB(A)	$L_{90} + 5$ dB(A)
Commercial and Business Areas	$L_{90} + 10$ dB(A)	$L_{90} + 10$ dB(A)
Industrial Areas	$L_{90} + 10$ dB(A)	$L_{90} + 10$ dB(A)

Source : The Planning Guidelines for Environmental Noise Limits and Control, 2004.

Note :  $L_{90}$  is the measured ninety percentile sound level for the respective time period of the existing areas of interest in the absence of the proposed new development.

SCHEDULE 3

LIMITING SOUND LEVEL ( $L_{Aeq}$ ) FROM ROAD TRAFFIC (FOR PROPOSED NEW ROADS AND/OR REDEVELOPMENT OF EXISTING ROADS)

Receiving Land Use Category	Day Time 7:00 a.m. – 10:00 p.m.	Night Time 10:00 p.m. – 7:00 a.m.
Noise Sensitive Areas, Low Density Residential Areas.	55 dB(A)	50 dB(A)
Suburban Residential (Medium Density)	60 dB(A)	55 dB(A)
Urban Residential (High Density) Commercial Business	65 dB(A) 70 dB(A)	60 dB(A) 60 dB(A)
Industrial Areas	75 dB(A)	65 dB(A)

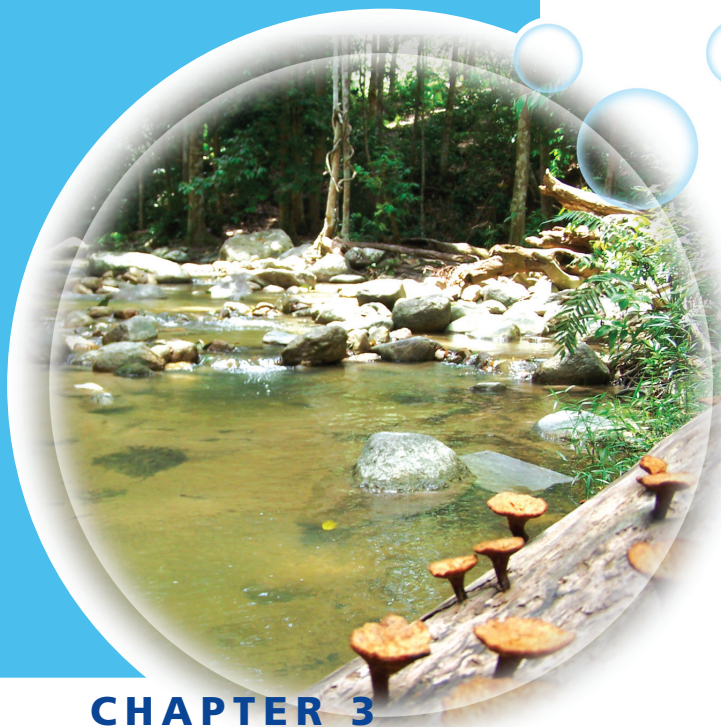
Source : The Planning Guidelines for Environmental Noise Limits and Control, 2004.

# CHAPTER 3

# RIVER WATER QUALITY



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## CHAPTER 3

# RIVER WATER QUALITY

### RIVER WATER QUALITY MONITORING

The Department of Environment (DOE) continued with the river water quality monitoring programme in 2007 to detect water quality changes in river water quality and to identify pollution sources. Water samples were collected at regular intervals from designated stations for in-situ and laboratory analysis to determine its physico-chemical and biological characteristics. The Water Quality Index (WQI) was used as a basis for assessment of a watercourse in relation to pollution load categorization and designation of classes of beneficial uses as stipulated in the National Water Quality Standards for Malaysia (NWQS) (**ANNEX**). The WQI was derived using Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Ammoniacal Nitrogen ( $\text{NH}_3\text{-N}$ ), Suspended Solids (SS) and pH.

### RIVER WATER QUALITY STATUS

In 2007, the number of river basins monitored was reduced from 146 to 143. This was due to the merging of three (3) river basins which are located close to each other. It was found that Lembangan Linggi in Malacca is actually linked to Lembangan Linggi in Negeri Sembilan; Lembangan Pontian in Johor merged

with Lembangan Rompin before flowing to the sea; and Lembangan Semerak in Kelantan is integrated with Lembangan Kemasin. Thus, Lembangan Linggi in Malacca, Lembangan Pontian and Lembangan Semerak were excluded resulting in 143 river basins. However the number of monitoring stations remain at 1,064 (**Maps 3.1, 3.2 and 3.3**).

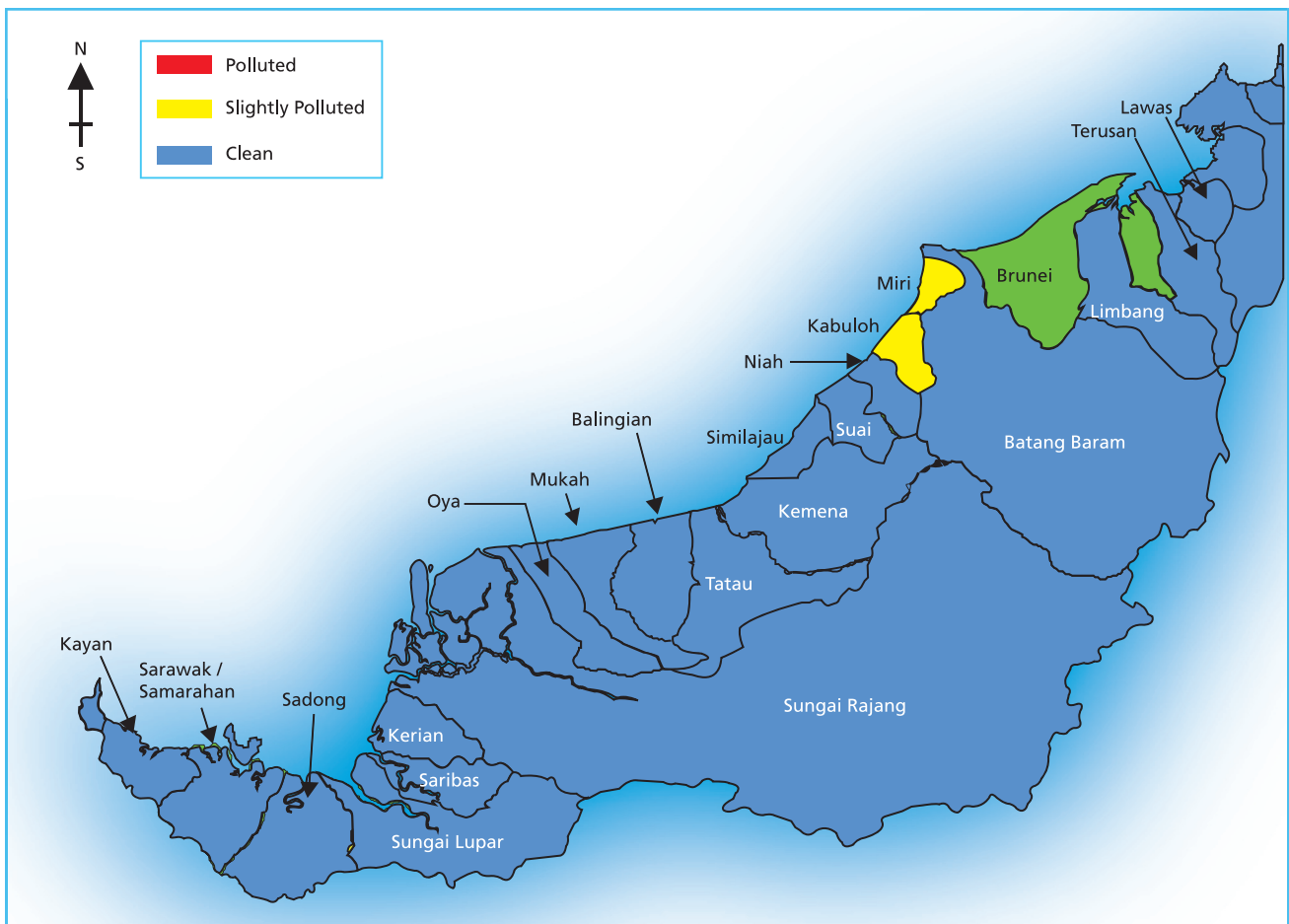
Out of these 1,064 monitoring stations, 638 (60%) were found to be clean, 376 (35%) slightly polluted and 50 (5%) polluted (**Tables 3.1, 3.2 and 3.3**). There was a significant improvement in the river water quality in 2007 compared with 2006. The number of clean river basins was 91 (64%) compared to 80 in 2006 and the number of slightly polluted river basins dropped from 59 in 2006 to 45 (31%) in 2007. However the number of polluted river basins remains at 7 (5%). The trend of the river basins water quality is shown in **Figure 3.1**. In 2006 the two (2) river basins namely Sungai Buloh (WQI 57) and Sungai Tebrau (WQI 57) with WQI slightly below the slightly polluted range (WQI 60 to 80) improved in the WQI ranging from 59 to 65 in 2007. Intensified enforcement efforts and good environmental management practices also have contributed to the improvement.

As in previous years the major pollutants detected were Biochemical Oxygen Demand (BOD), Ammoniacal Nitrogen ( $\text{NH}_3\text{-N}$ ) and Suspended Solids (SS). In line with the overall improvement in river water quality in 2007, the number of river basins polluted by BOD decreased from 22 in 2006 to 12 in 2007 and the number of river basins polluted by  $\text{NH}_3\text{-N}$  decreased from 42 to 36 but



Polluted River : Discharge of Untreated Industrial Effluent (DOE Photo Library)





Map 3.3 Malaysia: Water Quality Status for River Basins of Sarawak, 2007

the number of river basins polluted by SS remain at 42. High BOD can be attributed to untreated or partially treated sewage and discharges from agro-based and manufacturing industries. The main sources of  $\text{NH}_3\text{-N}$  were livestock farming and domestic sewage, whilst the sources for SS were earthworks and land clearing activities.

The Department of Environment maintained 15 continuous water quality monitoring stations for early detection of pollution influx. For the period of January to December 2007, 51 incidences of distinctive pollution influx were observed as shown in **Table 3.4**.

Cumulative water quality data compiled from these 15 continuous water quality monitoring stations are

presented in **Figures 3.2, 3.3, 3.4 and 3.5**. Based on the 90-percentile value, low dissolved oxygen levels were most frequent in Sungai Putat (40.3% saturation) followed by Sungai Klang (47.2% saturation) and Sungai Perai (52.5% saturation) (**Figure 3.2**). High ammonium levels were recorded more frequently in Sungai Klang (7.8 mg/l) followed by Sungai Putat (6.8 mg/l) and Sungai Skudai (2.9 mg/l) (**Figure 3.3**). High turbidity level was most frequently detected at Sungai Batang Benar (914.80 NTU), followed by Sungai Melaka (539.30 NTU) and Sungai Rajang (511.10 NTU), (**Figure 3.4**). Meanwhile pH value of 6.4 was recorded at Sungai Selangor and Sungai Perai, pH 6.5 at Sungai Terengganu and Sungai Skudai and pH 6.6 at Sungai Keratong (**Figure 3.5**).

Table 3.1 Malaysia : Water Quality Status of Clean River Basin, 2007

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
KEDAH	01PLA	KISAP	1	88.84 (93)	KISAP	1	89	C	II
					01PLC	ULU MELAKA	2	87.7 (90)	PETANG
					ULU MELAKA	1	84	C	II
	03	KEDAH	9	84.18 (84)	JANING	1	92	C	II
					KEDAH	1	75	SP	III
					PDG TERAP	4	86	C	II
					PEDU	1	88	C	II
					PENDANG	1	75	SP	III
					TEKAI	1	85	C	II
KEDAH/ P.PINANG	05	MUDA	13	83.17 (82)	CHEPIR	1	89	C	II
					JERUNG	2	65	SP	III
					KARANGAN	1	87	C	II
					KETIL	2	88	C	II
					MUDA	4	84	C	II
					PEGANG	1	93	C	I
					SEDIM	1	87	C	II
					TAWAR	1	81	C	II
					P.PINANG/ PERAK	08	KERIAN	9	81.44 (79)
KERIAN	4	84	C	II					
SELAMA	2	70	SP	III					
SERDANG	1	87	C	II					
PERAK	09	KURAU	6	84.87 (84)	ARA	1	93	C	II
					KURAU	5	82	C	II
	10	SEPETANG	15	82.67 (80)	BATU TEGUH	4	87	C	II
					JANA	1	84	C	II
					LARUT	1	73	SP	III
					LIDIN	1	83	C	II
					LIMAU	1	87	C	II
					MALAI	1	65	SP	III
					SEPETANG	2	79	SP	II
					TEMERLOH	2	87	C	II
					TRONG	1	89	C	II
					TUPAI	1	84	C	II
11	BRUAS	6	82.58 (84)	BRUAS	3	82	C	II	
				DANDANG	1	86	C	II	
				ROTAN	2	82	C	II	
PERAK/ SELANGOR	14	BERNAM	13	84.22 (85)	BERNAM	7	80	SP	II
					INKI	1	92	C	II
					SLIM	2	88	C	II
					TROLAK	3	90	C	II
	15	TENGI	3	81.912 (83)	TENGI	3	82	C	II
SELANGOR	16	SELANGOR	12	83.95 (82)	AIR HITAM	1	78	SP	II
					BATANG KALI	1	90	C	II
					KANCING	1	90	C	II

Table 3.1 Malaysia : Water Quality Status of Clean River Basin, 2007 (continued)

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
SELANGOR					KERLING	1	91	C	II
					KUNDANG	1	75	SP	III
					RAWANG	1	74	SP	III
					SELANGOR	5	86	C	II
					SEMBAH	1	77	SP	II
					SERENDAH	1	89	C	II
JOHOR/ N.SEMBILAN	25	MUAR	39	81.96 (81)	AIR PANAS	1	93	C	I
					GEMAS	1	84	C	II
					GEMENCHEH	2	84	C	II
					JUASSEH	1	87	C	II
					KELAMAH	1	79	SP	II
					LABIS	3	84	C	II
					MEDA	1	87	C	II
					MERBUDU	1	82	C	II
					MERLIMAU	1	73	SP	III
					MUAR	16	83	C	II
					P. MENKUANG	1	87	C	II
					PALONG	4	81	C	II
					SARANG BUAYA	1	70	SP	III
					SEGAMAT	1	82	C	II
					SENARUT	1	75	SP	III
					SEROM	1	70	SP	III
					SPG. LOI	1	69	SP	III
					TENANG	1	81	C	II
JOHOR	29	JOHOR	39	81.68 (80)	ANAK SG. SAYONG	2	60	SP	III
					BELITONG	1	86	C	II
					BERANGAN	1	66	SP	III
					BKT. BESAR	2	69	SP	III
					CHEMANGAR	1	85	C	II
					JOHOR	5	86	C	II
					LAYANG	1	91	C	II
					LAYAU KIRI	1	85	C	II
					LEBAM	1	79	SP	II
					LINGGIU	1	88	C	II
					PANTI	1	83	C	II
					PAPAN	1	86	C	II
					PELEPAH	1	93	C	I
					PENGGELI	1	88	C	II
					REMIS	1	85	C	II
					SANTI	1	83	C	II
					SAYONG	5	83	C	II
					SEBOL	1	84	C	II
					SELUYUT	1	86	C	II
					SEMANGER	1	89	C	II
SEMENCHU	1	78	SP	II					
SENING	1	74	SP	III					

Table 3.1 Malaysia : Water Quality Status of Clean River Basin, 2007 (continued)

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
JOHOR					SERAI	1	53	P	III
					TELOR	1	89	C	II
					TEMOH	1	88	C	II
					TIRAM	4	83	C	II
	30A	SEDILI BESAR	10	82.19 (81)	AMBAT	1	82	C	II
					DOHOL	1	87	C	II
					MUPUR	1	78	SP	II
					PASIR PANJANG	1	75	SP	III
					SEDILI BESAR	5	83	C	II
					TEMUBOR KANAN	1	87	C	II
	31A	MERSING	2	88.83 (87)	MERSING	2	89	C	II
	31B	JEMALUANG	2	83.26 (81)	JEMALUANG	2	83	C	II
	32	ENDAU	25	81.98 (78)	ANAK SG. SEMBERONG	1	82	C	II
					DENGAR	1	77	SP	II
					ENDAU	2	88	C	II
					JASIN	1	93	C	I
					JEBONG	1	81	C	II
					KAHANG	1	87	C	II
					LENGA	1	73	SP	III
					LENGGOR	1	83	C	II
					MAMAI	1	84	C	II
					MELATAI	1	68	SP	III
					MENKIBOL	3	76	SP	III
					PALOH	1	86	C	II
					PAMOL	1	73	SP	III
				SELAI	1	89	C	II	
				SEMBERONG	6	83	C	II	
				SINGOL	1	78	SP	II	
				TAMOK	1	88	C	II	
PAHANG	32AE	ANAK ENDAU	2	87 (89)	ANAK ENDAU	2	87	C	II
	33	ROMPIN	13	87.63 (88)	AUR	1	89	C	II
					BAKAR	1	80	SP	II
					JEKATIH	2	87	C	II
					JERAM	1	90	C	II
					KEPASING	1	85	C	II
					KERATONG	3	87	C	II
					PONTIAN	1	88	C	II
					PUKIN	3	90	C	II
					ROMPIN	4	86	C	II
					SEPAYANG	1	85	C	II
	34B	BEBAR	5	81.28 (84)	BEBAR	2	83	C	II
					MERBA	1	85	C	II
				SERAI	2	78	SP	II	
34M	MERCHONG	2	86.57 (85)	MERCHONG	2	87	C	II	
35P	PAHANG	91	86.42 (88)	ANAK SG. LEPAR	1	76	SP	III	
				BATU	1	74	SP	III	

Table 3.1 Malaysia : Water Quality Status of Clean River Basin, 2007 (continued)

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
PAHANG		PAHANG			BELAYAR	1	88	C	II
					BENTONG	4	87	C	II
					BENUS	2	89	C	II
					BERA	3	85	C	II
					BERKAPOR	1	89	C	II
					BERTAM	3	86	C	II
					BILUT	1	82	C	II
					BURUNG	1	93	C	I
					CHINI	1	87	C	II
					HABU	1	91	C	II
					JELAI	2	85	C	II
					JEMPOL	2	86	C	II
					JENKA	2	83	C	II
					KELAU	2	86	C	II
					KERTAM	1	82	C	II
					KOYAN	1	88	C	II
					KUNDANG	1	80	SP	II
					LENGGOK	1	92	C	II
					LEPAR	3	87	C	II
					LIPIS	3	88	C	II
					LUIT	1	87	C	II
					MARAN	1	84	C	II
					MENTIGA	2	86	C	II
					PAHANG	8	87	C	II
					PENJURING	1	92	C	II
					PERTANG	2	86	C	II
					PERTING	1	90	C	II
					RINGLET	1	86	C	II
					SEMANTAN	3	86	C	II
					SERTING	5	84	C	II
					T. PAYA BUNGOR	1	85	C	II
					TAHAN	1	92	C	II
					TANGLIR	1	81	C	II
					TASIK BERA	1	85	C	II
					TASIK CHINI	10	87	C	II
					TEKAL	1	88	C	II
					TEKAM	2	84	C	II
					TELANG	1	88	C	II
					TELEMONG	1	89	C	II
					TELOM	2	88	C	II
					TEMBELING	1	89	C	II
					TERANUM	1	86	C	II
TERAS	1	81	C	II					
TERLA	1	90	C	II					
TRIANG	2	87	C	II					
TRINGKAP	1	85	C	II					

Table 3.1 Malaysia : Water Quality Status of Clean River Basin, 2007 (continued)

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS				
PAHANG					BELAT	1	80	SP	II				
	36	KUANTAN	15	82.21 (82)	CHARU	1	90	C	II				
					GALING BESAR	1	53	P	III				
					GALING KECIL	1	64	SP	III				
					KENAU	1	91	C	II				
					KUANTAN	5	90	C	II				
					PANDAN	1	87	C	II				
					PINANG	1	83	C	II				
					REMAN	1	74	SP	III				
					RIAU	1	83	C	II				
					TALAM	1	81	C	II				
					BALOK	2	80	SP	II				
					37	BALOK	4	81 (82)	PANJANG	1	85	C	II
									YIOR	1	72	SP	III
	CHERATING	1	84	C					II				
	37A	CHERATING	1	84.11 (84)	TONGGOK	2	82	C	II				
	37B	TONGGOK	2	82.35	CHERUL	2	89	C	II				
	38	KEMAMAN	9	82.33 (89)	KEMAMAN	3	87	C	II				
					NERAM	1	77	SP	II				
					PERASING	1	83	C	II				
					RANSAN	2	62	SP	III				
					KERTIH	2	87	C	II				
	39K	KERTIH	2	86.73 (85)	BESUL	1	90	C	II				
	40	PAKA	6	87.09 (85)	PAKA	2	86	C	II				
					RASAU	2	89	C	II				
					RENGAT	1	84	C	II				
					DUNGUN	4	89	C	II				
	41	DUNGUN	5	88.99 (91)	TELEMBOH	1	85	C	II				
					IBAI	3	81	C	II				
	42I	IBAI	3	80.63 (81)	BERANG	2	89	C	II				
	43	TERENGGANU	12	81.51 (84)	NERUS	4	67	SP	III				
					PUEH	2	85	C	II				
					TELEMONG	1	87	C	II				
TERENGGANU					3	86	C	II					
CHALOK					2	81	C	II					
44	SETIU	5	86.19 (89)	SETIU	2	91	C	II					
				TAROM	1	87	C	II					
				BESUT	3	88	C	II					
46	BESUT	4	86.73 (90)	JERTIH	1	82	C	II					
				KLUANG	1	86	C	II					
47B	KLUANG	1	86 (89)	KEMASIN	2	81	C	II					
KELANTAN	47K	KEMASIN	5	85 (83)	SEMERAK	3	87	C	II				
					ARING	1	87	C	II				
	48	KELANTAN	42	85.7 (86)	BELATOP	2	80	SP	II				
BER					1	89	C	II					
BEROK					3	84	C	II					

Table 3.1 Malaysia : Water Quality Status of Clean River Basin, 2007 (continued)

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
KELANTAN		KELANTAN			BETIS	1	86	C	II
					CHIKU	1	87	C	II
					GALAS	5	87	C	II
					KELANTAN	3	85	C	II
					KELESA	1	90	C	II
					KERILLA	2	90	C	II
					KETIL	1	92	C	II
					LEBIR	4	86	C	II
					NAL	3	88	C	II
					NENGGIRI	3	80	SP	II
					PEHI	1	83	C	II
					PERGAU	6	89	C	II
					RELAI	2	88	C	II
					SOKOR	1	83	C	II
TUANG	1	92	C	II					
48D	PENKALAN DATU	3	81.6 (81)	PENKALAN DATU	3	82	C	II	
49	GOLOK	7	88.61 (89)	GOLOK	5	88	C	II	
				LANAS	1	89	C	II	
				TASIK GARU	1	94	C	I	
SARAWAK	50	KAYAN	3	81.08 (80)	KAYAN	3	81	C	II
	50S	SEMUNSAM	1	85 (86)	SEMUNSAM	1	85	C	II
	51	SARAWAK	16	85 (79)	KELANTAN	1	66	SP	III
					KUAP	2	84	C	II
					MAONG KIRI	1	72	SP	III
					SAMARAHAN	2	82	C	II
					SARAWAK	5	87	C	II
					SARAWAK KANAN	2	88	C	II
					SARAWAK KIRI	1	86	C	II
					SEMADANG	1	93	C	I
					SEMENGGOH	1	80	SP	II
	TABUAN	1	84	C	II				
	52	SADONG	7	84.5 (80)	KARANGAN	2	82	C	II
					SADONG	4	84	C	II
					TARAT	1	91	C	II
	53	LUPAR	8	86.51 (88)	AI	2	91	C	II
					LUPAR	3	84	C	II
					SEKERANG	1	86	C	II
					SETERAP	1	81	C	II
UNDUP					1	90	C	II	
54	SARIBAS	3	84.41 (80)	LAYAR	2	86	C	II	
				SARIBAS	1	81	C	II	
55	KERIAN	3	83.75 (78)	KERIAN	2	84	C	II	
				SEBLAK	1	84	C	II	
56	RAJANG	19	84.58 (84)	BALOI	1	85	C	II	
				BINATANG	1	93	C	II	
				JULAU	1	90	C	II	

Table 3.1 Malaysia : Water Quality Status of Clean River Basin, 2007 (continued)

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
SARAWAK					KANOWIT	1	90	C	II
					MERADONG	1	83	C	II
					RAJANG	12	83	C	II
					SALIM	1	86	C	II
					SARIKEI	1	86	C	II
	57	OYA	3	81.49 (80)	OYA	3	81	C	II
	58	MUKAH	4	82.21 (81)	MUKAH	4	82	C	II
	59	BALINGIAN	2	83.29 (83)	BALINGIAN	2	83	C	II
	60	TATAU	1	81 (82)	TATAU	1	81	C	II
	61	KEMENA	5	83 (83)	KEMENA	4	84	C	II
					SIBIU	1	80	SP	II
	62	SIMILAJAU	2	89 (87)	SIMILAJAU	2	89	C	II
	63	SUAI	1	87 (81)	SUAI	1	87	C	II
	64	NIAH	4	85 (82)	NIAH	2	89	C	II
					SEKALOH	2	76	SP	III
	67	BARAM	5	80.64 (80)	BARAM	4	81	C	II
TUTUH					1	80	SP	II	
68	LIMBANG	5	83 (78)	LIMBANG	5	83	C	II	
69	TRUSAN	1	88.52 (85)	TRUSAN	1	89	C	II	
70	LAWAS	3	90 (90)	LAWAS	3	90	C	II	
SABAH	71	MENGGALONG	2	88 (89)	MENGGALONG	2	88	C	II
	71A	LAKUTAN	1	87 (90)	LAKUTAN	1	87	C	II
	71B	LINGKUNGAN	2	89 (90)	BUKAU	1	89	C	II
					LINGKUNGAN	1	89	C	II
	72	PADAS	10	88 (87)	ANSIP	1	85	C	II
					BUNSIT	1	93	C	I
					LIAWAN	1	91	C	II
					PADAS	3	85	C	II
					PANGATAN	1	87	C	II
					PEGALAN	2	89	C	II
					TANDULU	1	92	C	II
	73	MEMBAKUT	1	87 (87)	MEMBAKUT	1	87	C	II
	74	KIMANIS	1	87.2 (88)	KIMANIS	1	87	C	II
	74A	BONGAWAN	1	83 (86)	BONGAWAN	1	83	C	II
	74	PAPAR	3	88.87 (88)	PAPAR	3	89	C	II
	76	MOYOG	4	91.55 (91)	MOYOG	4	92	C	II
76C	TELIPOK	2	85.1 (70)	TELIPOK	2	85	C	II	
77	TUARAN	5	90.47 (88)	DAMIT	2	88	C	II	
				SONG SAI	1	92	C	II	
				TUARAN	2	93	C	I	
78	KEDAMAIAN	4	90.06 (91)	KEDAMAIAN	1	91	C	II	
				TEMPASUK	2	91	C	II	
				WARIU	1	91	C	II	
78T	TENGHILAN	1	89.18 (88)	TENGHILAN	1	89	C	II	
79	BINGKONGAN	6	89 (91)	BANDAU	1	90	C	II	
				BINGKONGAN	2	91	C	II	

Table 3.1 Malaysia : Water Quality Status of Clean River Basin, 2007 (continued)

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
SABAH					MENGGARIS	2	89	C	II
					TANDEK	1	86	C	II
	80	BENGKOKA	2	86 (88)	BENGKOKA	2	86	C	II
	82	PAITAN	1	85 (85)	PAITAN	1	85	C	II
	83	SUGUT	6	92 (91)	BONGKUD	1	94	C	I
					LOHAN	1	92	C	II
					MERALI	1	93	C	I
					SUGUT	3	91	C	II
	84	LABOK	7	90 (89)	KINIPIR	2	91	C	II
					LABOK	1	88	C	II
					LIWAGU	2	89	C	II
					MALIAU	1	92	C	II
					TUNGUD	1	86	C	II
	84A	SAPI	4	86 (83)	SAPI	3	84	C	II
					SUALONG	1	91	C	II
	85	MOUNAD	2	86 (76)	MOUNAD	2	86	C	II
	85A	SEGALIUD	2	81.18 (76)	SEGALIUD	2	81	C	II
	87	SEGAMA	3	83.95 (85)	SEGAMA	3	84	C	II
	88	TUNGKU	2	88 (88)	TUNGKU	2	88	C	II
	88A	SILABUKAN	2	81.86 (79)	SILABUKAN	2	82	C	II
	89	TINGKAYU	2	84.71 (84)	TINGKAYU	2	85	C	II
	91	TAWAU	4	85 (88)	TAWAU	4	85	C	II
	91A	BALUNG	1	89 (89)	BALUNG	1	89	C	II
91B	APAS	1	90.32 (92)	APAS	1	90	C	II	
92	MEROTAI	3	81.47 (83)	MEROTAI	3	81	C	II	
93	UMAS-UMAS	1	88 (90)	UMAS-UMAS	1	88	C	II	
94	BRANTIAN	1	84 (85)	BRANTIAN	1	84	C	II	
95	KALABAKAN	3	81 (78)	KALABAKAN	3	81	C	II	

NOTE: 1. WQI BASED ON 6 MAJOR PARAMETERS: BOD, COD, SS, PH, DO, NH<sub>3</sub>-N

2. RIVER WATER QUALITY STATUS: C: CLEAN, SP: SLIGHTLY POLLUTED, P: POLLUTED

3. RIVER CLASS BASED ON INWQS

4. ( ) = Overall WQI for 2006

5. OVERALL WQI FOR RIVER BASIN IS CALCULATED BY AVERAGING WQI FROM ALL SAMPLING STATIONS IN EACH RIVER BASIN.

Table 3.2 Malaysia : Water Quality Status of Slightly Polluted River Basin, 2007

STATE	CODE	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
PERLIS	0101	PERLIS	9	80 (83)	JARUM	1	77	SP	II
					JERNIH	2	81	C	II
					KOK MAK	1	68	SP	III
					NGULANG	1	80	SP	II
					PELARIT	1	90	C	II
					PERLIS	1	72	SP	III
					SERAI	1	80	SP	II
					WANG KELIAN	1	91	C	II
KEDAH	01PLB	KUAH	1	67 (71)	KUAH	1	67	SP	III
	04	MERBOK	10	71 (68)	BAKAR ARANG	1	64	SP	III
					BONGKOK	1	76	SP	III
					BUKIT MERAH	1	83	C	II
					KOROK	1	61	SP	III
					MERBOK	1	64	SP	III
					PETANI	1	54	P	III
					TOK PAWANG	2	75	SP	III
					TUPAH	2	73	SP	III
P.PINANG	06K	KLUANG	4	74 (75)	ARA	2	86	C	II
					KLUANG	1	60	SP	III
					RELAU	1	66	SP	III
	06P	PERAI	20	64 (64)	AIR MELINTAS	1	42	P	IV
					JARAK	5	70	SP	III
					KARANGAN	1	89	C	II
					KELADI	1	64	SP	III
					KEREH	2	52	P	IV
					KUBANG SEMANG	1	45	P	IV
					KULIM	3	81	C	II
					PERAI	2	67	SP	III
					PERTAMA	1	50	P	IV
					SELUANG	1	53	P	III
					SELUANG BAWAH	2	57	P	III
	06T	BAYAN LEPAS	3	62 (60)	BAYAN LEPAS	1	59	P	III
					TIRAM	2	63	SP	III
	07	JEJAWI	7	63 (60)	CEMPEDAK	1	32	P	IV
					JAWI	1	47	P	IV
					JUNJONG	3	60	SP	III
MACHANG BUBOK					1	70	SP	III	
TENGAH					1	61	SP	III	
PERAK	12	RAJA HITAM	8	73 (75)	DERHAKA	2	63	SP	III
					MANJONG	2	82	C	II
					NYIOR	1	93	C	I
					RAJA HITAM	3	66	SP	III
	12W	WANGI	4	73 (78)	DERALIK	2	68	SP	III
					WANGI	2	79	SP	II
	13	PERAK	58	78 (76)	BATANG PADANG	3	84	C	II
					BIDOR	3	81	C	II

Table 3.2 Malaysia : Water Quality Status of Slightly Polluted River Basin, 2007 (continued)

STATE	CODE	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
PERAK		PERAK			CHENDERANG	2	83	C	II
					CHEPOR	1	94	C	I
					CUAR	1	93	C	I
					KAMPAR	2	84	C	II
					KANGSAR	2	83	C	II
					KEPAYANG	2	63	SP	III
					KERDAH	2	69	SP	III
					KINJANG	1	89	C	II
					KINTA	8	76	SP	III
					KLAH	2	87	C	II
					KLIAN BARU	2	64	SP	III
					KUANG	1	87	C	II
					NYAMOK	1	68	SP	III
					PARI	2	68	SP	III
					PELUS	2	88	C	II
					PERAK	8	85	C	II
					PINJI	2	69	SP	III
					RAIA	2	88	C	II
					SELUANG	1	63	SP	III
					SEROKAI	2	49	P	IV
					SINTANG	1	54	P	III
					SUNGKAI	2	88	C	II
					SUNGKAI MATI	2	80	SP	II
TUMBOH	1	74	SP	III					
SELANGOR	17	BULOH	5	65 (57)	BULOH	5	65	SP	III
SELANGOR/ WPKL	18	KLANG	30	62 (63)	AMPANG	1	67	SP	III
					BATU	3	74	SP	III
					BUNOS	1	62	SP	III
					DAMANSARA	3	59	P	III
					GOMBAK	3	78	SP	II
					JINJANG	2	55	P	III
					KERAYONG	2	58	P	III
					KEROH	2	61	SP	III
					KLANG	10	55	P	III
					KUYOH	1	62	SP	III
					PENCALA	1	44	P	IV
					SEMELAH	1	82	C	II
SELANGOR	19	LANGAT	28	79 (77)	ANAK CHUAU	1	80	SP	II
					BALAK	1	65	SP	III
					BATANG BENAR	2	75	SP	III
					BATANG LABU	2	82	C	II
					BATANG NILAI	2	66	SP	III
					BERANANG	1	82	C	II
					BUAN	1	84	C	II
					CHUAU	2	90	C	II
					JIJAN	1	87	C	II

Table 3.2 Malaysia : Water Quality Status of Slightly Polluted River Basin, 2007 (continued)

STATE	CODE	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
					LANGAT	8	74	SP	III
					LIMAU MANIS	1	79	SP	II
					LUI	1	91	C	II
					PAJAM	1	77	SP	II
					RINCHING	1	87	C	II
					SEMENYIH	3	86	C	II
	20	SEPANG	4	73 (71)	RAMBAI	1	59	P	III
					SEPANG	3	77	SP	II
N.SEMBILAN	20L	LUKUT	1	80 (82)	LUKUT	1	80	SP	II
	21	LINGGI	20	80 (76)	BATANG PENAR	3	84	C	II
					CHEMBONG	1	88	C	II
					KAYU ARA	1	82	C	II
					KEPAYONG	1	82	C	II
					KUNDUR BESAR	1	90	C	II
					LINGGI	6	77	SP	II
					PAROI	1	72	SP	III
					PEDAS	1	85	C	II
					REMBAU	2	85	C	II
					SENAWANG	1	63	SP	III
					SIMIN	1	80	SP	II
					SIMPANG EMPAT	1	78	SP	II
					SIPUT	2	83	C	II
					TEMIANG	2	79	SP	II
MELAKA	21BT	BARU	2	67 (64)	BARU	1	67	SP	III
					TUANG	1	74	SP	III
	21SM	SRI MELAKA	2	71 (64)	AIR SALAK	1	67	SP	III
					SRI MELAKA	1	75	SP	III
	22	MELAKA	21	75 (74)	BTG.MELAKA	2	87	C	II
					DURIAN TUNGGAL	1	85	C	II
					KEMUNTING	1	84	C	II
					KERU	1	88	C	II
					MELAKA	9	70	SP	III
					PUTAT	2	59	P	III
					REMBIA	2	78	SP	II
					TAMPIN	3	88	C	II
	23	DUYONG	4	76.44 (76)	DUYONG	3	73	SP	III
					GAPAM	1	88	C	II
	24	KESANG	7	77.96 (76)	CHIN-CHIN	1	55	P	III
					CHOHONG	2	88	C	II
					KESANG	3	83	C	II
					TANGKAK	1	67	SP	III
JOHOR	26	BATU PAHAT	20	75 (72)	AMRAN	1	82	C	II
					BANTANG	1	94	C	I
					BATU PAHAT	1	55	P	III
					BEKOK	5	82	C	II
					BERLIAN	1	72	SP	III

Table 3.2 Malaysia : Water Quality Status of Slightly Polluted River Basin, 2007 (continued)

STATE	CODE	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
JOHOR					CHAAH	1	86	C	II
					LENIK	1	83	C	II
					MEREK	1	88	C	II
					MERPO	1	68	SP	III
					SEMBERONG	2	73	SP	III
					SIMPANG KANAN	2	57	P	III
					SIMPANG KIRI	3	66	SP	III
	27A	AIR BALOI	3	62.01 (62)	AIR BALOI	3	62	SP	III
	27B	BENUT	7	76.69 (76)	BENUT	4	76	SP	III
					PARIT HJ. YASSIN	1	85	C	II
					PINGGAN	1	65	SP	III
					ULU BENUT	1	82	C	II
	28A	PONTIAN BESAR	7	66.78 (69)	AIR HITAM	1	73	SP	III
					AYER MERAH	1	45	P	IV
					PONTIAN BESAR	5	70	SP	III
	28B	PONTIAN KECIL	2	73.65 (77)	PONTIAN KECIL	2	74	SP	III
	28C	SKUDAI	11	71.65 (63)	MELANA	2	68	SP	III
					SKUDAI	9	72	SP	III
	28E	KEMPAS	2	61.9 (60)	KEMPAS	2	62	SP	III
28G	RAMBAH	2	61.38 (80)	RAMBAH	2	61	SP	III	
29C	SANGLANG	1	61.82 (66)	SANGLANG	1	62	SP	III	
29D	PULAI	3	76.85 (68)	PULAI	2	83	C	II	
				ULU CHOHO	1	64	SP	III	
30B	SEDILI KECIL	6	77.76 (77)	ANAK SEDILI KECIL	1	74	SP	III	
				BAHAN	2	79	SP	II	
				SEDILI KECIL	3	80	SP	II	
30C	PALOI	1	80 (77)	PALOI	1	80	SP	II	
31C	KIM-KIM	2	67.78 (75)	KIM-KIM	2	68	SP	III	
TERENGGANU	39C	CHUKAI	6	74 (77)	BUNGKUS	1	79	SP	II
					CHUKAI	1	83	C	II
					IBOK	2	86	C	II
					RUANG	2	62	SP	III
	42L	MERCHANG	2	80.45 (78)	LANDAS	1	67	SP	III
					MERCHANG	1	80	SP	II
42M	MARANG	3	77.76 (82)	KERAK	1	70	SP	III	
				MARANG	1	86	C	II	
				TEMALA	1	84	C	II	
45	MERANG	1	78.69 (82)	MERANG	1	79	SP	II	
KELANTAN	48C	PENGKALAN CHEPA	5	70 (70)	ALOR B	1	54	P	III
					ALOR LINTAH	1	50	P	IV
					KELADI	1	83	C	II
					PENGKALAN CHEPA	2	79	SP	II
					RAJA GALI	1	76	SP	III
SARAWAK	65	SIBUTI	6	79 (80)	KABULOH	2	69	SP	III
					KEJAPIL	1	85	C	II
					SATAP	1	87	C	II

Table 3.2 Malaysia : Water Quality Status of Slightly Polluted River Basin, 2007 (continued)

STATE	CODE	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS				
SARAWAK	66	MIRI	7	70.56 (72)	SIBUTI	2	83	C	II				
					ADONG	1	62	SP	III				
					DALAM	1	72	SP	III				
					LUTONG	2	65	SP	III				
					MIRI	2	71	SP	III				
					PADANG LIKU	1	89	C	II				
					SABAH	76A	SEMBULAN	2	65.29 (66)	SEMBULAN	2	65	SP
76B	LIKAS		8	79.32 (78)	DARAU	1	74	SP	III				
					INANAM	3	85	C	II				
					LIKAS	2	66	SP	III				
					MENGGATAL	2	86	C	II				
					86	KINABATANGAN	10	80 (81)	KARAMUAK	1	86	C	II
									KINABATANGAN	2	82	C	II
									KOYAH	1	83	C	II
									LEEPANG	1	73	SP	III
MENANGGUL	1	84	C	II									
PIN	1	76	SP	III									
TAKALA	1	75	SP	III									
TENEGANG BESAR	2	82	C	II									
90	KALUMPANG	5	78.08 (77)	KALUMPANG	3	88	C	II					
				PANG BURONG 1	1	65	SP	III					
				PANG BURONG 2	1	61	SP	III					

- NOTE: 1. WQI BASED ON 6 MAJOR PARAMETERS: BOD, COD, SS, PH, DO, NH<sub>3</sub>-N  
 2. RIVER WATER QUALITY STATUS: C: CLEAN, SP: SLIGHTLY POLLUTED, P: POLLUTED  
 3. RIVER CLASS BASED ON INWQS  
 4. ( ) = Overall WQI for 2006  
 5. OVERALL WQI FOR RIVER BASIN IS CALCULATED BY AVERAGING WQI FROM ALL SAMPLING STATIONS IN EACH RIVER BASIN.



A clean river is nature's beauty (DOE Photo Library)

Table 3.3 Malaysia : Water Quality Status of Polluted River Basins, 2007

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
P.PINANG	06J	JURU	12	57.1 (54)	ARA	1	53	P	III
					JURU	2	51	P	IV
					KILANG UBI	5	66	SP	III
					PASIR	1	52	P	III
					PMTG RAWA	1	68	SP	III
	06PP	PINANG	11	50.4 (46)	RAMBAI	2	50	P	IV
					AIR ITAM	5	51	P	IV
					AIR TERJUN	1	92	C	II
					DONDANG	3	51	P	IV
					JELUTONG	1	34	P	IV
					PINANG	1	52	P	IV
MELAKA	24A	MERLIMAU	4	55 (64)	MERLIMAU	4	55	P	III
	JOHOR	28	SEGGET	5	48.8 (50)	SEGGET	5	49	P
28D		TEBRAU	11	59.1 (57)	BALA	1	58	P	III
					PANDAN	1	53	P	III
					PLENTONG	1	54	P	III
					SEBULUNG	1	60	SP	III
					SENGKUANG	1	45	P	IV
					TAMPOI	1	43	P	IV
					TEBRAU	5	62	SP	III
28F	DANGA	2	52.7 (51)	DANGA	2	53	P	III	
JOHOR	29B	KAW. PASIR GUDANG	5	40.2 (42)	BULUH	1	25	P	V
					LATOH	1	52	P	III
					MASAI	1	56	P	III
					PEREMBI	1	44	P	IV
					TUKANG BATU	1	24	P	V

- NOTE : 1. WQI BASED ON 6 MAJOR PARAMETERS: BOD, COD, SS, PH, DO, NH<sub>3</sub>-N  
2. RIVER WATER QUALITY STATUS: C: CLEAN, SP: SLIGHTLY POLLUTED, P: POLLUTED  
3. RIVER CLASS BASED ON INWQS  
4. ( ) = Overall WQI for 2006  
5. OVERALL WQI FOR RIVER BASIN IS CALCULATED BY AVERAGING WQI FROM ALL SAMPLING STATIONS IN EACH RIVER BASIN.

Table 3.4 Malaysia : Pollution Influx Observed at Continuous Water Quality Station

Station	Date	Parameter	Pollution Sources
Sg. Batang Benar	8-Jan-07	NH4 : 2.64 mg/l	Sewage or latex based industry or industrial discharge
Sg. Batang Benar	11-Jan-07	NH4 : 3.09 mg/l	Sewage or latex based industry or industrial discharge
Sg. Perai	19-Jan-07	NH4 : 10.54 mg/l	Sewage or industrial discharge
Sg. Batang Benar	9-Feb-07	NH4 : 3.97 mg/l	Sewage or latex based industry or industrial discharge
Sg. Langat	13-Feb-07	NH4 : 2.23 mg/l	Sewage or industrial discharge
Sg. Batang Benar	5-Mar-07	NH4 : 2.98mg/l	Sewage or latex based industry or industrial discharge
Sg. Labu	5-Mar-07	NH4 : 2.04 mg/l	Sewage or latex based industry or industrial discharge
Sg. Linggi	14-Mar-07	NH4 : 3.12 mg/l	Sewage or industrial discharge
Sg. Labu	14-Mar-07	NH4 : 2.39 mg/l	Sewage or latex based industry or industrial discharge
Sg. Batang Benar	14-Mar-07	NH4 : 4.36 mg/l	Sewage or latex based industry or industrial discharge
Sg. Labu	17-Mar-07	H4 : 2.40 mg/l	Sewage or latex based industry or industrial discharge
Sg. Keratong	19-Apr-07	NH4 : 1.98 mg/l	Sewage or industrial discharge
Sg. Batang Benar	29-Apr-07	NH4 : 5.39 mg/l	Sewage or latex based industry or industrial discharge
Sg. Batang Benar	30-Apr-07	NH4 : 3.96 mg/l	Sewage or latex based industry or industrial discharge
Sg. Batang Benar	8-May-07	NH4 : 4.47 mg/l	Sewage or latex based industry or industrial discharge
Sg. Batang Benar	8-May-07	pH : 8.37	Sewage or latex based industry or industrial discharge
Sg. Labu	14-May-07	NH4 : 2.30 mg/l	Sewage or latex based industry or industrial discharge
Sg. Batang Benar	28-May-07	pH : 9.58	Sewage or latex based industry or industrial discharge
Sg. Batang Benar	15-Jun-07	pH : 10.31	Sewage or latex based industry or industrial discharge
Sg. Labu	23-Jun-07	NH4 : 2.21 mg/l	Sewage or latex based industry or industrial discharge
Sg. Batang Benar	5-Jul-07	pH : 8.54	Sewage or latex based industry or industrial discharge
Sg. Labu	16-Jul-07	NH4 : 1.95 mg/l	Sewage or latex based industry or industrial discharge
Sg. Batang Benar	17-Jul-07	pH : 8.84	Sewage or latex based industry or industrial discharge
Sg. Melaka	21-Jul-07	pH : 9.09	Sewage or latex based industry
Sg. Batang Benar	21-Jul-07	pH : 10.35	Sewage or latex based industry or industrial discharge
Sg. Batang Benar	11-Aug-07	NH4 : 3.74 mg/l	Sewage or latex based industry or industrial discharge
Sg. Batang Benar	13-Aug-07	NH4 : 3.49 mg/l	Sewage or latex based industry or industrial discharge
Sg. Batang Benar	15-Aug-07	NH4 : 3.37 mg/l	Sewage or latex based industry or industrial discharge
Sg. Melaka	17-Aug-07	pH : 8.05	Sewage or latex based industry
Sg. Batang Benar	23-Aug-07	NH4 : 3.65 mg/l	Sewage or latex based industry or industrial discharge
Sg. Batang Benar	27-Aug-07	pH : 9.64	Sewage or latex based industry or industrial discharge
Sg. Melaka	28-Aug-07	pH : 7.97	Sewage or latex based industry
Sg. Batang Benar	2-Sep-07	NH4 : 1.97 mg/l	Sewage or latex based industry or industrial discharge
Sg. Melaka	8-Sep-07	pH : 7.14	Sewage or latex based industry
Sg. Batang Benar	10-Sep-07	pH : 8.44	Sewage or latex based industry or industrial discharge
Sg. Melaka	12-Sep-07	pH : 6.98	Sewage or latex based industry
Sg. Batang Benar	14-Sep-07	NH4 : 1.43 mg/l	Sewage or latex based industry or industrial discharge
Sg. Melaka	21-Sep-07	pH : 7.17	Sewage or latex based industry
Sg. Batang Benar	21-Sep-07	pH : 3.81	Sewage or latex based industry or industrial discharge
Sg. Batang Benar	5-Oct-07	pH : 8.91	Sewage or latex based industry or industrial discharge
Sg. Batang Benar	6-Oct-07	pH : 8.15	Sewage or latex based industry or industrial discharge
Sg. Melaka	9-Oct-07	pH : 7.95	Sewage or latex based industry
Sg. Batang Benar	24-Oct-07	pH : 4.42	Sewage or latex based industry or industrial discharge
Sg. Batang Benar	26-Oct-07	pH : 3.58	Sewage or latex based industry or industrial discharge
Sg. Batang Benar	27-Oct-07	NH4 : 4.74 mg/l	Sewage or latex based industry or industrial discharge
Sg. Batang Benar	7-Nov-07	pH : 9.82	Sewage or latex based industry or industrial discharge
Sg. Melaka	16-Nov-07	pH : 7.10	Sewage or latex based industry
Sg. Labu	5-Dec-07	NH4 : 1.94 mg/l	Sewage or latex based industry or industrial discharge
Sg. Batang Benar	11-Dec-07	pH : 8.70	Sewage or latex based industry or industrial discharge
Sg. Batang Benar	13-Dec-07	pH : 9.11	Sewage or latex based industry or industrial discharge
Sg. Batang Benar	24-Dec-07	NH4 : 3.03mg/l	Sewage or latex based industry or industrial discharge

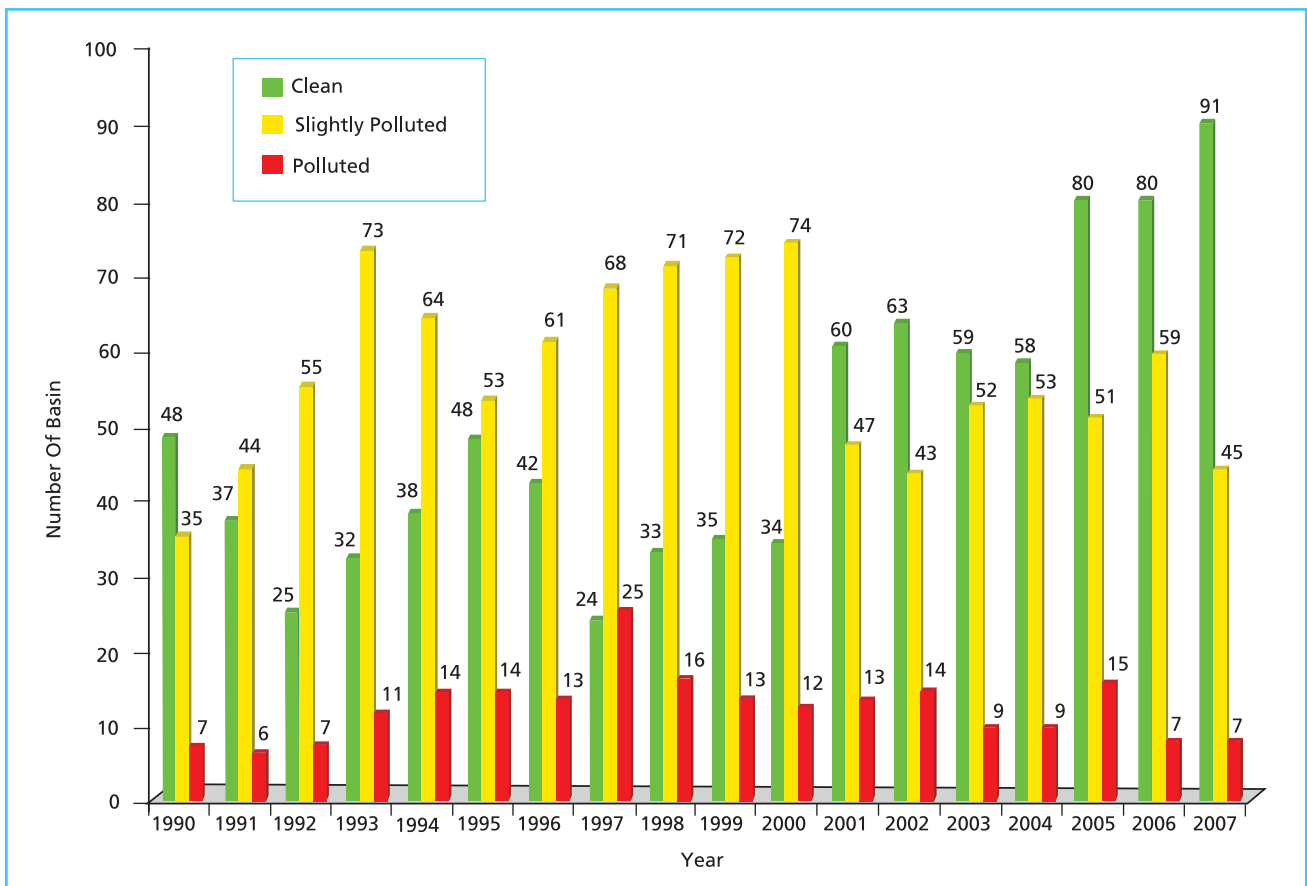


Figure 3.1 Malaysia : River Basins Water Quality Trend (1990 - 2007)

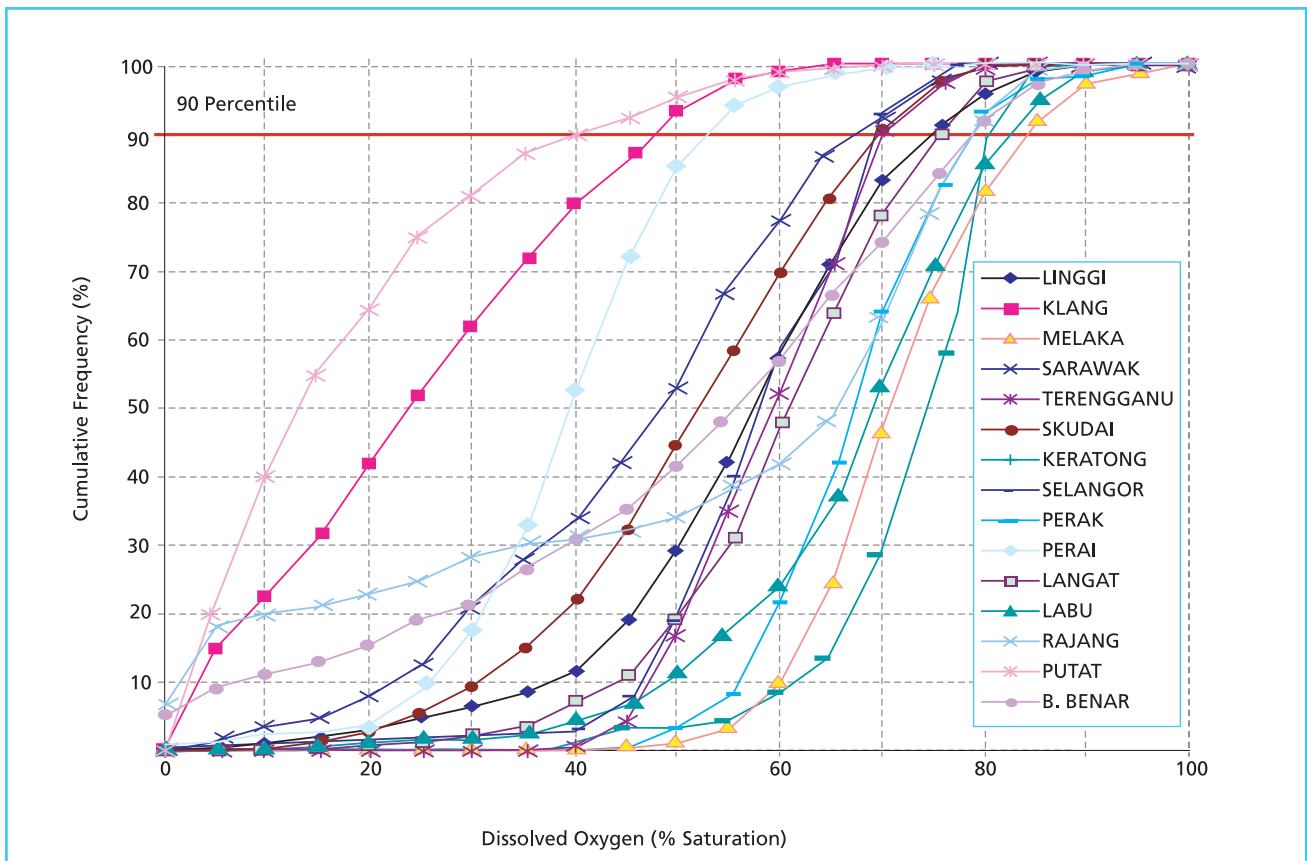


Figure 3.2 : Comparison of Cumulative Frequency for 15 CWQM Stations - Dissolved Oxygen : 1st January - 31st December 2007

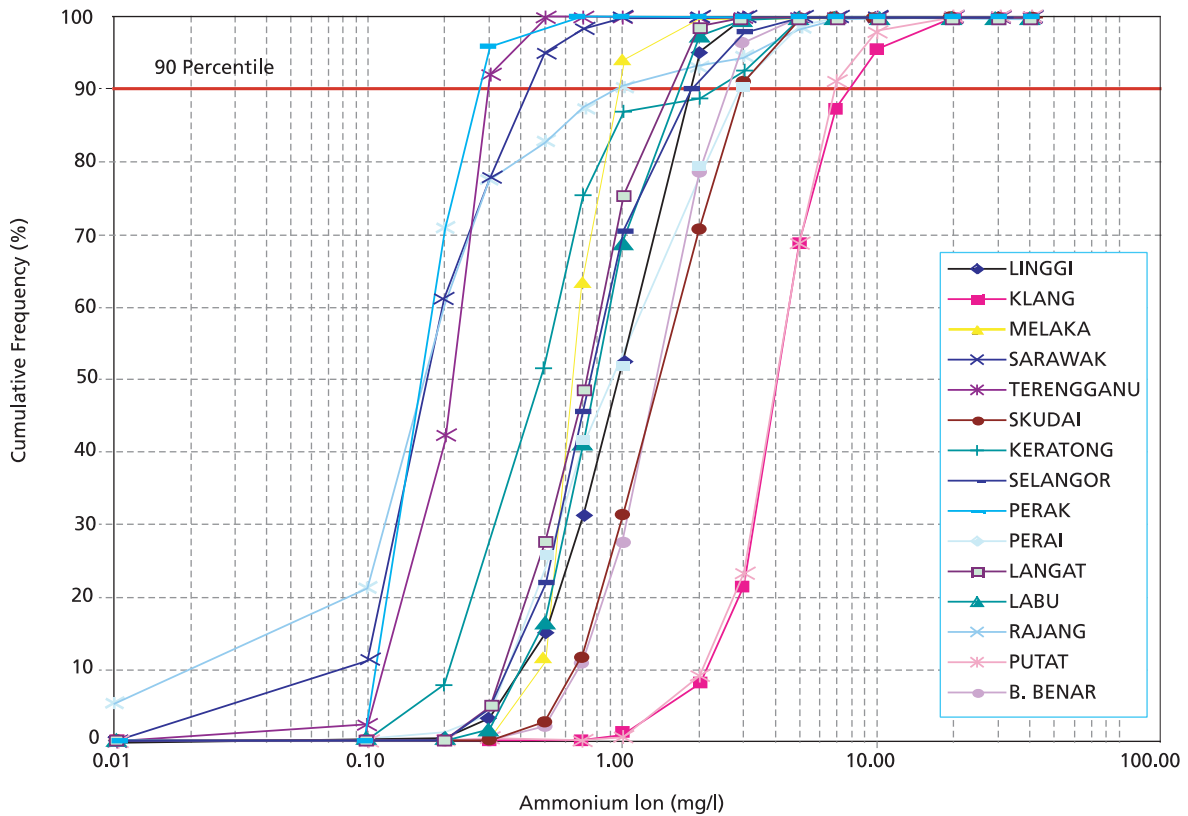


Figure 3.3: Comparison of Cumulative Frequency for 15 CWQM Stations - Ammonium Ion Concentration : 1st January - 31st December 2007

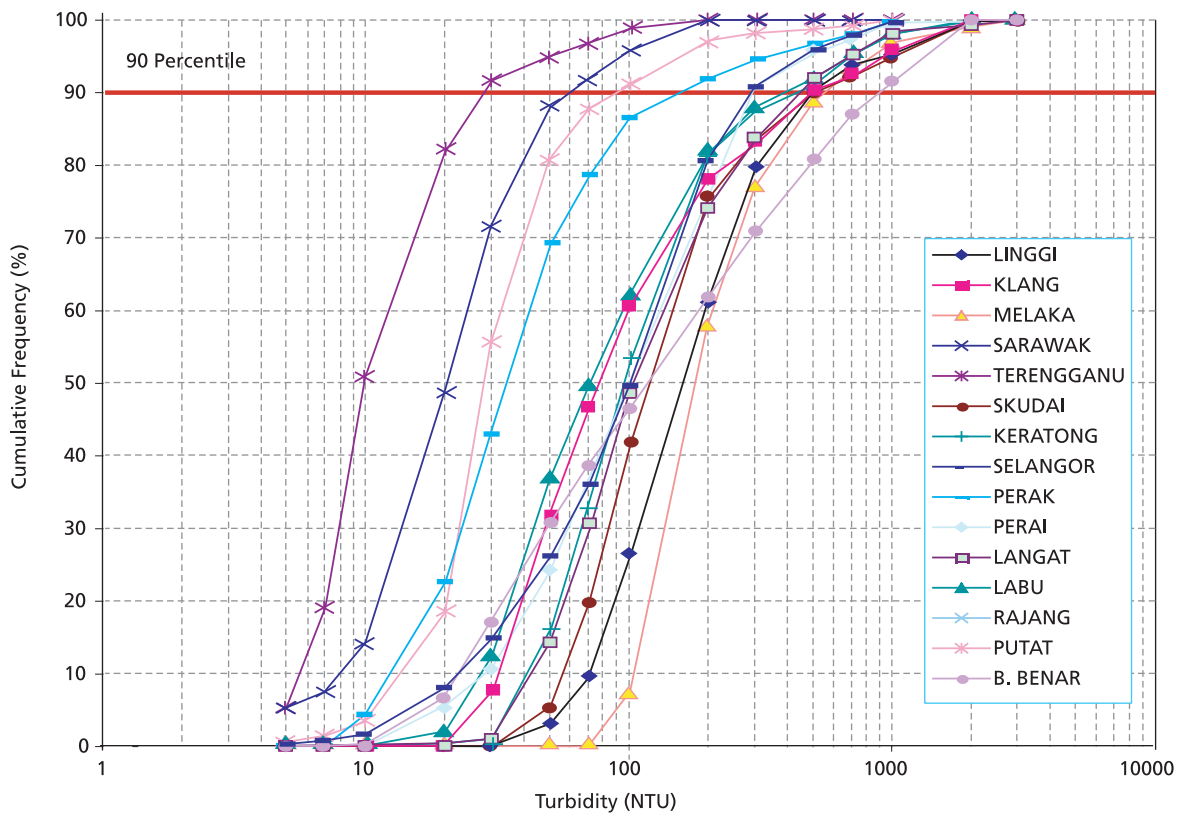


Figure 3.4: Comparison of Cumulative Frequency for 15 CWQM Stations - Turbidity : 1st January - 31 December 2007

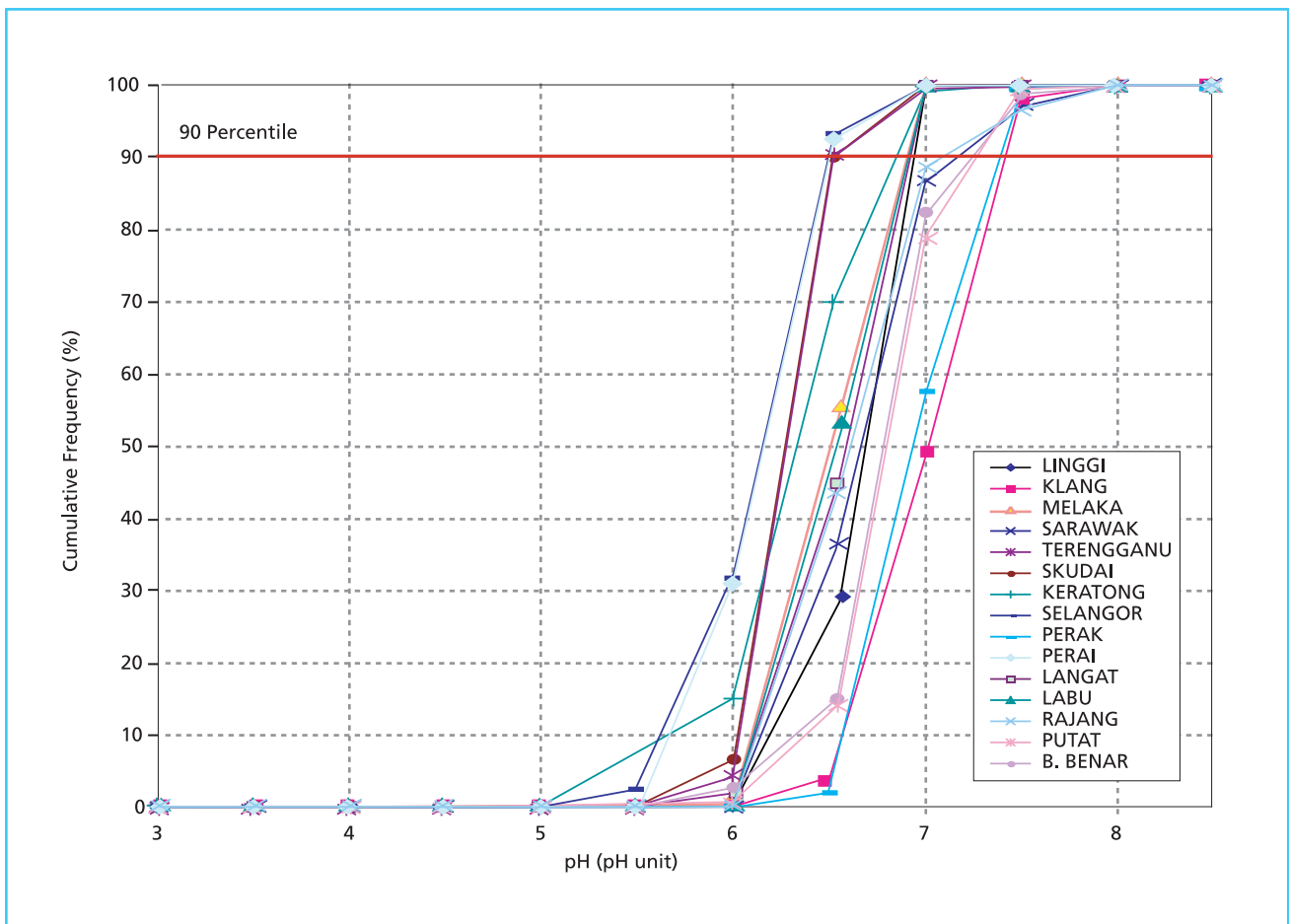


Figure 3.5: Comparison of Cumulative Frequency for 15 CWQM Stations - pH Level : 1st January - 31st December 2007

### RIVER WATER POLLUTION SOURCES

Figures 3.6, 3.7 and 3.8 show the status of river water quality in terms of BOD, NH<sub>3</sub>-N and SS. Based on BOD level, 12 river basins were categorized as polluted, 37 river basins as slightly polluted and 9 river basins as clean (Figure 3.6). Based on NH<sub>3</sub>-N, 36 river basins were categorized as polluted, 59 river basins as slightly polluted and 48 river basins as clean (Figure 3.7). Meanwhile, 42 river basins were categorized as polluted by SS, 39 river basins as slightly polluted and 62 river basins as clean (Figure 3.8).

Water samples were also analysed for heavy metals. From the 5,618 water samples analysed, almost all samples complied with Class III of the National Water Quality Standards for arsenic (As), mercury (Hg), cadmium (Cd), chromium (Cr), lead (Pb) and zinc (Zn), except iron (Fe) where the compliance was 86 percent.



Clean River : Freshwater Prawn Catch (DOE Photo Library)

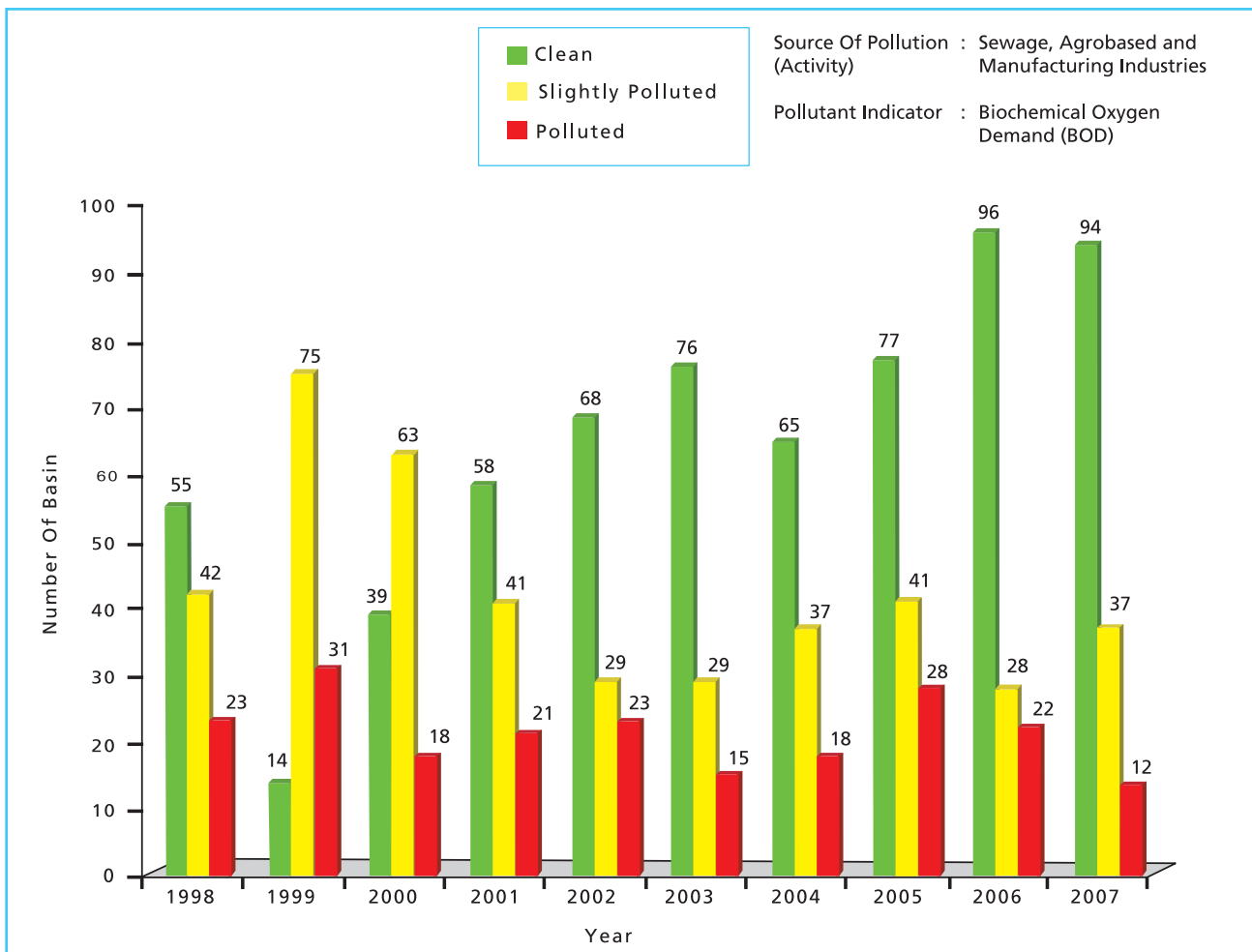


Figure 3.6 Malaysia : River Basins Water Quality Trend based on BOD Subindex (1998 - 2007)

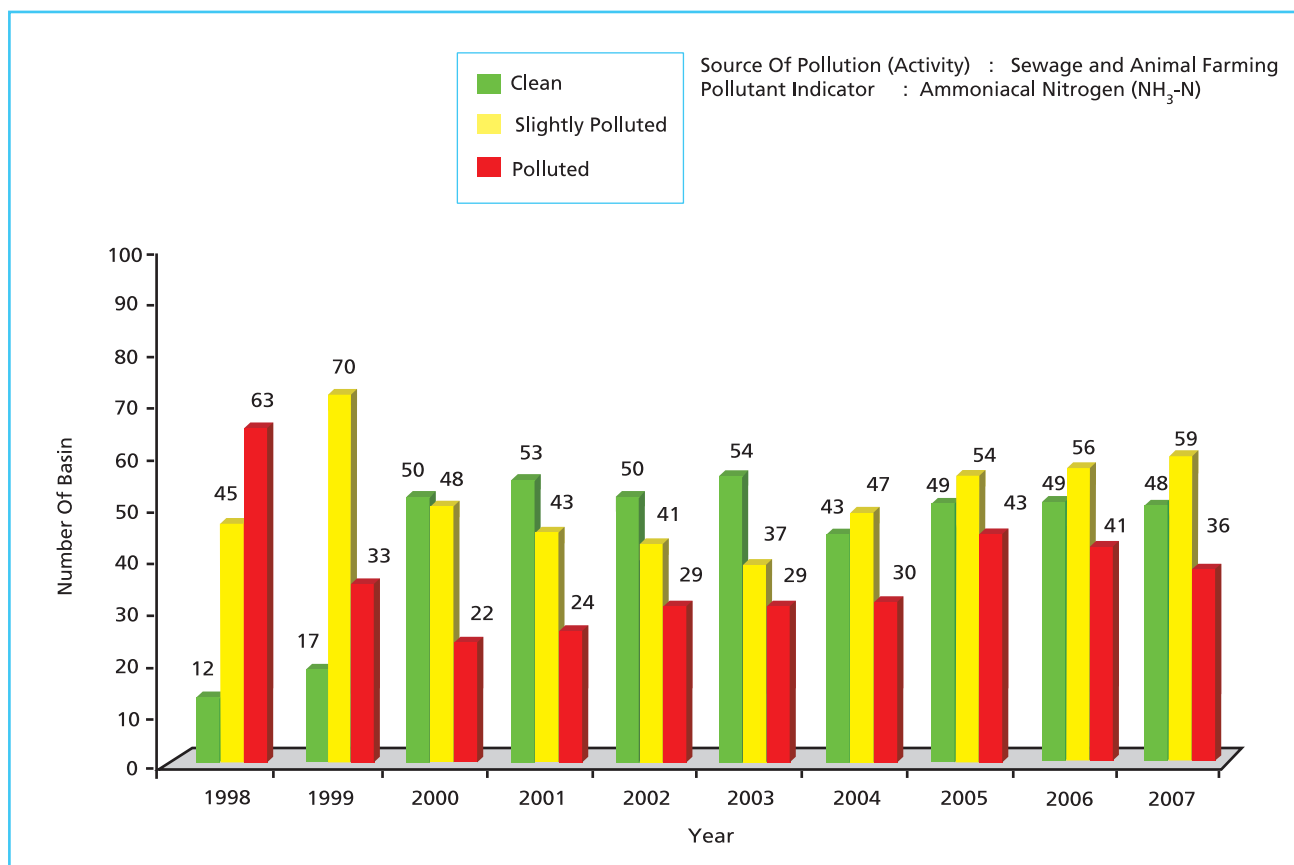


Figure 3.7 : River Basins Water Quality Trend Based on NH<sub>3</sub>-N Subindex (1998 - 2007)

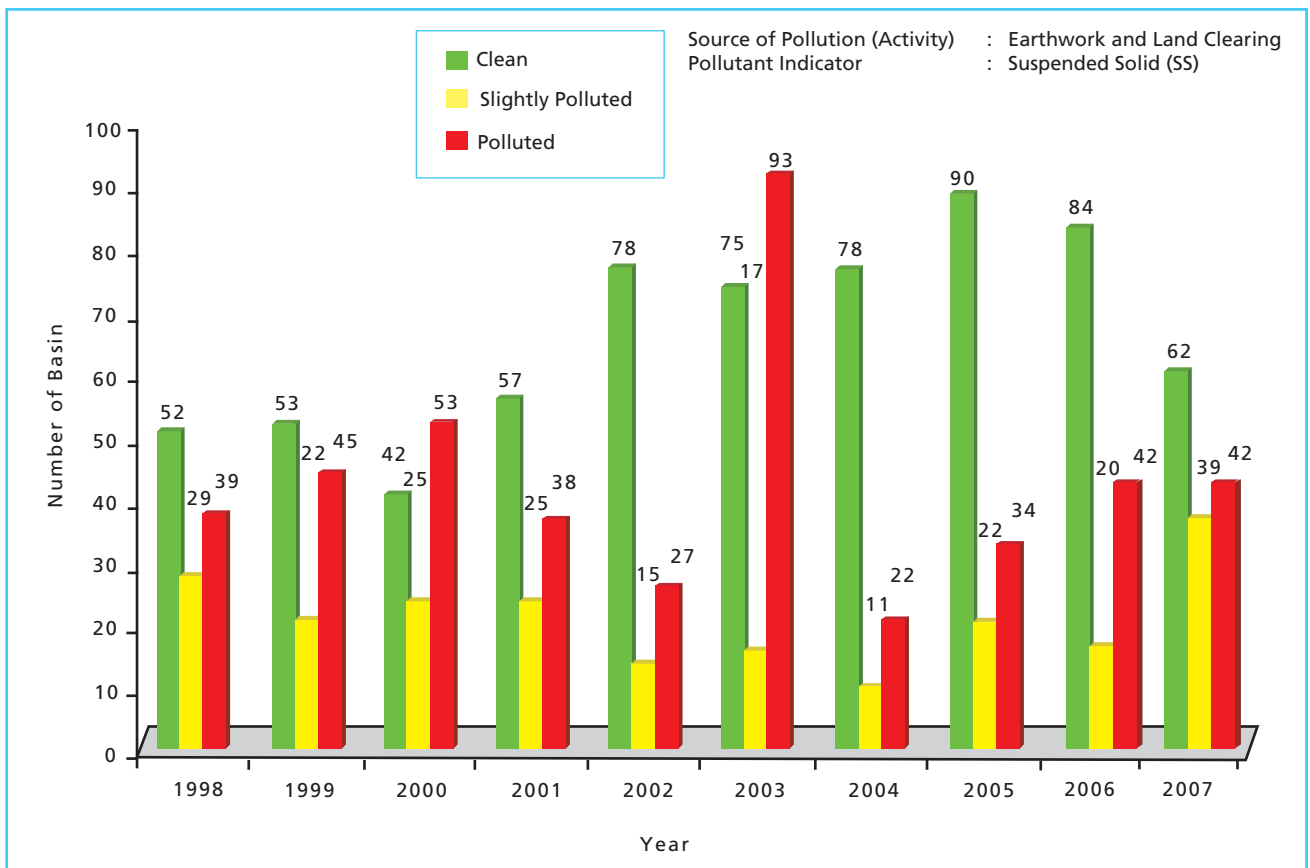


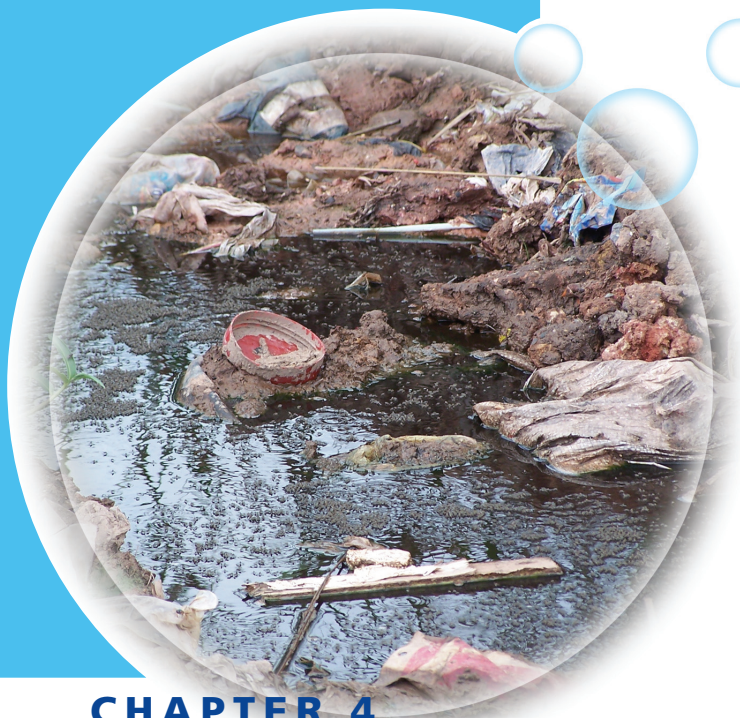
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# CHAPTER 4

# GROUNDWATER QUALITY



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## CHAPTER 4 GROUNDWATER QUALITY

### GROUNDWATER QUALITY MONITORING

Groundwater quality monitoring was carried out using 88 monitoring wells in Peninsular Malaysia, 19 wells in Sarawak and 15 wells in Sabah (**Table 4.1**) as part of the National Groundwater Monitoring Programme that was initiated in 1997. The sites selected were according to the land use such as agricultural, urban/suburban, rural and industrial and special interests sites such as solid waste landfills, golf courses, radioactive landfill, animal burial areas, municipal water supply and ex-mining (gold mine).

### GROUNDWATER QUALITY STATUS

In 2007, 303 water samples were taken from these monitoring wells and analysed for volatile organic compounds (VOCs), pesticides, heavy metals, anions, bacteria (coliform), phenolic compounds, radioactivity (Gross Alpha and Beta), total hardness, total dissolved solids (TDS), pH, temperature, conductivity and dissolved oxygen (DO). The results were then compared with the National Guidelines For Raw Drinking Water

Table 4.1 Malaysia : Distribution of Groundwater Monitoring Wells, 2007

Category	Number of Wells
Agricultural Areas	12
Urban/Suburban Areas	12
Industrial Sites	18
Solid Waste Landfills	27
Golf Courses	7
Radioactive Landfill	1
Rural Areas	5
Ex-mining Areas (Gold Mine)	3
Municipal Water Supply	11
Animal Burial Areas	16
Aquaculture Farms	9
Resorts	1
<b>Total</b>	<b>122</b>

Quality established by the Ministry of Health (Revised December 2000) (**Table 4.2**) to determine the status of its quality.

From the monitoring results it was found that arsenic (As), iron (Fe), manganese (Mn), total coliform and phenol recorded the most number of samples in all categories of land use exceeding the guideline values. The least number of samples exceeding the guideline values were mercury (Hg), cadmium (Cd), copper (Cu), zinc (Zn), nitrate and sulphate. **Figure 4.1** shows the percentage of the samples exceeding the guideline values for all the parameters monitored.

Table 4.2 Malaysia : National Guidelines for Raw Drinking Water Quality (Revised December 2000)

Parameter	Symbol	Benchmark
Sulphate	SO <sub>4</sub>	250 mg/l
Hardness	CaCO <sub>3</sub>	500 mg/l
Nitrate	NO <sub>3</sub>	10 mg/l
Coliform	-	Must not be detected in any 100 ml sample
Manganese	Mn	0.1 mg/l
Chromium	Cr	0.05 mg/l
Zinc	Zn	3 mg/l
Arsenic	As	0.01 mg/l
Selenium	Se	0.01 mg/l
Chloride	Cl	250 mg/l
Phenolics	-	0.002 mg/l
TDS	-	1000 mg/l
Iron	Fe	0.3 mg/l
Copper	Cu	1.0 mg/l
Lead	Pb	0.01 mg/l
Cadmium	Cd	0.003 mg/l
Mercury	Hg	0.001 mg/l

Source: Ministry of Health, Malaysia



Contamination of groundwater : Untreated leachate (DOE Photo Library)

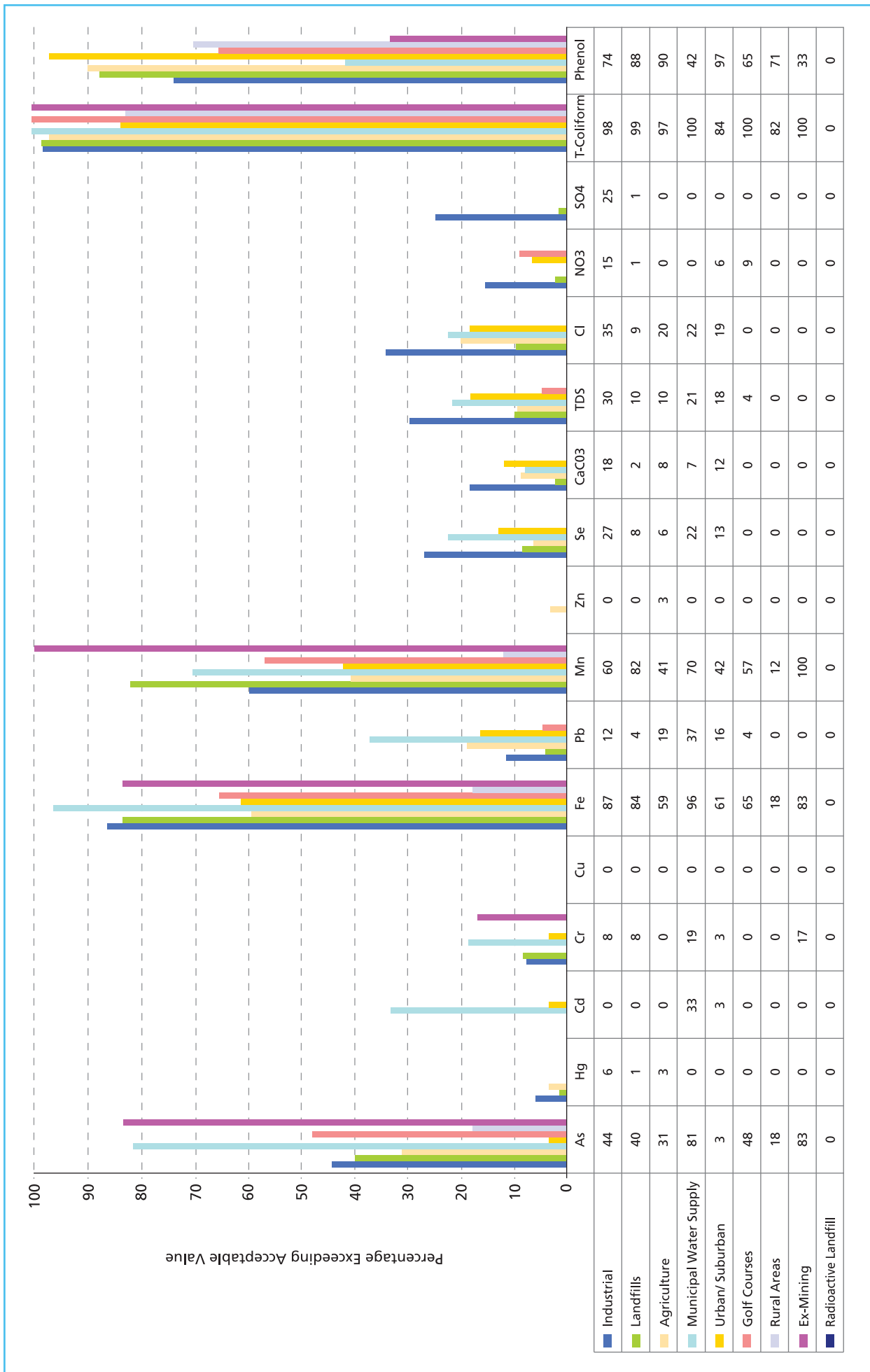


Figure 4.1 Malaysia : Percentage of Non Compliance of Selected Contaminants by Land Use, 2007

# CHAPTER 5

# MARINE AND ISLAND

# MARINE WATER QUALITY

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## CHAPTER 5

# MARINE AND ISLAND MARINE WATER QUALITY

### MARINE WATER QUALITY MONITORING

The Department of Environment (DOE) continues with the marine water quality monitoring programme that was started in 1978 for Peninsular Malaysia and in 1985 for Sabah and Sarawak. Marine water quality monitoring plays an important role in determining the

degree of pollution from land-based sources as well as from the sea that can pose threats to the marine resources which contribute to the stability and diversity of the marine ecosystem.

The marine water quality monitoring programme included in-situ measurements and laboratory analyses for parameters as listed in **Table 5.1**. The Interim Marine Water Quality Standards (IMWQS) are as shown in **Table 5.2**.

### MARINE WATER QUALITY STATUS

In 2007 a total of 1008 samples from 233 monitoring stations were collected for analysis as shown in **Table 5.3**. The most number of samples that exceeded the Interim Marine Water Quality Standards (IMWQS) were total suspended solids (56.9%), followed by *Escherichia coli* (*E.coli*) (44.1%) and oil and grease (43.6%). **Figure 5.1** shows the trend of marine water quality contaminants from 2005 to 2007. There was an improvement compared to 2006 for total suspended solids and *E.coli* but slight deterioration for oil and grease. As for heavy metals there was an increase in the number of samples exceeding IMWQS for copper, lead and cadmium and a decrease for mercury, arsenic and total chromium as compared to the previous year.

Total suspended solids remained a significant contaminant of our marine water. In Negeri Sembilan all the samples collected exceeded the IMWQS whilst Pahang has the least number of samples (6%) exceeding the standards (**Table 5.3**).

Table 5.1 Malaysia: Marine Environmental Quality Parameters

In-situ Measurement	Unit	Parameter (Laboratory Analysis)	Unit
Temperature	°C	<i>Escherichia coli</i> ( <i>E. coli</i> )	MPN/100ml
pH	-	Oil and grease (O & G)	mg/l
Dissolved oxygen	% Sat	Total suspended solids (TSS)	mg/l
Dissolved oxygen	Mg/l	Arsenic (As)	mg/l
Conductivity	µS/cm	Cadmium (Cd)	mg/l
Salinity	ppt	Total chromium (Cr)	mg/l
Turbidity	NTU	Copper (Cu)	mg/l
Tarball	g/100m	Lead (Pb)	mg/l
		Mercury (Hg)	mg/l

Table 5.2 Malaysia: Interim Marine Water Quality Standards

Parameter (Laboratory Analysis)	Unit	Standards
<i>Escherichia coli</i> ( <i>E. coli</i> )	MPN/100ml	100
Oil and grease (O & G)	mg/l	0
Total suspended solids (TSS)	mg/l	50
Arsenic (As)	mg/l	0.1
Cadmium (Cd)	mg/l	0.1
Total chromium (Cr)	mg/l	0.5
Copper (Cu)	mg/l	0.1
Lead (Pb)	mg/l	0.1
Mercury (Hg)	mg/l	0.001

Table 5.3 Malaysia: Status of Marine Water Quality Parameters Exceeding Standards (%), 2007

Parameter Exceeding Interim Standards (%)											
State	No. of Station	No of Sample	Total Suspended Solids	Oil and Grease	<i>Escherichia coli</i>	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury
Perlis	2	20	88	31	100	0	0	0	0	6	13
Pulau Langkawi	7	35	46	40	26	0	0	0	0	0	23
Kedah	3	12	33	8	22	0	0	0	0	0	8
Pulau Pinang	25	160	28	40	49	0	0	1	2	6	9
Perak	13	66	66	82	48	0	7	7	28	24	0
Selangor	14	67	91	63	54	0	0	0	0	0	14
N. Sembilan	13	52	100	58	50	0	0	0	0	0	2
Melaka	9	54	94	NA	65	NA	0	NA	0	0	NA
Johor	51	155	56	15	55	0	0	0	34	2	3
Pahang	11	80	6	83	31	0	0	0	0	48	14
Terengganu	19	76	45	59	36	0	41	0	25	80	13
Kelantan	10	40	73	88	45	0	20	0	0	68	0
W.P. Labuan	5	23	23	0	54	NA	0	0	0	69	NA
Sabah	26	78	22	0	5	0	0	0	12	40	0
Sarawak	25	90	84	43	22	0	0	0	0	20	12
<b>Malaysia (Sum)</b>	<b>233</b>	<b>1008</b>	<b>TSS</b>	<b>O &amp; G</b>	<b><i>E.coli</i></b>	<b>As</b>	<b>Cd</b>	<b>Cr</b>	<b>Cu</b>	<b>Pb</b>	<b>Hg</b>
<b>Average (%)</b>			<b>56.9</b>	<b>43.6</b>	<b>44.1</b>	<b>0.0</b>	<b>4.5</b>	<b>0.6</b>	<b>6.7</b>	<b>24.2</b>	<b>8.5</b>

Note : NA = Not available

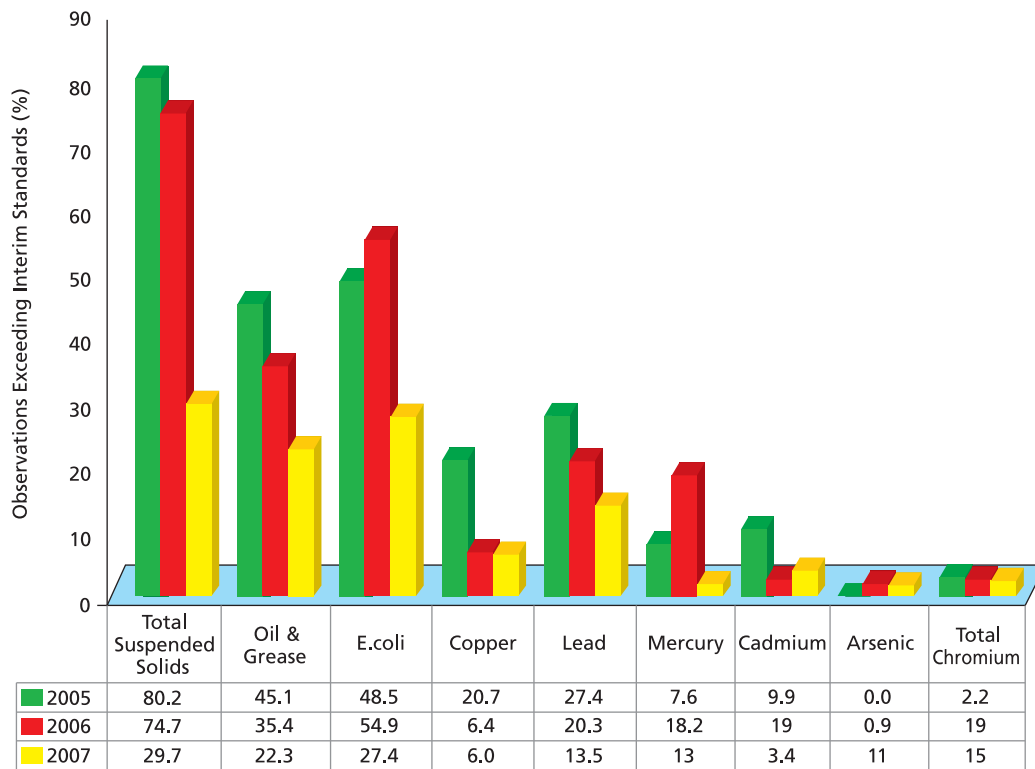


Figure 5.1 Malaysia : Marine Water Quality Status, 2005 - 2007

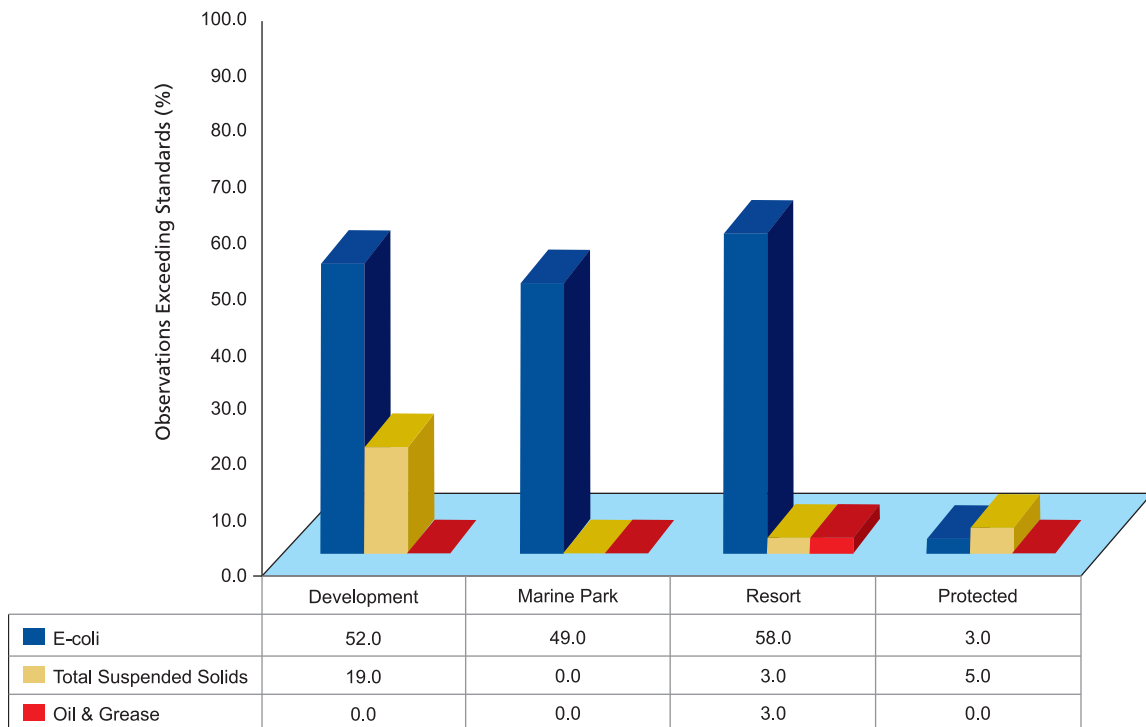


Figure 5.2 Malaysia : Island Marine Water Quality Status, 2007

For oil and grease contamination, Kelantan recorded the highest percentage (88%) exceeding the IMWQS, whilst Sabah and Labuan were free from oil and grease contamination. *E. coli* contamination recorded was highest in Perlis (100%) and lowest in Sabah (5%).

Lead was the most prominent heavy metal detected in the marine waters with 24.2 percent exceeding the IMWQS, followed by mercury (8.5%), copper (6.7%), cadmium (4.5%) and chromium (0.6%). All samples collected show that arsenic levels were below the IMWQS.

Total suspended solids in the marine waters can be attributed to land-based activities such as uncontrolled land clearing for development and agriculture activities as well as coastal development. The main sources of *E. coli* were untreated or partially treated animal and domestic wastes and also uncontrolled sewage from coastal premises including hotels and restaurants. The presence of oil and grease in the coastal waters were from discharges by shipping vessels and leakages and disposal of engine oil by boat operators. As for heavy metals they were mainly land-based uncontrolled industrial discharges.

## ISLAND MARINE WATER QUALITY STATUS

The waters around 71 islands were monitored in 2007. The islands monitored were categorised as development islands (3 islands), resort islands (25 islands), marine park

islands (38 islands) and protected islands (5 islands). A total of 344 samples were collected and analysed. The main pollutants analysed were total suspended solids, *E. coli* and oil and grease.

*E. coli* recorded the highest number of samples that exceeded the IMWQS in all the islands monitored. In development islands 72.2 percent exceeded the interim standards followed by resort islands 55.8 percent, marine parks 29.9 percent and protected islands 15.0 percent. In terms of total suspended solids, development islands and protected islands recorded total suspended solids exceeding the standards by 26.4 and 25.0 percent respectively while in marine parks all the samples were within the interim standards. All islands monitored were free of oil and grease pollution except resort islands, where 2.9 percent of the samples exceeded the standards (**Figure 5.2**).

As shown in **Figure 5.3**, *E. coli* contamination was highest in Pulau Pinang island marine waters where 86.4 percent of the samples exceeded the standard of 100 MPN/100 ml whilst Sarawak has the lowest where 8.3 percent of samples exceeding the standards. As for total suspended solids again Pulau Pinang recorded the highest samples exceeding the standard at 25.0 percent. However, total suspended solids for islands in Selangor, Johor, Perak, Pahang, Terengganu, Sarawak and Sabah were in compliance. Oil and grease in all States were within the IMWQS except Pulau Pinang where 6.8 percent of samples monitored exceeded the interim standards.



Clean Marine Water : Abundance of Aquatic Life (DOE Photo Library)

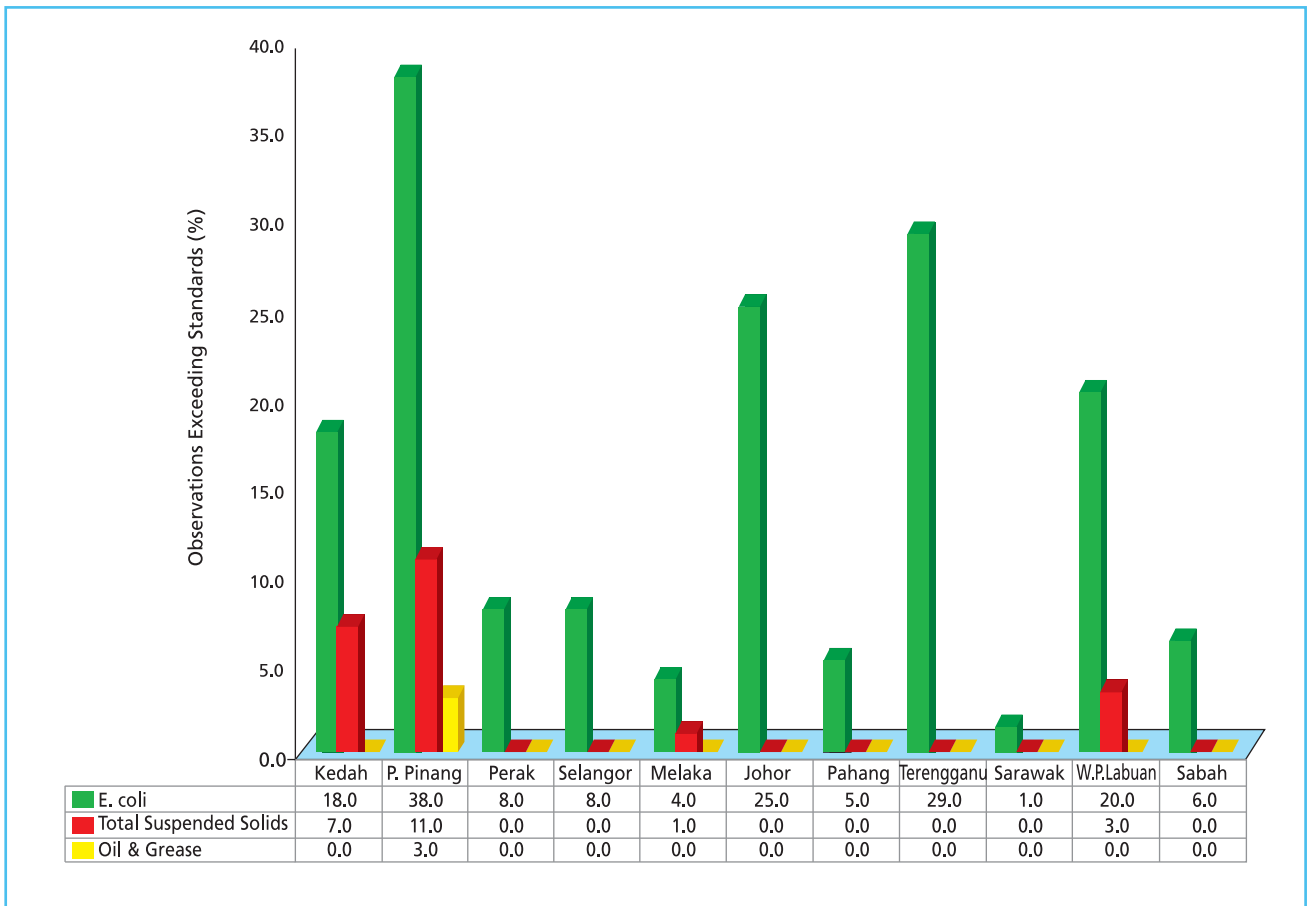


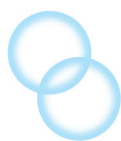
Figure 5.3 Malaysia : Status of Island Marine Water Quality by State, 2007

## TARBALL MONITORING

Tarball residues on beaches are usually caused by oily discharges from fishing boats as well as passing vessels. In 2007 it was found that all the 133 monitoring stations were free from tarball pollution.



Unpolluted Coastal Area : Fishing Activity (DOE Photo Library)



## CHAPTER 6

# POLLUTION SOURCES INVENTORY



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## WATER POLLUTION SOURCES

The sources of water pollution can be categorized as point and non-point sources. Point sources include sewage treatment plants, manufacturing and agro-based industries and animal farms. Non-point sources are mainly diffused sources such as agricultural activities and surface runoffs.

The Department of Environment (DOE) maintains mainly records of point sources. In 2007, 19,320 water pollution point sources were recorded. These comprise sewage treatment plants (9,337: 48.3% inclusive of 640 Network Pump Stations), manufacturing industries (8,708: 45.1%), animal farms (779: 4.0%) and agro-based industries (485: 2.5%) as shown in **Figure 6.1**.

The DOE compiles statistics of industrial water pollution sources from agro-based and manufacturing industries through field surveys and questionnaires. **Figure 6.2** shows the distribution of these sources in 2007. A total of 9,204 sources were identified with Selangor having the highest number of water pollution sources (1,956: 21.25%).

Data from the Veterinary Department of Malaysia shows that there were 1.74 million standing pig population in

## CHAPTER 6

# POLLUTION SOURCES INVENTORY

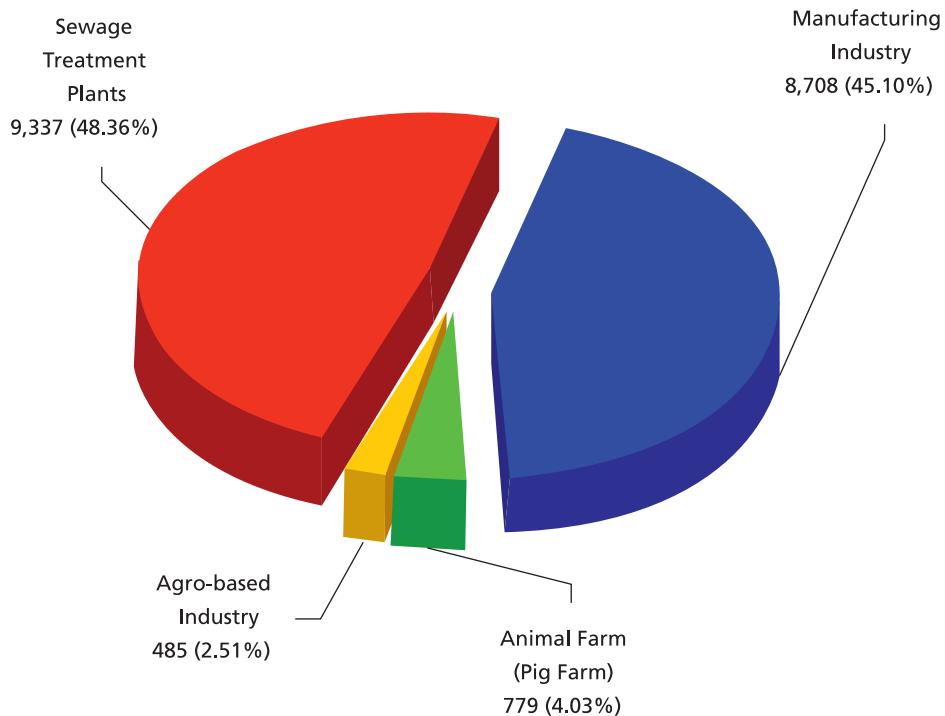


Figure 6.1 Malaysia : Composition of Water Pollution Sources by Sector, 2007



Controlled hill farming : Tea Plantation (DOE Photo Library)

2007. This was an increase of 4.2 percent compared to 2006 where the standing pig population was 1.67 million. However, the number of pig farms decreased from 869 in the previous year to 779 farms in 2007.

Indah Water Konsortium Sdn. Bhd. (IWK) managed sewage treatment plants only in Peninsular Malaysia

and Labuan. The number of sewage treatment plants under the management of IWK increased from 9,060 plants in 2006 to 9,337 in 2007. Selangor had the largest number of sewage treatment plants (2,649: 28.4%), followed by Perak (1,398: 15.0%), Johor (1,038: 11.1%) and Negeri Sembilan (937: 10.0%) (**Figure 6.3**).

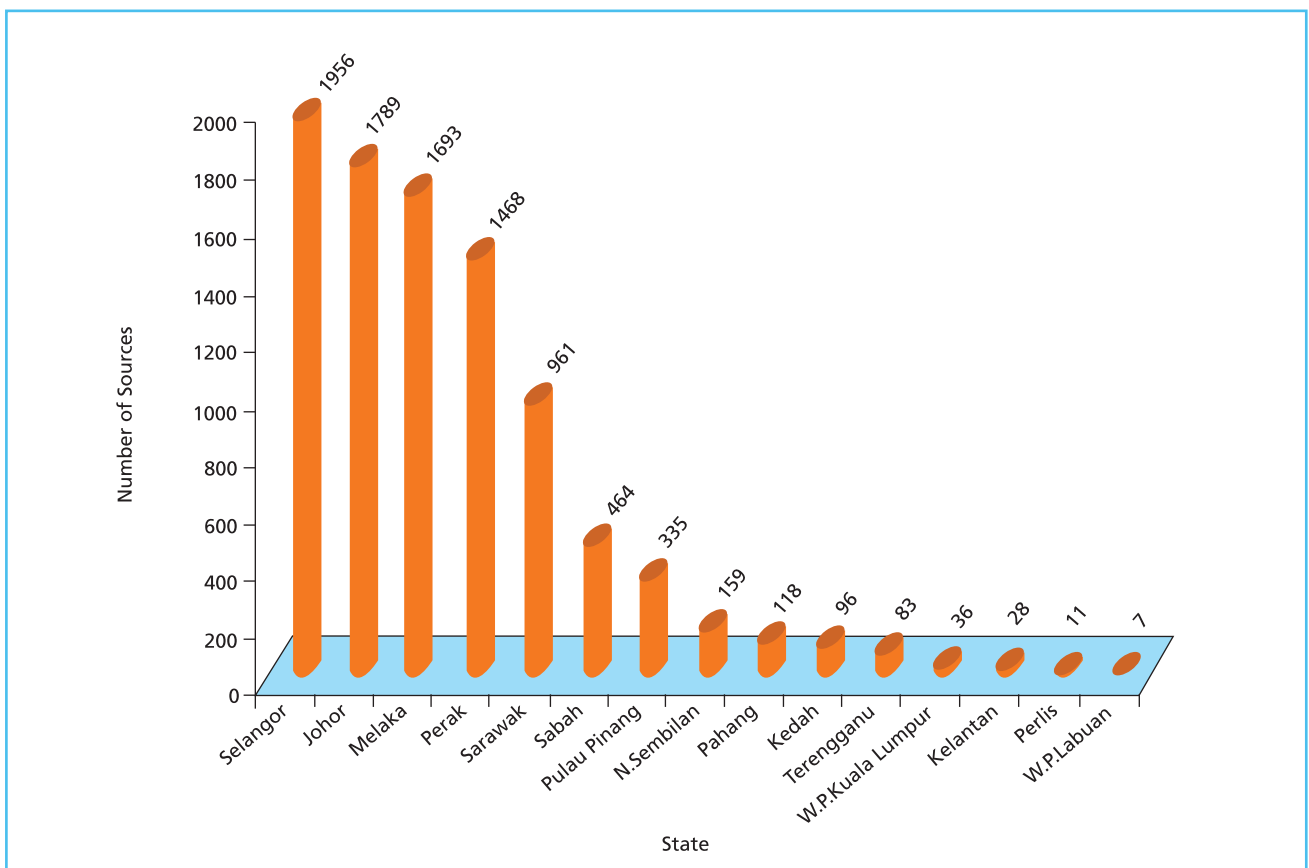


Figure 6.2 Malaysia : Distribution of Industrial Water Pollution Sources (Agro-based and Manufacturing Industries) by State, 2007

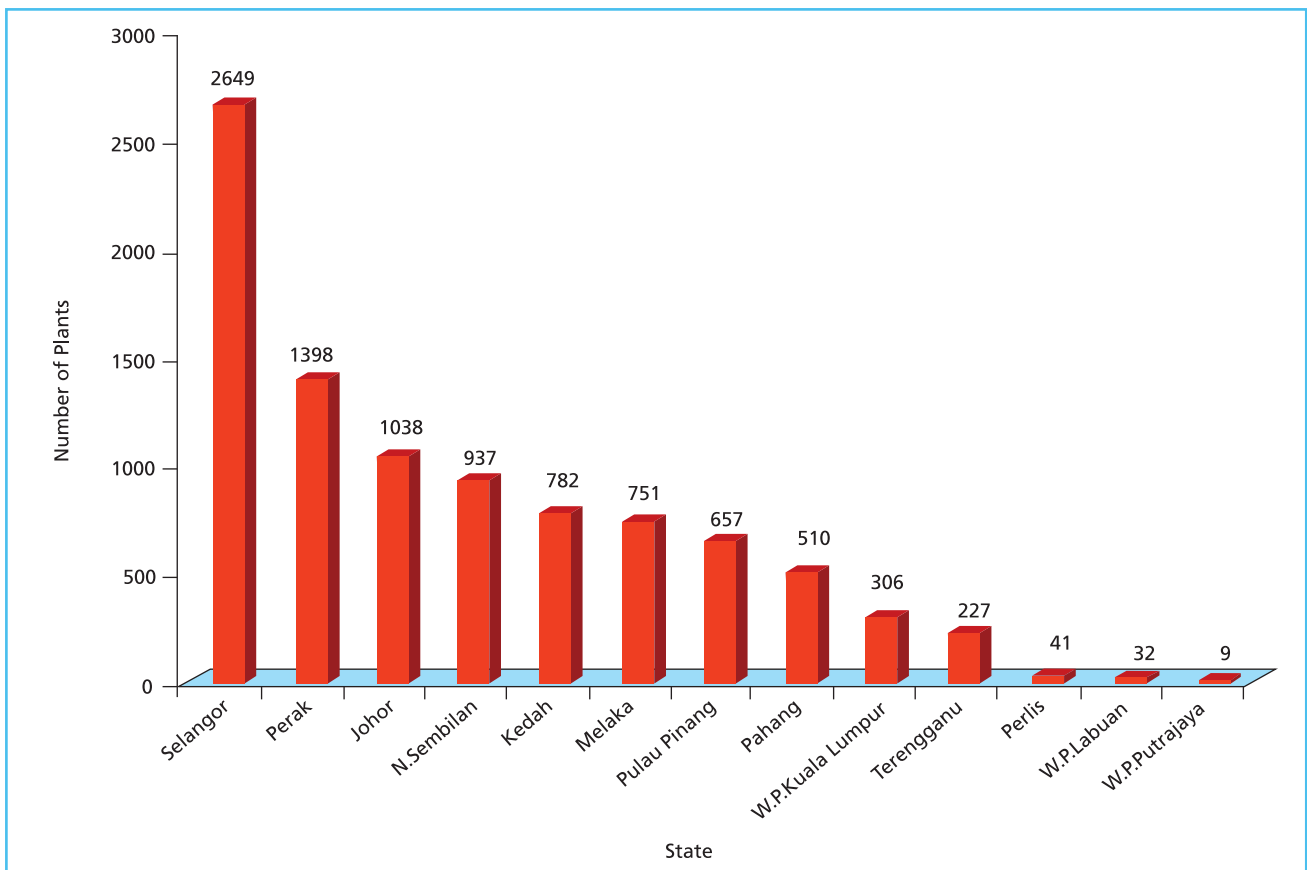


Figure 6.3 Malaysia : Distribution of Sewage Treatment Plants by State, 2007  
Source : IWK Sdn. Bhd

## BOD LOAD

In terms of BOD load, domestic treated and partially treated sewage remained the largest contributor with an estimated load of 941,934.27 kg/day. The other major contributors were pig farming (223,062 .kg/day) and agro-based and manufacturing industries (81,596.83 kg/day).

**Table 6.1** shows the total BOD load in kg/day discharged from sewage treatment plants in the states managed by IWK in 2007.

## SOURCES OF AIR POLLUTION

The main sources of air pollution in the country are generally from the following:

- Industries (including power stations)
- Motor vehicles
- Open burning

In 2007 a total of 13,443 industrial sources were identified to be subjected to the Environmental Quality (Clean Air) Regulations 1978 (**Figure 6.4**). The highest number of stationary pollution sources was in Selangor (2,943: 21.9%) followed by Johor (2,693: 20.0%) and Sarawak (2,015: 14.9%).

The other major contributor of air pollution especially in urban areas was motor vehicles that include passenger cars, taxis, buses, motorcycles, vans and lorries. In 2007 there was an overall increase in the number of motor vehicles registered. The number of registered passenger cars increased by 6.9 percent, motorcycles by 6.4 percent, goods vehicles by 4.4 percent, buses by 5.6 percent and taxis by 2.5 percent in 2007 compared to 2006. The number of registered vehicles in Malaysia for the year 2006 and 2007 is shown in **Figure 6.5**. As to the number of in-use or active taxis there was a marked increase by 420 percent, goods vehicles by 103 percent, buses by 35 percent, passenger cars by 10.8 percent and motorcycles by 6.4 percent (**Figure 6.6**).

Table 6.1 Malaysia : Total BOD Load (kg/day) from Sewage Treatment Plants

State	No. of STP	Total PE	Flow (m <sup>3</sup> /day)	BOD Load (kg/day)
Selangor	2,649	6,366,224	1,432,400	358,100.10
Perak	1,398	1,373,084	308,944	77,235.98
Johor	1038	1,265,618	284,764	71,191.01
Negeri Sembilan	937	1,001,532	225,345	56,336.18
Kedah	782	601,618	135,364	33,841.01
Melaka	751	622,932	140,160	35,039.93
Pulau Pinang	657	2,198,113	494,575	123,643.86
Pahang	510	337,231	75,877	18,969.24
WP Kuala Lumpur	306	2,760,202	621,045	155,261.36
Terengganu	227	80,957	18,215	4,553.83
Perlis	41	21,066	4,740	1,184.96
WP Labuan	32	43,099	9,697	2,424.32
WP Putrajaya	9	73,822	16,610	4,152.49
<b>Total</b>	<b>9,337</b>	<b>16,745,498</b>	<b>3,767,736</b>	<b>941,934.27</b>

Note : STP = Sewage Treatment Plant  
PE = Population Equivalent

Source : IWK Sdn. Bhd

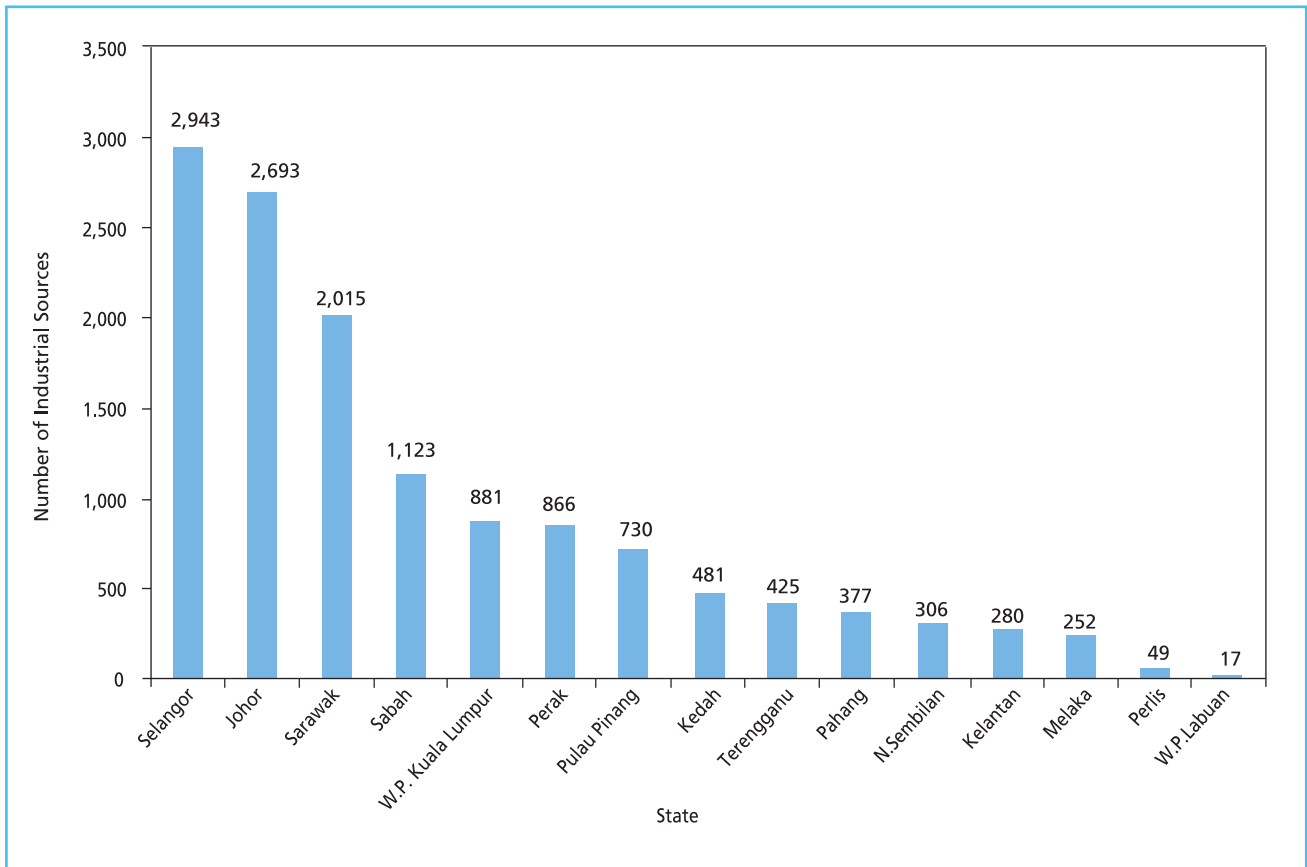


Figure 6.4 Malaysia : Industrial Air Pollution Sources by State, 2007

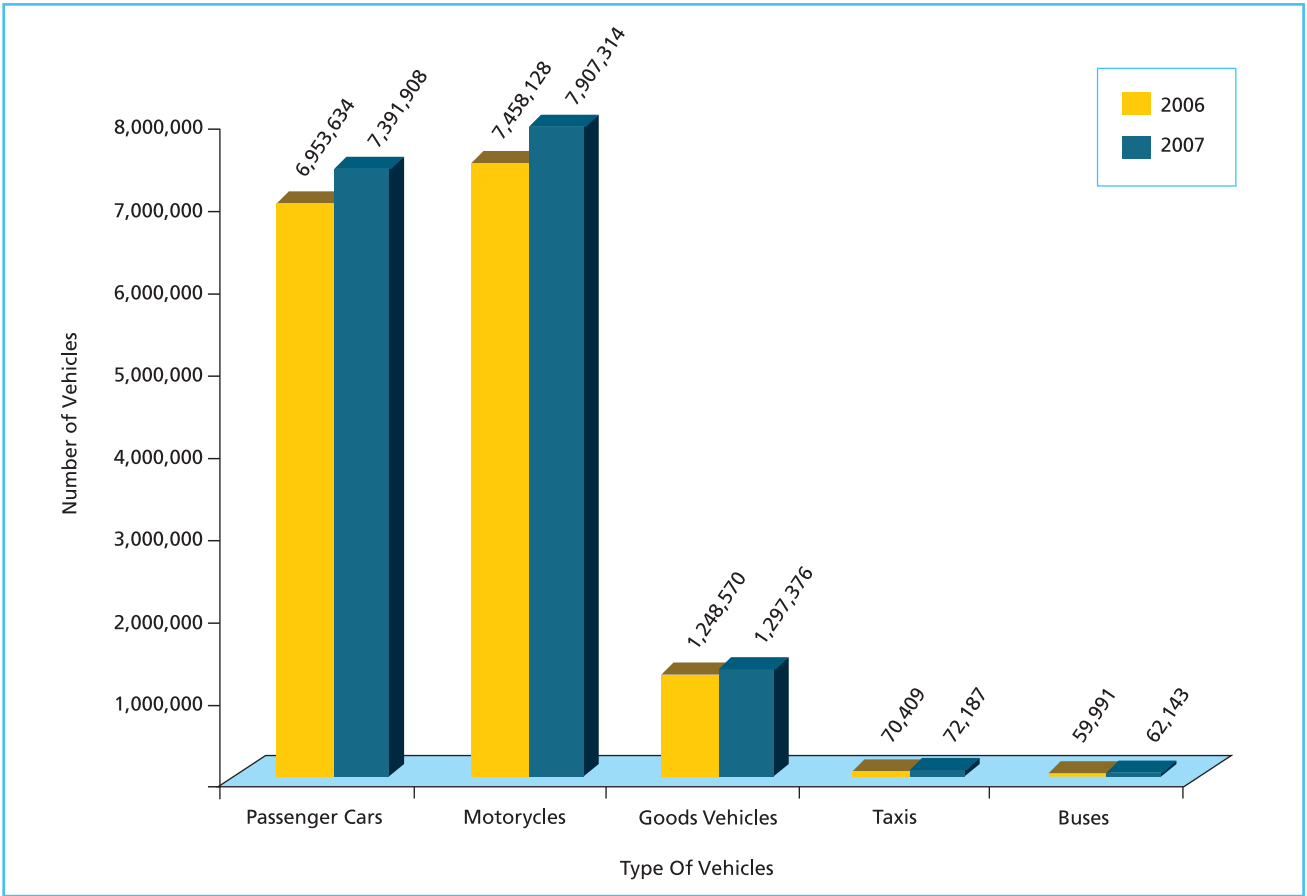


Figure 6.5 Malaysia : Number of Registered Vehicles in 2006 and 2007

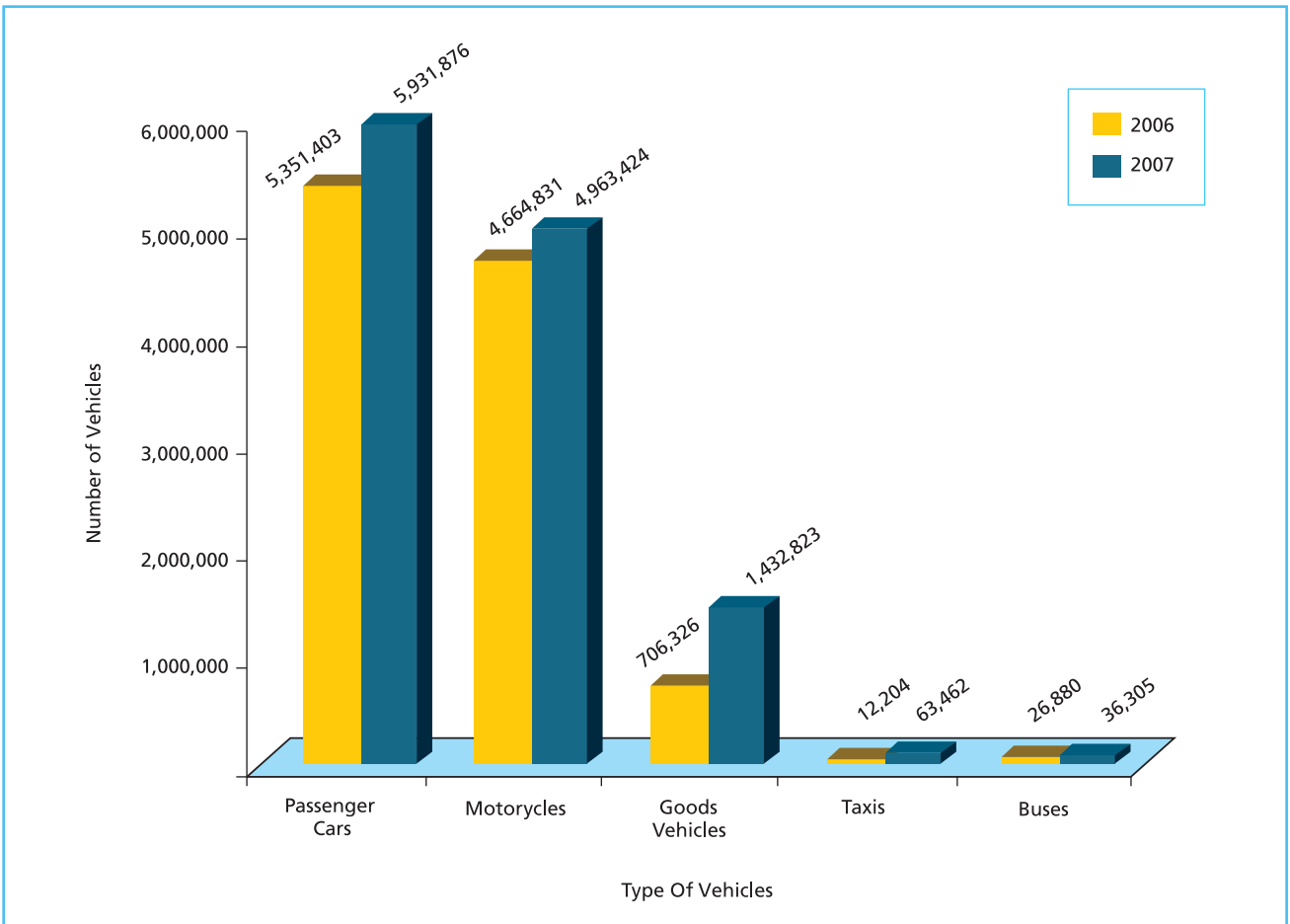


Figure 6.6 Malaysia : Number of In-Use Vehicles in 2006 and 2007

## AIR POLLUTANT EMISSION LOAD

It is estimated that in 2007 the combined air pollutant emission load was 1,774,396 metric tonnes of carbon monoxide (CO); 563,078 metric tonnes of nitrogen oxides (NO<sub>x</sub>); 158,120 metric tonnes of sulphur dioxide (SO<sub>2</sub>) and 38,763 metric tonnes of particulate matter (PM). A comparison of the combined air pollutant emission load in 2006 and 2007 is shown in **Figure 6.7**. Other than SO<sub>2</sub> there was an increase in CO, NO<sub>x</sub> and PM in 2007 compared with 2006.

Power stations contributed the highest SO<sub>2</sub> emission load at (41%), industries (23%), motor vehicles (16%) and others (20%) (**Figure 6.8**). As to PM the highest contributor was industries (40%) followed by motor vehicles (28%), power stations (14%) and others (18%) (**Figure 6.9**). As shown in **Figure 6.10** the highest contributor of NO<sub>x</sub> was from motor vehicles (70%). Similarly the highest contributor of CO was also from motor vehicles at 98% whilst industries and power stations contributed 1% each (**Figure 6.11**).



Uncontrolled Hill Cutting (DOE Photo Library)

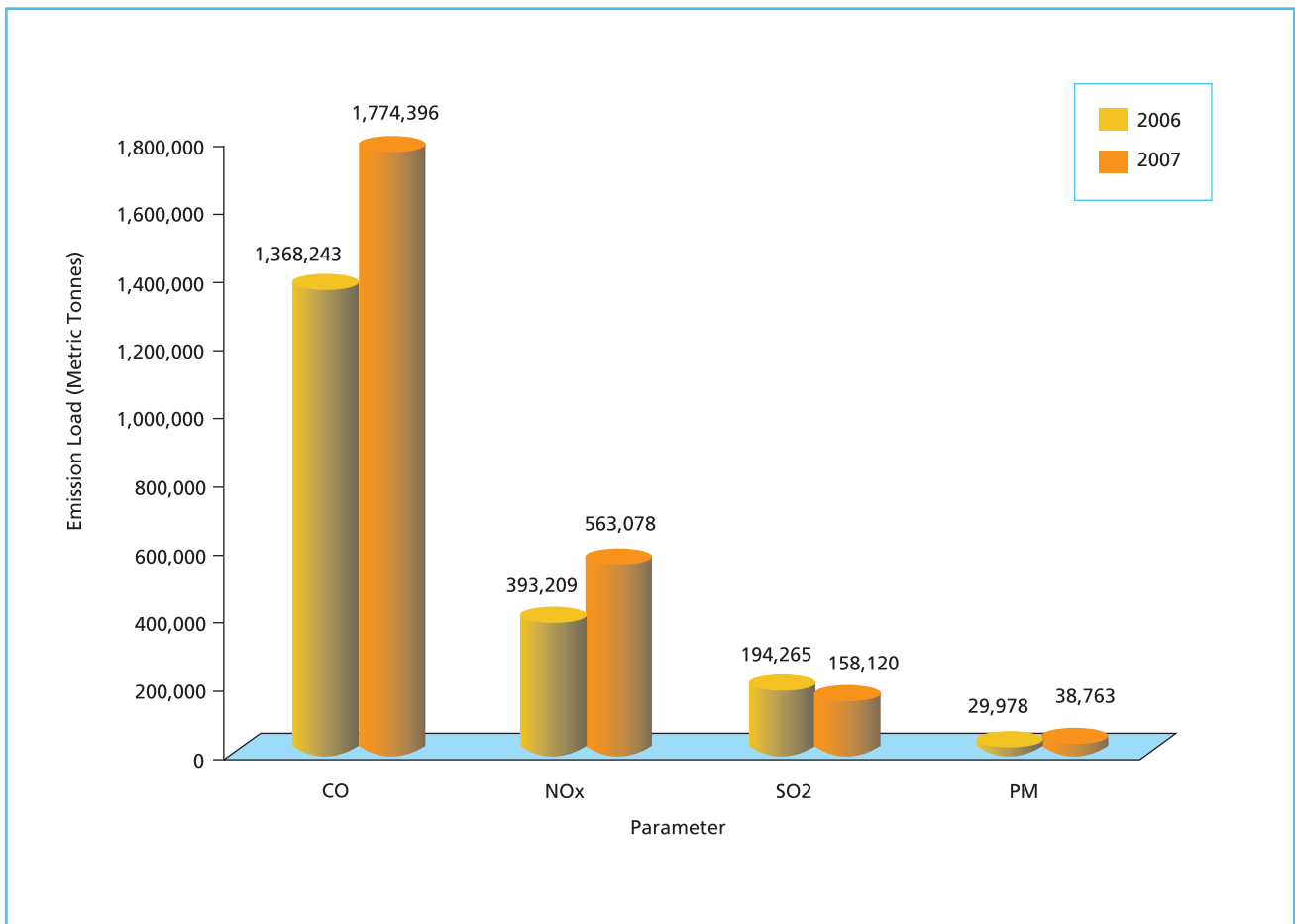


Figure 6.7 Malaysia : Air Pollutant Emission Load from All Sources, 2006-2007

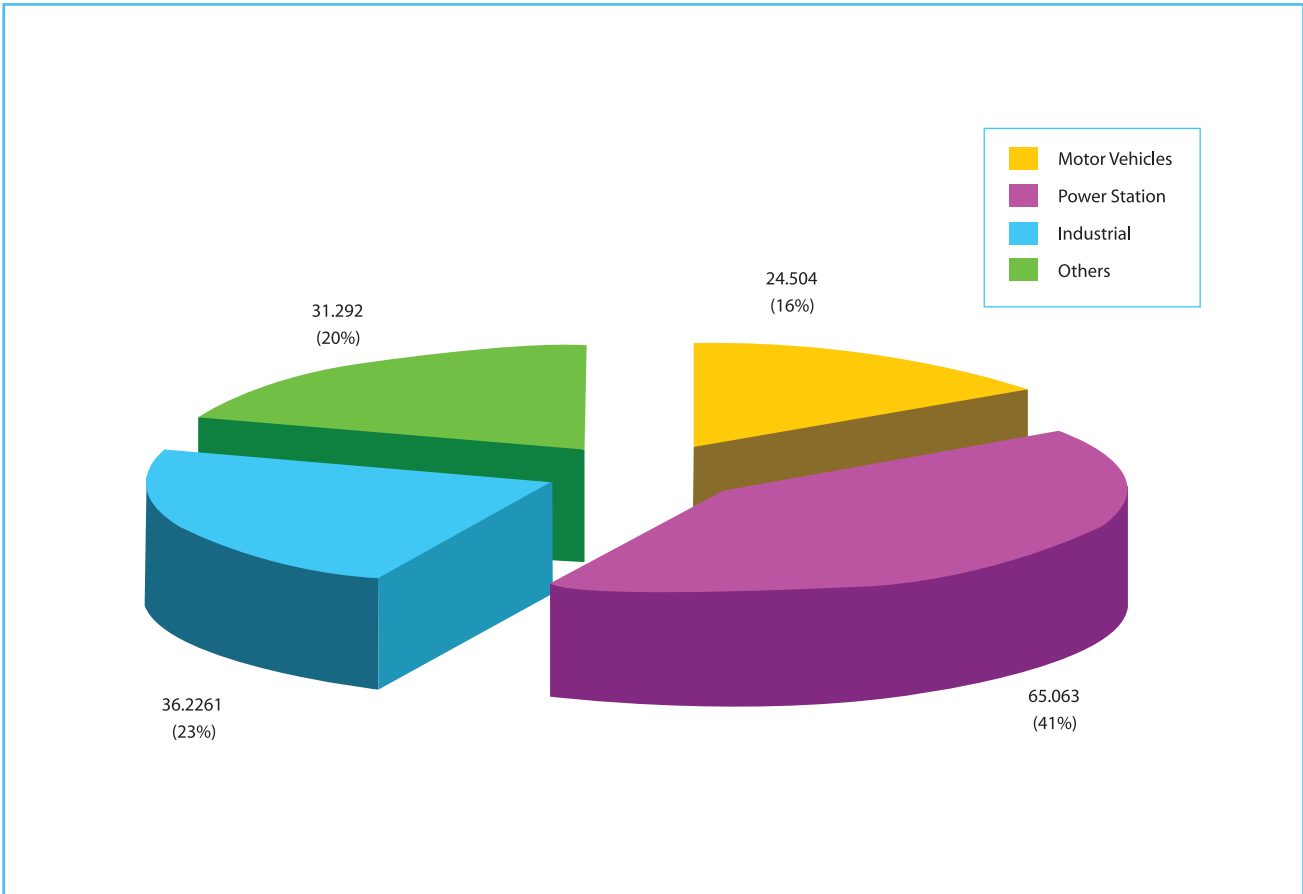


Figure 6.8 Malaysia : SO<sub>2</sub> Emission by Sources (Metric Tonnes), 2007

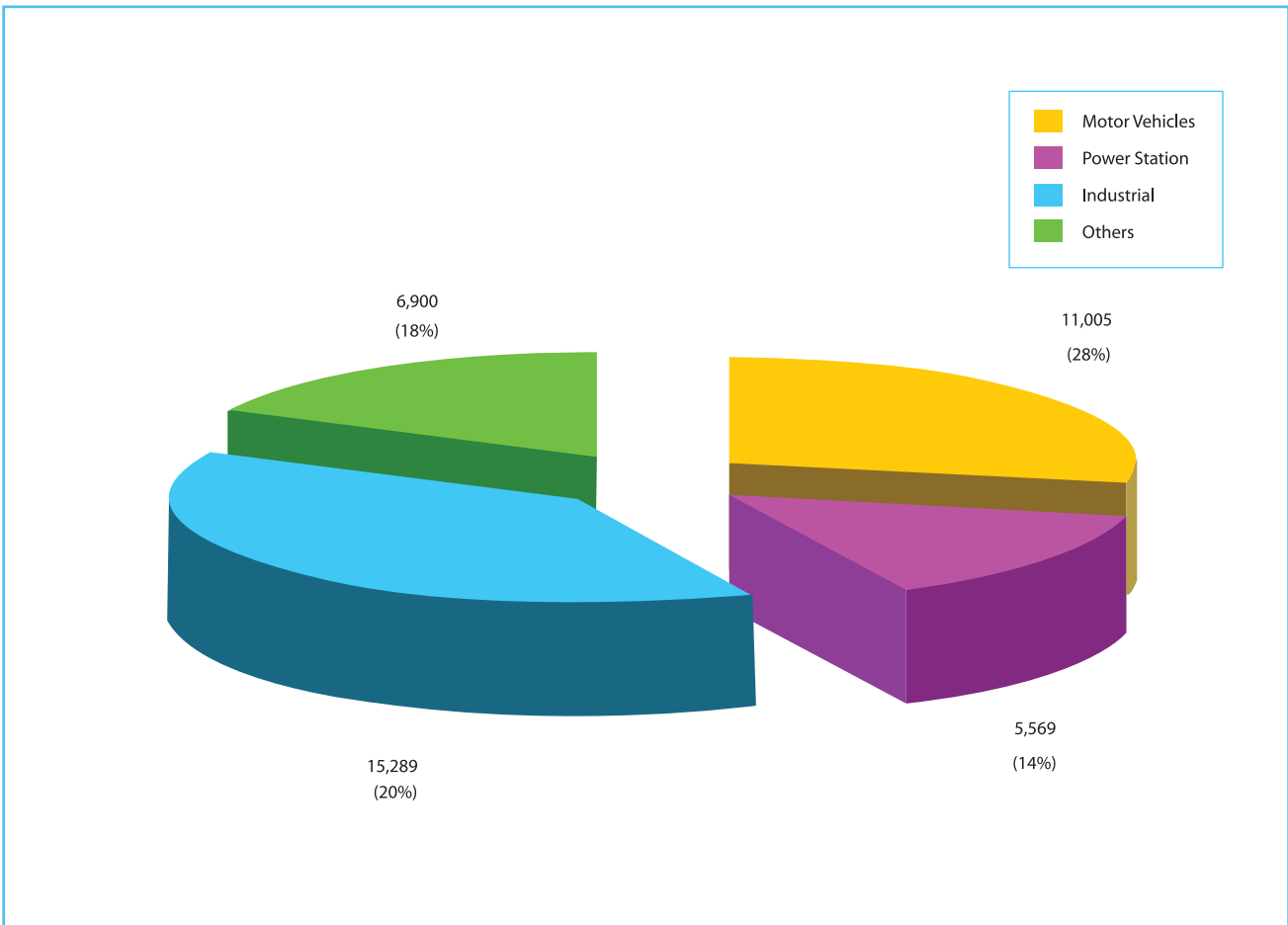


Figure 6.9 Malaysia : PM Emission by Sources (Metric Tonnes), 2007

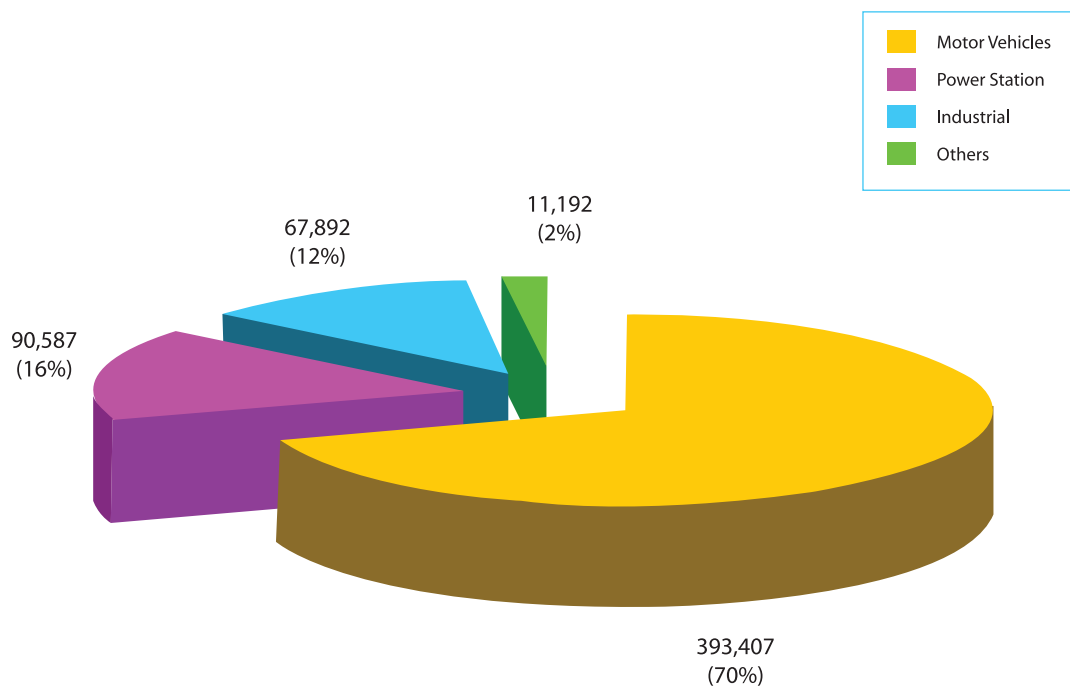


Figure 6.10 Malaysia : NO<sub>x</sub> Emission by Sources (Metric Tonnes), 2007

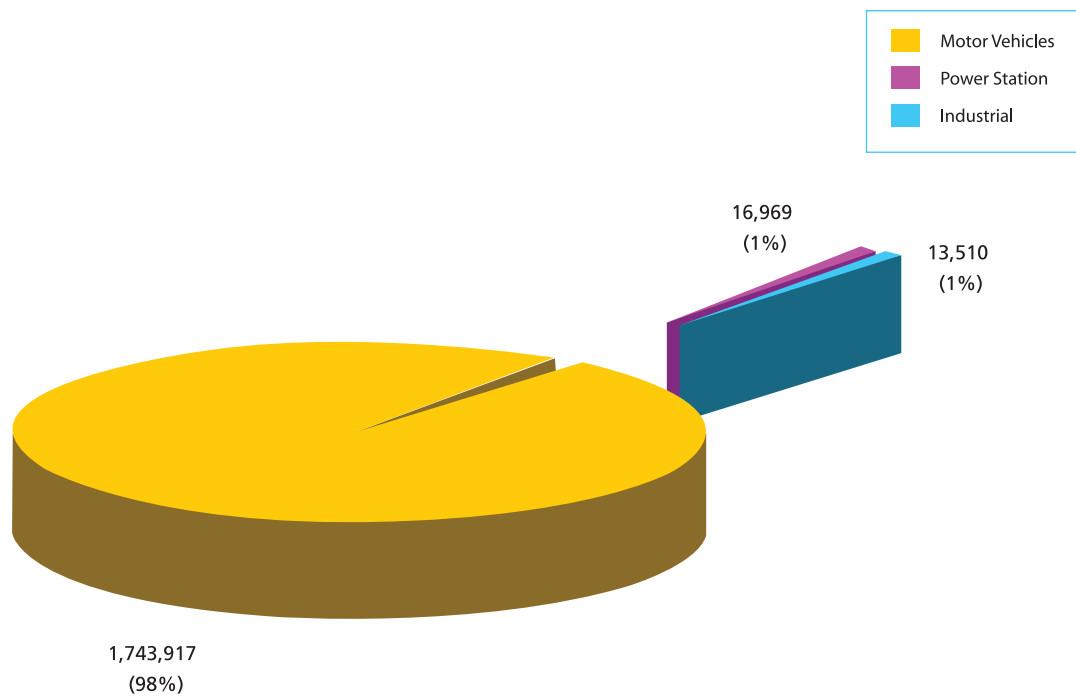


Figure 6.11 Malaysia : CO Emission by Sources (Metric Tonnes), 2007

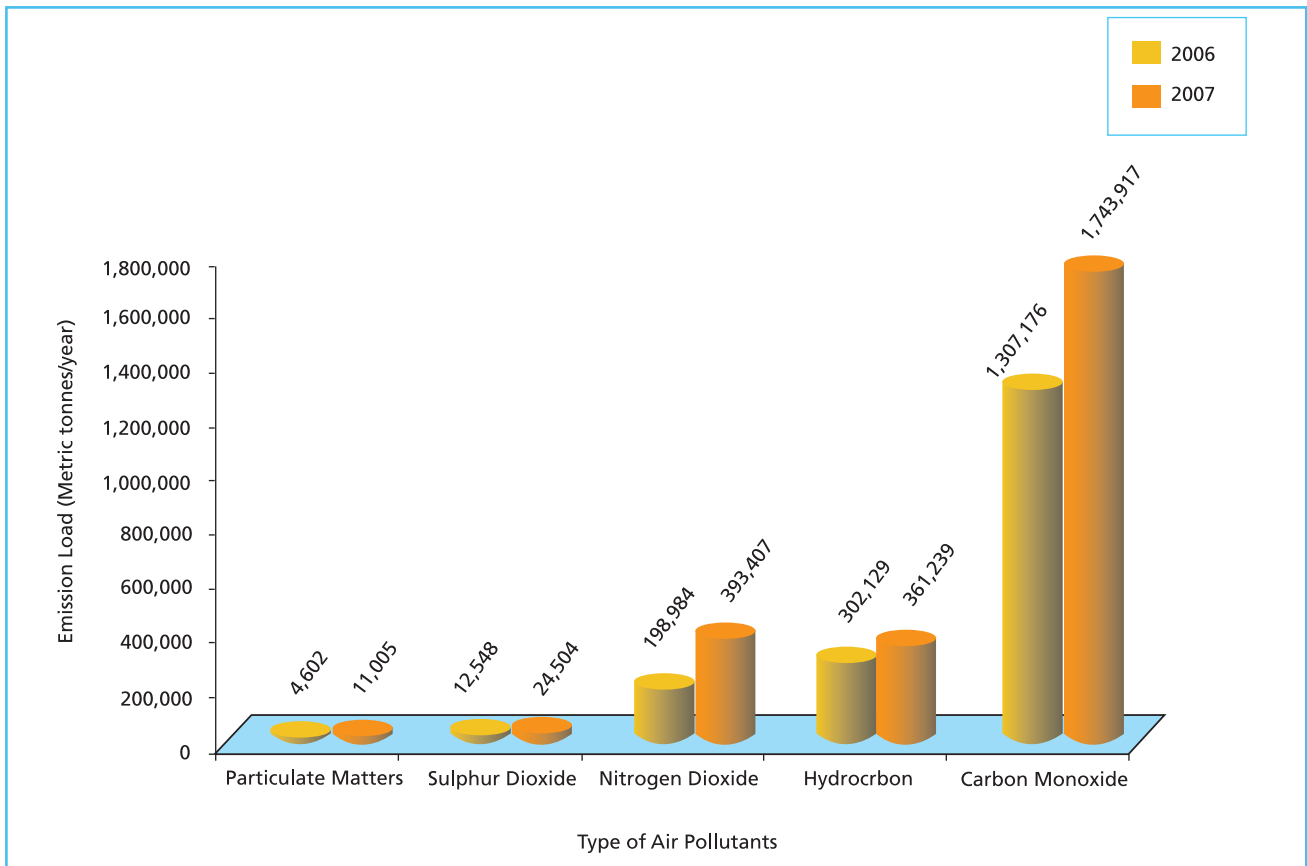


Figure 6.12 Malaysia : Air Pollutant Emission Load from Mobile Sources, 2006 - 2007



Air Pollution : Increased number of motor vehicles  
(DOE Photo Library)

The estimated annual air pollutant emission loads of hydrocarbon (HC), carbon monoxide (CO), particulate matter (PM), nitrogen dioxide (NO<sub>2</sub>) and sulphur dioxide (SO<sub>2</sub>) from the mobile sources for 2006 and 2007 is shown in **Figure 6.12**. In 2007, the emission loads of PM, NO<sub>2</sub>, SO<sub>2</sub>, CO and HC were estimated to be 11,005 metric tonnes, 393,407 metric tonnes, 24,504 metric tonnes, 1,743,917 metric tonnes and 361,239 metric tonnes respectively, an increase of 139.1 percent for PM, 97.7 percent for NO<sub>2</sub>, 95.3 percent for SO<sub>2</sub>, 33.4 percent for CO and 19.6 percent for HC emission load in 2007 compared to 2006.

The increase in PM, NO<sub>2</sub> and SO<sub>2</sub> load in 2007 was due to the increase in goods vehicles and buses and the increase in CO and HC load was due to the increase in passenger cars and motorcycles.

**Figure 6.13** to **Figure 6.17** show the contribution of various categories of vehicle to the respective air pollutant emission load in 2007. It was estimated that 80.8 percent of PM emission load was contributed by vans and lorries, 17.5 percent by buses, 1.5 percent by taxis and 0.2 percent by passenger cars (**Figure 6.13**).

For NO<sub>2</sub> it was estimated that 72.6 percent of the emission load was contributed by vans and lorries, 13.5 percent by buses, 11.6 percent by passenger cars, 1.4 percent by motorcycles and 0.9 percent by taxis (**Figure 6.14**).

**Figure 6.15** shows that vans and lorries contributed 70.8 percent of the total emission of SO<sub>2</sub>, 13.1 percent by buses, 11.9 percent by passenger cars, 2.7 percent by motorcycles and 1.5 percent by taxis.

In terms of HC, motorcycles contributed 58.0 percent of the total emissions, 22.3 percent by vans and lorries, 17.2 percent by passenger cars while buses and taxis contributed 1.5 percent and 1.0 percent respectively as shown in **Figure 6.16**.

The highest contributor of CO from mobile sources was vans and lorries at 43.2 percent, passenger cars 38.3 percent, motorcycles 14.2 percent, taxis 2.3 percent and buses 2.0 percent (**Figure 6.17**).



E-Waste : Electronic Components (DOE Photo Library)

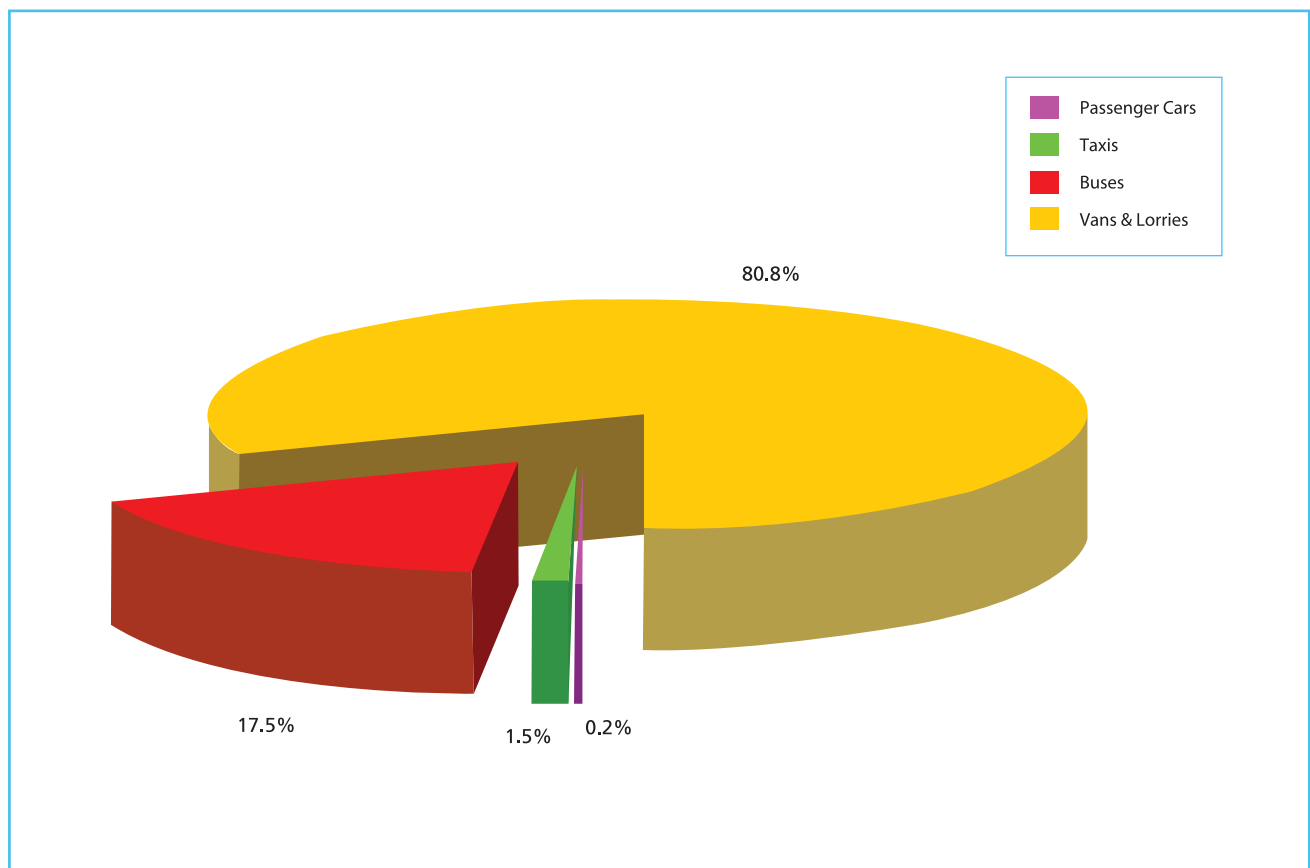


Figure 6.13 Malaysia : Distribution of PM Emission Load from Mobile Sources, 2007

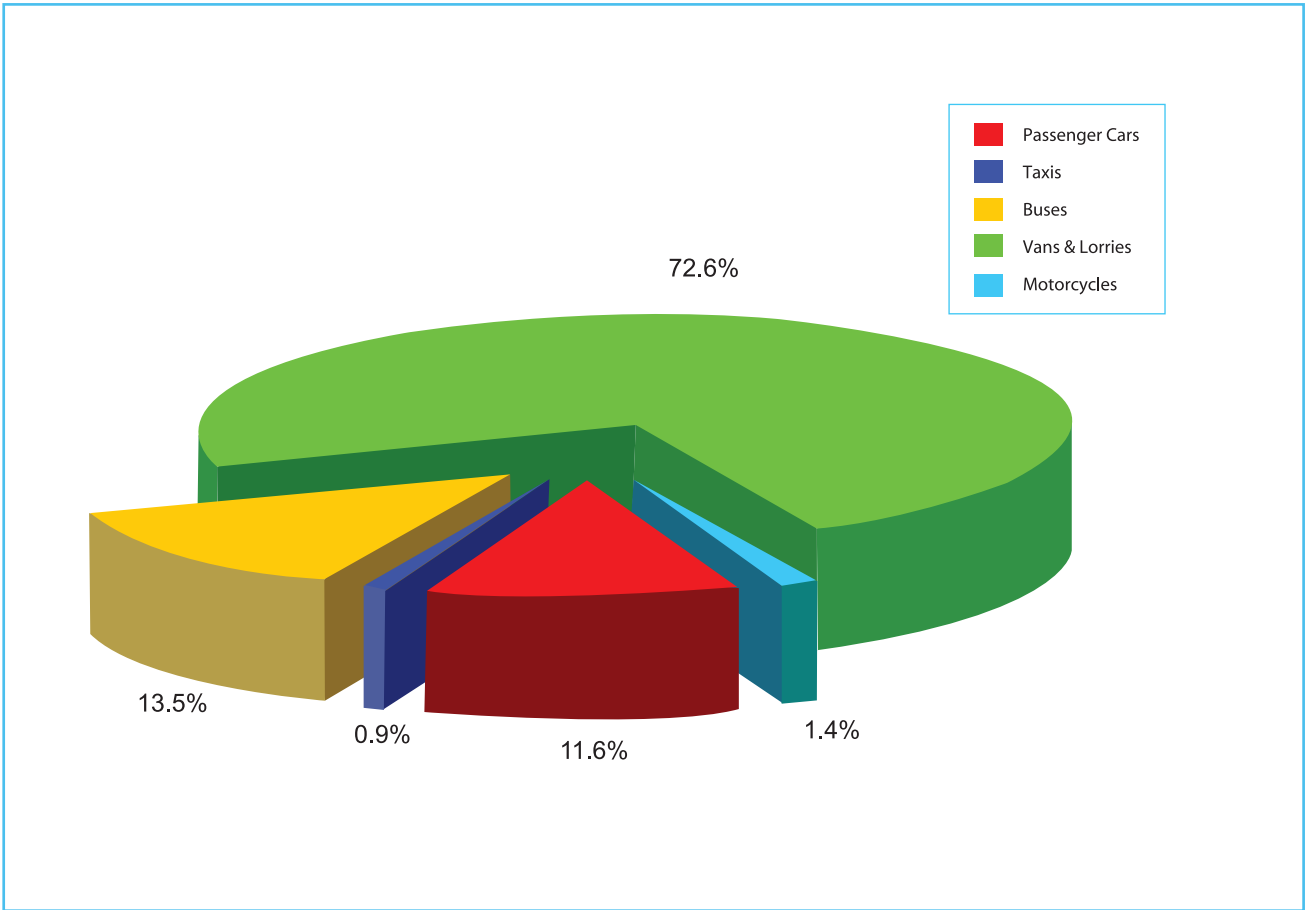


Figure 6.14 Malaysia : Distribution of NO<sub>2</sub> Emission Load from Mobile Sources, 2007

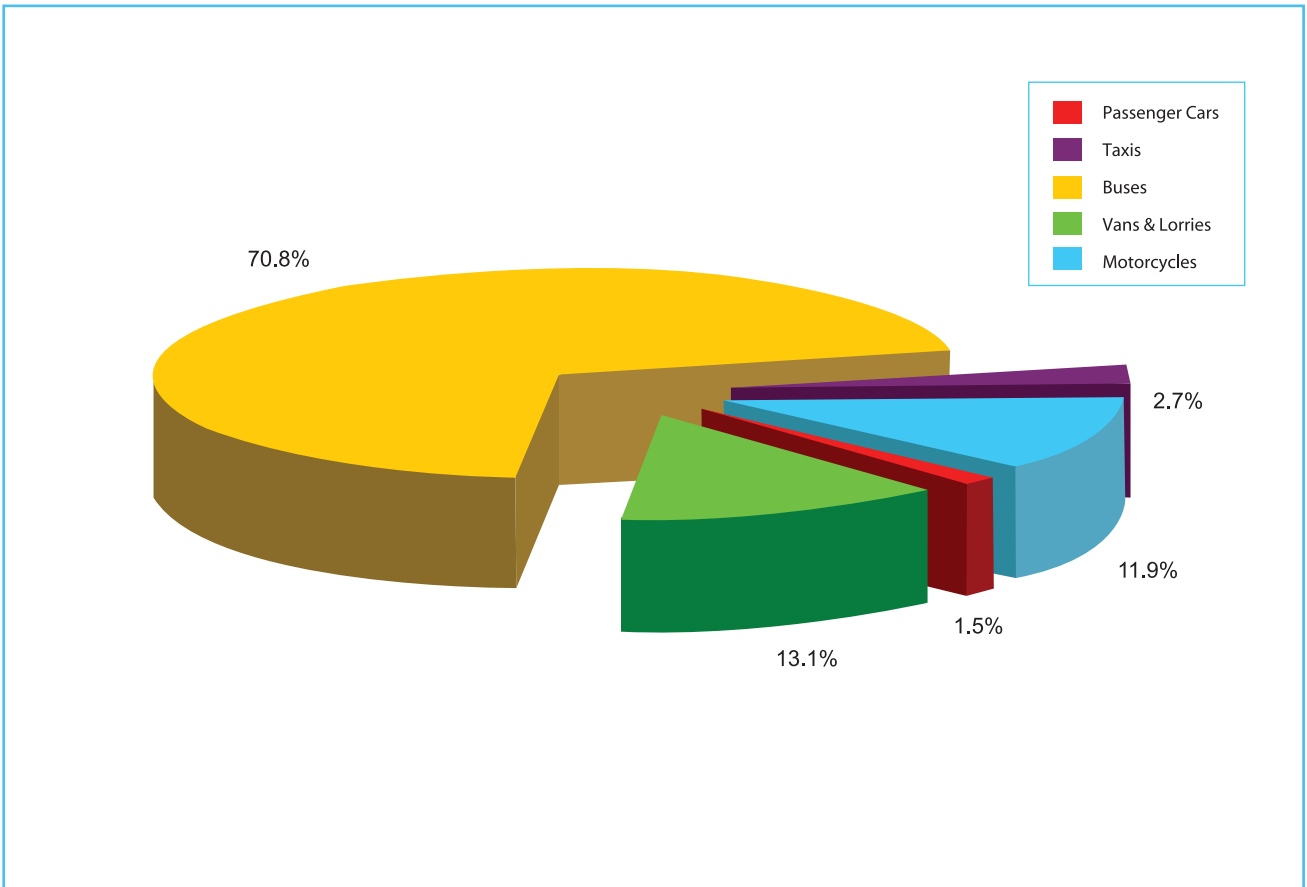


Figure 6.15 Malaysia : Distribution of SO<sub>2</sub> Emission Load from Mobile Sources, 2007

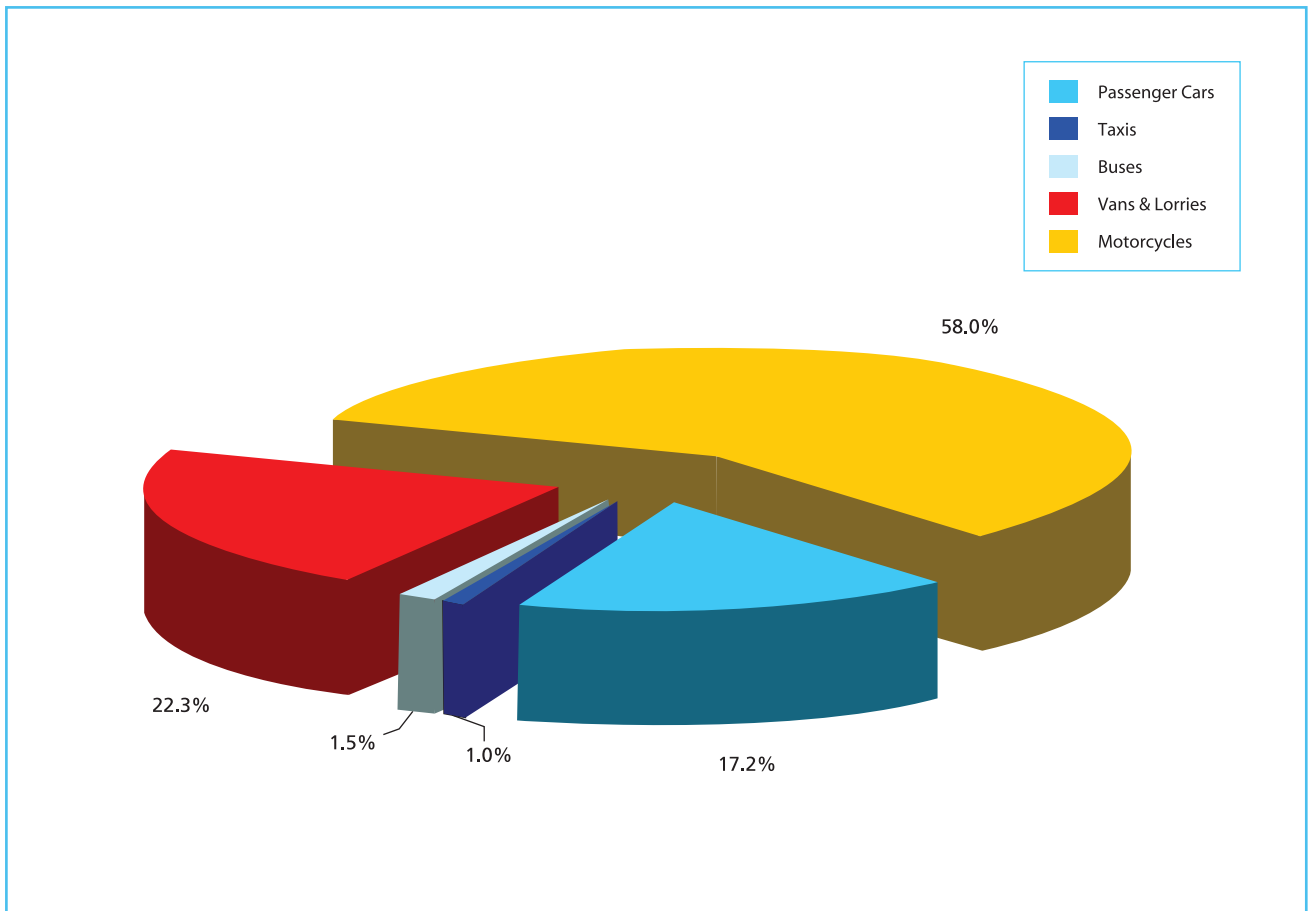


Figure 6.16 Malaysia : Distribution of HC Emission Load from Mobile Sources, 2007

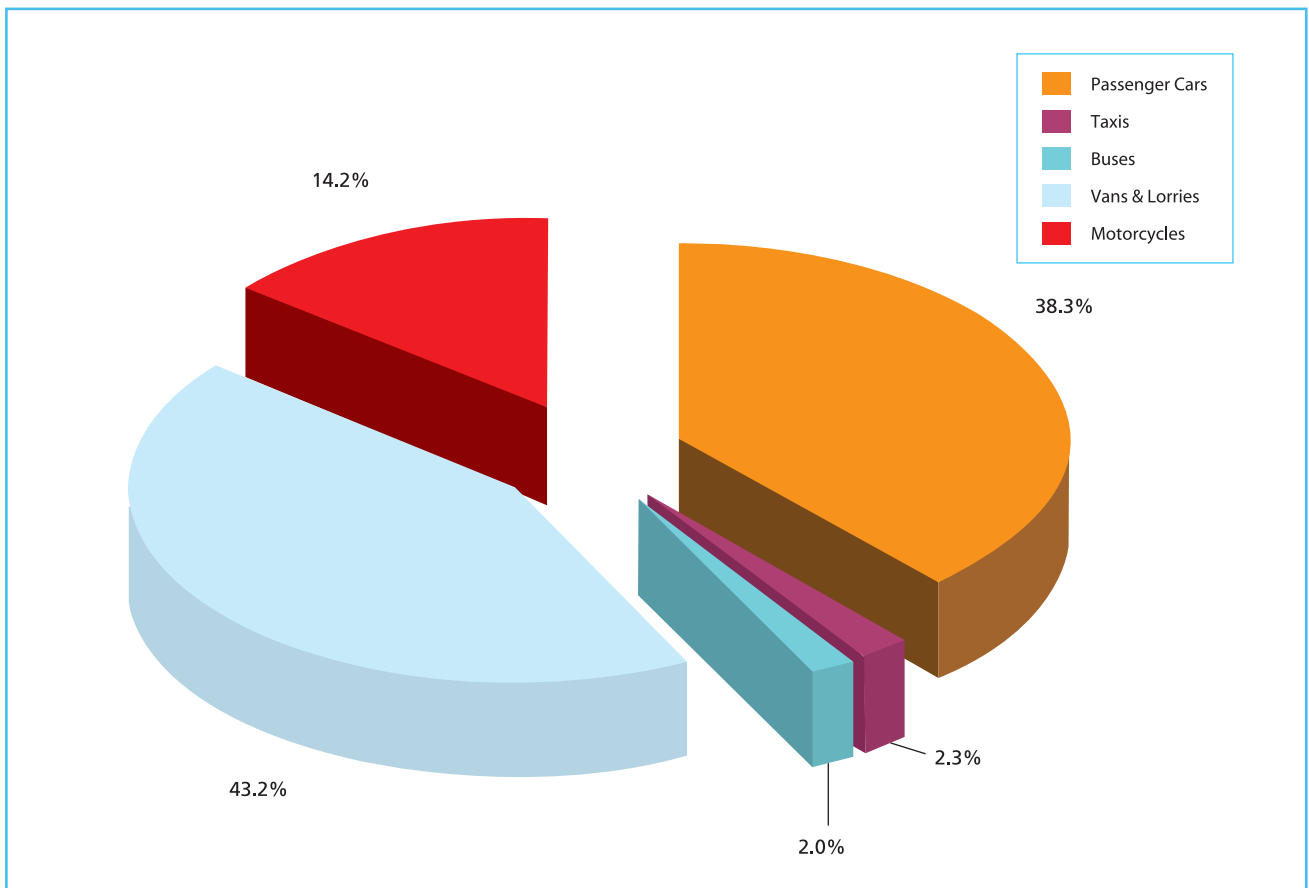


Figure 6.17 Malaysia : Distribution of CO Emission Load from Mobile Sources, 2007

## SCHEDULED WASTES INVENTORY

A total of 1,138,839.491 metric tonnes of scheduled wastes were generated in 2007 as compared to 1,103,457.06 metric tonnes in 2006.

The main categories of waste produce in the country

were gypsum, dross/slag/clinker, oil and hydrocarbon, heavy metal sludge, mineral sludge and e-waste were the main categories of waste produced in the country. The breakdown according to waste categories and industry type are given in **Tables 6.2, 6.3** and **Figures 6.18, 6.19** respectively.

Table 6.2 Malaysia : Quantity of Scheduled Wastes Generated by Category, 2007

NO.	CATEGORY OF WASTE	QUANTITY OF WASTE	
		(MT / Year)	PERCENTAGE (%)
1	GYPSUM	497,691.98	43.7
2	DROSS/SLAG/CLINKER	134,396.28	11.8
3	OIL & HYDROCARBON	84,345.26	7.4
4	HEAVY METAL SLUDGE	71,793.23	6.3
5	MINERAL SLUDGE	62,306.69	5.5
6	E-WASTE	52,718.19	4.6
7	SPENT SOLVENT	41,662.09	3.7
8	USED CONTAINERS	31,795.18	2.8
9	BATTERIES	30,731.53	2.7
10	RESIDUE	23,396.23	2.1
11	ACID & ALKALI	20,306.00	1.8
12	CLINICAL/PHARMACEUTICAL	17,742.96	1.6
13	INK & PAINT SLUDGE	16,888.01	1.5
14	PAPER & PLASTIC	14,041.79	1.2
15	MIXED WASTES	12,977.42	1.1
16	RUBBER SLUDGE	8,853.98	0.8
17	CATALYST	5,886.48	0.5
18	MERCURY	2,907.87	0.3
19	CHEMICAL WASTE	2,236.59	0.2
20	OTHERS	1,591.81	0.1
21	PHENOL/ADHESIVE/RESIN	1,546.26	0.1
22	CONTAMINATED ACTIVE CARBON	1,526.12	0.1
23	ASBESTOS	698.91	0.1
24	CONTAMINATED LAND/SOIL	664.24	0.1
25	PHOTOGRAPHY	134.42	0.0
	<b>TOTAL</b>	<b>1,138,839.49</b>	<b>100.0</b>

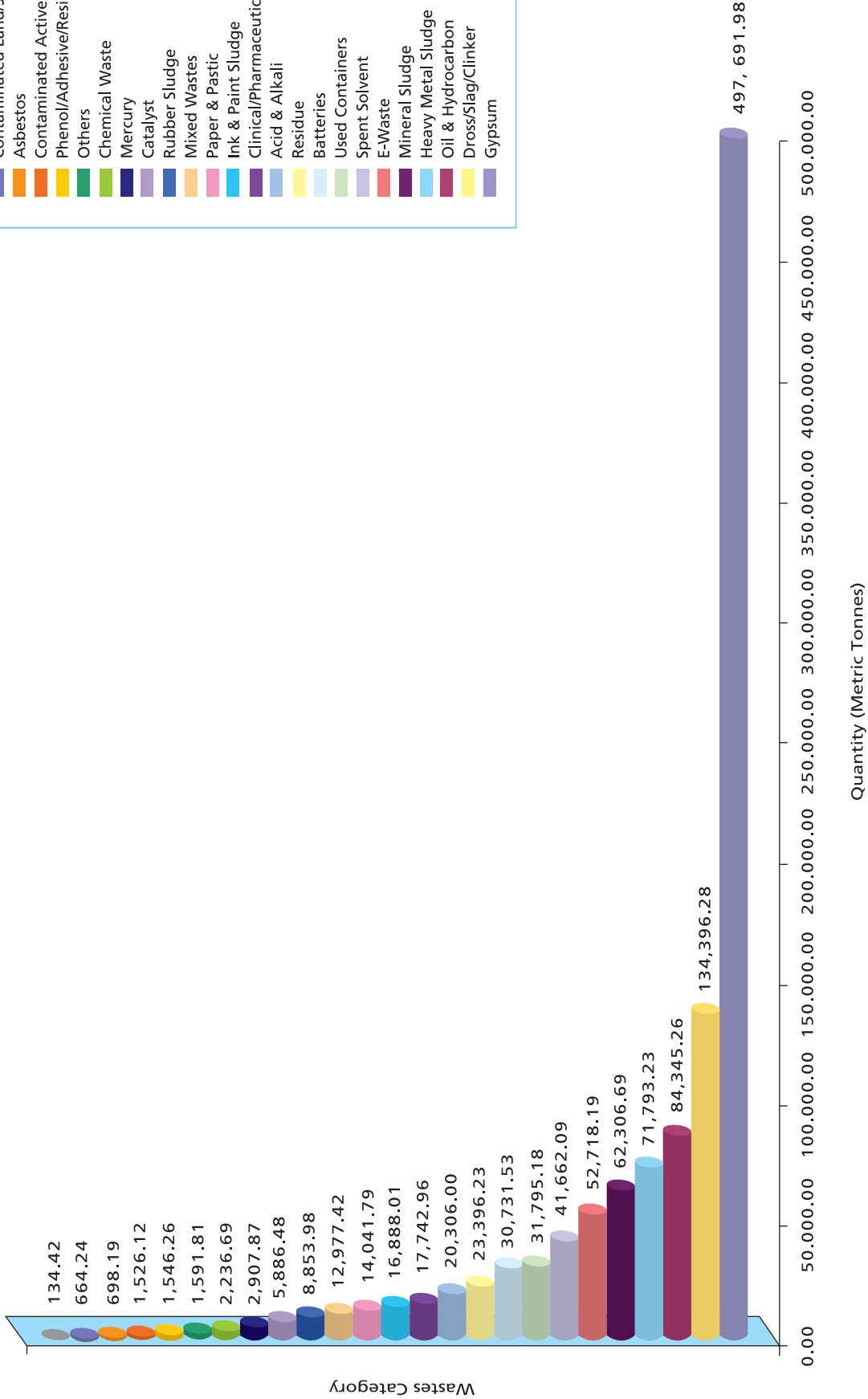
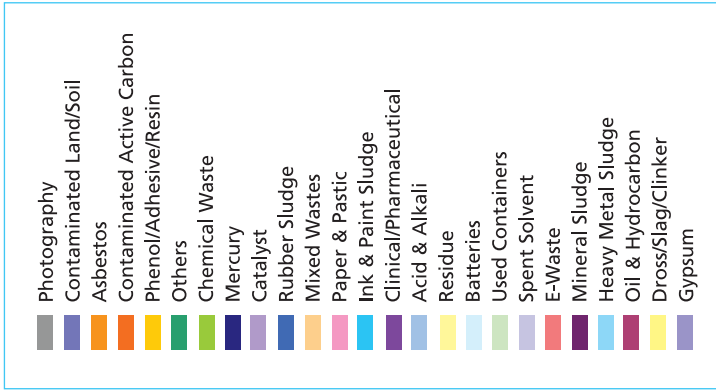


Figure 6.18 Malaysia : Quantity of Scheduled Waste Generated by Category, 2007

Table 6.3 Malaysia: Quantity of Scheduled Wastes Generated by Industry, 2007

NO.	CATEGORY OF INDUSTRY	QUANTITY OF WASTE	
		(MT / Year)	PERCENTAGE (%)
1	CHEMICAL	584,344.66	51.3
2	ELECTRONIC	239,440.49	21.0
3	METAL	104,955.95	9.2
4	LICENCED FACILITY	79,921.95	7.0
5	AUTOMOTIVE/WORKSHOP	29,283.00	2.6
6	INDUSTRIAL GAS	19,198.57	1.7
7	PETROLEUM/OLEOCHEMICAL	17,578.66	1.5
8	HOSPITAL/PHARMACEUTICAL	14,425.46	1.3
9	RUBBER	8,354.47	0.7
10	BATTERIES	8,339.27	0.7
11	PAPER & PLASTIC	8,292.63	0.7
12	PRINTING & PACKAGING	5,295.42	0.5
13	WATER TREATMENT PLANT/POWER STATION	4,956.76	0.4
14	SHIPPING	4,796.24	0.4
15	OTHERS	4,019.65	0.4
16	WOOD BASED	3,257.42	0.3
17	MINERAL/CERAMIC/TILES/PLASTER	1,168.98	0.1
18	TEXTILE	743.99	0.1
19	RESIN & ADHESIVE	465.92	0.0
	<b>TOTAL</b>	<b>1,138,839.49</b>	<b>100.0</b>



Clean up of scheduled waste at illegal dump site (DOE Photo Library)

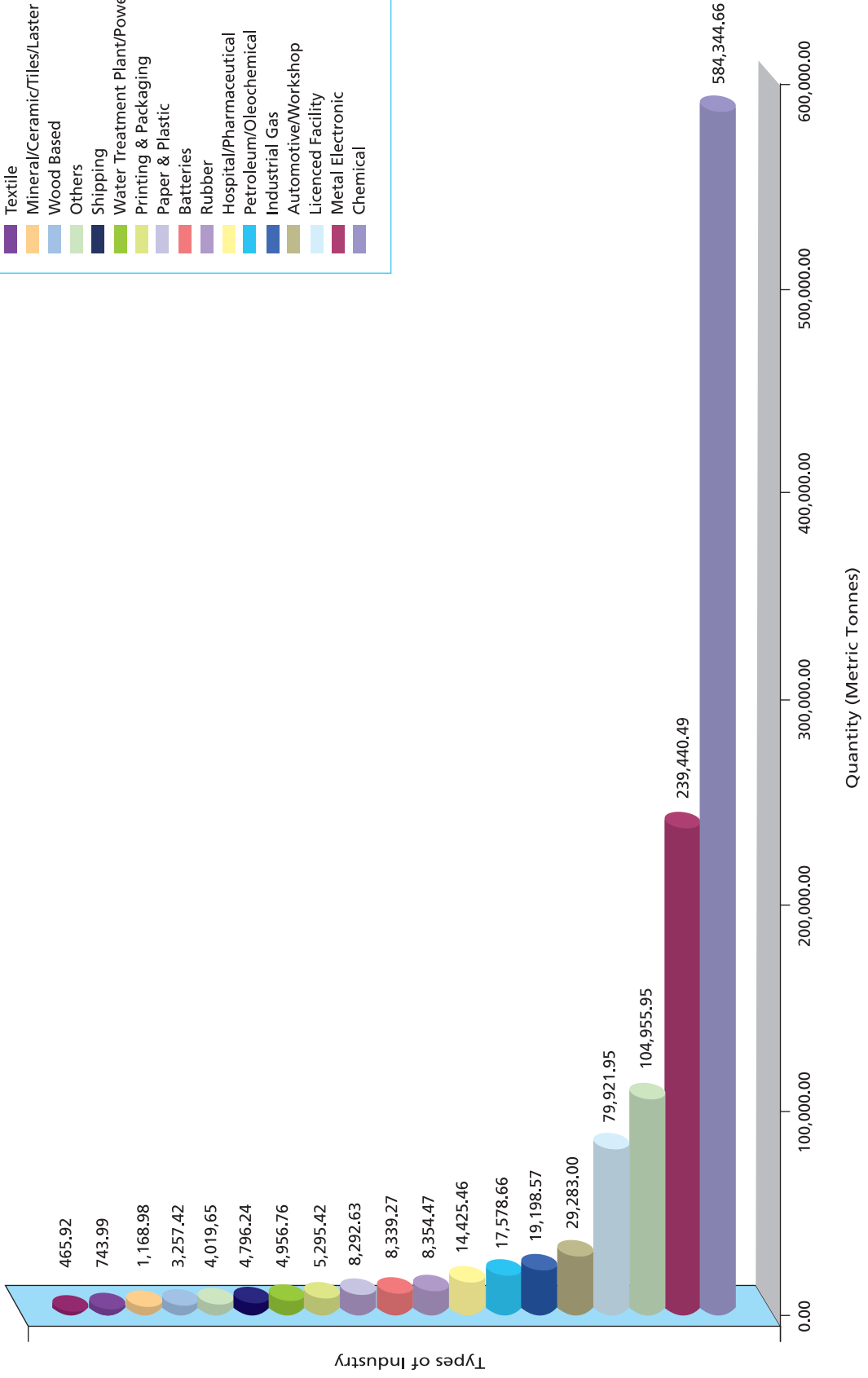
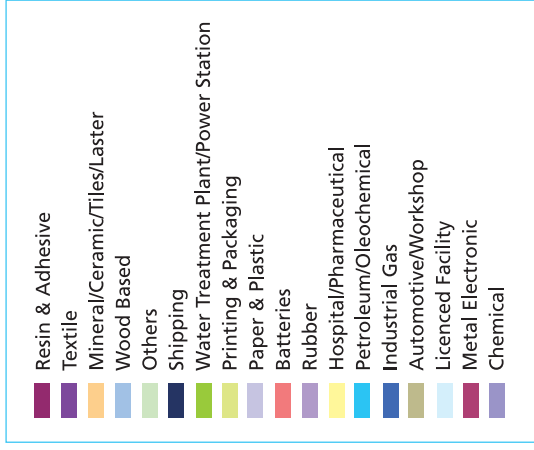


Figure 6.19 Malaysia : Quantity of Scheduled Waste Generated by Industry, 2007

Of the total scheduled wastes produced, an estimated 579,652.39 metric tonnes or 50.9% were treated on-site, 355,471.20 metric tonnes (31.2%) were recovered at off-site facilities, 55,075.45 metric tonnes (4.8%) were stored on-site at waste generators' premises and 141,532.65 metric tonnes (12.5%) were treated and disposed, 7,107.80 metric tonnes (0.6%) were exported for recovery purposes. Of the 141,532.65 metric tonnes of wastes (12.5%) that were treated and disposed, 117,982.26 metric tonnes (10.4%) were carried out at Kualiti Alam Sdn. Bhd., 11,016.81 metric tonnes (1.0%) at Trinekens (Sarawak) Sdn. Bhd. while 12,533.58 metric tonnes (1.1%) of clinical wastes were incinerated at licensed off-site facilities. (Table 6.4) DOE also licensed 3 landfarms for on-site treatment and 18 on-site waste incinerators.

### THE BASEL CONVENTION ON THE CONTROL OF TRANSBOUNDARY MOVEMENT OF HAZARDOUS WASTES AND THEIR DISPOSAL, 1989

The Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal, 1989 came into force on 5th May 1992. Among others The Basel Convention allows the transboundary movement of hazardous wastes if the wastes are required as raw material for recycling or recovery industries in the importing countries.

In 2007, eight (8) Written Approvals were issued for the import of 133,074 tonnes of wastes for use as raw materials. The wastes comprised of :

- waste gypsum from power plant (84,890 MT, 63.79 %)
- copper slag (28,400 MT, 21.34 %)
- waste glass from cathode ray tube (CRT) (14,966

MT, 11.25 %)

- spent ultra pure acid (3,276 MT, 2.46 %)
- calcium hydroxide sludge (1542 MT, 1.16%)

The trend of wastes imported over the last 5 years (2003-2007) is shown in **Figure 6.20**. Waste gypsum was used as raw materials in the cement manufacturing plants, copper slag was used in shipyard sand blasting operations, spent acid was used as a raw material in the sulphuric acid recovery process, waste CRT for use as a raw material in manufacturing of cathode ray tube and the calcium hydroxide sludge was used in waste water treatment plant.

Malaysia also exported 7,108 tonnes of scheduled wastes in 2007 to recovery facilities in the importing countries. The exported wastes were from 57 waste generators and comprised of :

- metal hydroxide sludges containing heavy metals such as silver, nickel and copper (2,592 MT, 36.47 %)
- electrical and electronic wastes (e-waste) (2,350 MT, 33.06 %)
- zinc dross (1050 MT, 14.77 %)
- spent catalyst (794 MT, 11.17 %)
- waste containing formaldehyde ( 132 MT, 1.86%)
- used blasting material (120 MT, 1.69 %)
- used toner ( 47 MT, 0.66 %)
- waste containing mercury compound (23 MT, 0.32%)

The trend of wastes exported for recovery to various countries for the last five years is shown in **Table 6.5**. The quantity and type of wastes exported between 2003 and 2007 are shown in **Figure 6.21**.

Table 6.4 Malaysia : Facilities Handling Scheduled Wastes, 2007

NO.	FACILITY	TONNES	PERCENTAGE (%)
1	On-site Treatment	579,652.39	50.9
2	Local Off-site Recovery Facilities	355,471.20	31.2
3	Kualiti Alam Sdn. Bhd	117,982.26	10.4
4	On-site Storage	55,075.45	4.8
5	Off-site Clinical Waste Incinerators	12,533.58	1.1
6	Trinekens (Sarawak) Sdn. Bhd.	11,016.81	1.0
7	Foreign Facilities (Import/Export)	7,107.80	0.6
	<b>TOTAL</b>	<b>1,138,839.49</b>	<b>100.0</b>

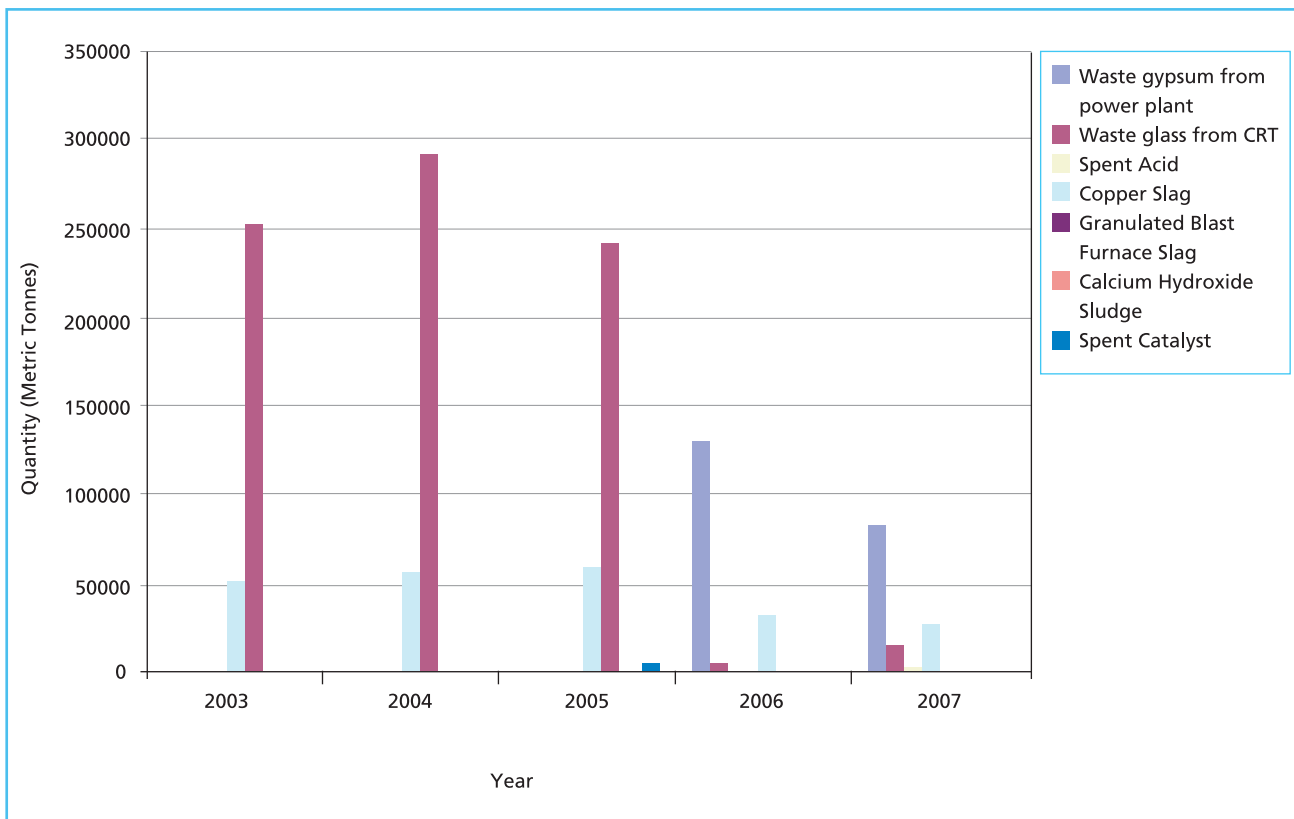


Figure 6.20 Malaysia : Quantity and Type of Scheduled Wastes Imported (Tonnes), 2003 - 2007

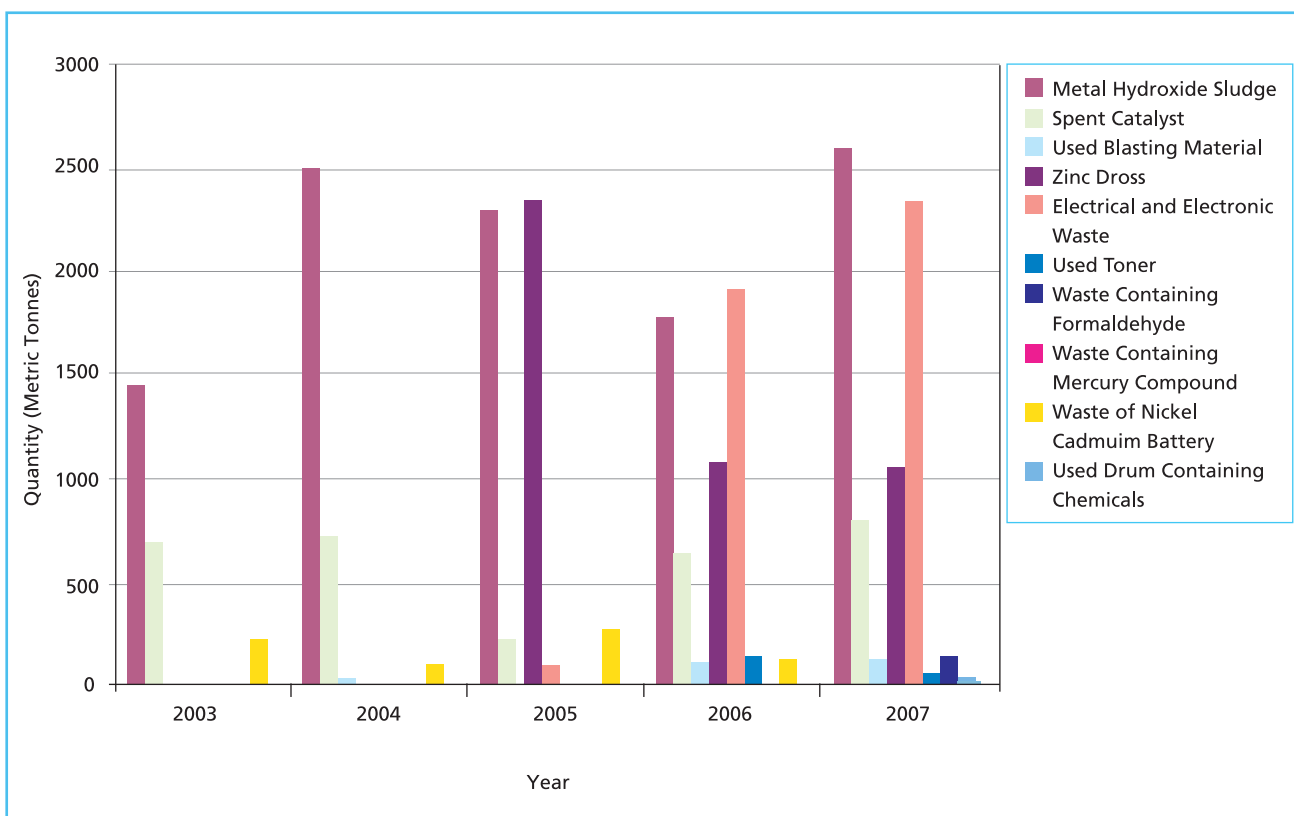


Figure 6.21 Malaysia : Quantity and Type of Scheduled Waste Exported (Tonnes), 2003-2007

Table 6.5 Malaysia : Quantity and Destination of Scheduled Waste Exported (metric tonnes), 2003-2007

Country	2003	2004	2005	2006	2007
Singapore	-	22	14	10	11
South Africa	-	-	1,555	424	140
Thailand	-	-	90	233	136
Italy	28	-	-	98	92
Finland	23	190	-	381	360
Belgium	140	51	-	119	807
USA	60	80	-	1,847	1,721
Germany	349	476	492	537	1,681
Japan	1,006	1,019	1,793	660	2,092
Sweden	7	6	8	21	35
Estonia	-	-	-	-	33
Philippines	-	1,000	1,000	1,280	-
South Korea	118	-	-	117	-
Australia	209	-	-	-	-
Holland	323	294	-	-	-
France	98	189	272	-	-
Canada	-	25	-	-	-
China	-	-	-	79	-
<b>Total (metric tonne)</b>	<b>2,361</b>	<b>3,352</b>	<b>5,224</b>	<b>5,806</b>	<b>7,108</b>



Illegal Dumping of Scheduled Waste (DOE Photo Library)



# ANNEX

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National Water Quality Standards for Malaysia	82
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DOE Water Quality Index Classification	84
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National Water Quality Standards For Malaysia

PARAMETER	UNIT	CLASS				
		I	IIA/IIB	III#	IV	IV
Al	mg/l	▲	-	(0.06)	0.5	▲
As	mg/l		0.05	0.4 (0.05)	0.1	
Ba	mg/l		1	-	-	
Cd	mg/l		0.01	0.01* (0.001)	0.01	
Cr (IV)	mg/l		0.05	1.4 (0.05)	0.1	
Cr (III)	mg/l		-	2.5	-	
Cu	mg/l		0.02	-	0.2	
Hardness	mg/l		250	-	-	
Ca	mg/l		-	-	-	
Mg	mg/l		-	-	-	
Na	mg/l		-	-	3 SAR	
K	mg/l		-	-	-	
Fe	mg/l		1	1	1 (Leaf) 5 (Others)	
Pb	mg/l		0.05	0.02* (0.01)	5	L
Mn	mg/l		0.1	0.1	0.2	E
Hg	mg/l	N	0.001	0.004 (0.0001)	0.002	V
Ni	mg/l	A	0.05	0.9*	0.2	E
Se	mg/l	T	0.01	0.25 (0.04)	0.02	L
Ag	mg/l	U	0.05	0.0002	-	S
Sn	mg/l	R	-	0.004	-	
U	mg/l	A	-	-	-	A
Zn	mg/l	L	5	0.4*	2	B
B	mg/l		1	(3.4)	0.8	O
Cl	mg/l	L	200	-	80	V
Cl <sub>2</sub>	mg/l	E	-	(0.02)	-	E
CN	mg/l	V	0.02	0.06 (0.02)	-	
F	mg/l	E	1.5	10	1	IV
NO <sub>2</sub>	mg/l	L	0.4	0.4 (0.03)	-	
NO <sub>3</sub>	mg/l	S	7	-	5	
P	mg/l		0.2	0.1	-	
Silica	mg/l	O	50	-	-	
SO <sub>4</sub>	mg/l	R	250	-	-	
S	mg/l		0.05	(0.001)	-	
CO <sub>2</sub>	mg/l	A	-	-	-	
Gross- <sub>1</sub>	Bq/l	B	0.1	-	-	
Gross- <sub>2</sub>	Bq/l	S	1	-	-	
Ra-226	Bq/l	E	< 0.1	-	-	
Sr-90	Bq/l	N	< 1	-	-	▼
CCE	μq/l	T	500	-	-	
MBAS/BAS	μq/l		500	5000 (200)	-	-
O & G (Mineral)	μq/l		40; N	N	-	-
O & G (Emulsified Edible)	μq/l		7000; N	N	-	-
PCB	μq/l		0.1	6 (0.05)	-	-
Phenol	μq/l		10	-	-	-
Aldrin/Dieldrin	μq/l		0.02	0.2 (0.01)	-	-
BHC	μq/l		2	9 (0.1)	-	-
Chlordane	μq/l		0.08	2 (0.02)	-	-
t-DDT	μq/l		0.1	(1)	-	-
Endosulfan	μq/l		10	-	-	-
Heptachlor/Epoxide	μq/l		0.05	0.9 (0.06)	-	-
Lindane	μq/l		2	3 (0.4)	-	-
2,4-D	μq/l		70	450	-	-
2,4,5-T	μq/l		10	160	-	-
2,4,5-TP	μq/l		4	850	-	-
Paraquat	μq/l	▼	10	1800	-	-

Notes :

\* = At hardness 50 mg/l CaCO<sub>3</sub>

# = Maximum (unbracketed) and 24-hour average (bracketed) concentrations

N = Free from visible film sheen, discolouration and deposits

National Water Quality Standards For Malaysia

PARAMETER	UNIT	CLASS				
		I	IIA	IIB	III	V
Ammoniacal Nitrogen	mg/l	0.1	0.3	0.3	0.9	2.7
Biochemical Oxygen Demand	mg/l	1	3	3	6	12
Chemical Oxygen Demand	mg/l	10	25	25	50	100
Dissolved Oxygen	mg/l	7	5 - 7	5 - 7	3 - 5	< 3
pH	-	6.5 - 8.5	6 - 9	6 - 9	5 - 9	5 - 9
Colour	TCU	15	150	150	-	-
Electrical Conductivity*	mS/cm	1000	1000	-	-	6000
Floatables	-	N	N	N	-	-
Odour	-	N	N	N	-	-
Salinity	%	0.5	1	-	-	2
Taste	-	N	N	N	-	-
Total Dissolved Solid	mg/l	500	1000	-	-	4000
Total Suspended Solid	mg/l	25	50	50	150	300
Temperature	°C	-	Normal + 2 °C	-	Normal + 2 °C	-
Turbidity	NTU	5	50	50	-	-
Faecal Coliform**	count/100 ml	10	100	400	5000 (20000)a	5000 (20000)a
Total Coliform	count/100 ml	100	5000	5000	50000	50000

Notes :

*N* : No visible floatable materials or debris, no objectional odour or no objectional taste

*\** : Related parameters, only one recommended for use

*\*\** : Geometric mean

*a* : Maximum not to be exceeded

Water Classes And Uses

CLASS	USES
Class I	Conservation of natural environment. Water Supply I – Practically no treatment necessary. Fishery I – Very sensitive aquatic species.
Class IIA	Water Supply II – Conventional treatment required. Fishery II – Sensitive aquatic species.
Class IIB	Recreational use with body contact.
Class III	Water Supply III – Extensive treatment required. Fishery III – Common, of economic value and tolerant species; livestock drinking.
Class IV	Irrigation
Class V	None of the above.

DOE Water Quality Classification Based On Water Quality Index

SUB INDEX & WATER QUALITY INDEX	INDEX RANGE		
	CLEAN	SLIGHTLY POLLUTED	POLLUTED
Biochemical Oxygen Demand (BOD)	91 - 100	80 - 90	0 - 79
Ammoniacal Nitrogen (NH <sub>3</sub> -N)	92 - 100	71 - 91	0 - 70
Suspended Solids (SS)	76 - 100	70 - 75	0 - 69
Water Quality Index (WQI)	81 - 100	60 - 80	0 - 59

DOE Water Quality Index Classification

PARAMETER	UNIT	CLASS				
		I	II	III	IV	V
Ammoniacal Nitrogen	mg/l	< 0.1	0.1 – 0.3	0.3 – 0.9	0.9 – 2.7	> 2.7
Biochemical Oxygen Demand	mg/l	< 1	1 – 3	3 – 6	6 – 12	> 12
Chemical Oxygen Demand	mg/l	< 10	10 – 25	25 – 50	50 – 100	> 100
Dissolved Oxygen	mg/l	> 7	5 – 7	3 – 5	1 – 3	< 1
pH	-	> 7.0	6.0 – 7.0	5.0 – 6.0	< 5.0	> 5.0
Total Suspended Solid	mg/l	< 25	25 – 50	50 – 150	150 – 300	> 300
Water Quality Index (WQI)		< 92.7	76.5 – 92.7	51.9 – 76.5	31.0 – 51.9	< 31.0

**WQI FORMULA AND CALCULATION**

**FORMULA**

WQI = (0.22 \* SIDO) + (0.19 \* SIBOD) + (0.16 \* SICOD) + (0.15 \* SIAN) + (0.16 \* SISS) + (0.12 \* SlpH)  
 where;

- SIDO = Subindex DO (% saturation)
- SIBOD = Subindex BOD
- SICOD = Subindex COD
- SIAN = Subindex NH<sub>3</sub>-N
- SISS = Subindex SS
- SlpH = Subindex pH
- 0 ≤ WQI ≤ 100

**BEST FIT EQUATIONS FOR THE ESTIMATION OF VARIOUS SUBINDEX VALUES**

**Subindex for DO (in % saturation)**

- SIDO = 0 for x ≤ 8
- SIDO = 100 for x ≥ 92
- SIDO = -0.395 + 0.030x<sup>2</sup> - 0.00020x<sup>3</sup> for 8 < x < 92

**Subindex for BOD**

- SIBOD = 100.4 - 4.23x for x ≤ 5
- SIBOD = 108 \* exp(-0.055x) - 0.1x for x > 5

**Subindex for COD**

- SICOD = -1.33x + 99.1 for x ≤ 20
- SICOD = 103 \* exp(-0.0157x) - 0.04x for x > 20

**Subindex for NH<sub>3</sub>-N**

- SIAN = 100.5 - 105x for x ≤ 0.3
- SIAN = 94 \* exp(-0.573x) - 5 \* | x - 2 | for 0.3 < x < 4
- SIAN = 0 for x ≥ 4

**Subindex for SS**

- SISS = 97.5 \* exp(-0.00676x) + 0.05x for x ≤ 100
- SISS = 71 \* exp(-0.0061x) - 0.015x for 100 < x < 1000
- SISS = 0 for x ≥ 1000

**Subindex for pH**

- SlpH = 17.2 - 17.2x + 5.02x<sup>2</sup> for x < 5.5
- SlpH = -242 + 95.5x - 6.67x<sup>2</sup> for 5.5 ≤ x < 7
- SlpH = -181 + 82.4x - 6.05x<sup>2</sup> for 7 ≤ x < 8.75
- SlpH = 536 - 77.0x + 2.76x<sup>2</sup> for x ≥ 8.75

Note:

\* means multiply with

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