Malaysia Environmental Quality Report

2008

Department of Environment
Ministry of Natural Resources and Environment
Malaysia

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Foreword

It is my pleasure to present The Environmental Quality Report 2008 as required under Section 3(1)(i) of the Environmental Quality Act 1974.

The quality of the environment with respect to overall air quality remained good to moderate most of the time. There was a slight improvement in the air quality as indicated by increasing number of good air quality days recorded in 2008 at 59% compared to 56% in 2007 as a result of more intensified surveillance and preventive measures. The wetter than normal weather conditions experienced in the region had also to some extent influenced the above situation. There was no transboundary haze pollution observed in 2008.

Compared to 2007, there was a slight deterioration in river and marine water quality in 2008. The number of clean river basins has decreased from 91 rivers to 76 while the number of slightly polluted river basins has increased from 45 to 60. The number of polluted river basins remained at 7. Increased in the number of pollution sources and pollution load contributed to the degrading water quality especially during the drier months of the year. Meanwhile, main contaminants of coastal waters have increased namely suspended solids, *Escherichia coli*, oil and grease in the range of 6 to 18 percent.

A new programme namely the Notification and Registration of Environmental Hazardous Substances was launched to further enhance the existing management of environmental hazardous substances including chemicals. With the programme in place, the Malaysian Chemicals Register was established that comprises information on the identity of substances, their uses, hazard classification and accumulated amounts in the country.

The main challenge for the Department of Environment is to find effective ways and means to increase community sensitivity and commitment as well as enhancing the latter's role and responsibility towards safeguarding the environment. Efforts taken by the Department alone would be ineffective if there is no corresponding participation by the general public to respond, in an environmentally responsible and conscientious manner. Existing values, systems and attitudes need to be reviewed and changed and more environment friendly lifestyle practiced. The environment needs the commitment from everyone to walk the talk.

"Environmental Conservation, Our Shared Responsibility"

With best wishes,

Dato' Hajah Rosnani Ibarahim
Director General of Environmental Quality
Malaysia
31st July 2009

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chapter 1

Air Quality

AIR QUALITY MONITORING

The Department of Environment (DOE) monitors the country's ambient air quality through a network of 51 continuous monitoring 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.

Refreshingly Cool (DOE Photo Library)

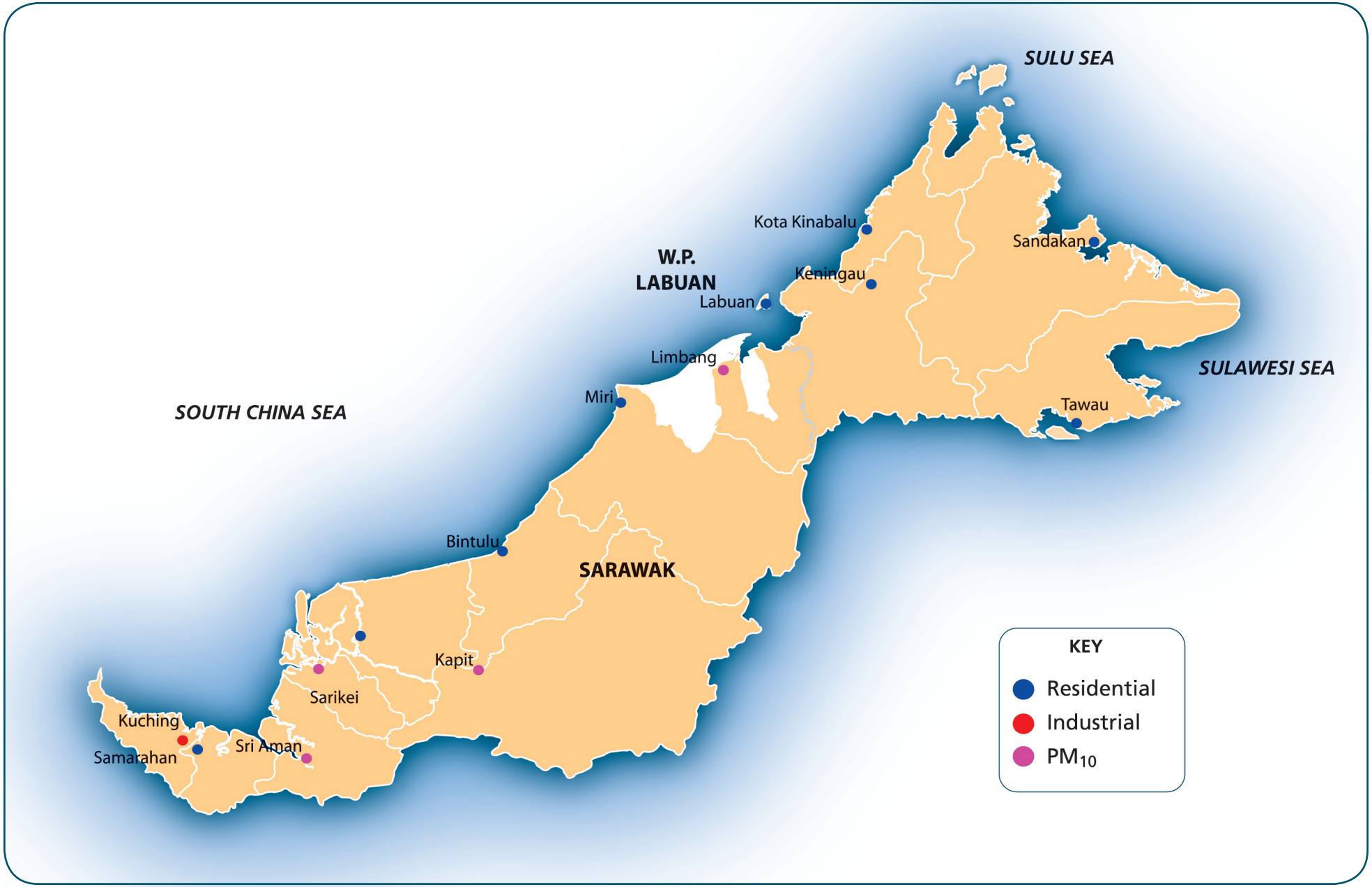
Table 1.1 Malaysia : Air Pollutant Index (API)

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

In addition to the 51 stations in the National Continuous Air Quality Monitoring Network, manual air quality monitoring stations using High Volume Samplers were also established at 21 different sites for measuring total suspended particulates, particulate matter (PM_{10}) and heavy metals such as lead. The air quality status is reported in terms of Air Pollutant Index (API).

The air pollutants used in computing the API are ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and particulate matter of less than 10 microns in size (PM_{10}). The API is categorized as good, moderate, unhealthy, very unhealthy and hazardous as presented in **Table 1.1.**

Map 1.1 Malaysia : Location of Continuous Air Quality Monitoring Stations, Peninsular Malaysia, 2008



Map 1.2 Malaysia : Location of Continuous Air Quality Monitoring Stations, East Malaysia, 2008

City Skyline (DOE Photo Library)

AIR QUALITY STATUS

Based on the Air Pollutant Index (API), the overall air quality in 2008 was between good to moderate levels most of the time. There was a slight improvement in the air quality as indicated by the increasing number of good air quality days recorded in 2008 (59 percent of the time) compared to that in 2007 (56 percent) while remaining 40 percent at moderate level and only (1) percent at unhealthy level. This is partly attributed to an intensified surveillance programme and preventive measures undertaken by the Department to improve the air quality status in the country. The wet weather conditions experienced in the region had

Table 1.2 Malaysia : Ambient Air Quality Guidelines

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

Note : **(mg/m^3)

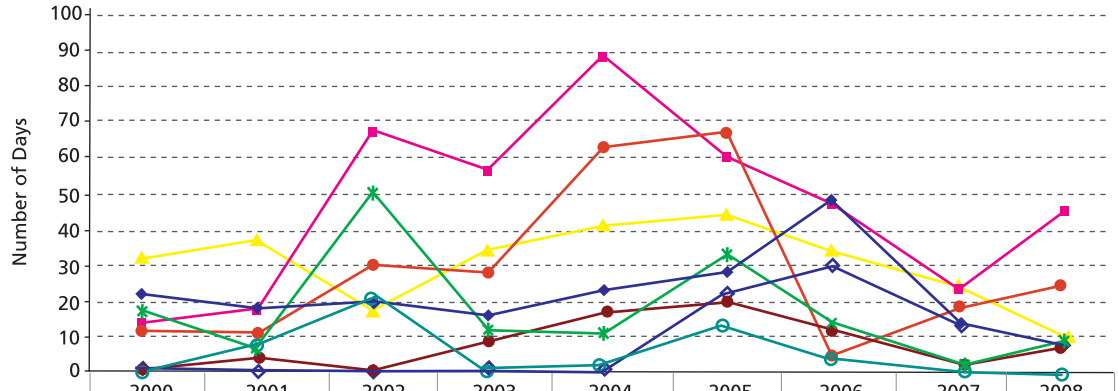
also to some extend influence the above situation. No transboundary haze pollution was observed in 2008.

The annual average concentrations of air pollutants measured namely CO, NO_2, O_3, SO_2 and PM_{10} were found to be below the stipulated levels of the Malaysian Ambient Air Quality Guidelines. (**Table 1.2**)

Besides PM_{10}, O_3 remained the pollutant of concerned due to the conducive atmospheric conditions and emission from motor vehicles in urban areas that enhance its formation. These resulted in several unhealthy days recorded at various locations in the Klang Valley and in the States of Negeri Sembilan, Perak, Kedah, Pulau Pinang and Johor.

On some days the daily maximum 1-hour concentration of O_3 exceeded the Malaysian Ambient Air Quality Guidelines for several stations in the Klang Valley, as shown in **Figure 1.1(a)** and **Figure 1.1(b)**. These conditions lead to a number of unhealthy days recorded in those stations located in areas of central business districts with heavy traffic volume.

With respect to PM_{10}, the daily concentrations of PM_{10} in Klang occasionally exceeded the guidelines value as shown in **Figure 1.1(c)** due to unfavourable weather conditions of hot and dry periods. However the daily concentrations of PM_{10} in other areas were found to be in compliance to the Malaysian Ambient Air Quality Guidelines. **Figure 1.1(d)** shows the daily concentrations of PM_{10} for Klang in comparison with selected stations in sub-urban and rural areas which recorded lower levels of PM_{10}.



	2000	2001	2002	2003	2004	2005	2006	2007	2008
Gombak	22	19	20	16	23	28	48	13	8
Shah Alam	14	19	67	56	88	60	47	23	44
Kajang	32	37	17	34	41	44	34	24	11
Kuala Lumpur	12	11	30	28	63	67	5	19	24
Klang	17	7	50	12	11	33	14	2	8
Petaling Jaya	0	4	0	9	17	20	12	2	7
Kuala Selangor	0	8	21	0	2	13	4	0	0
Putrajaya	0	0	0	1	1	22	30	13	13

Figure 1.1 Malaysia : Number of Unhealthy Days, Klang Valley, 2000 - 2008

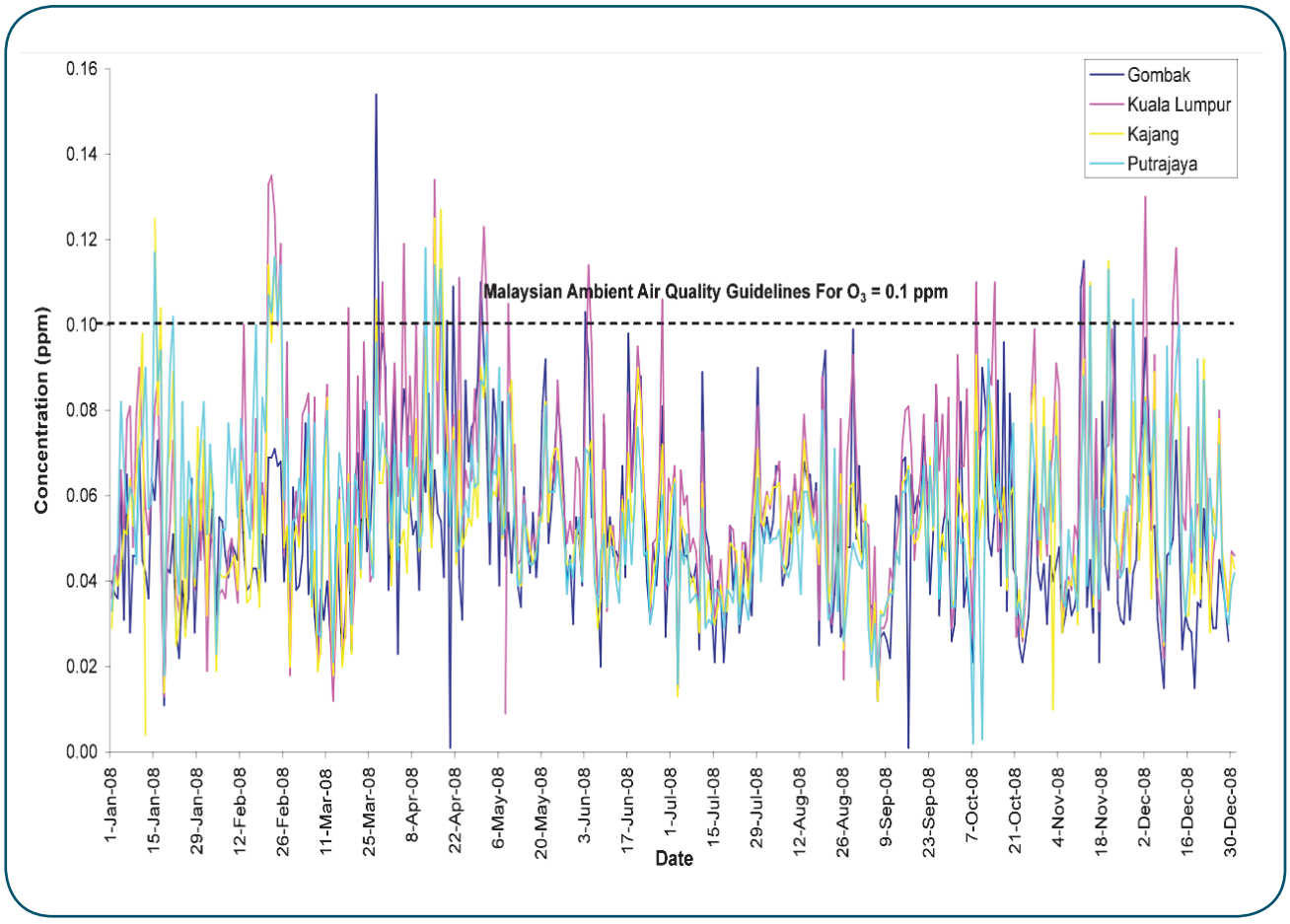


Figure 1.1(a) Malaysia : Trend of Daily Maximum 1-hour Concentration of Ozone (O_3), Klang Valley, 2008

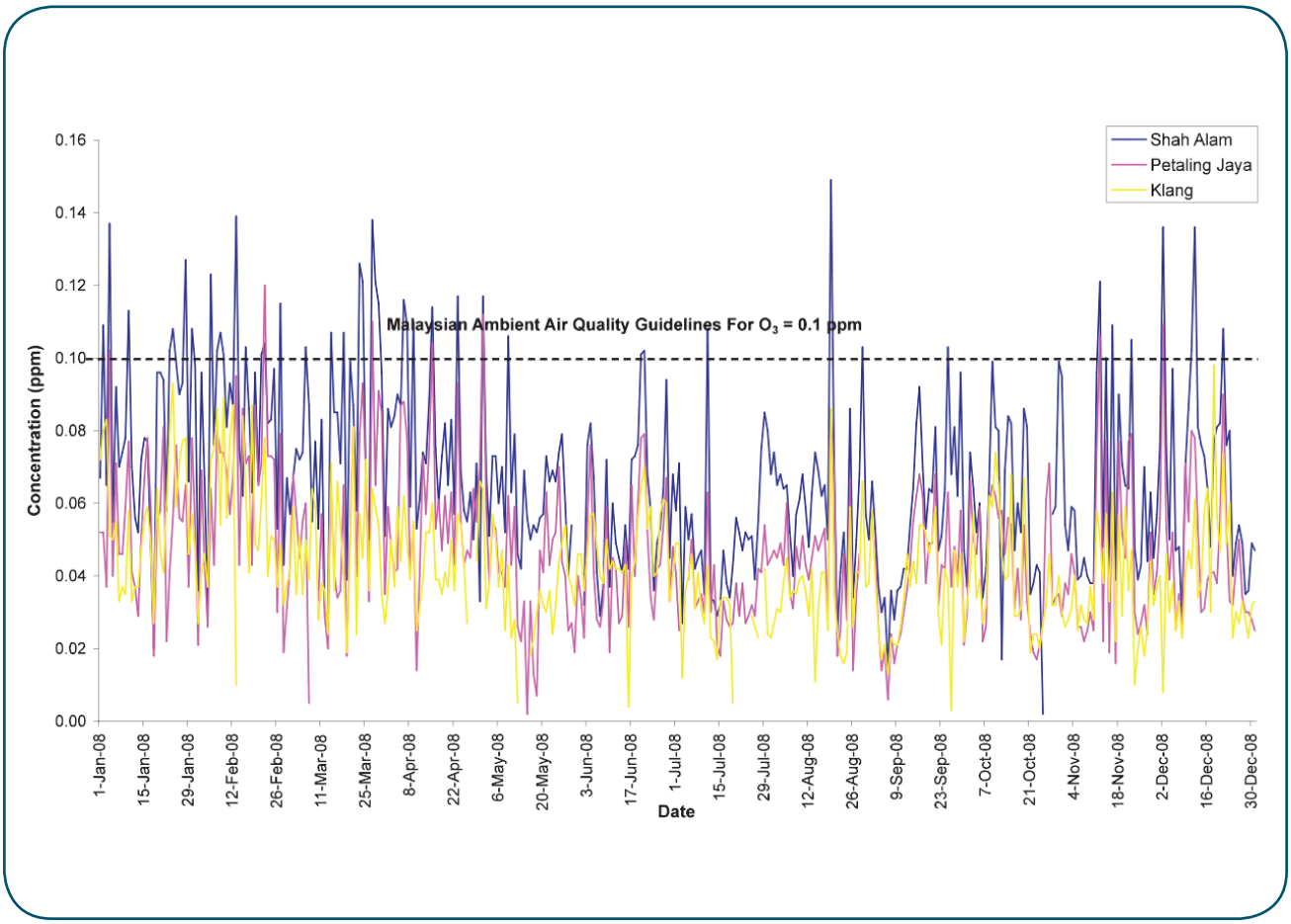


Figure 1.1(b) Malaysia : Trend of Daily Maximum 1-hour Concentration of Ozone (O_3), Klang Valley, 2008

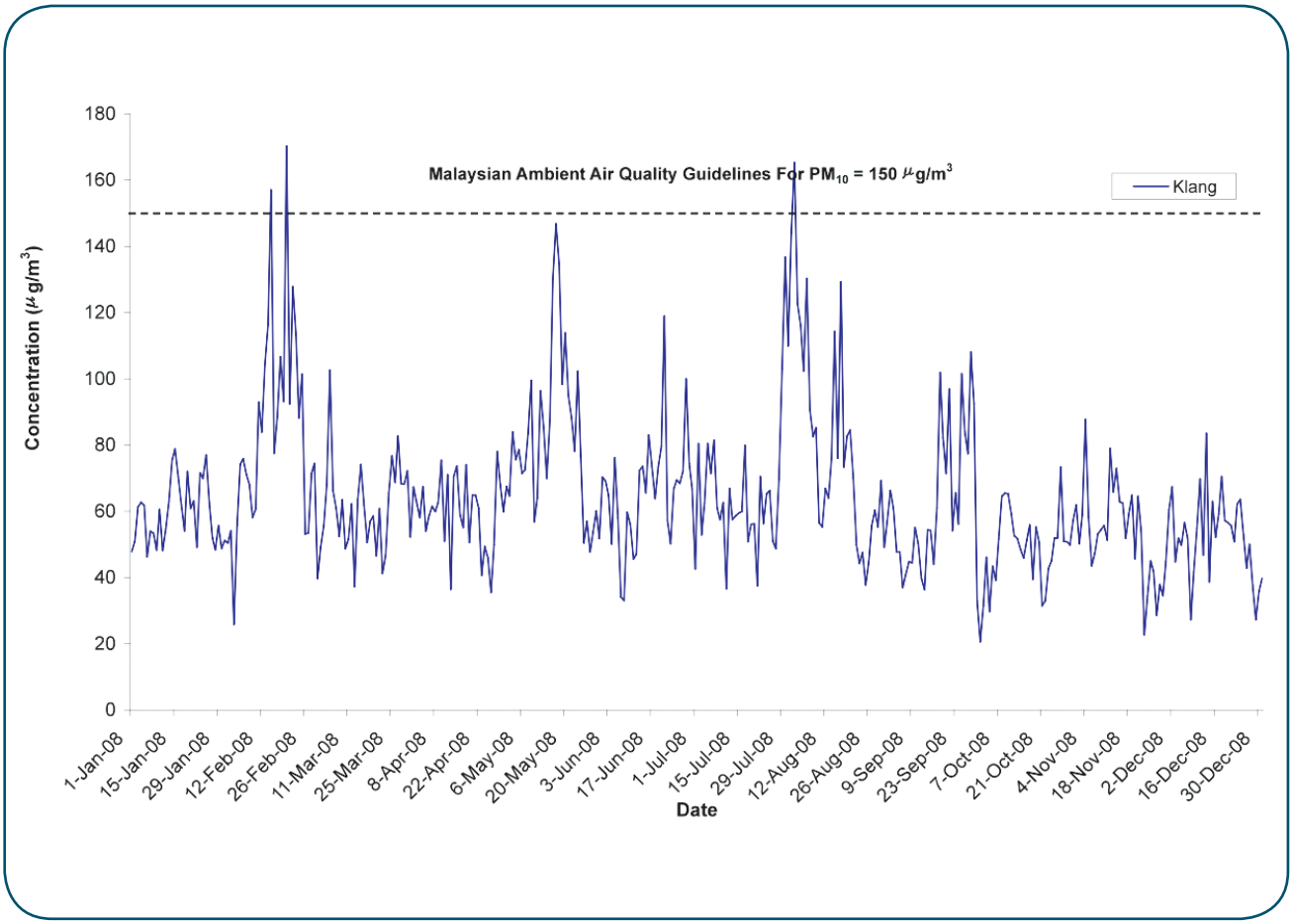


Figure 1.1(c) Malaysia : Trend of 24-hour Concentration of Particulate Matter (PM_{10}), Klang, 2008

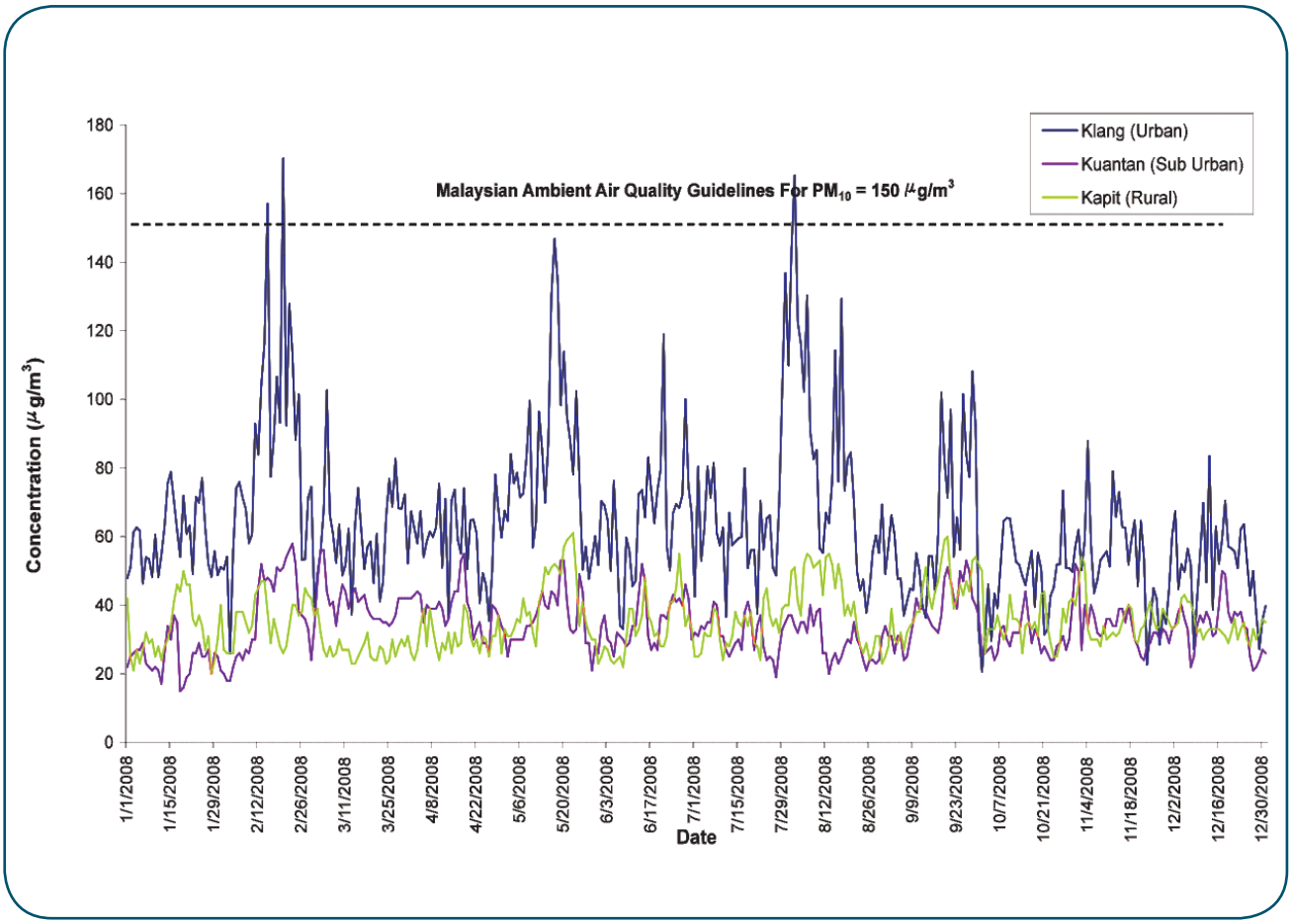


Figure 1.1(d) Malaysia : Trend of 24-hour Concentration of Particulate Matter (PM_{10}), Klang and Selected Sub Urban/Rural Areas, 2008

Air Quality Status in the West Coast

Klang Valley

In 2008, the air quality in the Klang Valley was good 33 percent of the time, moderate 63 percent and the remaining four (4) percent at an unhealthy level. The highest number of unhealthy days was recorded in Shah Alam (44 days) (**Figure 1.1**), compared to 24 days in Kajang in 2007. The unhealthy days recorded were due to the ground level Ozone (O_3). In Klang area, the unhealthy days were caused by PM due to peatland burning during the dry period. The overall air quality status in Klang Valley is shown in **Figure 1.2**.

Northern Region

The overall air quality of the northern region of the West Coast of Malaysia (Perlis, Kedah, Pulau Pinang and Perak), was between good to moderate most of the time. However, Tanjung Malim recorded 18 unhealthy days while Sungai Petani recorded two (2) unhealthy days and Tasek recorded four (4) unhealthy days. The pollutant of concerned was ground level Ozone (O_3).

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 recorded in Nilai (2 days) Larkin (1 day), Seremban (1 day), Port Dickson (2 days), Johor Bahru (2 days) and Pasir Gudang (4 days). The pollutant of concerned was ground level Ozone (O_3). **Figure 1.3** shows the overall air quality status for the West Coast of Peninsular Malaysia.

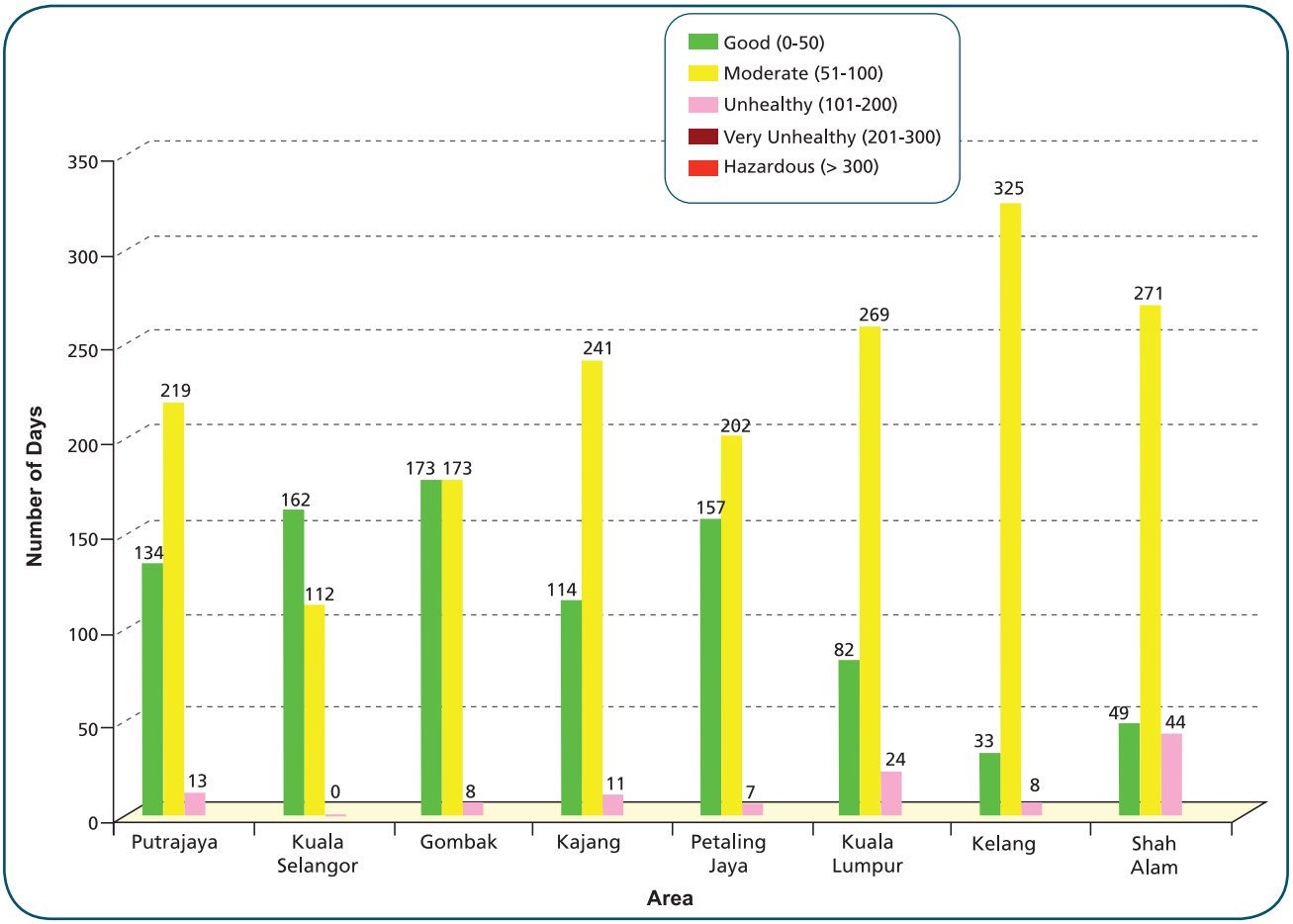


Figure 1.2 Malaysia : Klang Valley Air Quality Status, 2008

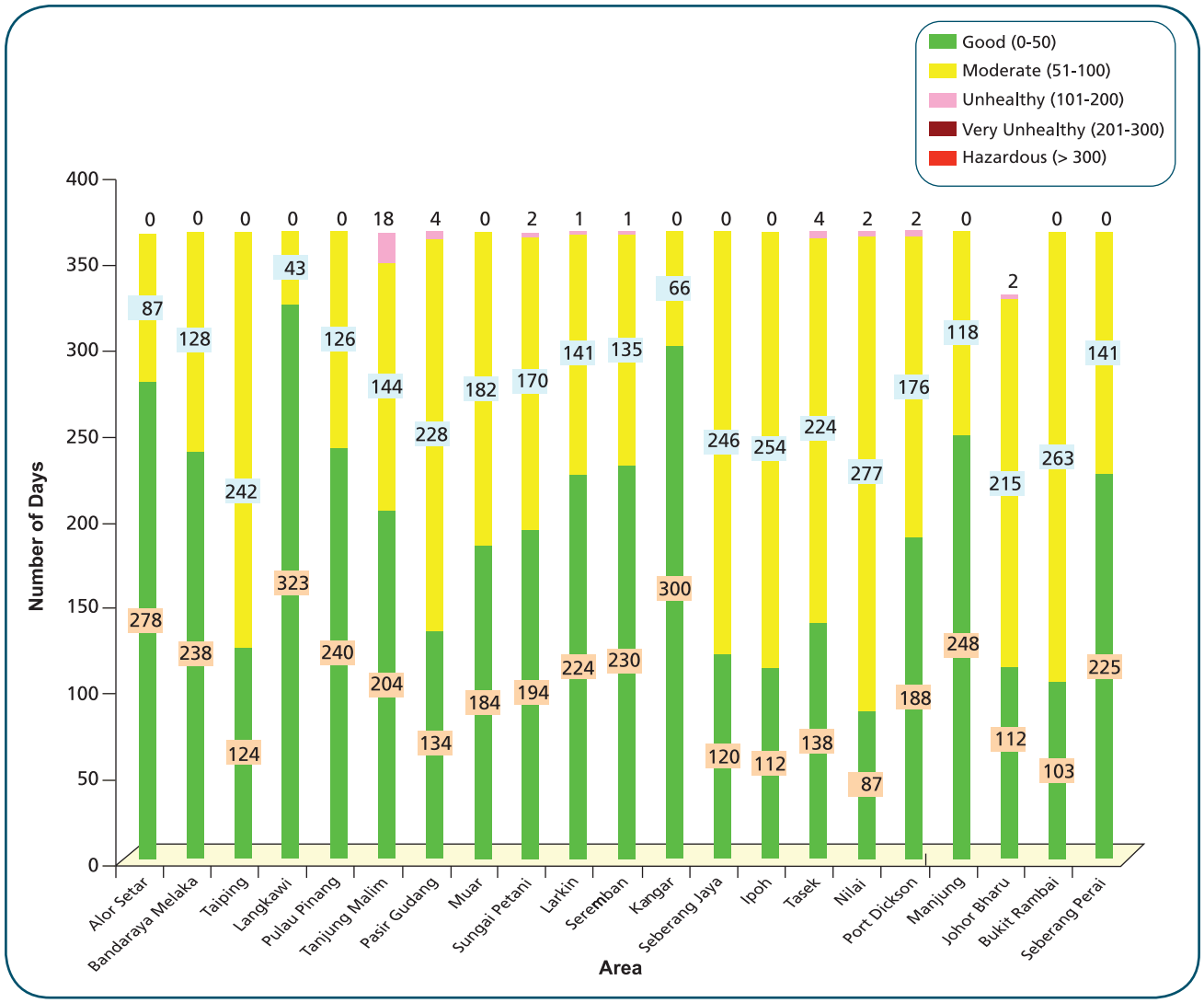


Figure 1.3 Malaysia : Air Quality Status, West Coast Peninsular Malaysia, 2008

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 days were recorded. The overall air quality status in the East Coast of Peninsular Malaysia 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. No unhealthy day was recorded in 2008. The overall air quality status in Sabah, Labuan and Sarawak is shown in **Figure 1.5**.

AIR QUALITY TREND

Six(6) air pollutants, namely Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Ozone (O_3), Sulphur Dioxide (SO_2) and Particulate Matter (PM_{10}) 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 of 1998 to 2008 was computed by averaging direct measurements from the monitoring sites on a yearly basis and cross-referenced with the Malaysian Ambient Air Quality Guidelines as shown in **Table 1.2**.

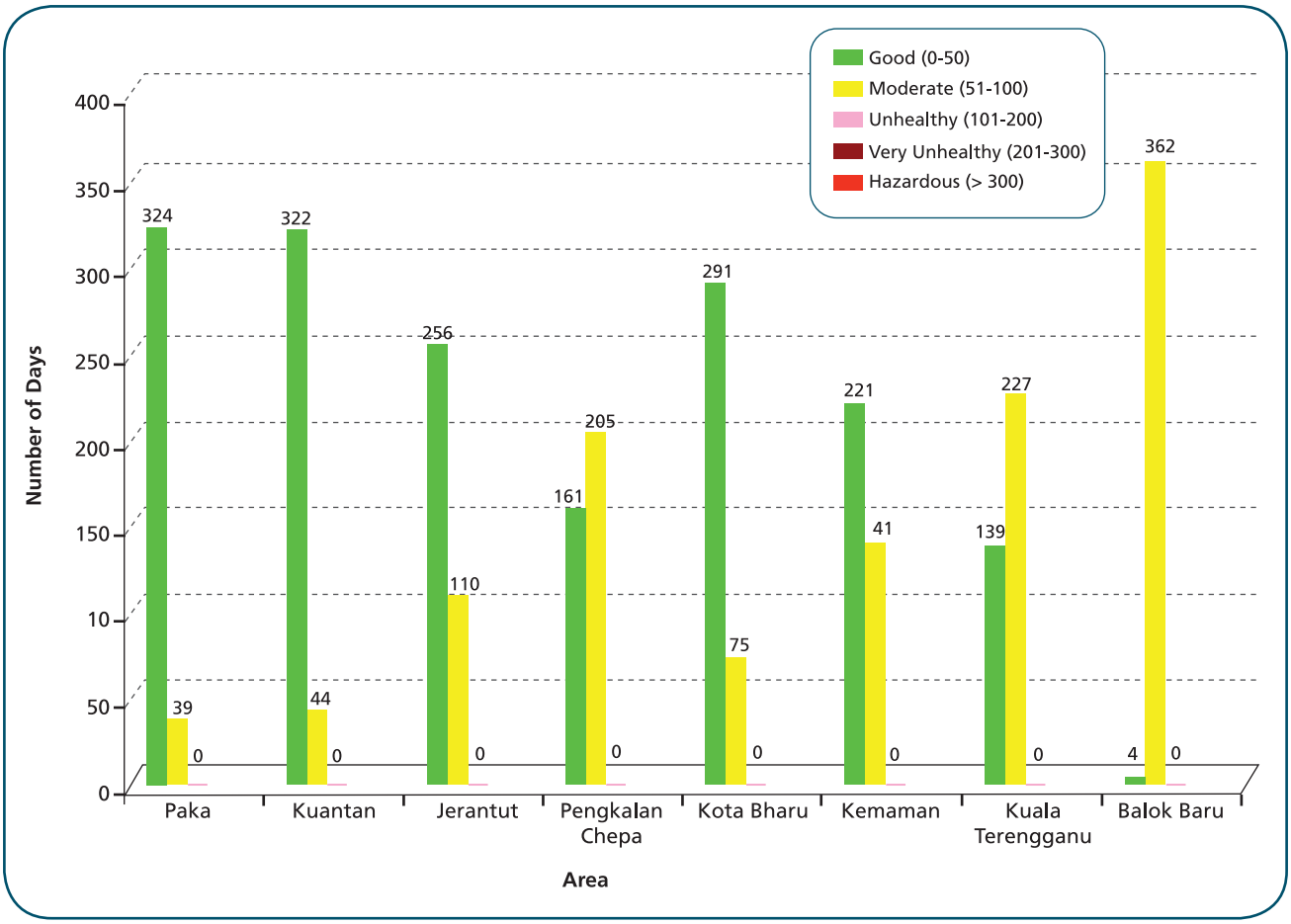


Figure 1.4 Malaysia : Air Quality Status, East Coast Peninsular Malaysia, 2008

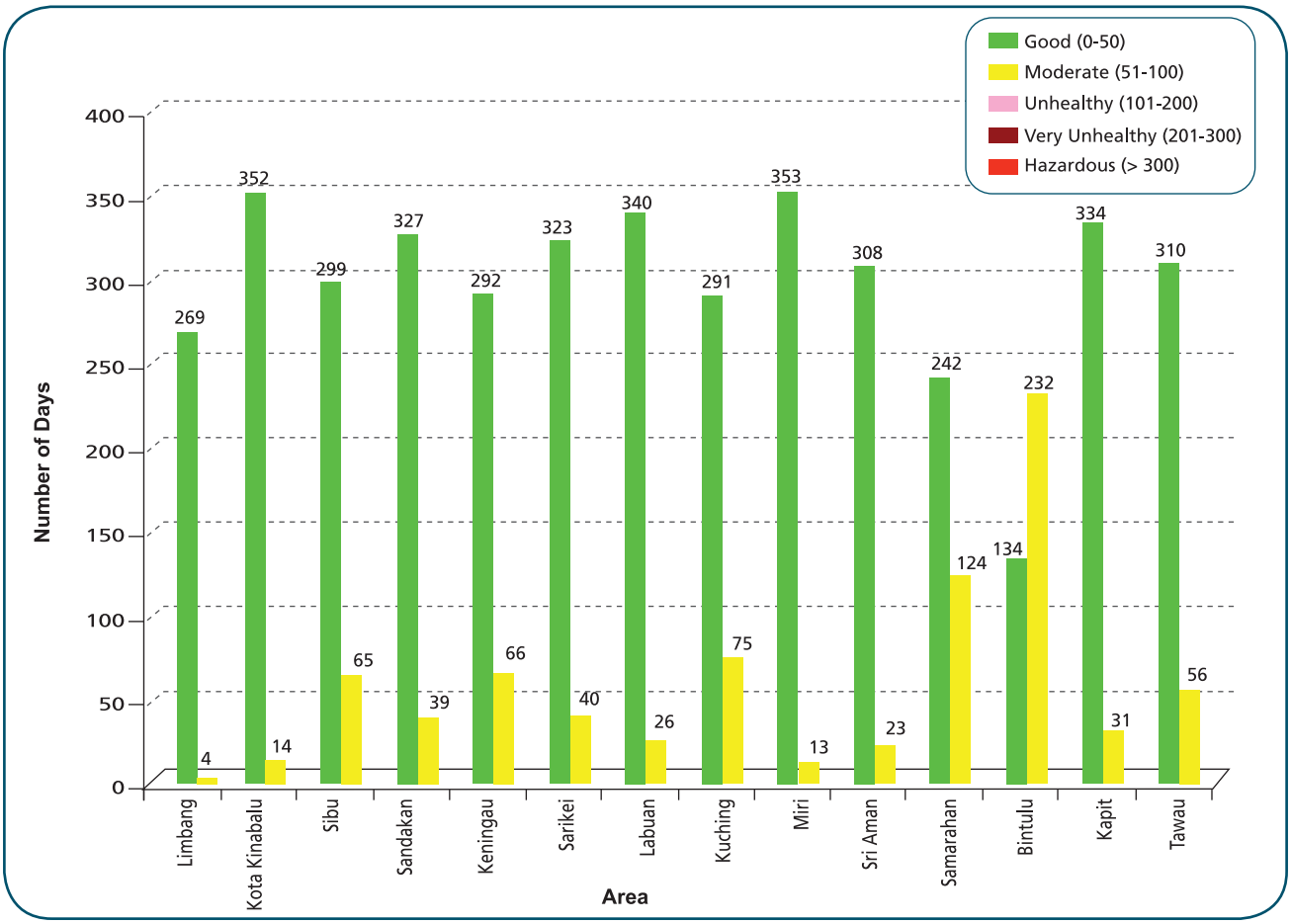


Figure 1.5 Malaysia : Air Quality Status in Sabah, Labuan and Sarawak, 2008

Particulate Matter (PM_{10})

In 2008 the annual average value of PM_{10} was 42 ug/m^3 which is below the Malaysian Ambient Air Quality Guidelines value of 50 ug/m^3. There was no significant change compared to the annual average value of PM_{10} (43 ug/m^3) in 2007.

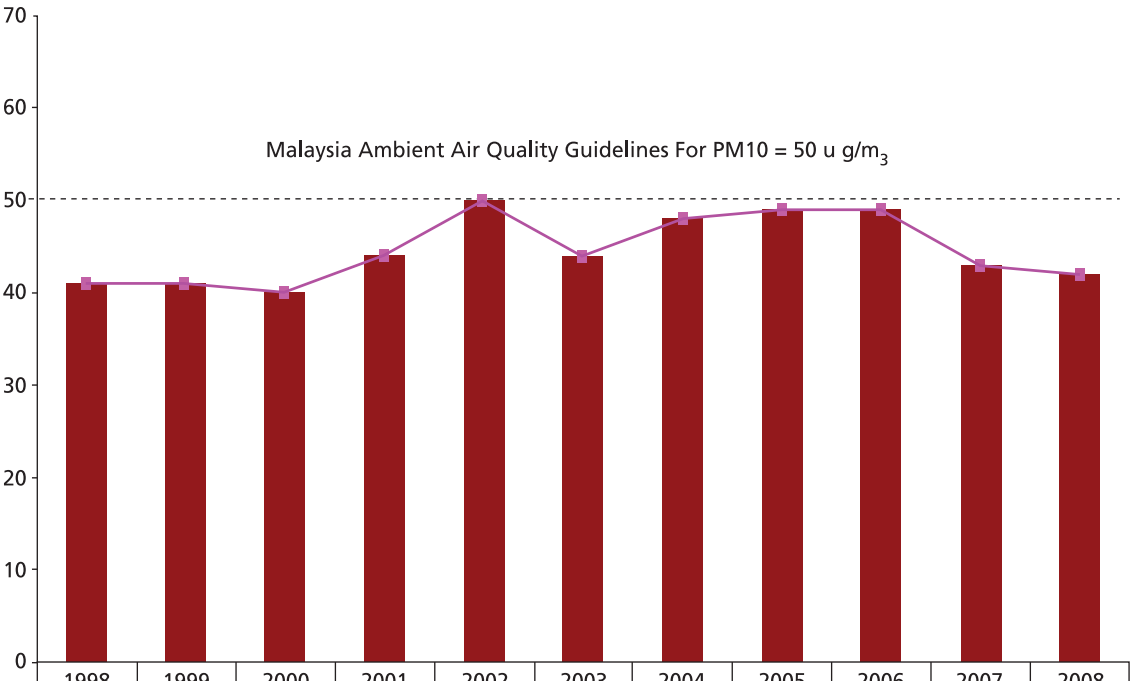
The trend of the annual average levels of PM_{10} concentration in the ambient air between 1998 and 2008 complited to the Malaysian Ambient Air Quality Guidelines as shown in **Figure 1.6**. Based on land use categories, PM_{10} concentration was also below the Malaysian Ambient Air Quality Guidelines as shown in **Figure 1.6(a)**.

Sulphur Dioxide (SO_2)

Generally the annual average SO_2 concentration shows a declining trend between 1998 and 2008 (**Figure 1.7**). It is well below the Malaysian Ambient Air Quality Guidelines. This could be attributed to stricter enforcement by the DOE as well as more widely use of natural gas for industrial combustion process and vehicles. **Figure 1.7(a)** shows the annual average concentrations of sulphur dioxide for different categories of land use.

Nitrogen Dioxide (NO_2)

In 2008, the NO_2 concentration increased by six (6) percent from the 2007 levels. The NO_2 concentrations remain high in urban and industrial areas mainly due to a significant increase in the number of motor vehicles and combustion processes from industrial sources. Estimate on NO_X emission load indicates 49 percent is from motor vehicles , 48 percent from power stations and industries and the remaining there (3) percent from other sources. The annual average



	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Concentration	41	41	40	44	50	44	48	49	49	43	42
Number of Sites	37	45	60	50	50	51	51	51	51	51	51

Figure 1.6 Malaysia : Annual Average Concentration of Particulate Matter (PM_{10}), 1998 - 2008

concentrations of NO_2 in the ambient air from 1998 to 2008 remains almost constant but well below the Malaysian Ambient Air Quality Guidelines. (**Figure 1.8** and **Figure 1.8(a)**

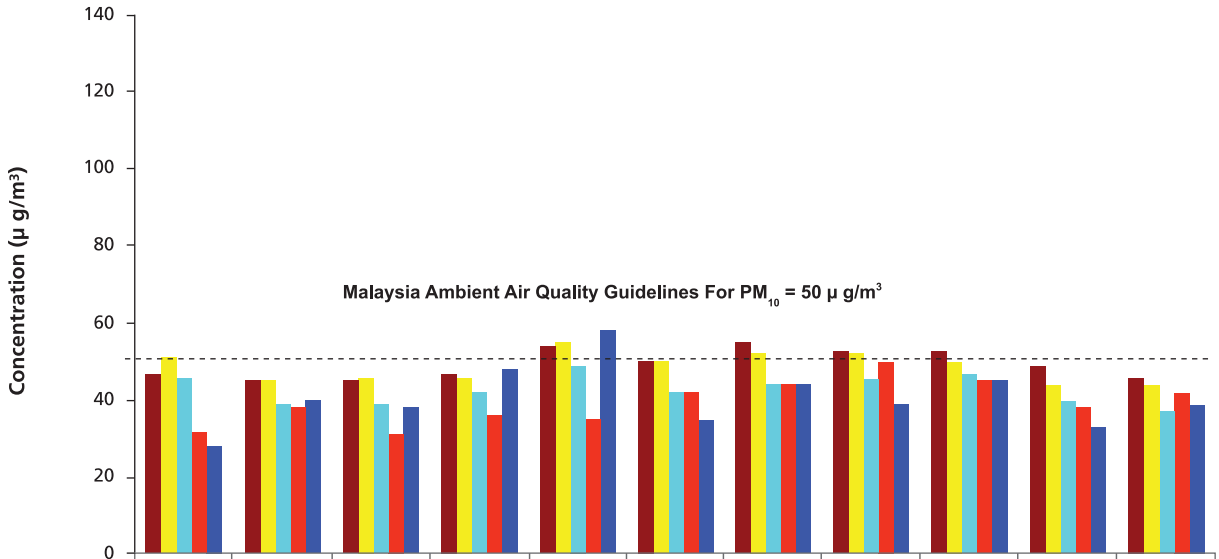
Ground Level Ozone (O_3)

In 2008, the annual average daily maximum one-hour O_3 concentrations increased by half (0.5) percent compared to 2007. The annual average daily maximum one-hour O_3 concentrations in ambient air for 1998 to 2008 remain almost constant and but well below the Malaysian Ambient Quality Guidelines as shown in **Figure 1.9. Figure 1.9(a)** shows the O_3 concentration for various land use categories between 1998 and 2008. Urban areas recorded higher levels of O_3 due to higher traffic volume and a conducive atmospheric condition resulting in its formation.

Carbon Monoxide (CO)

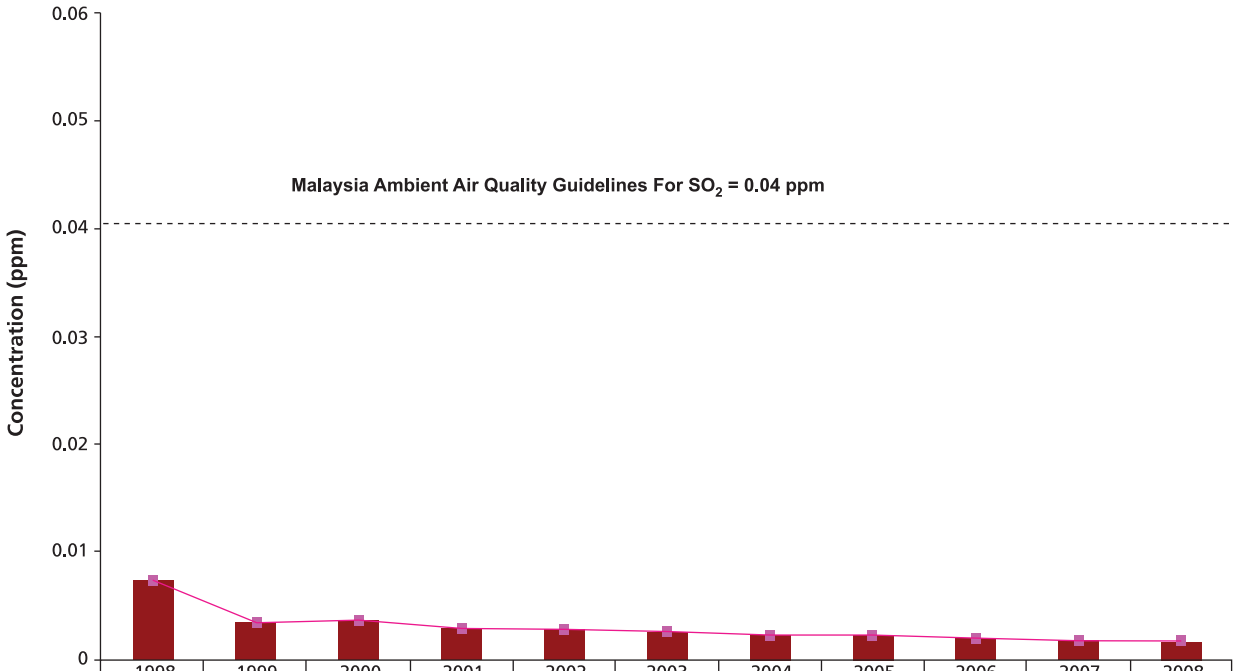
There was an almost five (5) percent increased in CO levels in 2008 compared to 2007. However the trend of CO concentration from 1998 to 2008 remains almost constant. The levels recorded were well below the Malaysian Ambient Air Quality Guidelines (**Figure 1.10**). In urban areas the concentration of CO was higher where the main sources of emission were motor vehicles which contributed to 97 percent of CO emission load. **Figure 1.10(a)** shows CO concentrations for various categories of land use.

Blue Skies : Haze Free (DOE Photo Library)



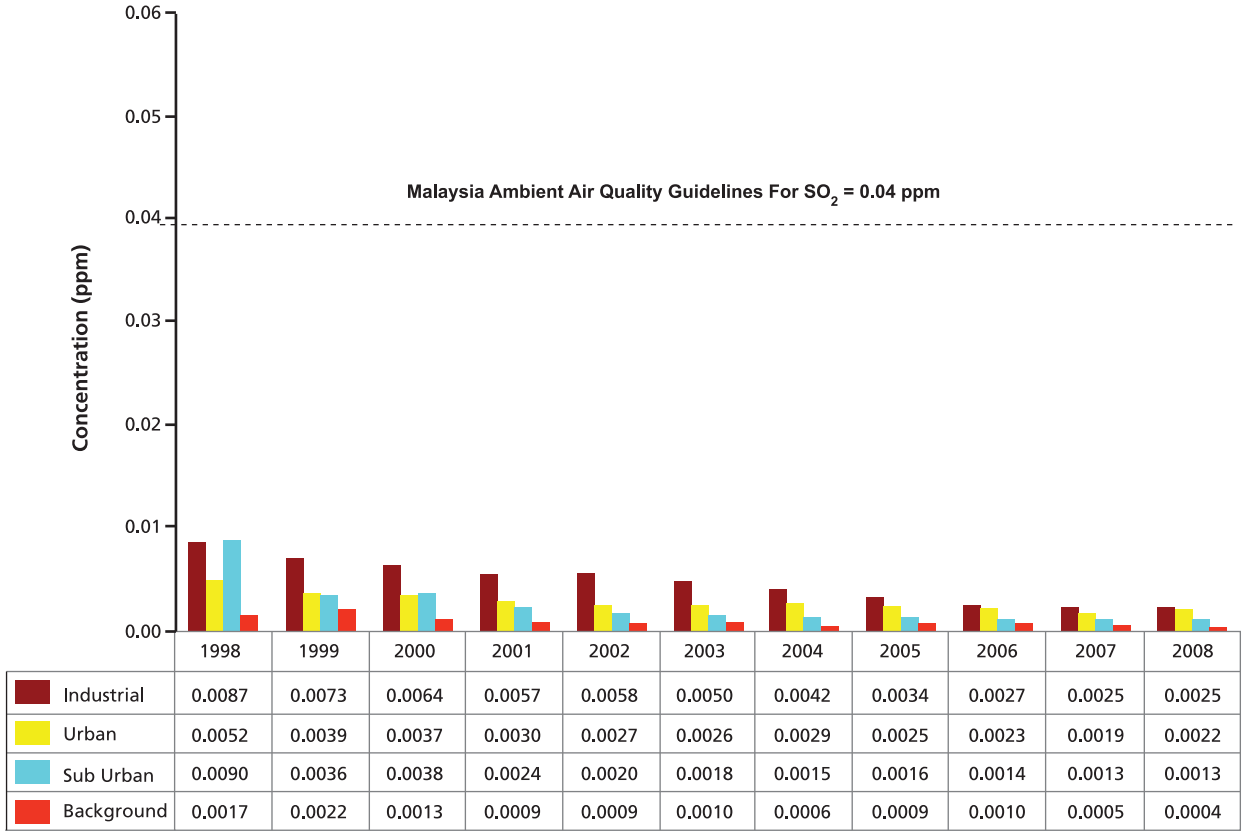
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Industrial	47	45	45	47	54	50	55	53	53	49	46
Urban	51	45	46	46	55	50	52	52	50	44	44
Sub Urban	46	39	39	42	49	42	44	46	47	40	37
Background	32	38	31	36	35	42	44	50	45	38	42
Rural	28	40	38	48	58	35	44	39	45	33	39

Figure 1.6(a) Malaysia : Annual Average Concentration of Particulate Matter (PM_{10}) by Land Use, 1998-2008



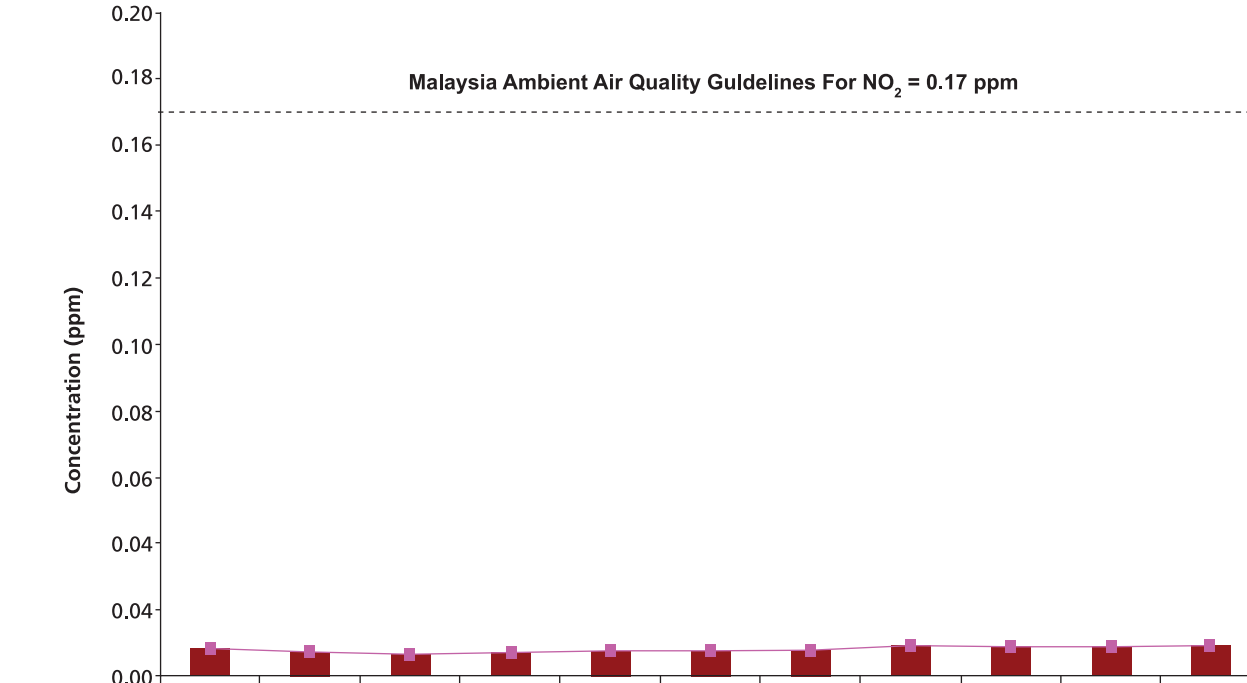
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Concentration	0.0074	0.0035	0.0038	0.003	0.0029	0.0025	0.0023	0.0024	0.0021	0.0019	0.0018
Number of Sites	0.27	33	39	43	43	43	44	44	44	44	44

Figure 1.7 Malaysia : Annual Average Concentration of Sulphur Dioxide (SO_2) 1998-2008



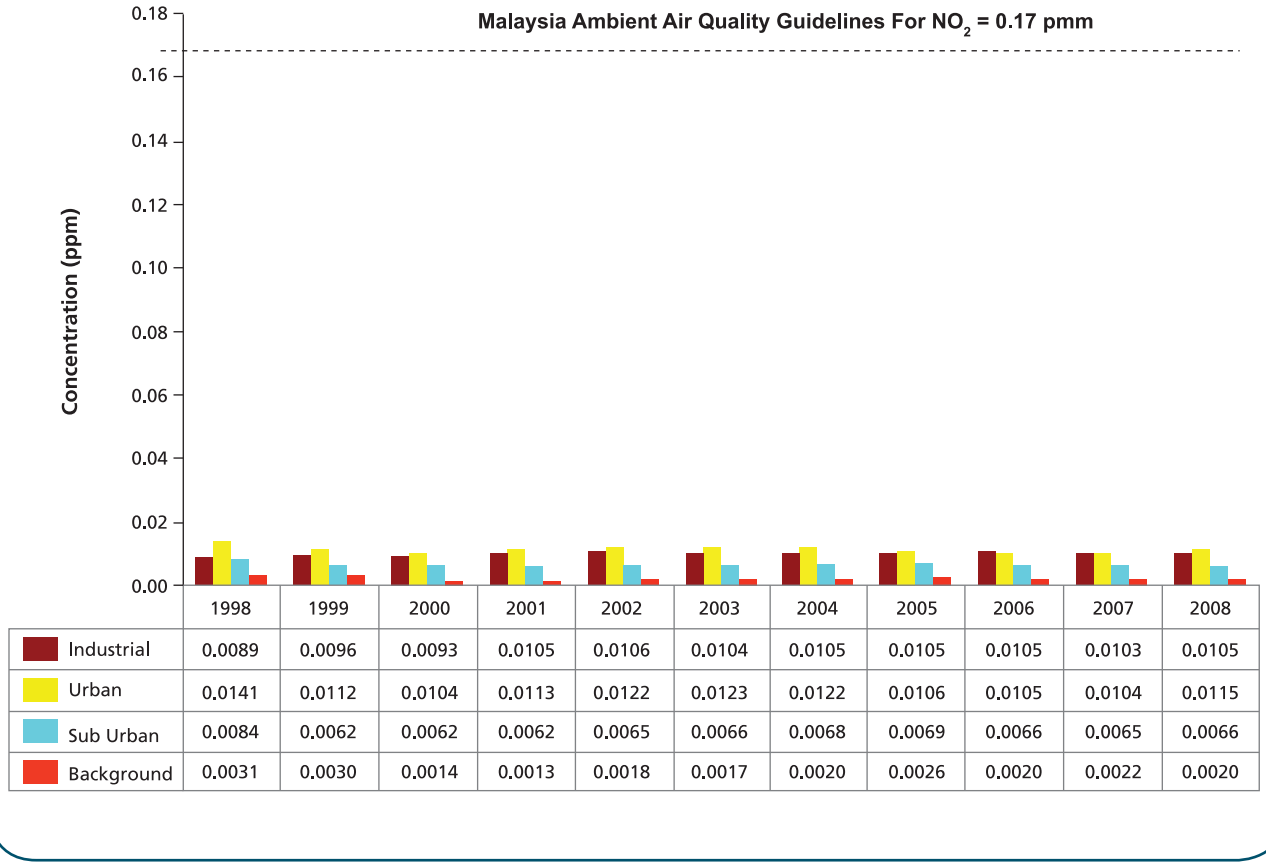
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Industrial	0.0087	0.0073	0.0064	0.0057	0.0058	0.0050	0.0042	0.0034	0.0027	0.0025	0.0025
Urban	0.0052	0.0039	0.0037	0.0030	0.0027	0.0026	0.0029	0.0025	0.0023	0.0019	0.0022
Sub Urban	0.0090	0.0036	0.0038	0.0024	0.0020	0.0018	0.0015	0.0016	0.0014	0.0013	0.0013
Background	0.0017	0.0022	0.0013	0.0009	0.0009	0.0010	0.0006	0.0009	0.0010	0.0005	0.0004

Figure 1.7(a) Malaysia : Annual Average Concentration of Sulphur Dioxide (SO_2) by Land Use, 1998-2008



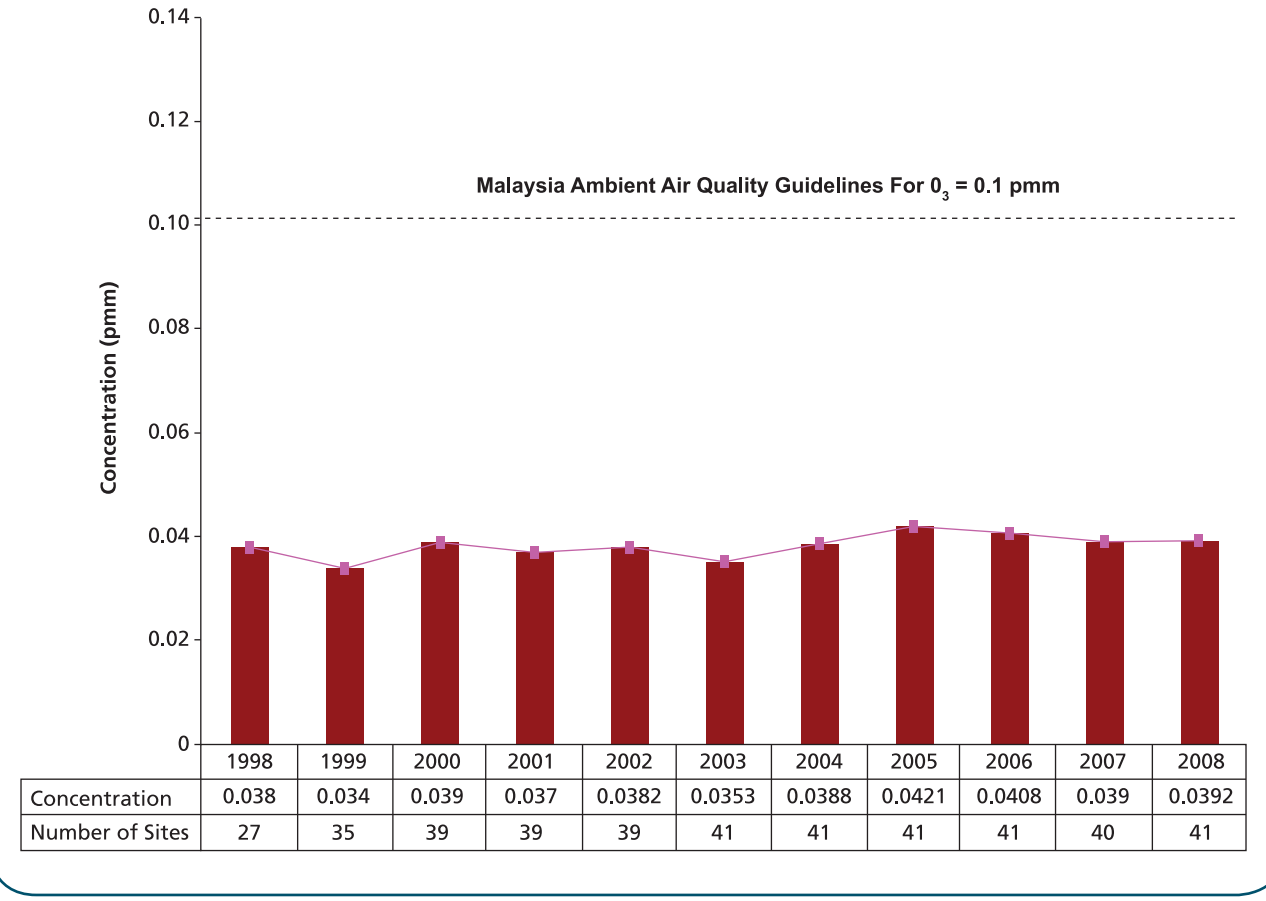
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Concentration	0.0086	0.0074	0.0068	0.0073	0.0078	0.0078	0.0079	0.0095	0.0091	0.0089	0.0094
Number of Sites	27	33	39	43	43	43	44	44	44	44	44

Figure 1.8 Malaysia : Annual Average Concentration of Nitrogen Dioxide (NO_2), 1998-2008



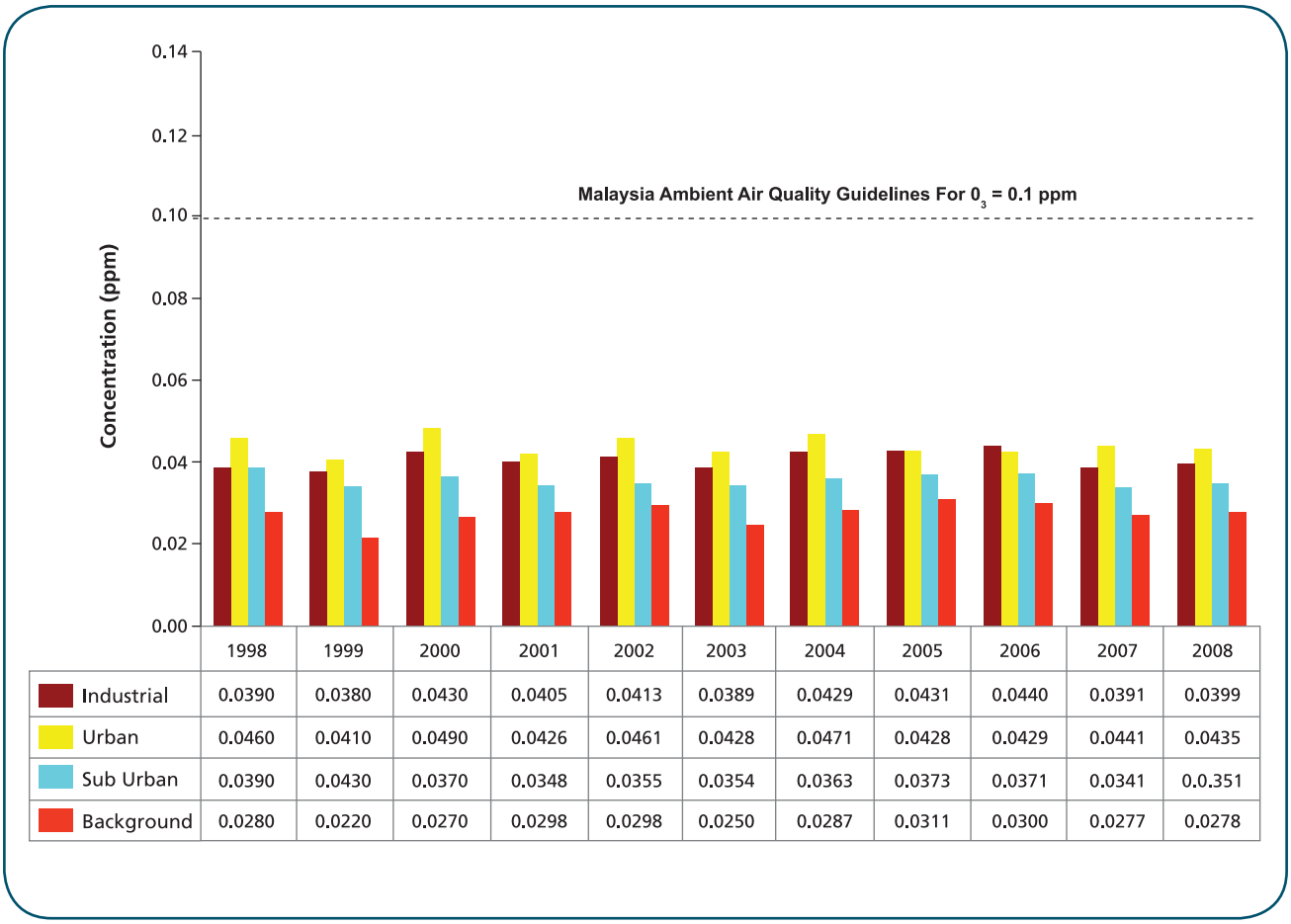
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Industrial	0.0089	0.0096	0.0093	0.0105	0.0106	0.0104	0.0105	0.0105	0.0105	0.0103	0.0105
Urban	0.0141	0.0112	0.0104	0.0113	0.0122	0.0123	0.0122	0.0106	0.0105	0.0104	0.0115
Sub Urban	0.0084	0.0062	0.0062	0.0062	0.0065	0.0066	0.0068	0.0069	0.0066	0.0065	0.0066
Background	0.0031	0.0030	0.0014	0.0013	0.0018	0.0017	0.0020	0.0026	0.0020	0.0022	0.0020

Figure 1.8(a) Malaysia : Annual Average Concentration of Nitrogen Dioxide (NO_2) by Land Use, 1998-2008



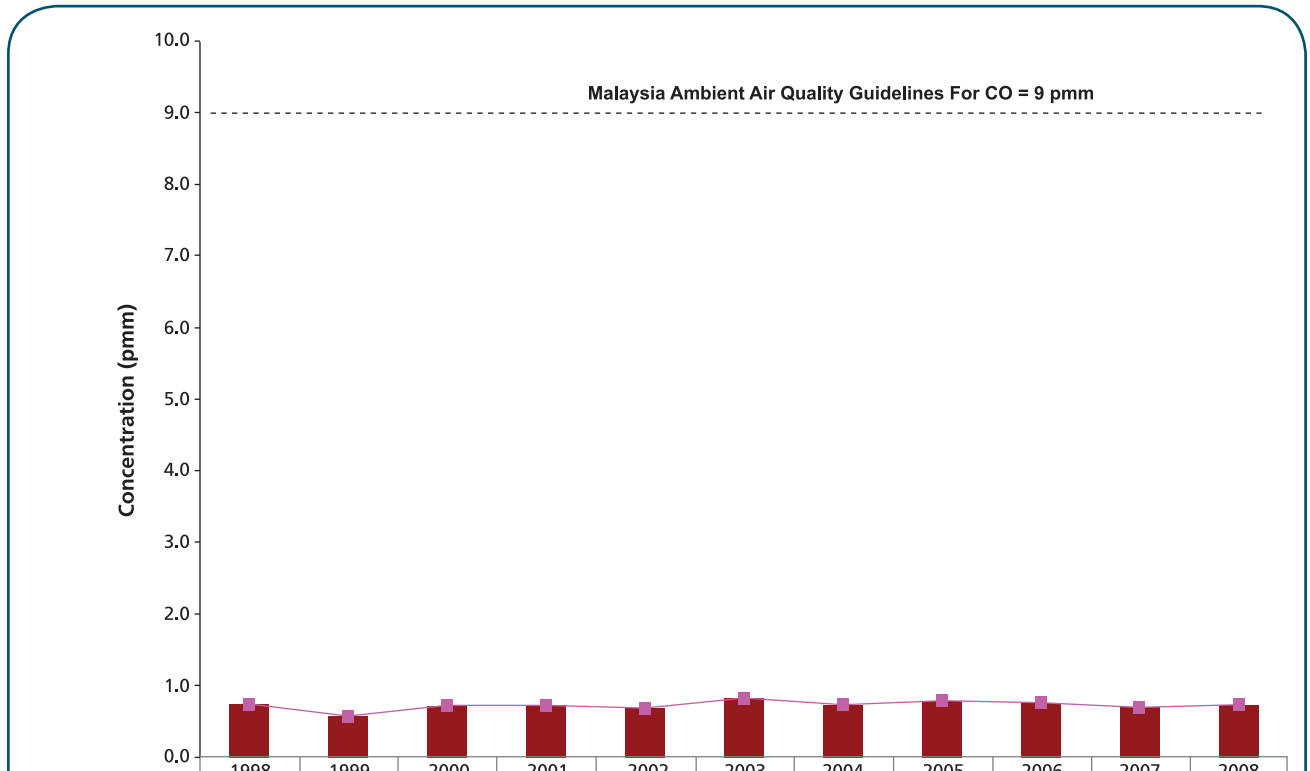
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Concentration	0.038	0.034	0.039	0.037	0.0382	0.0353	0.0388	0.0421	0.0408	0.039	0.0392
Number of Sites	27	35	39	39	39	41	41	41	41	40	41

Figure 1.9 Malaysia : Annual Average Daily Maximum 1 Hour Concentration of Ozone (O_3), 1998-2008



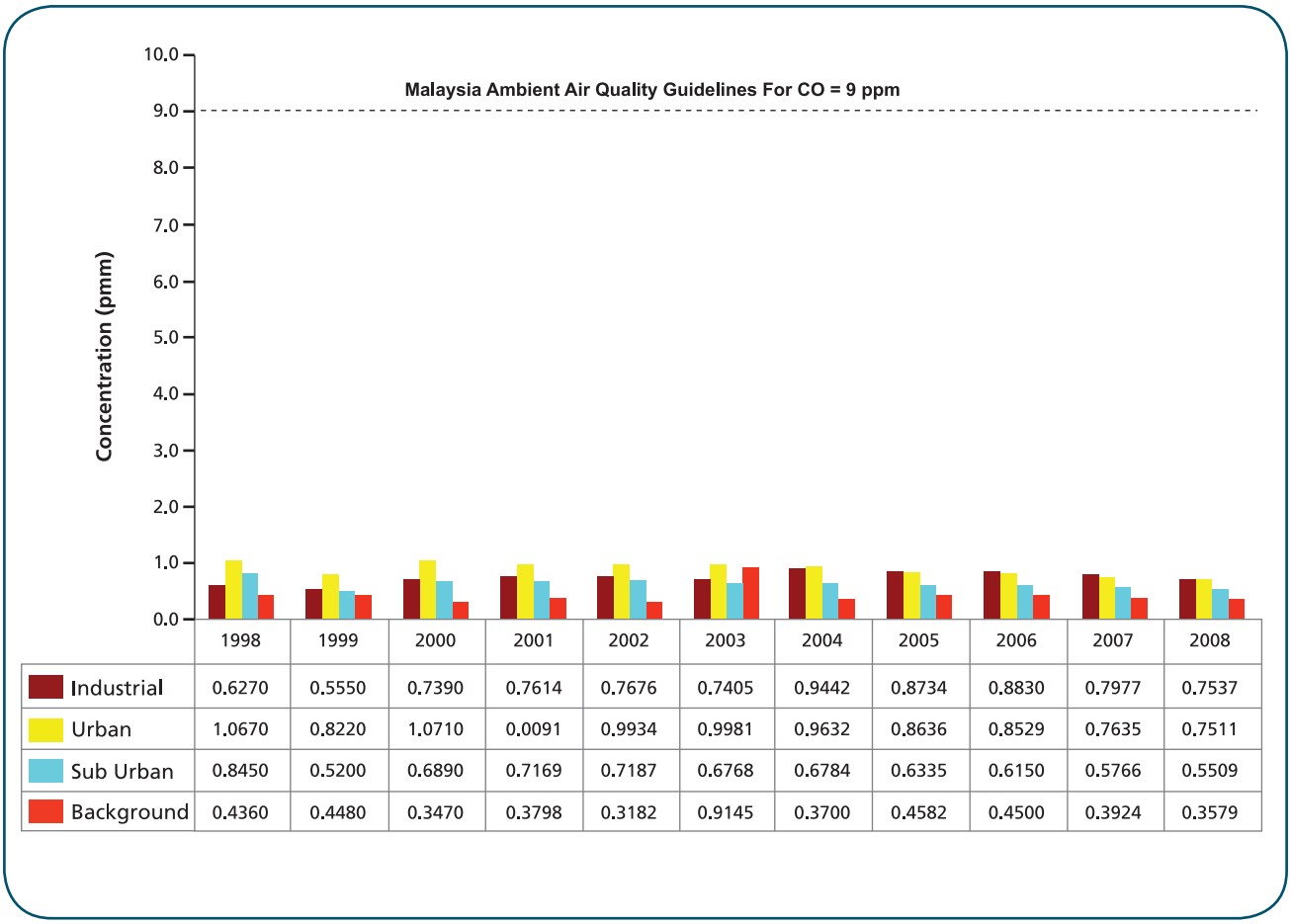
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Industrial	0.0390	0.0380	0.0430	0.0405	0.0413	0.0389	0.0429	0.0431	0.0440	0.0391	0.0399
Urban	0.0460	0.0410	0.0490	0.0426	0.0461	0.0428	0.0471	0.0428	0.0429	0.0441	0.0435
Sub Urban	0.0390	0.0430	0.0370	0.0348	0.0355	0.0354	0.0363	0.0373	0.0371	0.0341	0.0.351
Background	0.0280	0.0220	0.0270	0.0298	0.0298	0.0250	0.0287	0.0311	0.0300	0.0277	0.0278

Figure 1.9(a) Malaysia : Annual Average Daily Maximum 1 Hour Concentration of Ozone (O_3) by Land Use, 1998-2008



	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Concentration	0.7440	0..5860	0.7120	0.7213	0.6995	0.8325	0.7389	0.7918	0.7649	0.6973	0.7309
Number of Sites	27	35	39	39	39	41	41	41	41	41	41

Figure 1.10 Malaysia : Annual Average Concentration of Carbon Monoxide (CO), 1998-2008



	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Industrial	0.6270	0.5550	0.7390	0.7614	0.7676	0.7405	0.9442	0.8734	0.8830	0.7977	0.7537
Urban	1.0670	0.8220	1.0710	0.0091	0.9934	0.9981	0.9632	0.8636	0.8529	0.7635	0.7511
Sub Urban	0.8450	0.5200	0.6890	0.7169	0.7187	0.6768	0.6784	0.6335	0.6150	0.5766	0.5509
Background	0.4360	0.4480	0.3470	0.3798	0.3182	0.9145	0.3700	0.4582	0.4500	0.3924	0.3579

Figure 1.10(a) Malaysia : Annual Average Concentration of Carbon Monoxide (CO) by Land Use, 1998-2008

Clear Skies : Good Air Quality (DOE Photo Library)

Chapter 2

NOISE MONITORING

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25	Figure 2.2 Malaysia	:	Existing Noise Level in Suburban Residential Area (Medium Density)
26	Figure 2.3 Malaysia	:	Noise Level for selected Urban Residential Areas in various states
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chapter 2

Noise Monitoring

NATIONAL AMBIENT NOISE MONITORING PROGRAMME

The Department of Environment continues to monitor the ambient noise level in 2008 at five (5) different types of receiving land use. They were in noise sensitive areas namely schools and hospitals, suburban residential areas (medium density), urban residential areas (high density and residential-commercial), commercial business zones and designated industrial zones. Traffic noise in areas that are planned for future development or redevelopment of existing roads were also measured. For ambient noise monitoring, 'a single 60 minutes sample' on noise level are measured in the morning, afternoon and evening.

Figure 2.1, Figure 2.2, Figure 2.3, Figure 2.4, Figure 2.5 and **Figure 2.6** show the LAeq noise levels recorded for selected areas in the various states. The data collected from this National Ambient Noise Monitoring Programme would be beneficial as a baseline data for planning purposes and new development in the future.

In 2008, most of the readings collected exceeded the level specified in The Planning Guidelines for Environmental Noise Limits and Control, 2004. This could be attributed to insufficient buffer zone.

The Planning Guidelines for Environmental Noise Limits and Control 2004 specify maximum permissible sound levels for different category of receiving land use as shown **Schedule 1** and **Schedule 2** for any new development and **Schedule 3** for road traffic (for proposed new roads and/or redevelopment of existing roads).

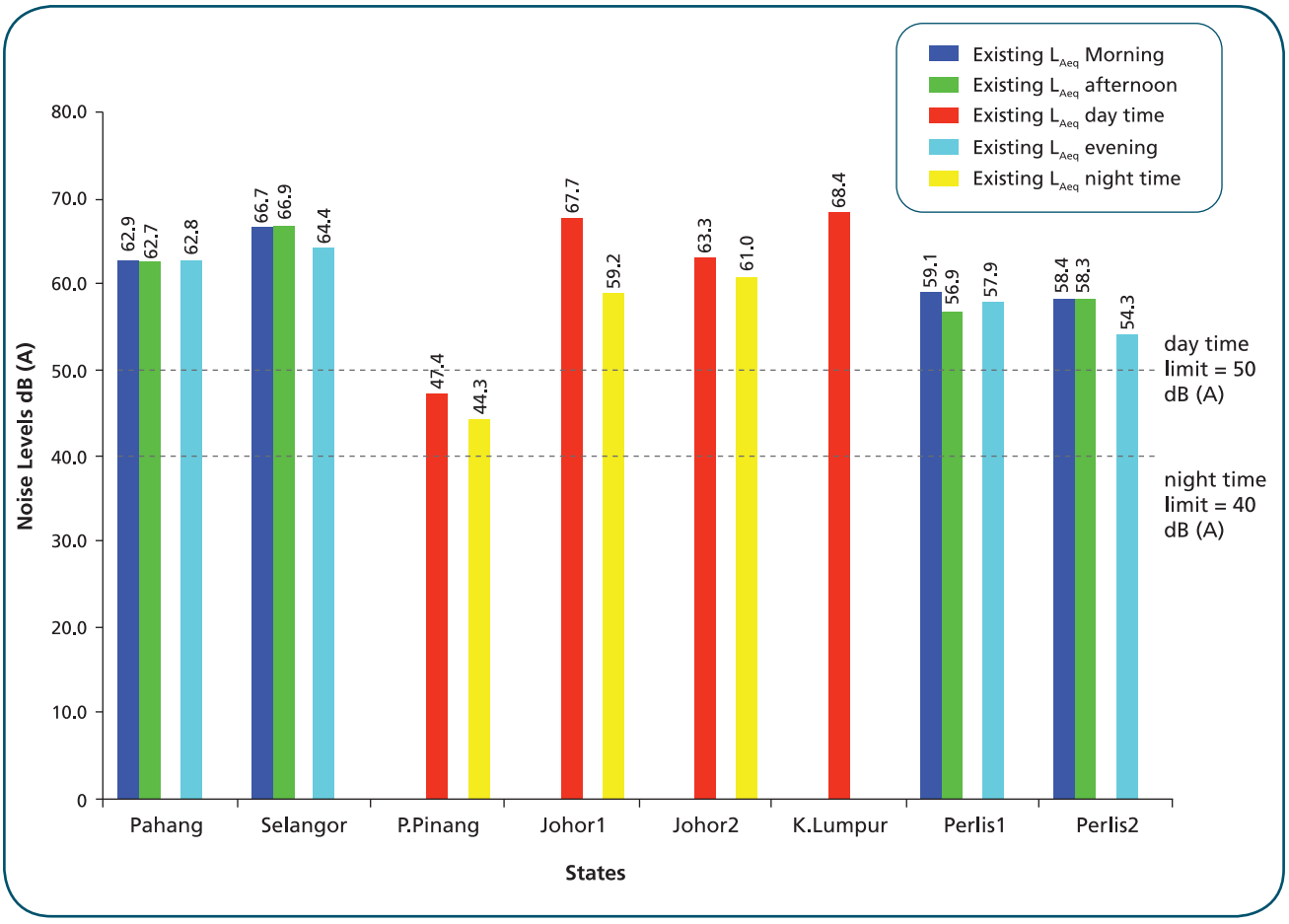

Figure 2.1 Malaysia : Noise Level for selected Noise Sensitive Areas in various states

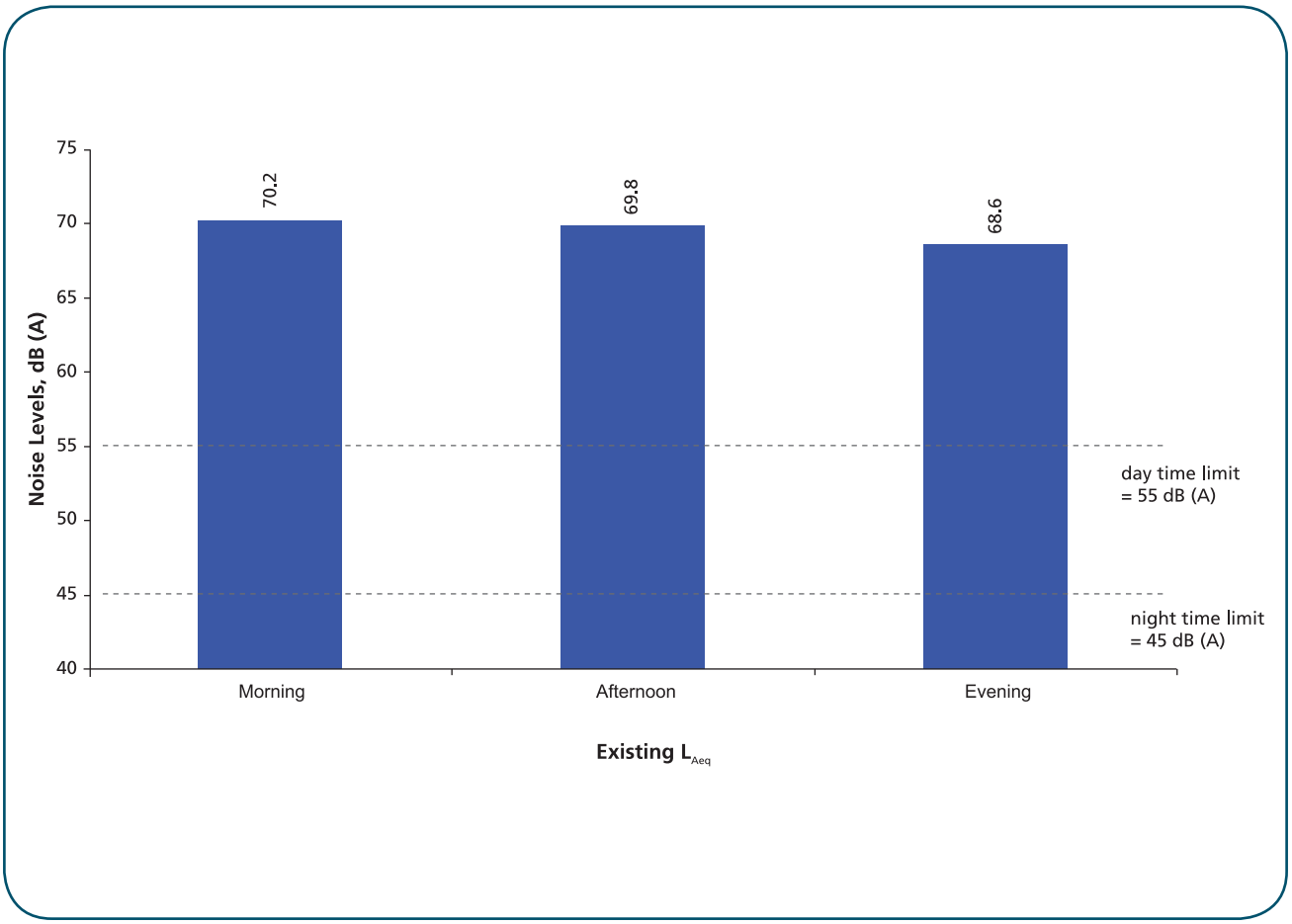

Figure 2.2 Malaysia : Existing Noise Level in Suburban Residential Area (Medium Density)

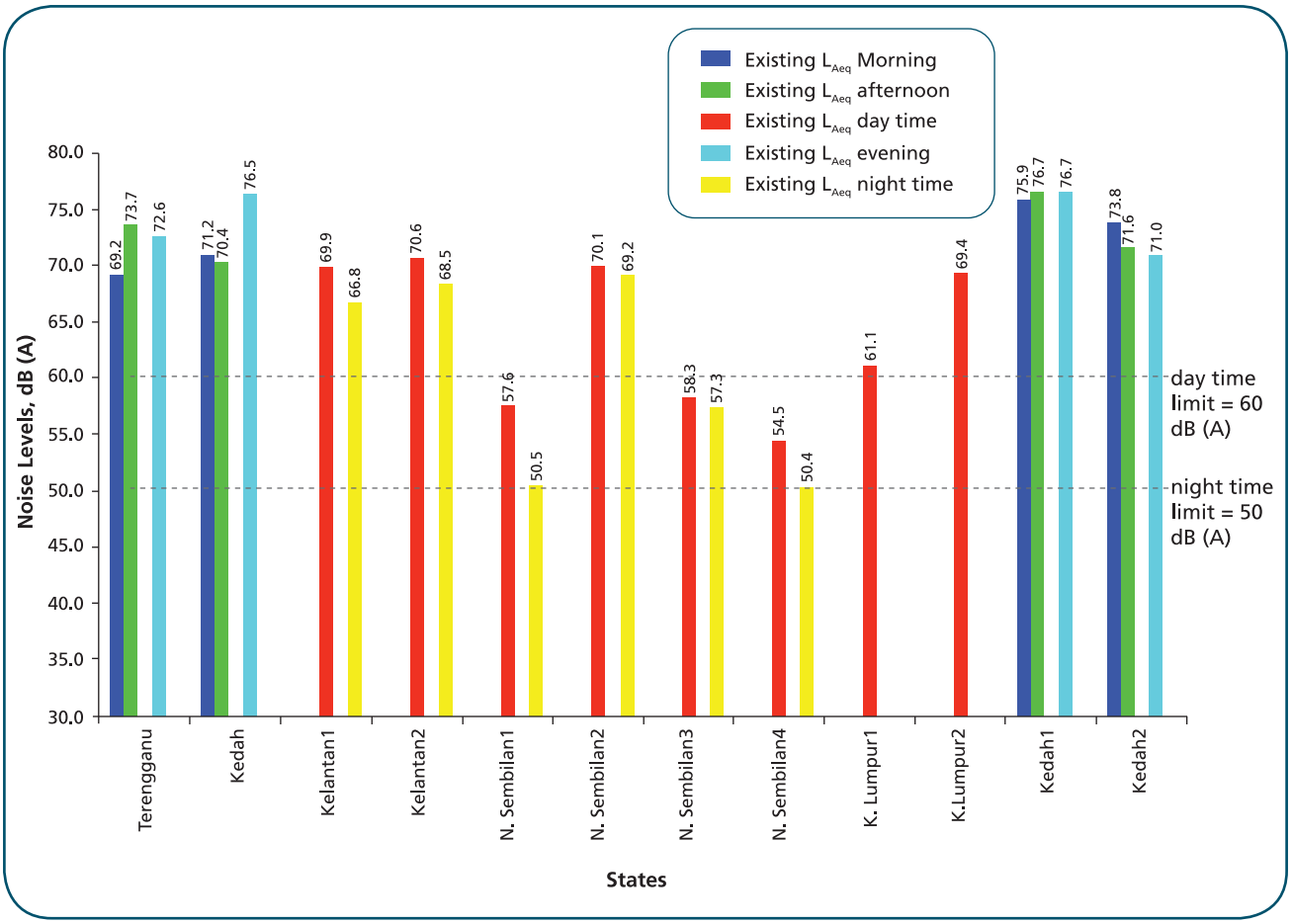

Figure 2.3 Malaysia : Noise Level for selected Urban Residential Areas in various states

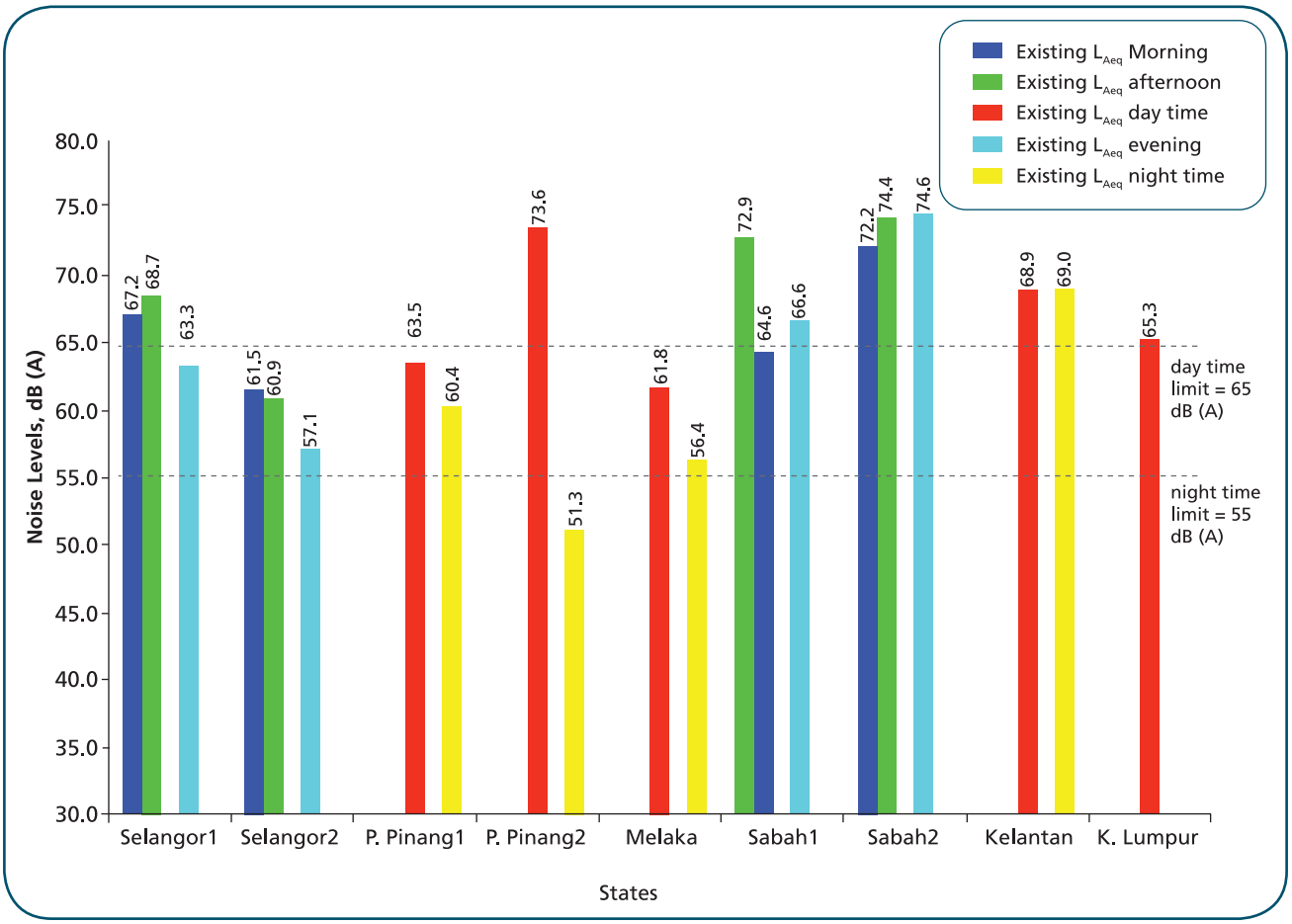

Figure 2.4 Malaysia : Noise Level for selected Commercial Business Zones in various states

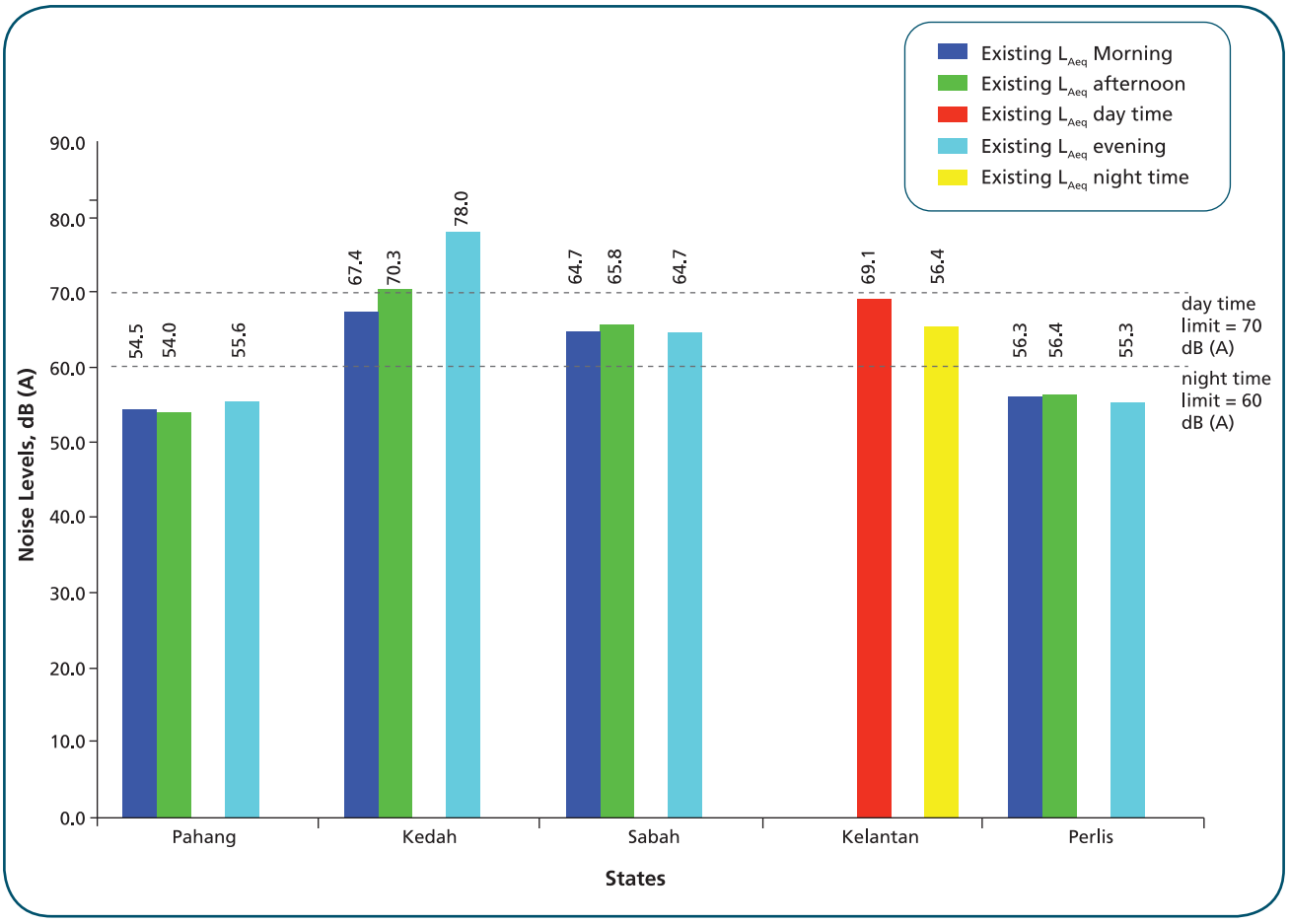

Figure 2.5 Malaysia : Noise Level for selected Designated Industrial Zones in various states

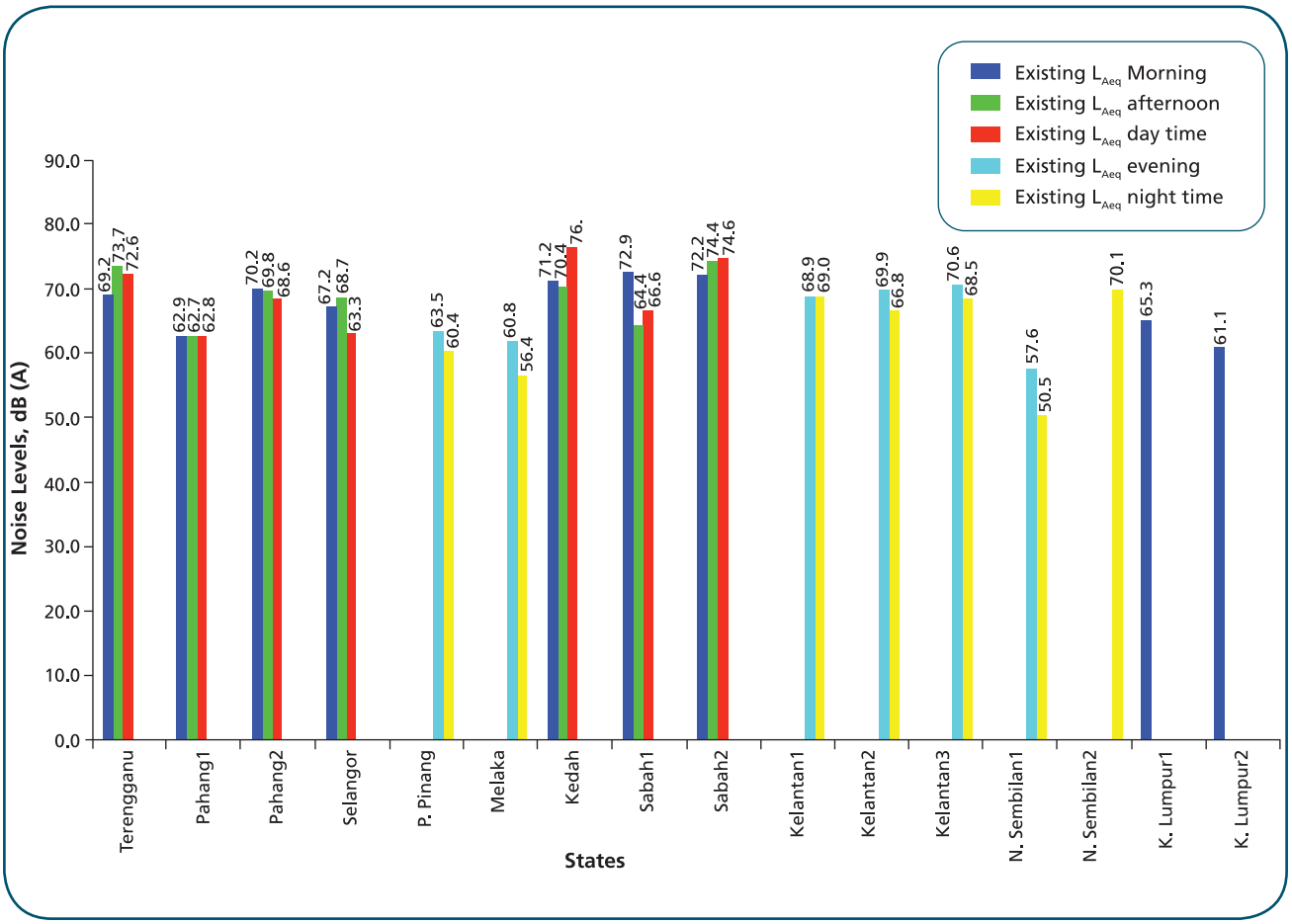

Figure 2.6 Malaysia : Noise Level due to traffic for selected areas in various states

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.

Well Maintained Motor Vehicles on the Road (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.

Green Neighbourhood (DOE Photo Library)

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.

Fresh Water at Source (DOE Photo Library)

Chapter 3

RIVER WATER QUALITY

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36 Table 3.1 Malaysia : Water Quality Status of Clean River Basins, 2008

43 Table 3.2 Malaysia : Water Quality Status of Slightly Polluted River Basins, 2008

48 Table 3.3 Malaysia : Water Quality Status of Polluted River Basins, 2008

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

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53 Figure 3.8 Malaysia : River Basins Water Quality Trend based on BOD subindex (1998 - 2008)

54 Figure 3.9 Malaysia : River Basins Water Quality Trend based on NH_3-N subindex (1998 - 2008)

54 Figure 3.10 Malaysia : River Basins Water Quality Trend based on SS subindex (1998 - 2008)

chapter 3

River Water Quality

RIVER WATER QUALITY MONITORING

The main objective of the river water quality monitoring is 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 (NH_3-N), Suspended Solids (SS) and pH.

RIVER WATER QUALITY STATUS

In 2008, the number of river basins monitored remained at 143 and the number of monitoring stations was 1,063 (**Maps 3.1, 3.2 and 3.3**). Out of these 1,063 monitoring stations, 612 (58%) were found to be clean, 412 (38%) slightly polluted and 39 (4%) polluted (**Tables 3.1, 3.2 and 3.3**). There was a significantly reduction in the number of clean river basins in 2008 compared with 2007. There were 76 (53%) clean river basins in 2008 as compared with 91 in 2007. However, the number of polluted river basins remained at 7. The trend of the river basins water quality is shown in **Figure 3.1**. The decrease in the number of clean river basins were attributed to two factors. Firstly, an increase in the number of polluting sources such as sewage treatment plants, agro-based factories and pig farms which contributed to an increase in the pollutant load. Secondly, a decrease in the amount of rainfall in the states of Pahang and Sarawak resulted in five (5) and eleven (11) rivers, deteriorated from clean to slightly polluted respectively. Also a small change of water quality index will cause a major shift in the category of rivers.

As in previous years, the major pollutants detected were BOD, NH_3-N and SS. High BOD can be attributed to untreated or partially treated sewage and discharges from agro-based and manufacturing industries. The main sources of NH_3-N were livestock farming and domestic sewage, whilst the sources for SS were earthworks and land clearing activities.

The DOE maintained 15 continuous water quality monitoring stations for early detection of pollution influx. For the period of January to December 2008,

40 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 DO levels were most frequent in Sungai Putat (37.6% saturation) followed by Sungai Perai (43.8% saturation) and Sungai Klang (45.2% saturation) (**Figure 3.2**). High ammonium levels were recorded more frequently in Sungai Putat (8.5 mg/l) followed by Sungai Rajang (6.3 mg/l) and Sungai Klang (5.8 mg/l) (**Figure 3.3**). High turbidity level was most frequently detected at Sungai Klang (2333.2 NTU), followed by Sungai Rajang (621.5 NTU) and Sungai Langat (536.2 NTU) (**Figure 3.4**). Meanwhile pH value of 6.4 was recorded at Sungai Selangor and Sungai Terengganu, pH 6.5 at Sungai Skudai and pH 6.6 at Sungai Perai and Sungai Keratong (**Figure 3.5**).

RIVER WATER POLLUTION SOURCES

Figures 3.6, 3.7 and 3.8 show the status of river water quality in terms of BOD, NH_3-N and SS. Based on BOD level, 18 river basins were categorized as polluted, 46 river basins as slightly polluted and 79 river basins as clean (**Figure 3.6**). Based on NH_3-N, 33 river basins were categorized as polluted, 38 river basins as slightly polluted and 72 river basins as clean (**Figure 3.7**). Meanwhile, 53 river basins were categorized as polluted by SS, 33 river basins as slightly polluted and 57 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.

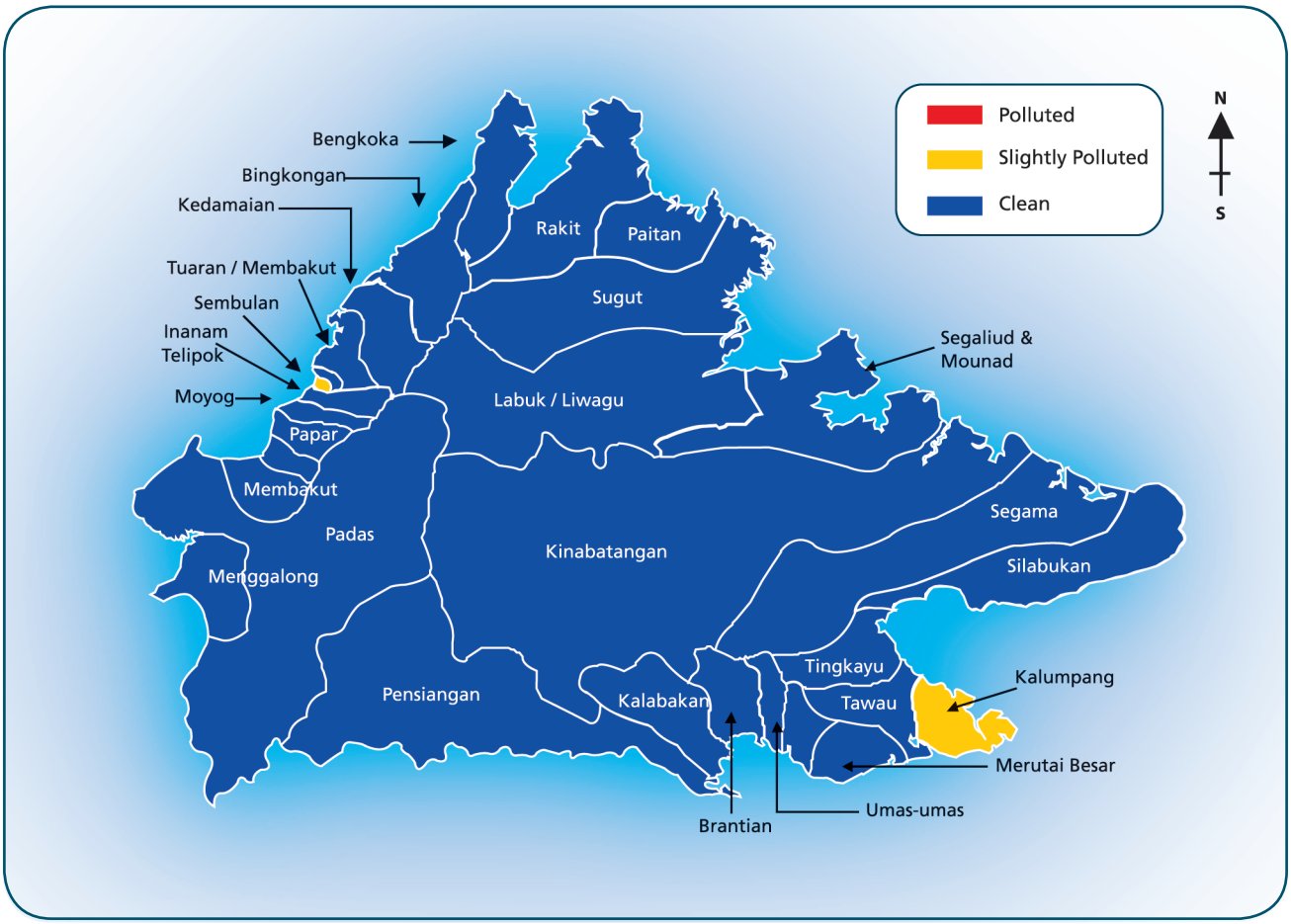
RIVER WATER STUDIES

The DOE River Pollution Prevention and Water Quality Improvement Programme was initiated and implemented since the year 2001 and a number of river studies have been carried out to identify the pollution sources responsible for the deterioration of the river water quality. The rivers were Sungai Langat (Selangor), Sungai Melaka (Melaka), Sungai Batang Rajang (Sarawak), Sungai Segget and Sungai Tebrau (Johor), Sungai Linggi (Negeri Sembilan) and River System in Cameron Highlands (Pahang).

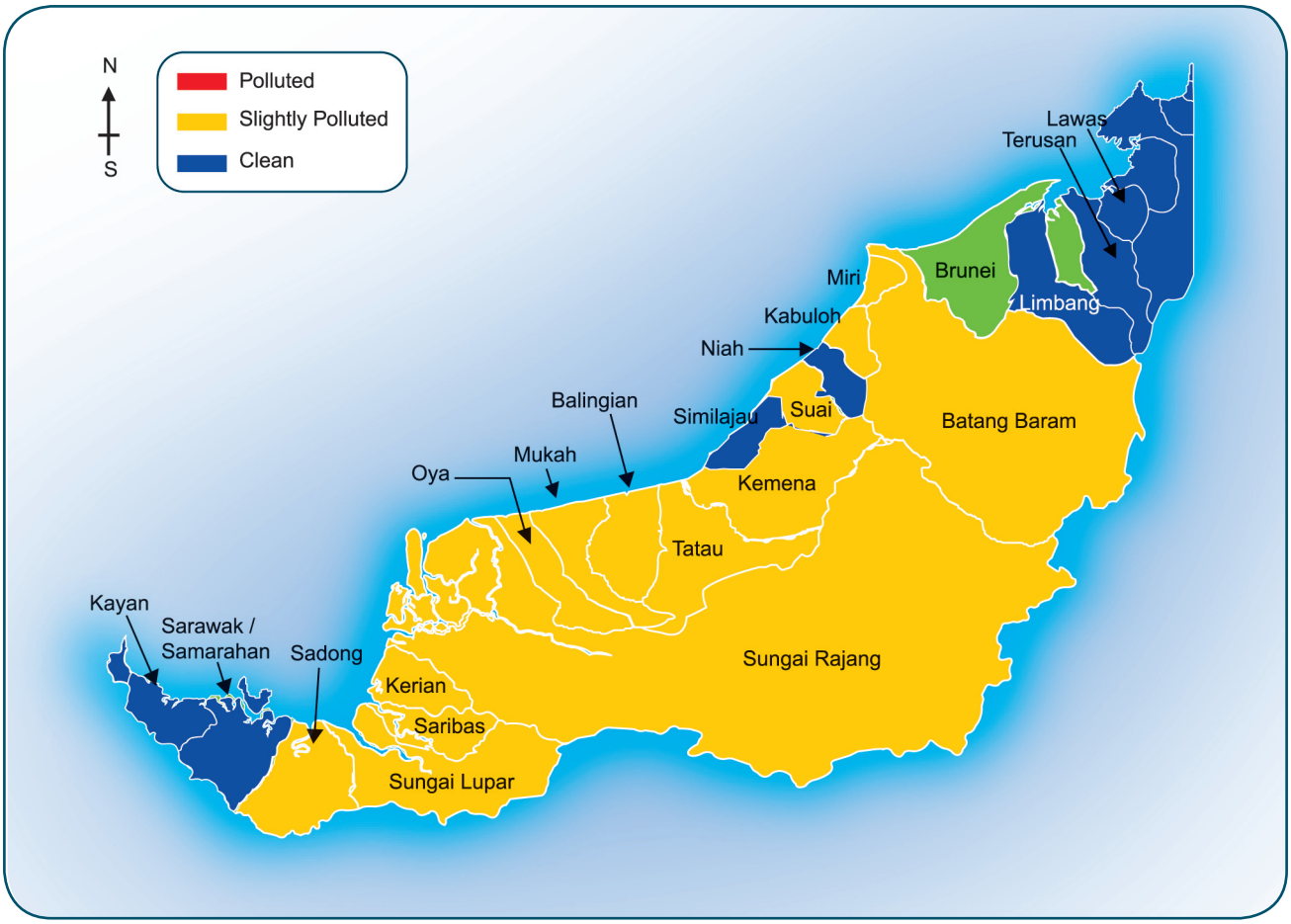
In the year 2008, the river water studies for Sungai Sepetang (Perak) and Sungai Merbok (Kedah) were completed while studies for Sungai Kinabatangan (Sabah) is currently being implemented and due for completion at the end of 2009.

Clear Clean River (DOE Photo Library)

Map 3.1 Malaysia: Water Quality Status for River Basins of Peninsular Malaysia, 2008



Map 3.2 Malaysia: Water Quality Status for River Basins of Sabah, 2008



Map 3.3 Malaysia: Water Quality Status for River Basins of Sarawak, 2008

Aquaculture Activity (DOE Photo Library)

Table 3.1 Malaysia : Water Quality Status of Clean River Basins, 2008

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
PERLIS	01	PERLIS	9	82 (80)	JARUM	1	83	C	II
					JERNIH	2	87	C	II
					KOK MAK	1	73	SP	III
					NGULANG	1	76	SP	III
					PELARIT	1	92	C	II
					PERLIS	1	71	SP	III
					SERAI	1	78	SP	II
					WANG KELIAN	1	93	C	I
KEDAH	01PLA	KISAP	1	93 (89)	KISAP	1	93	C	I
	01PLB	KUAH	1	82 (67)	KUAH	1	82	C	II
	01PLC	ULU MELAKA	2	91 (88)	PETANG	1	93	C	I
					ULU MELAKA	1	88	C	II
	03	KEDAH	9	84 (84)	JANING	1	93	C	I
					KEDAH	1	71	SP	III
					PDG TERAP	4	85	C	II
					PEDU	1	90	C	II
					PENDANG	1	78	SP	II
					TEKAI	1	87	C	II
KEDAH/ P.PINANG	05	MUDA	13	86 (83)	CHEPIR	1	86	C	II
					JERUNG	2	72	SP	III
					KARANGAN	1	85	C	II
					KETIL	2	86	C	II
					MUDA	4	87	C	II
					PEGANG	1	93	C	I
					SEDIM	1	85	C	II
					TAWAR	1	88	C	II
PERAK	09	KURAU	6	83 (85)	ARA	1	90	C	II
					KURAU	5	79	SP	II
	10	SEPETANG	15	83 (83)	BATU TEGOH	4	86	C	II
					JANA	1	86	C	II
					LARUT	1	75	SP	III
					LIDIN	1	69	SP	III
					LIMAU	1	91	C	II
					MALAI	1	67	SP	III
					SEPETANG	2	77	SP	II
					TEMERLOH	2	92	C	II
					TRONG	1	90	C	II
					TUPAI	1	86	C	II
	11	BRUAS	6	83 (83)	BRUAS	3	82	C	II
					DANDANG	1	82	C	II
					ROTAN	2	89	C	II
	13	PERAK	58	81 (78)	BATANG PADANG	3	84	C	II
					BIDOR	3	84	C	II
					CHENDERIANG	2	84	C	II
					CHEPOR	1	93	C	I
					CUAR	1	93	C	I
					KAMPAR	2	91	C	II
					KANGSAR	2	85	C	II
					KEPAYANG	2	67	SP	III
					KERDAH	2	74	SP	III

Table 3.1 Malaysia : Water Quality Status of Clean River Basins, 2008 (continued)

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
PERAK		PERAK			KINJANG	1	94	C	I
					KINTA	8	77	SP	II
					KLAH	2	85	C	II
					KLIAN BARU	2	76	SP	III
					KUANG	1	83	C	II
					NYAMOK	1	72	SP	III
					PARI	2	71	SP	III
					PELUS	2	89	C	II
					PERAK	8	86	C	II
					PINJI	2	69	SP	III
					RAIA	2	90	C	II
					SELUANG	1	59	P	III
					SEROKAI	2	64	SP	III
					SINTANG	1	61	SP	III
					SUNGKAI	2	87	C	II
					SUNGKAI MATI	2	81	C	II
					TUMBOH	1	74	SP	III
PERAK/ SELANGOR	14	BERNAM	13	85 (84)	BERNAM	7	81	C	II
					INKI	1	93	C	I
					SLIM	2	88	C	II
					TROLAK	3	91	C	II
SELANGOR	16	SELANGOR	13	84 (84)	AIR HITAM	1	75	SP	III
					BATANG KALI	1	91	C	II
					KANCHING	1	91	C	II
					KERLING	1	91	C	II
					KUNDANG	1	72	SP	III
					RAWANG	1	78	SP	II
					SELANGOR	5	86	C	II
					SEMBAH	1	78	SP	II
					SERENDAH	1	88	C	II
MELAKA	23	DUYONG	4	81 (76)	DUYONG	3	77	SP	II
					GAPAM	1	93	C	I
JOHOR/ N.SEMBILAN	25	MUAR	39	81 (82)	AIR PANAS	1	92	C	II
					GEMAS	1	85	C	II
					GEMENCHEH	2	82	C	II
					JUASSEH	2	87	C	II
					KELAMAH	1	64	SP	III
					LABIS	3	81	C	II
					MEDA	1	86	C	II
					MERBUDU	1	78	SP	II
					MERLIMAU	1	75	SP	III
					MUAR	17	83	C	II
					P. MENKUANG	1	83	C	II
					PALONG	2	81	C	II
					SARANG BUAYA	1	67	SP	III
					SEGAMAT	1	85	C	II
					SENARUT	1	76	SP	III
					SEROM	1	74	SP	III
					SPG. LOI	1	76	SP	III
					TENANG	1	80	SP	II

Table 3.1 Malaysia : Water Quality Status of Clean River Basins, 2008 (continued)

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
JOHOR	29	JOHOR	39	84 (82)	ANAK SG. SAYONG	2	85	C	II
					BELITONG	1	87	C	II
					BERANGAN	1	68	SP	III
					BUKIT BESAR	2	88	C	II
					CHEMANGAR	1	79	SP	II
					JOHOR	5	85	C	II
					LAYANG	1	90	C	II
					LAYAU KIRI	1	90	C	II
					LEBAM	1	81	C	II
					LINGGIU	1	88	C	II
					PANTI	1	86	C	II
					PAPAN	1	87	C	II
					PELEPAH	1	91	C	II
					PENGGELI	1	88	C	II
					REMIS	1	85	C	II
					SANTI	1	82	C	II
					SAYONG	5	85	C	II
					SEBOL	1	86	C	II
					SELUYUT	1	85	C	II
					SEMANGAR	1	88	C	II
					SEMENCHU	1	81	C	II
					SENING	1	79	SP	II
					SERAI	1	59	P	III
					TELOR	1	87	C	II
					TEMOH	1	89	C	II
					TIRAM	4	80	SP	II
	30A	SEDILI BESAR	10	81 (82)	AMBAT	1	84	C	II
					DOHOL	1	87	C	II
					MUPUR	1	68	SP	III
					PASIR PANJANG	1	74	SP	III
					SEDILI BESAR	5	81	C	II
					TEMUBOR KANAN	1	87	C	II
	30B	SEDILI KECIL	6	81 (78)	ANAK SEDILI KECIL	1	78	SP	II
					BAHAN	2	82	C	II
					SEDILI KECIL	3	81	C	II
	30C	PALOI	1	87 (80)	PALOI	1	87	C	II
	31A	MERSING	2	87 (89)	MERSING	2	87	C	II
	31B	JEMALUANG	2	83 (83)	JEMALUANG	2	83	C	II
	32	ENDAU	25	81 (82)	ANAK SG. SEMBERONG	1	84	C	II
					DENGAR	1	73	SP	III
					ENDAU	2	87	C	II
					JASIN	1	94	C	I
					JEBONG	1	76	SP	III
					KAHANG	1	85	C	II
					LENGA	1	63	SP	III
					LENGGOR	1	82	C	II

Table 3.1 Malaysia : Water Quality Status of Clean River Basins, 2008 (continued)

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
JOHOR		JOHOR			MAMAI	1	84	C	II
					MELATAI	1	62	SP	III
					MENGKIBOL	3	74	SP	III
					PALOH	1	85	C	II
					PAMOL	1	69	SP	III
					SELAI	1	90	C	II
					SEMBERONG	6	84	C	II
					SINGOL	1	86	C	II
					TAMOK	1	88	C	II
PAHANG	32AE	ANAK ENDAU	2	87 (87)	ANAK ENDAU	2	87	C	II
	33	ROMPIN	18	86 (88)	AUR	1	89	C	II
					BAKAR	1	78	SP	II
					JEKATIH	2	87	C	II
					JERAM	1	91	C	II
					KEPASING	1	88	C	II
					KERATONG	3	86	C	II
					PONTIAN	1	90	C	II
					PUKIN	3	88	C	II
					ROMPIN	4	85	C	II
					SEPAYANG	1	68	SP	III
	34M	MERCHONG	2	86 (87)	MERCHONG	2	86	C	II
	35P	PAHANG	91	86 (86)	ANAK SG. LEPAR	1	76	SP	III
					BATU	1	73	SP	III
					BELAYAR	1	92	C	II
					BENTONG	4	89	C	II
					BENUS	2	92	C	II
					BERA	3	85	C	II
					BERKAPOR	1	89	C	II
					BERTAM	3	81	C	II
					BILUT	1	87	C	II
					BURUNG	1	93	C	I
					CHINI	1	85	C	II
					HABU	1	89	C	II
					JELAI	2	87	C	II
					JEMPOL	2	87	C	II
					JENGKA	2	84	C	II
					KELAU	2	88	C	II
					KERTAM	1	84	C	II
					KOYAN	1	89	C	II
					KUNDANG	1	78	SP	II
					LENGGOK	1	90	C	II
					LEPAR	3	86	C	II
					LIPIS	3	89	C	II
					LUIT	1	89	C	II
					MARAN	1	81	C	II
					MENTIGA	2	86	C	II
					PAHANG	8	85	C	II
					PENJURING	1	93	C	I
					PERTANG	2	86	C	II
					PERTING	1	93	C	I

Table 3.1 Malaysia : Water Quality Status of Clean River Basins, 2008 (continued)

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
PAHANG		PAHANG			RINGLET	1	85	C	II
					SEMANTAN	3	83	C	II
					SERTING	5	81	C	II
					T. PAYA BUNGOR	1	87	C	II
					TAHAN	1	91	C	II
					TANGLIR	1	89	C	II
					TASIK BERA	1	87	C	II
					TASIK CHINI	10	86	C	II
					TEKAL	1	83	C	II
					TEKAM	2	84	C	II
					TELANG	1	90	C	II
					TELEMONG	1	91	C	II
					TELOM	2	88	C	II
					TEMBELING	1	91	C	II
					TERANUM	1	85	C	II
					TERAS	1	88	C	II
					TERLA	1	93	C	II
					TRIANG	2	86	C	II
					TRINGKAP	1	85	C	II
TERENGGANU	38	KEMAMAN	9	83 (82)	CHERUL	2	84	C	II
					KEMAMAN	3	85	C	II
					NERAM	1	63	SP	III
					PERASING	1	85	C	II
					RANSAN	2	75	SP	III
	39K	KERTIH	2	85 (87)	KERTIH	2	85	C	II
	40	PAKA	6	84 (87)	BESUL	1	87	C	II
					PAKA	2	83	C	II
					RASAU	2	87	C	II
					RENGAT	1	75	SP	III
	41	DUNGUN	5	88 (89)	DUNGUN	4	88	C	II
					TELEMBOH	1	85	C	II
	42M	MARANG	3	85 (78)	KERAK	1	82	C	II
					MARANG	1	86	C	II
					TEMALA	1	89	C	II
	43	TERENGGANU	12	85 (82)	BERANG	2	92	C	II
					NERUS	4	77	SP	II
					PUEH	2	90	C	II
					TELEMONG	1	87	C	II
					TERENGGANU	3	86	C	II
	44	SETIU	5	87 (86)	CHALOK	2	71	SP	III
					SETIU	2	85	C	II
					TAROM	1	90	C	II
	46	BESUT	4	90 (87)	BESUT	3	91	C	II
					JERTIH	1	86	C	II
	47B	KLUANG	1	87 (86)	KLUANG	1	87	C	II
KELANTAN	47K	KEMASIN	5	83 (85)	KEMASIN	2	81	C	II
					SEMERAK	3	85	C	II
	48	KELANTAN	42	87 (86)	ARING	1	85	C	II
					BELATOP	2	80	SP	II
					BER	1	92	C	II

Table 3.1 Malaysia : Water Quality Status of Clean River Basins, 2008 (continued)

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
KELANTAN		KELANTAN			BEROK	3	85	C	II
					BETIS	1	90	C	II
					CHIKU	1	89	C	II
					GALAS	5	87	C	II
					KELANTAN	3	85	C	II
					KELESA	1	88	C	II
					KERILLA	2	93	C	I
					KETIL	1	86	C	II
					LEBIR	4	86	C	II
					NAL	3	90	C	II
					NENGGIRI	3	85	C	II
					PEHI	1	87	C	II
					PERGAU	6	91	C	II
					RELAI	2	86	C	II
					SOKOR	1	86	C	II
					TUANG	1	89	C	II
	49	GOLOK	7	90 (89)	GOLOK	5	89	C	II
					LANAS	1	92	C	II
					TASIK GARU	1	75	SP	III
SARAWAK	50	KAYAN	3	82 (81)	KAYAN	3	82	C	II
	50S	SEMUNSAM	1	86 (85)	SEMUNSAM	1	86	C	II
	51	SARAWAK	17	81 (85)	KELANTAN	1	63	SP	III
					KUAP	2	81	C	II
					MAONG KIRI	1	65	SP	III
					SAMARAHAN	2	78	SP	II
					SARAWAK	5	86	C	II
					SARAWAK KANAN	2	78	SP	II
					SARAWAK KIRI	1	86	C	II
					SEMADANG	1	90	C	II
					SEMENGGOH	1	75	SP	III
					TABUAN	1	68	SP	III
	59	BALINGIAN	2	81 (83)	BALINGIAN	2	81	C	II
	62	SIMILAJAU	2	84 (89)	SIMILAJAU	2	84	C	II
	64	NIAH	4	81 (85)	NIAH	2	82	C	II
					SEKALOH	2	79	SP	II
	68	LIMBANG	5	81 (83)	LIMBANG	5	81	C	II
	69	TRUSAN	1	88 (89)	TRUSAN	1	88	C	II
SABAH	70	LAWAS	3	90 90	LAWAS	3	90	C	II
	71	MENGGALONG	2	90 (88)	MENGGALONG	2	90	C	II
	71A	LAKUTAN	1	91 (87)	LAKUTAN	1	91	C	II
	71B	LINGKUNGAN	2	91 (89)	BUKAU	1	89	C	II
					LINGKUNGAN	1	93	C	I
	72	PADAS	10	87 (88)	BUNSIT	1	91	C	II
					LIAWAN	1	90	C	II
					PADAS	3	84	C	II
					PANGATAN	1	85	C	II
					PEGALAN	3	87	C	II
					TANDULU	1	92	C	II
	73	MEMBAKUT	1	86 (87)	MEMBAKUT	1	86	C	II

Table 3.1 Malaysia : Water Quality Status of Clean River Basins, 2008 (continued)

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI		RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
SABAH	74	KIMANIS	1	86	(87)	KIMANIS	1	86	C	II
	74A	BONGAWAN	1	86	(83)	BONGAWAN	1	86	C	II
	74	PAPAR	3	89	(89)	PAPAR	3	89	C	II
	76	MOYOG	4	91	(92)	MOYOG	4	91	C	II
	77	TUARAN	5	88	(90)	DAMIT	2	85	C	II
						SONG SAI	1	88	C	II
						TUARAN	2	91	C	II
	78	KEDAMAIAN	4	93	(90)	KEDAMAIAN	1	93	C	I
						TEMPASUK	2	92	C	II
						WARIU	1	92	C	II
	78T	TENGHILAN	1	90	(89)	TENGHILAN	1	90	C	II
	79	BINGKONGAN	6	91	(89)	BANDAU	1	92	C	II
						BINGKONGAN	2	92	C	II
						MENGGARIS	2	92	C	II
						TANDEK	1	88	C	II
	80	BENGKOKA	2	84	(86)	BENGKOKA	2	84	C	II
	82	PAITAN	1	87	(85)	PAITAN	1	87	C	II
	83	SUGUT	6	92	(92)	BONGKUD	1	93	C	I
		SUGUT				LOHAN	1	91	C	II
						MERALI	1	93	C	I
						SUGUT	3	91	C	II
	84	LABOK	7	89	(90)	KINIPIR	2	89	C	II
						LABOK	1	86	C	II
						LIWAGU	2	87	C	II
						MALIAU	1	93	C	I
						TUNGUD	1	88	C	II
	84A	SAPI	4	84	(86)	SAPI	3	81	C	II
						SUALONG	1	92	C	II
	85	MOUNAD	2	83	(86)	MOUNAD	2	83	C	II
	87	SEGAMA	3	85	(84)	SEGAMA	3	85	C	II
	88	TUNGKU	2	88	(88)	TUNGKU	2	88	C	II
	88A	SILABUKAN	2	81	(82)	SILABUKAN	2	81	C	II
	89	TINGKAYU	2	84	(85)	TINGKAYU	2	84	C	II
	91	TAWAU	4	88	(85)	TAWAU	4	88	C	II
	91A	APAS	1	86	(90)	APAS	1	86	C	II
	91B	BALUNG	1	87	(89)	BALUNG	1	87	C	II
	92	MEROTAI	3	88	(81)	MEROTAI	3	88	C	II
	93	UMAS-UMAS	1	82	(88)	UMAS-UMAS	1	82	C	II
	94	BRANTIAN	1	84	(84)	BRANTIAN	1	84	C	II
	95	KALABAKAN	3	82	(81)	KALABAKAN	3	82	C	II

NOTE: 1. WQI BASED ON 6 MAJOR PARAMETERS:BOD, COD, SS, PH, DO, NH_3-N
2. RIVER WATER QUALITY STATUS: C: CLEAN, SP: SLIGHTLY POLLUTED, P: POLLUTED
3. RIVER CLASS BASED ON INWQS
4. ( ) = Overall WQI for 2007
5. OVERALL WQI FOR RIVER BASIN IS CALCULATED BY AVERAGING WQI FROM ALL SAMPLING STATIONS IN EACH RIVER BASIN THROUGH OUT THE YEAR.

Table 3.2 Malaysia : Water Quality Status of Slightly Polluted River Basins, 2008

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI		RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
KEDAH	04	MERBOK	10	71	(71)	BAKAR ARANG	1	69	SP	III
						BONGKOK	1	67	SP	III
						BUKIT MERAH	1	83	C	II
						KOROK	1	57	P	III
						MERBOK	1	73	SP	III
						PETANI	1	53	P	III
						TOK PAWANG	2	87	C	II
						TUPAH	2	94	C	I
P.PINANG	06J	JURU	12	61	(57)	ARA	1	58	P	III
						JURU	2	53	P	III
						KILANG UBI	5	69	SP	III
						PASIR	1	60	SP	III
						PMTG RAWA	1	62	SP	III
						RAMBAI	2	55	P	III
	06K	KLUANG	4	72	(74)	ARA	2	80	SP	II
						KLUANG	1	62	SP	III
						RELAU	1	66	SP	III
	06P	PERAI	20	67	(64)	AIR MELINTAS	1	40	P	IV
						JARAK	5	72	SP	III
						KARANGAN	1	91	C	II
						KELADI	1	78	SP	II
						KEREH	2	50	P	IV
						KUBANG SEMANG	1	62	SP	III
						KULIM	3	82	C	II
						PERAI	2	65	SP	III
						PERTAMA	1	57	P	III
						SELUANG	1	54	P	III
						SELUANG BAWAH	2	57	P	III
	06T	BAYAN LEPAS	3	67	(62)	BAYAN LEPAS	1	61	SP	III
						TIRAM	2	70	SP	III
	07	JAWI	7	63	(63)	CHEMPEDAK	1	43	P	IV
						JAWI	1	57	P	III
						JUNJONG	3	73	SP	III
						MACHANG BUBOK	1	77	SP	II
						TENGAH	1	46	P	IV
P.PINANG/ PERAK	08	KERIAN	9	76	(81)	KECHIL	2	79	SP	II
						KERIAN	4	79	SP	II
						SELAMA	2	72	SP	III
						SERDANG	1	69	SP	III
PERAK	12	RAJA HITAM	8	80	(73)	DERHAKA	2	64	SP	III
						MANJONG	2	82	C	II
						NYIOR	1	93	C	I
						RAJA HITAM	3	72	SP	III
	12W	WANGI	4	74	(73)	DERALIK	2	69	SP	III
						WANGI	2	77	SP	II
	15	TENGI	3	80	(82)	TENGI	3	80	SP	II
	17	BULOH	5	67	(65)	BULOH	5	67	SP	III
SELANGOR/	18	KLANG	30	64	(62)	AMPANG	1	64	SP	III

Table 3.2 Malaysia : Water Quality Status of Slightly Polluted River Basins, 2008 (continued)

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
SELANGOR/ WPKL		KLANG			BATU	3	72	SP	III
					BUNOS	1	55	P	III
					DAMANSARA	3	64	SP	III
					GOMBAK	3	82	C	II
					JINJANG	2	52	P	III
					KERAYONG	2	51	P	IV
					KEROH	2	51	P	IV
					KLANG	10	63	SP	III
					KUYOH	1	64	SP	III
					PENCHALA	1	46	P	IV
					SEMELAH	1	83	C	II
SELANGOR	19	LANGAT	28	75 (79)	ANAK CHUAU	1	78	SP	II
					BALAK	1	61	SP	III
					BATANG BENAR	2	66	SP	III
					BATANG LABU	2	78	SP	II
					BATANG NILAI	2	54	P	III
					BERANANG	1	84	C	II
					BUAN	1	77	SP	II
					CHUAU	2	89	C	II
					JIJAN	1	87	C	II
					LANGAT	8	73	SP	III
					LIMAU MANIS	1	67	SP	III
					LUI	1	92	C	II
					PAJAM	1	77	SP	II
					RINCHING	1	74	SP	III
					SEMENYIH	3	82	C	II
	20	SEPANG	4	72 (73)	RAMBAI	1	62	SP	III
					SEPANG	3	76	SP	III
N.SEMBILAN	20L	LUKUT	1	77 (80)	LUKUT	1	77	SP	II
	21	LINGGI	24	78 (80)	BATANG PENAR	3	86	C	II
					CHEMBONG	1	85	C	II
					KAYU ARA	1	72	SP	III
					KEPAYONG	1	77	SP	II
					KUNDUR BESAR	1	85	C	II
					LINGGI	6	75	SP	III
					PAROI	1	75	SP	III
					PEDAS	1	82	C	II
					REMBAU	2	84	C	II
					SENAWANG	1	65	SP	III
					SIMIN	1	77	SP	II
					SIMPANG EMPAT	1	81	C	II
					SIPUT	2	86	C	II
					TEMIANG	2	67	SP	III
MELAKA	21BT	TUANG	2	71 (67)	BARU	1	71	SP	III
					TUANG	1	48	P	IV
	21SM	SERI MELAKA	2	67 (71)	AIR SALAK	1	66	SP	III
					SERI MELAKA	1	68	SP	III
	22	MELAKA	21	73 (75)	BTG.MELAKA	2	86	C	II
					DURIAN TUNGGAL	1	85	C	II

Table 3.2 Malaysia : Water Quality Status of Slightly Polluted River Basins, 2008 (continued)

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
MELAKA		KESANG			KEMUNTING	1	81	C	II
					KERU	1	88	C	II
					MELAKA	9	70	SP	III
					PUTAT	2	61	SP	III
					REMBIA	2	70	SP	III
					TAMPIN	3	84	C	II
	24	KESANG	7	79 (78)	CHIN-CHIN	1	55	P	III
					CHOHONG	2	90	C	II
					KESANG	3	83	C	II
					TANGKAK	1	66	SP	III
	24A	MERLIMAU	4	60 (55)	MERLIMAU	4	60	SP	III
JOHOR	26	BATU PAHAT	20	78 (75)	AMRAN	1	79	SP	II
					BANTANG	1	93	C	I
					BATU PAHAT	1	65	SP	III
					BEKOK	5	82	C	II
					BERLIAN	1	75	SP	III
					CHAAH	1	85	C	II
					LENIK	1	86	C	II
					MEREK	1	87	C	II
					MERPO	1	83	C	II
					SEMBERONG	2	72	SP	III
					SIMPANG KANAN	2	66	SP	III
					SIMPANG KIRI	3	70	SP	III
	27B	BENUT	7	77 (77)	BENUT	4	77	SP	II
					PARIT HJ. YASSIN	1	85	C	II
					PINGGAN	1	71	SP	III
					ULU BENUT	1	79	SP	II
	28A	PONTIAN BESAR	7	66 (67)	AIR HITAM	1	70	SP	III
					AYER MERAH	1	42	P	IV
					PONTIAN BESAR	5	70	SP	III
	28B	PONTIAN KECIL	2	78 (74)	PONTIAN KECIL	2	78	SP	II
	28C	SKUDAI	11	69 (72)	MELANA	2	65	SP	III
					SKUDAI	9	70	SP	III
	28E	KEMPAS	2	63 (62)	KEMPAS	2	63	SP	III
	29C	SANGLANG	1	61 (62)	SANGLANG	1	61	SP	III
	29D	PULAI	3	76 (77)	PULAI	2	80	SP	II
					ULU CHOH	1	68	SP	III
	31C	KIM-KIM	2	67 (68)	KIM-KIM	2	67	SP	III
PAHANG	34B	BEBAR	5	80 (81)	BEBAR	2	82	C	II
					MERBA	1	82	C	II
					SERAI	2	78	SP	II
	36	KUANTAN	15	80 (82)	BELAT	1	85	C	II
					CHARU	1	88	C	II
					GALING BESAR	1	46	P	IV
					GALING KECIL	1	59	P	IV
					KENAU	1	90	C	II
					KUANTAN	5	87	C	II
					PANDAN	1	87	C	II
					PINANG	1	81	C	II
					REMAN	1	66	SP	III

Table 3.2 Malaysia : Water Quality Status of Slightly Polluted River Basins, 2008 (continued)

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI		RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
PAHANG		KUANTAN				RIAU	1	77	SP	II
						TALAM	1	81	C	II
	37	BALOK	4	75	(81)	BALOK	2	73	SP	III
						PANJANG	1	78	SP	III
						YIOR	1	71	SP	III
	37A	CHERATING	1	80	(84)	CHERATING	1	80	SP	II
	37B	TONGGOK	2	79	(82)	TONGGOK	2	79	SP	II
TERENGGANU	39C	CHUKAI	6	79	(74)	BUNGKUS	1	81	C	II
						CHUKAI	1	88	C	II
						IBOK	2	85	C	II
						RUANG	2	69	SP	III
	42I	IBAI	3	78	(81)	IBAI	3	78	SP	II
	42L	MERCHANG	2	71	(80)	LANDAS	1	51	P	IV
						MERCHANG	1	71	SP	III
	45	MERANG	1	71	(79)	MERANG	1	71	SP	III
KELANTAN	48C	PENGKALAN CHEPA	6	72	(70)	ALOR B	1	61	SP	III
						ALOR LINTAH	1	58	P	III
						KELADI	1	82	C	II
						PENGKALAN CHEPA	2	77	SP	II
						RAJA GALI	1	73	SP	III
	48D	PENGKALAN DATU	3	79	(82)	PENGKALAN DATU	3	79	SP	II
SARAWAK	52	SADONG	7	76	(85)	KARANGAN	2	72	SP	III
						SADONG	4	79	SP	II
						TARAT	1	88	C	II
	53	LUPAR	8	80	(87)	AI	2	87	C	II
						LUPAR	3	75	SP	III
						SEKERANG	1	79	SP	II
						SETERAP	1	77	SP	II
						UNDUP	1	85	C	II
	54	SARIBAS	3	78	(84)	LAYAR	2	82	C	II
						SARIBAS	1	70	SP	III
	55	KERIAN	3	79	(84)	KERIAN	2	78	SP	II
						SEBLAK	1	79	SP	II
	56	RAJANG	19	79	(85)	BALOI	1	81	C	II
						BINATANG	1	89	C	II
						JULAU	1	87	C	II
						KANOWIT	1	86	C	II
						MERADONG	1	74	SP	III
						RAJANG	12	78	SP	II
						SALIM	1	73	SP	III
						SARIKEI	1	82	C	II
	57	OYA	3	78	(81)	OYA	3	78	SP	II
	58	MUKAH	4	77	(82)	MUKAH	4	77	SP	II
	60	TATAU	1	79	(81)	TATAU	1	79	SP	II
	61	KEMENA	5	79	(83)	KEMENA	4	78	SP	II
						SIBIU	1	81	C	II
	63	SUAI	1	79	(87)	SUAI	1	79	SP	II
	65	SIBUTI	6	77	(79)	KABULOH	2	68	SP	III

Table 3.2 Malaysia : Water Quality Status of Slightly Polluted River Basins, 2008 (continued)

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
SARAWAK		SIBUTI			KEJAPIL	1	84	C	II
					SATAP	1	80	SP	II
					SIBUTI	2	81	C	II
	66	MIRI	7	62 (71)	ADONG	1	53	P	III
					DALAM	1	72	SP	III
					LUTONG	2	67	SP	III
					MIRI	2	57	P	III
					PADANG LIKU	1	87	C	II
	67	BARAM	5	79 (81)	BARAM	4	79	SP	II
					TUTUH	1	77	SP	II
SABAH	76A	SEMBULAN	2	67 (65)	SEMBULAN	2	67	SP	III
	76B	LIKAS	8	79 (79)	DARAU	1	75	SP	III
					INANAM	3	84	C	II
					LIKAS	2	63	SP	III
					MENGGATAL	2	91	C	II
	76C	TELIPOK	2	80 (85)	TELIPOK	2	80	SP	II
	85A	SEGALIUD	2	79 (81)	SEGALIUD	2	79	SP	II
	86	KINABATANGAN	10	79 (80)	KARAMUAK	1	85	C	II
					KINABATANGAN	2	78	SP	II
					KOYAH	1	84	C	II
					LEEPANG	1	80	SP	II
					MENANGGUL	1	76	SP	III
					PIN	1	79	SP	II
					TAKALA	1	72	SP	III
					TENEGANG BESAR	2	81	C	II
	90	KALUMPANG	5	78 (78)	KALUMPANG	3	88	C	II
					PANG BURONG 1	1	66	SP	III
					PANG BURONG 2	1	64	SP	III

NOTE: 1. WQI BASED ON 6 MAJOR PARAMETERS:BOD, COD, SS, PH, DO, NH_3-N
2. RIVER WATER QUALITY STATUS: C: CLEAN, SP: SLIGHTLY POLLUTED, P: POLLUTED
3. RIVER CLASS BASED ON INWQS
4. ( ) = Overall WQI for 2007
5. OVERALL WQI FOR RIVER BASIN IS CALCULATED BY AVERAGING WQI FROM ALL SAMPLING STATIONS IN EACH RIVER BASIN THROUGH OUT THE YEAR.

Table 3.3 Malaysia : Water Quality Status of Polluted River Basins, 2008

STATE	CODE WQR	RIVER BASIN	NO. OF STATIONS	OVERALL WQI	RIVER	NO. OF STATIONS	WQI	RIVER STATUS	CLASS
P.PINANG	06PP	PINANG	11	57 (50)	AIR ITAM	5	59	P	III
					AIR TERJUN	1	95	C	I
					DONDANG	3	49	P	IV
					JELUTONG	1	38	P	IV
					PINANG	1	61	SP	III
JOHOR	27A	AIR BALOI	3	51 (62)	AIR BALOI	3	51	P	IV
	28	SEGGET	5	52 (49)	SEGGET	5	52	P	III
	28D	TEBRAU	11	59 (59)	BALA	1	54	P	III
					PANDAN	1	50	P	IV
					PLENTONG	1	47	P	IV
					SEBULUNG	1	48	P	IV
					SENGKUANG	1	49	P	IV
					TAMPOI	1	47	P	IV
					TEBRAU	5	73	SP	III
	28F	DANGA	2	52 (53)	DANGA	2	52	P	III
	28G	RAMBAH	2	58 (61)	RAMBAH	2	58	P	III
	29B	KAW. PASIR GUDANG	5	44 (40)	BULUH	1	33	P	IV
					LATOH	1	53	P	III
					MASAI	1	56	P	III
					PEREMBI	1	52	P	III
					TUKANG BATU	1	26	P	V

NOTE: 1. WQI BASED ON 6 MAJOR PARAMETERS:BOD, COD, SS, PH, DO, NH_3-N
2. RIVER WATER QUALITY STATUS: C: CLEAN, SP: SLIGHTLY POLLUTED, P: POLLUTED
3. RIVER CLASS BASED ON INWQS
4. ( ) = Overall WQI for 2007
5. OVERALL WQI FOR RIVER BASIN IS CALCULATED BY AVERAGING WQI FROM ALL SAMPLING STATIONS IN EACH RIVER BASIN THROUGH OUT THE YEAR.

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

Station	Date	Parameter	Pollution Sources
Sg. Batang Benar	11-Jan-08	NH4 : 9.82 mg/l	Sewage or latex based industry or industrial discharge.
Sg. Melaka	18-Jan-08	NH4 : 1.47 mg/l	Sewage or latex based industry
Sg. Batang Benar	21-Jan-08	pH : 8.14	Sewage or latex based industry or industrial discharge.
Sg. Labu	28-Jan-08	NH4 : 2.70 mg/l	Sewage or latex based industry or industrial discharge.
Sg. Batang Benar	2-Feb-08	pH : 7.61	Sewage or latex based industry or industrial discharge.
Sg. Melaka	26-Feb-08	NH4 : 1.93 mg/l	Sewage or latex based industry
Sg. Melaka	13-Mar-08	pH : 8.31	Sewage or latex based industry
Sg. Melaka	15-Mar-08	pH : 8.36	Sewage or latex based industry
Sg. Batang Benar	23-Mar-08	pH : 8.45	Sewage or latex based industry or industrial discharge.
Sg. Batang Benar	29-Mar-08	pH : 9.25	Sewage or latex based industry or industrial discharge.
Sg. Batang Benar	2-Apr-08	pH : 9.22	Sewage or latex based industry or industrial discharge.
Sg. Melaka	4-Apr-08	pH : 7.65	Sewage or latex based industry
Sg. Batang Benar	12-Apr-08	pH : 8.49	Sewage or latex based industry or industrial discharge.
Sg. Melaka	22-Apr-08	pH : 7.85	Sewage or latex based industry
Sg. Labu	26-Apr-08	pH : 8.82	Sewage or latex based industry or industrial discharge.
Sg. Batang Benar	1-May-08	pH : 8.04	Sewage or latex based industry or industrial discharge.
Sg. Batang Benar	10-May-08	pH : 5.08	Sewage or latex based industry or industrial discharge.
Sg. Batang Benar	11-May-08	pH : 4.72	Sewage or latex based industry or industrial discharge.
Sg. Melaka	20-May-08	pH : 7.75	Sewage or latex based industry
Sg. Skudai	22-May-08	pH : 8.95	Sewage or latex based industry or industrial discharge.
Sg. Melaka	16-Jun-08	pH : 7.67	Sewage or latex based industry
Sg. Labu	18-Jun-08	NH4 : 3.76 mg/l	Sewage or latex based industry or industrial discharge.
Sg. Batang Benar	18-Jun-08	pH : 8.76	Sewage or latex based industry or industrial discharge.
Sg. Batang Benar	20-Jun-08	pH : 3.66	Sewage or latex based industry or industrial discharge.
Sg. Batang Benar	24-Jun-08	pH : 8.48	Sewage or latex based industry or industrial discharge.
Sg. Skudai	10-Jul-08	pH : 7.92	Sewage or latex based industry or industrial discharge.
Sg. Batang Benar	13-Jul-08	pH : 9.13	Sewage or latex based industry or industrial discharge.
Sg. Labu	1-Aug-08	NH4 : 4.15 mg/l	Sewage or latex based industry or industrial discharge.
Sg. Batang Benar	7-Aug-08	pH : 8.60	Sewage or latex based industry or industrial discharge.
Sg. Keratong	24-Aug-08	NH4 : 1.40 mg/l	Sewage or industrial discharge
Sg. Batang Benar	28-Aug-08	pH : 9.27	Sewage or latex based industry or industrial discharge.
Sg. Batang Benar	4-Sep-08	pH : 9.51	Sewage or latex based industry or industrial discharge.
Sg. Batang Benar	6-Sep-08	pH : 9.82	Sewage or latex based industry or industrial discharge.
Sg. Batang Benar	12-Sep-08	pH : 9.20	Sewage or latex based industry or industrial discharge.
Sg. Perai	22-Sep-08	NH4 : 5.18 mg/l	Sewage or industrial discharge.
Sg. Labu	26-Sep-08	NH4 : 8.66 mg/l	Sewage or latex based industry or industrial discharge.
Sg. Batang Benar	12-Nov-08	NH4 : 4.14 mg/l	Sewage or latex based industry or industrial discharge.
Sg. Batang Benar	5-Dec-08	pH : 7.71	Sewage or latex based industry or industrial discharge.
Sg. Batang Benar	20-Dec-09	pH : 8.07	Sewage or latex based industry or industrial discharge.
Sg. Labu	26-Dec-08	NH4 : 4.15 mg/l	Sewage or latex based industry or industrial discharge.

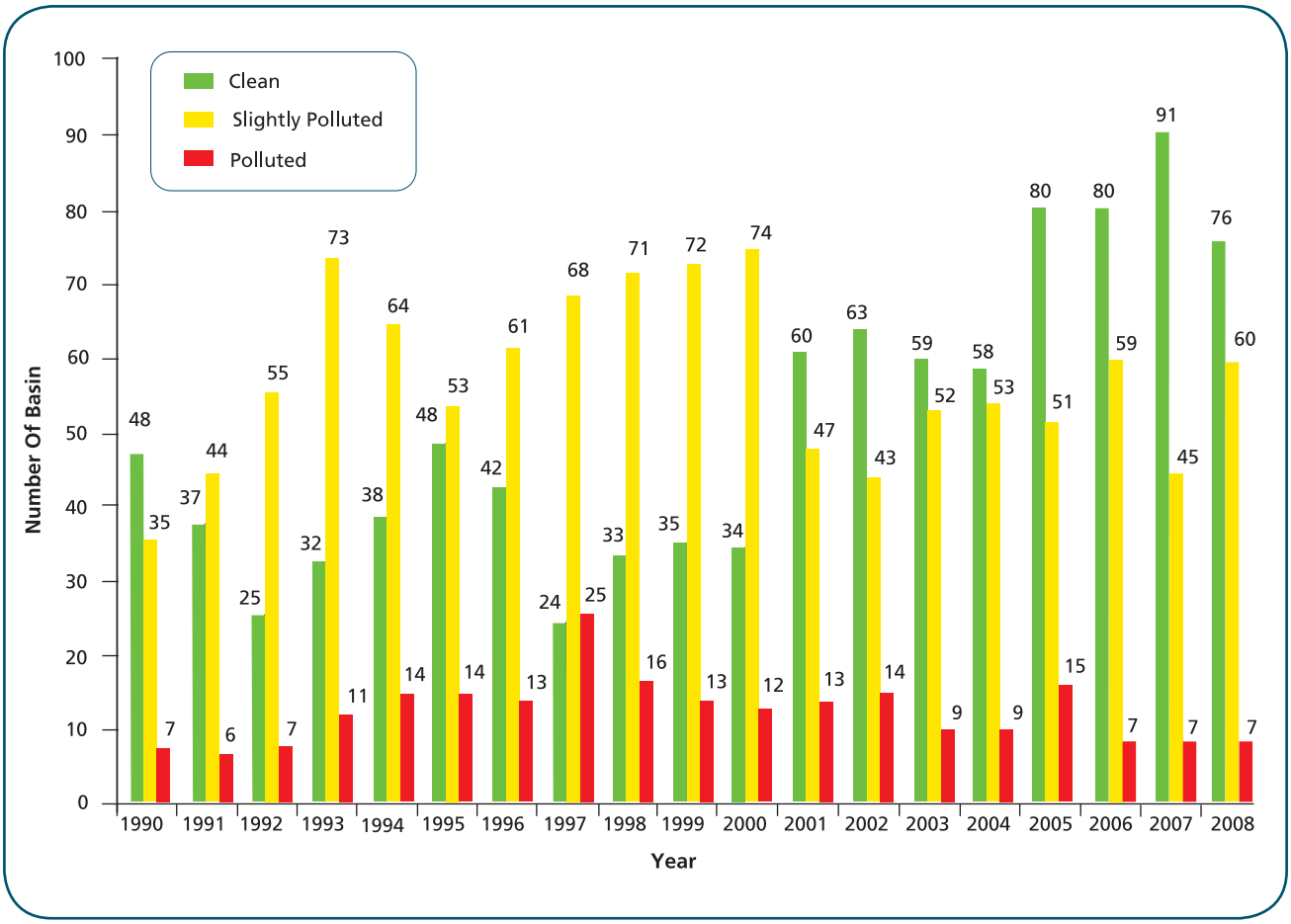


Figure 3.1 Malaysia : River Basins Water Quality Trend (1990-2008)

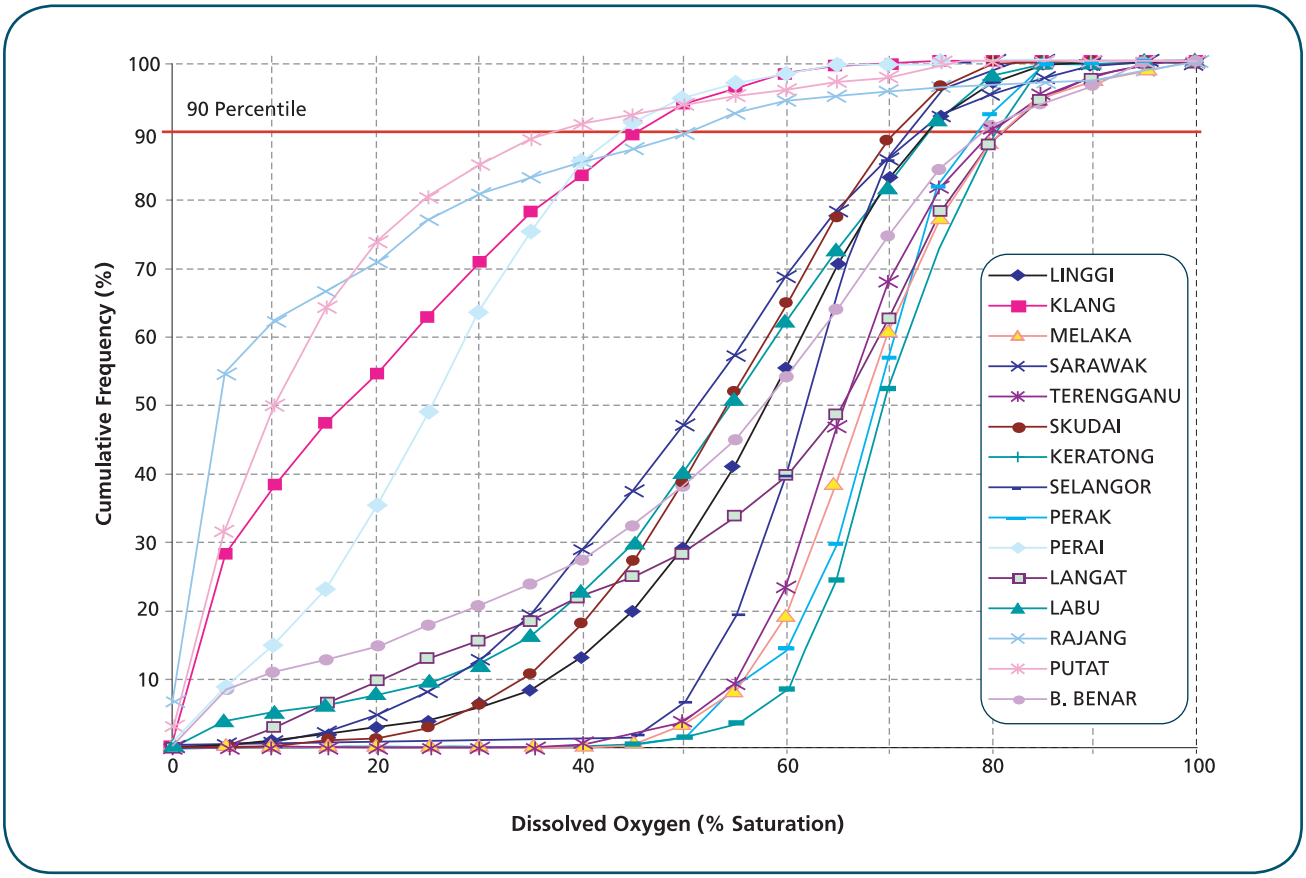


Figure 3.2 Malaysia : Comparison of Cumulative Frequency for 15 CWQM Stations - Dissolved Oxygen : 1st January 2008 - 31st December 2008

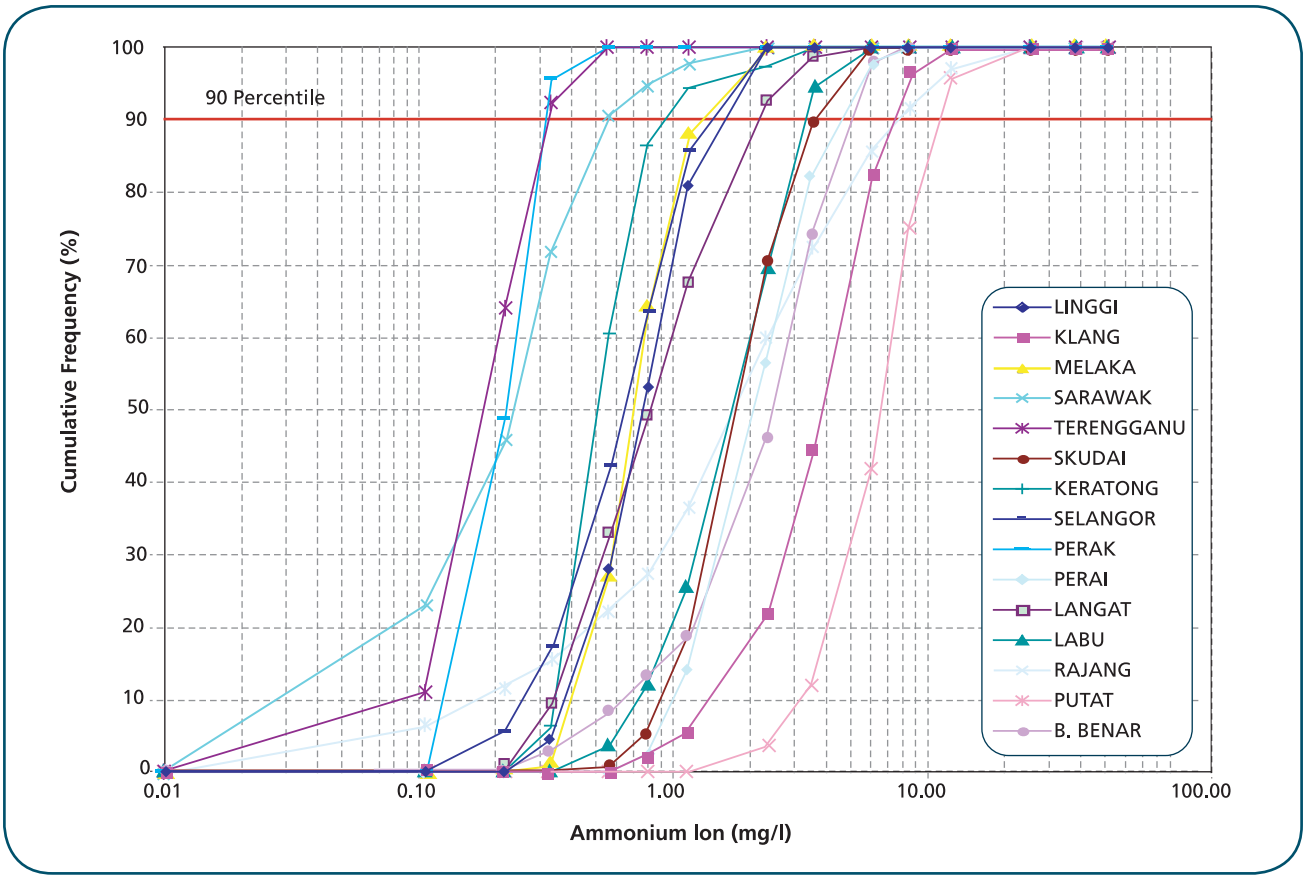


Figure 3.3 Malaysia : Comparison of Cumulative Frequency for 15 CWQM Stations - Ammonium Ion Concentration : 1st January 2008 - 31st December 2008

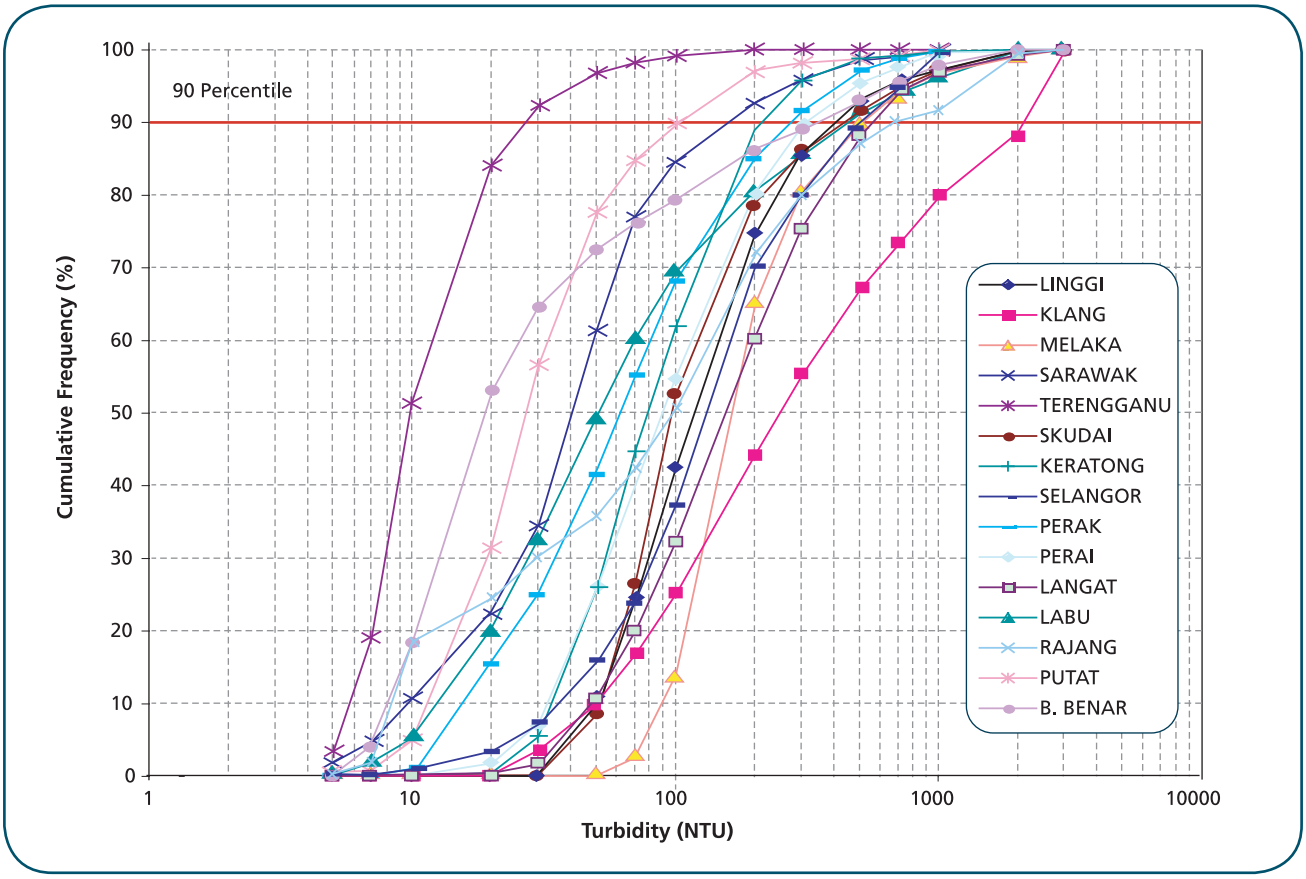


Figure 3.4 Malaysia : Comparison of Cumulative Frequency for 15 CWQM Stations - Turbidity : 1st January 2008 - 31st December 2008

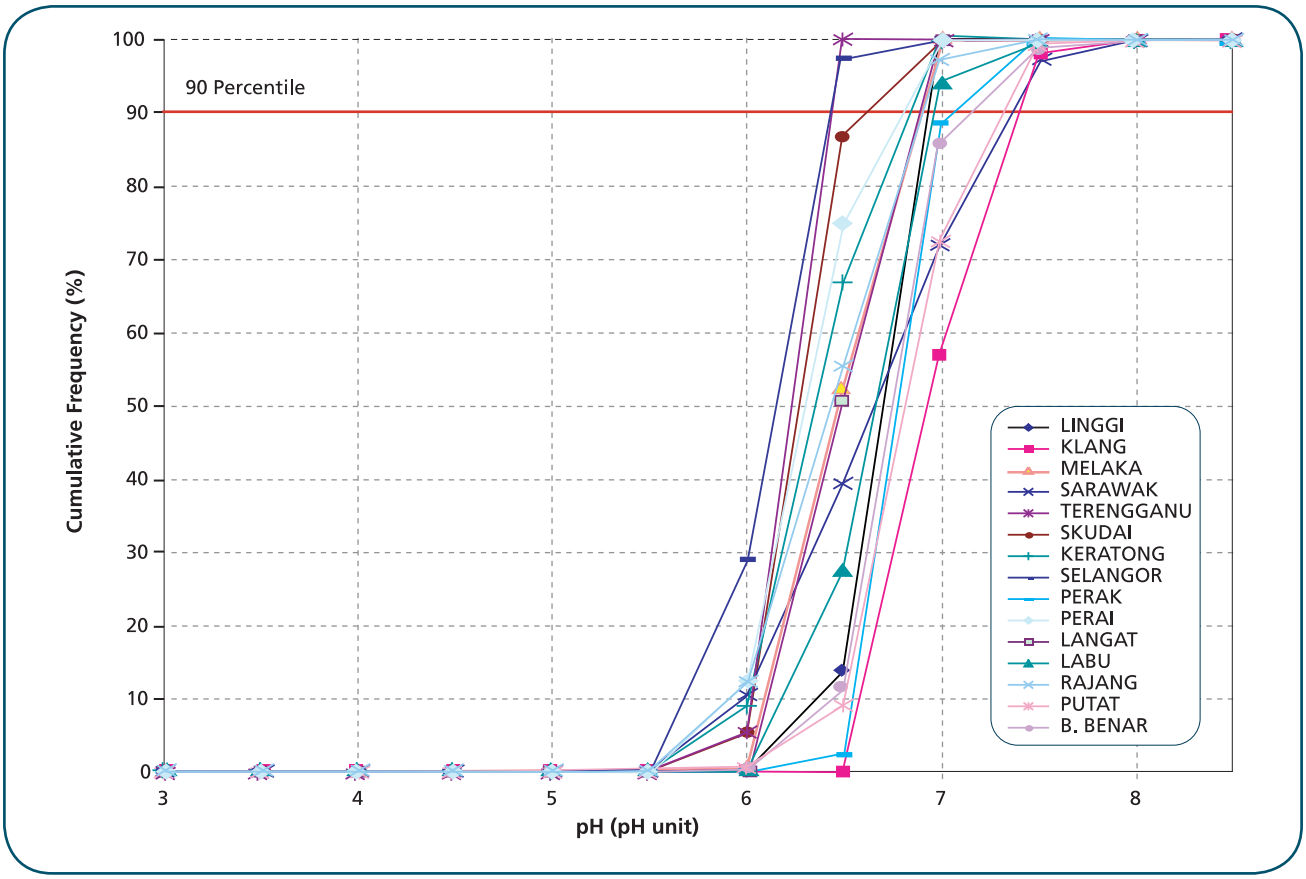


Figure 3.5 Malaysia : Comparison of Cumulative Frequency for 15 CWQM Stations - pH Level : 1st January 2008 - 31st December 2008

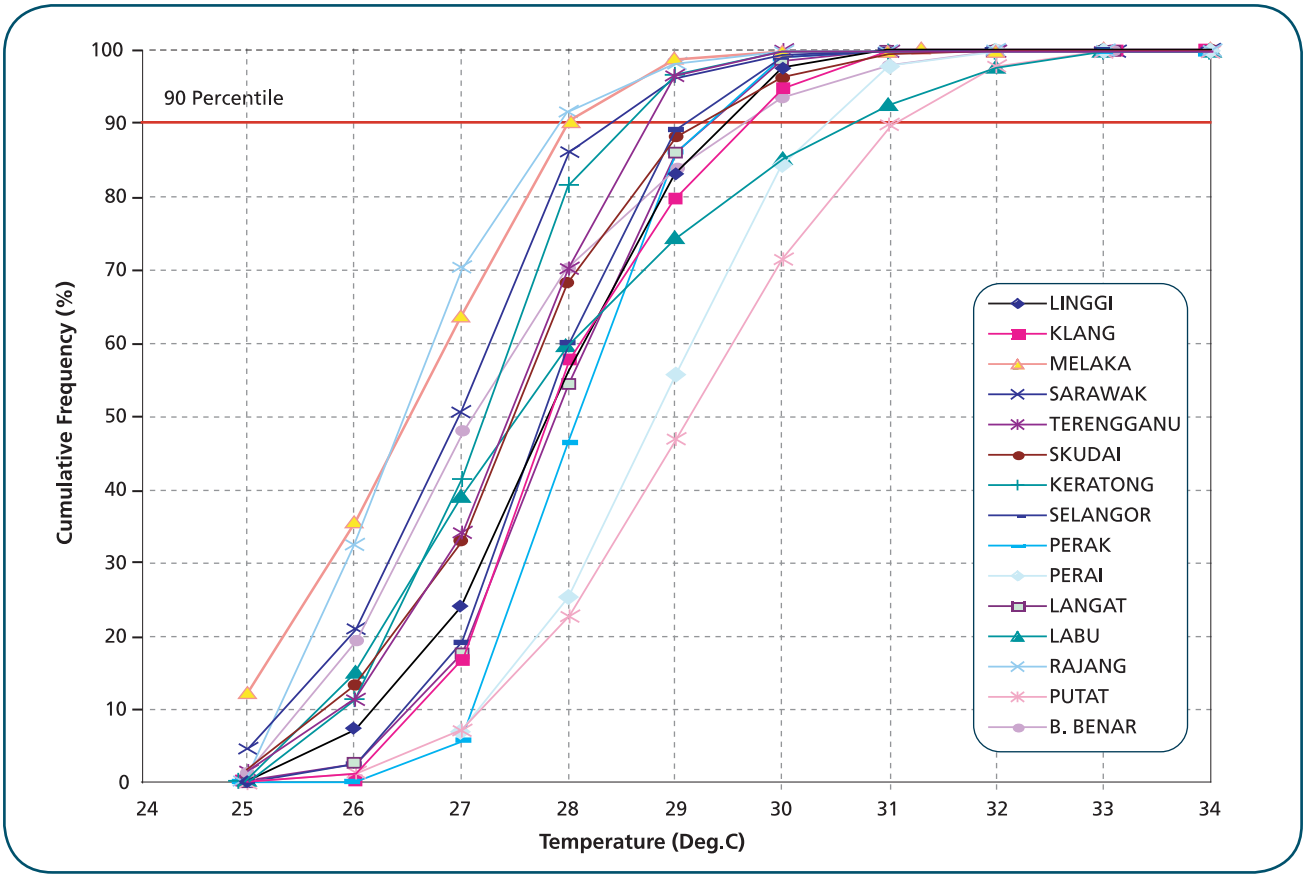


Figure 3.6 Malaysia : Comparison of Cumulative Frequency for 15 CWQM Stations - Temperature : 1st January 2008 - 31st December 2008

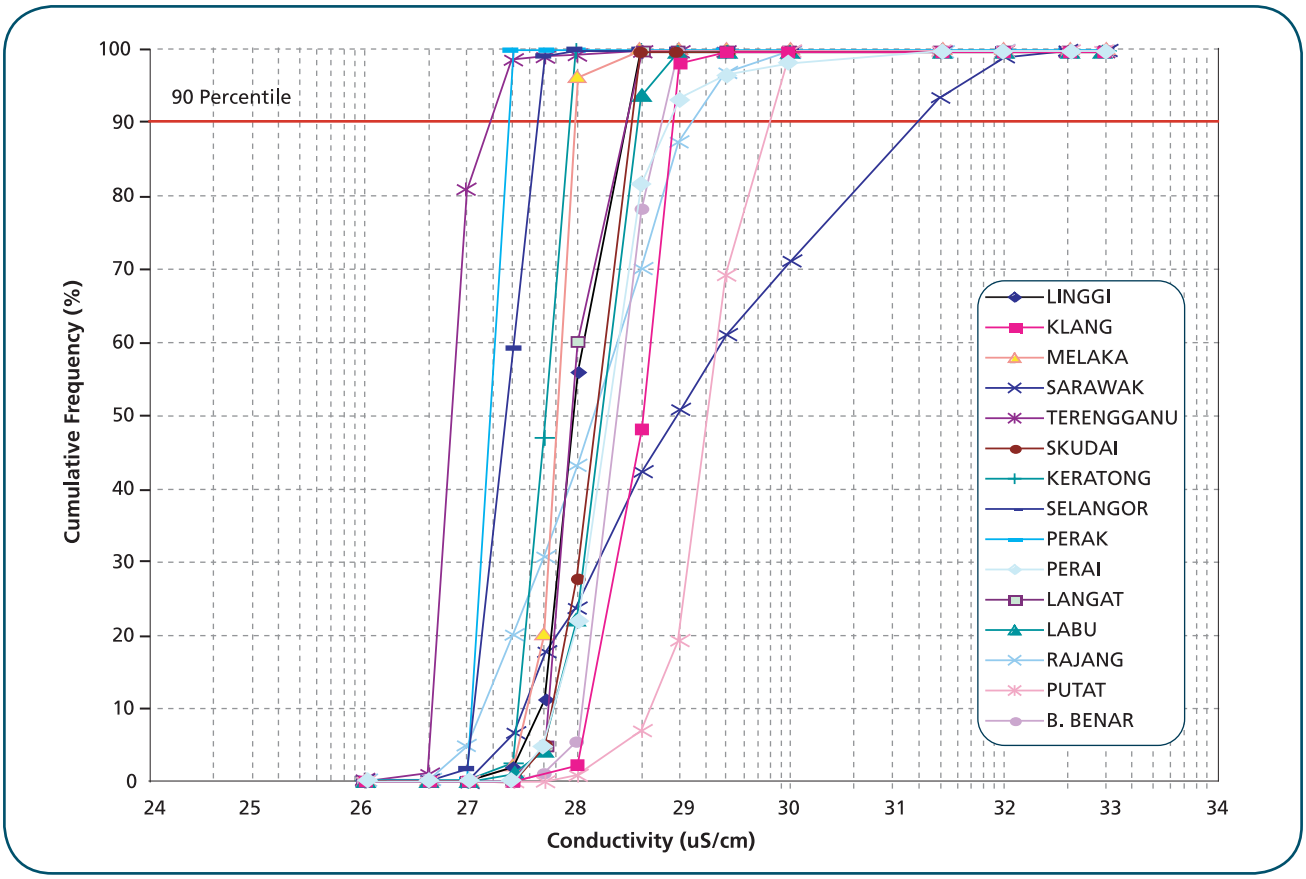


Figure 3.7 Malaysia : Comparison of Cumulative Frequency for 15 CWQM Stations - Conductivity : 1st January 2008 - 31st December 2008

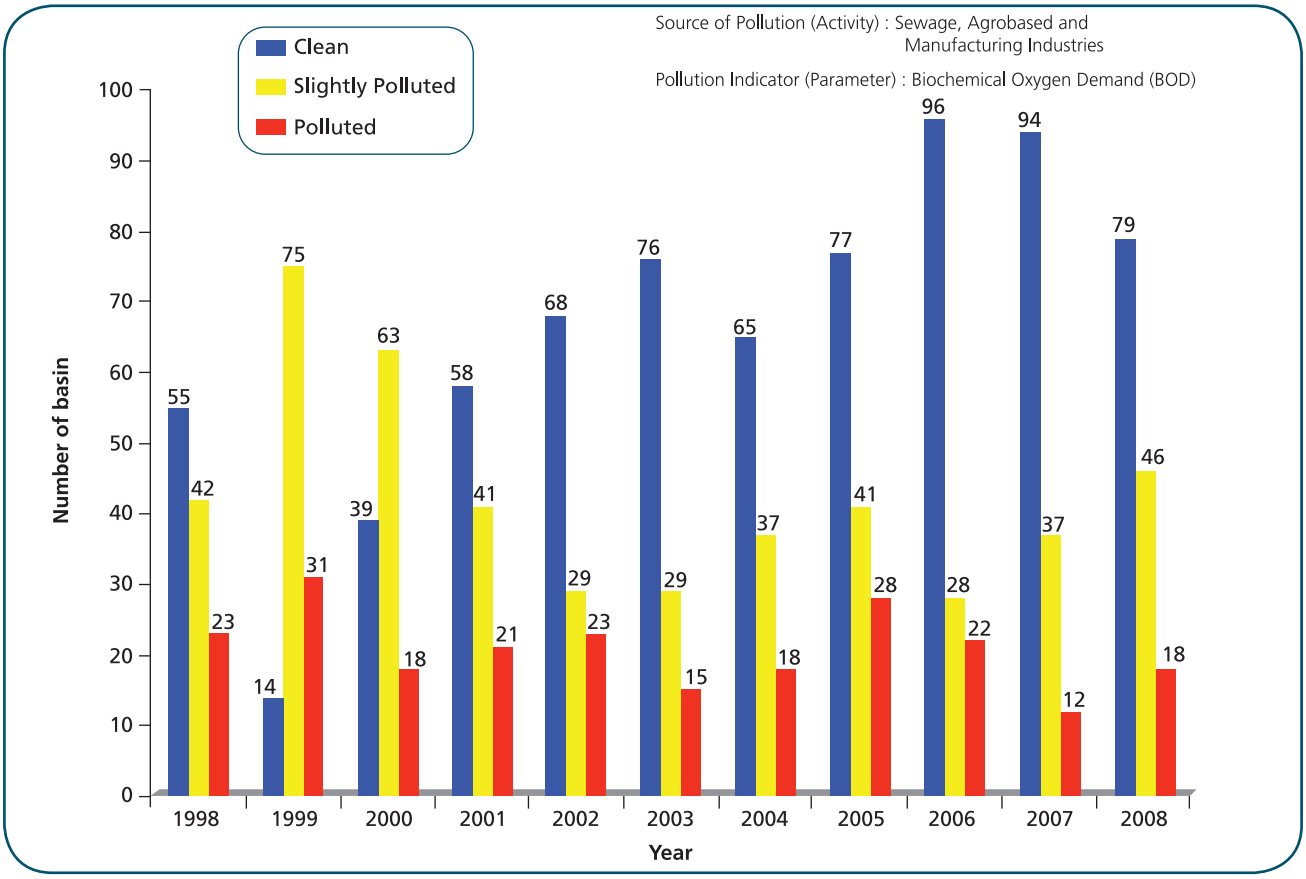


Figure 3.8 Malaysia : River Basins Water Quality Trend based on BOD subindex (1998 - 2008)

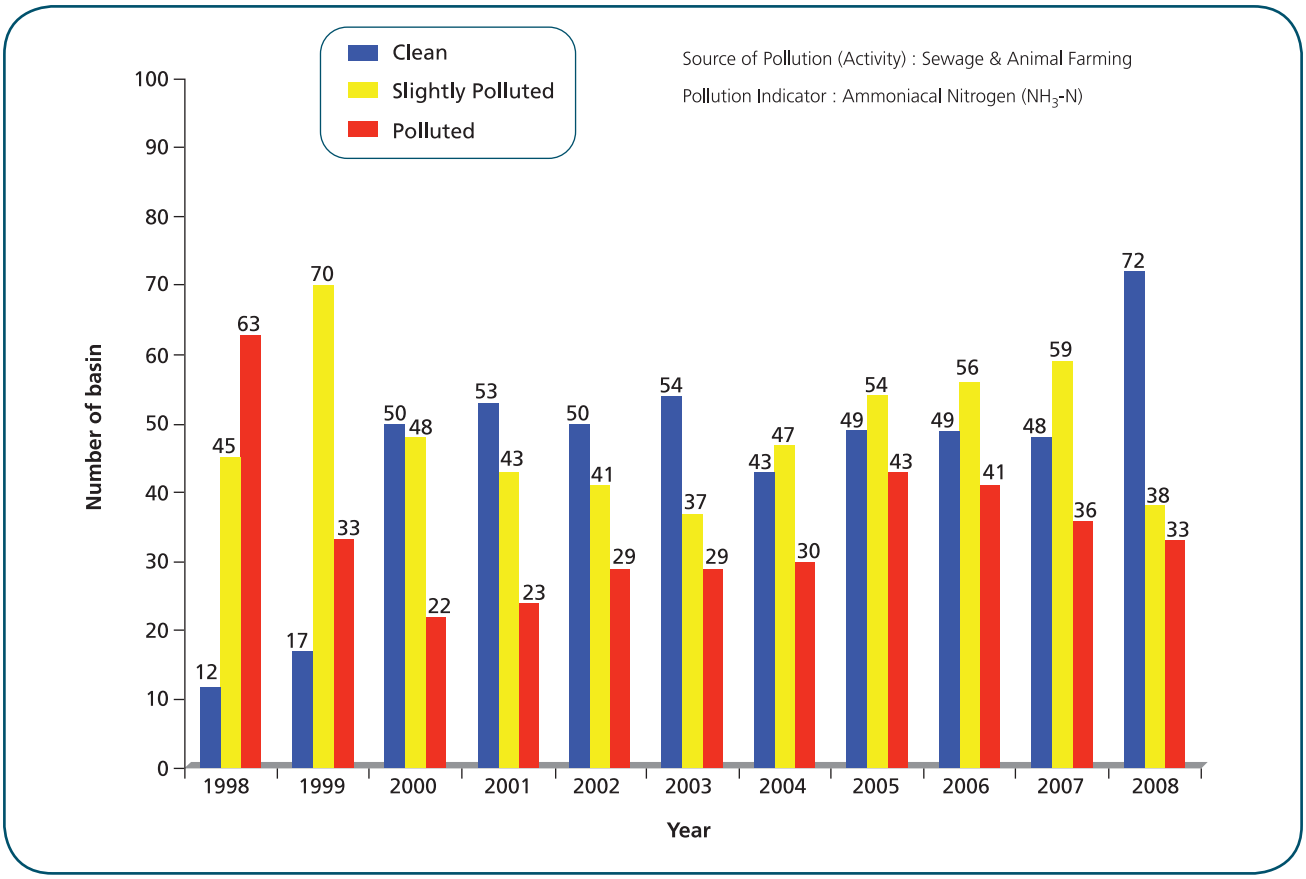


Figure 3.9 Malaysia : River Basins Water Quality Trend based on NH_3-N subindex (1998 - 2008)

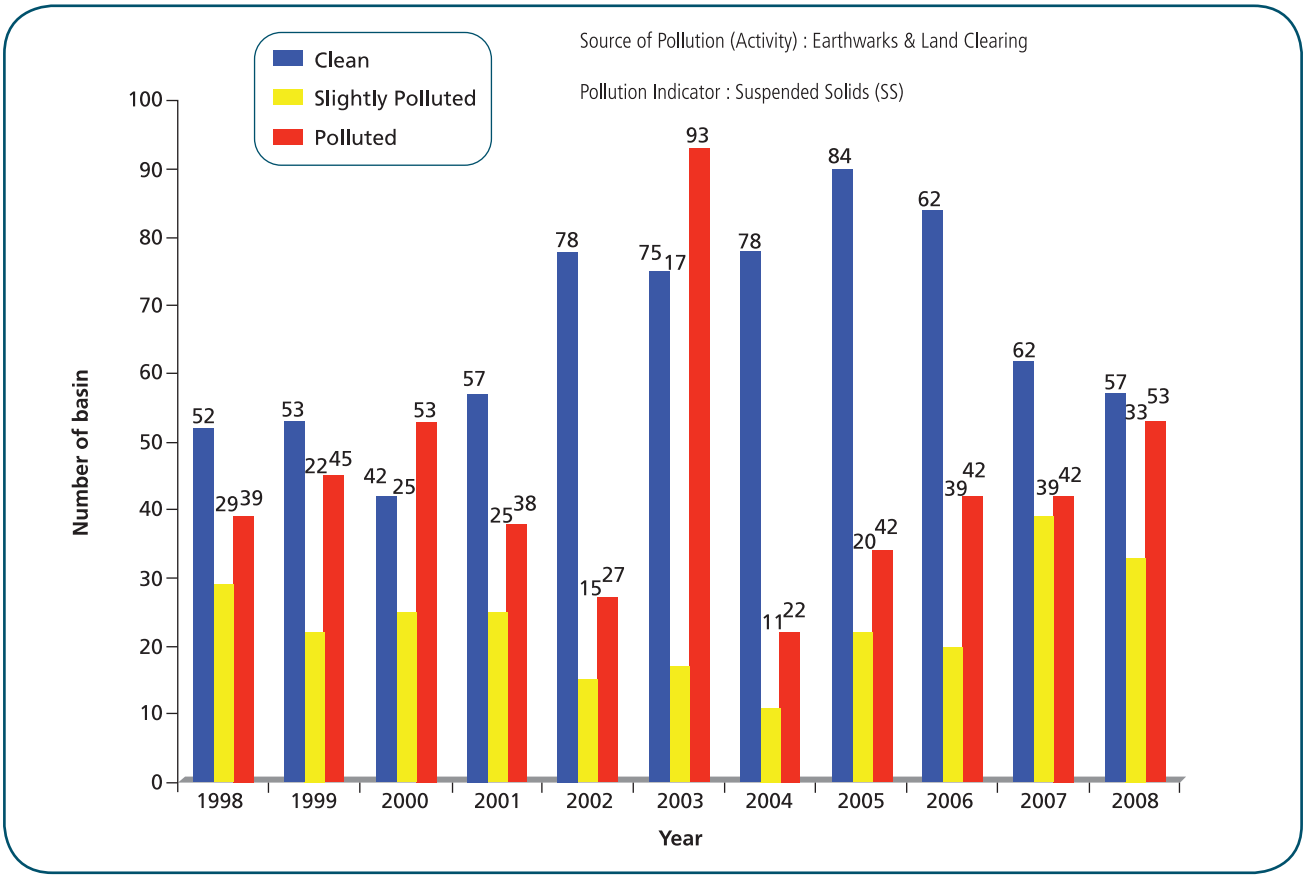


Figure 3.10 Malaysia : River Basins Water Quality Trend based on SS subindex (1998 - 2008)

Chapter 4

GROUNDWATER QUALITY MONITORING

56 Table 4.1 Malaysia : Distribution of Groundwater Monitoring Wells, 2008

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

58 Figure 4.1 Malaysia : Percentage of Non Compliance of Selected Contaminants by Land Use, 2008

chapter 4

Ground Water Quality

GROUNDWATER QUALITY MONITORING

Groundwater quality monitoring was carried out at 81 monitoring wells in Peninsular Malaysia, 16 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, animal burial areas, municipal water supply and ex-mining (gold mine).

GROUNDWATER QUALITY STATUS

In 2008, 335 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 Quality established by the Ministry of Health (Revised December 2000) (**Table 4.2**) to determine the status of its quality.

Table 4.1 Malaysia :
Distribution of Groundwater Monitoring Wells, 2008

Category	Number of Wells
Agricultural Areas	12
Urban/Suburban Areas	11
Industrial Sites	18
Solid Waste Landfills	26
Golf Courses	7
Rural Areas	5
Ex-mining Areas (Gold Mine)	3
Municipal Water Supply	9
Animal Burial Areas	14
Aquaculture Farms	6
Resorts	1
Total	**112**

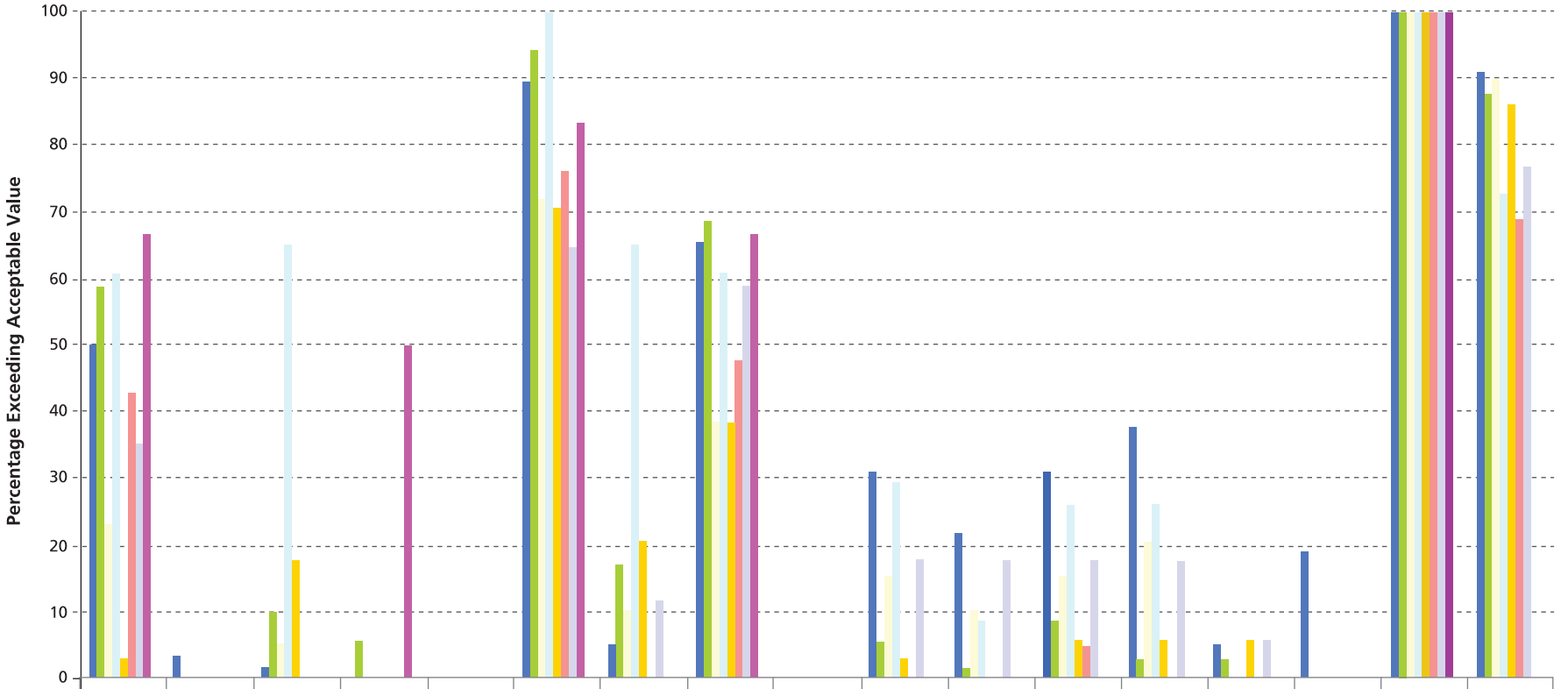
From the monitoring results it was found that arsenic (As), iron (Fe), manganese (Mn), total coliform and phenol recorded the most number of samples exceeding the guideline values. The least number of samples exceeding the guideline values were mercury (Hg), and chromium (Cr) cadmium (Cd), nitrate (NO_3) and sulphate (SO_4). There was no exceedance of copper (Cu) and zinc (Zn) recorded in all samples monitored. **Figure 4.1** shows the percentage of the samples exceeding the guideline values for all the parameters monitored.

Blossoms at an ex-mining area (DOE Photo Library)

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

Parameter	Symbol	Benchmark
Sulphate	SO_4	250 mg/l
Hardness	$CaCO_3$	500 mg/l
Nitrate	NO_3	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



	AS	HG	Cd	Cr	Cu	Fe	Pb	Mn	Zn	Se	CaC03	TDS	Cl	NO3	SO4	T-Coliform	Phenal
Industrial	50	3	2	0	0	90	5	66	0	31	22	31	38	5	19	100	91
Landfils	59	0	10	6	0	94	17	69	0	6	1	9	3	3	0	100	88
Agricuture	23	0	5	0	0	72	10	38	0	15	10	15	21	0	0	100	90
Municipal Water Supply	61	0	65	0	0	100	65	61	0	29	9	26	25	0	0	100	73
Urban/ Suburban	3	0	18	0	0	71	21	38	0	3	0	6	6	6	0	100	86
Golf Courses	43	0	0	0	0	76	0	48	0	0	0	5	0	0	0	100	69
Rural Areas	53	0	0	0	0	65	12	59	0	18	18	18	18	6	0	100	77
Ex-Mining	67	0	0	50	0	83	0	67	0	0	0	0	0	0	0	100	0
Radioactive Landfill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 4.1 Malaysia : Percentage of Non Compliance of Selected Contaminants by Land Use, 2008

Chapter 5

MARINE AND ISLAND MARINE WATER QUALITY

60 Table 5.1 Malaysia : Marine Environmental Quality Parameters

61 Table 5.2 Malaysia : Interim Marine Water Quality Standards

62 Table 5.3 Malaysia : Status of Marine Water Quality Parameters Exceeding Standards (%), 2008

63 Figure 5.1 Malaysia : Marine Water Quality Status, 2006 - 2008

63 Figure 5.2 Malaysia : Island Marine Water Quality Status, 2008

64 Figure 5.3 Malaysia : Status of Island Marine Water Quality by State, 2008

65 Table 5.4 Malaysia : 10 Best Coastal and Estuary Monitoring Sites, 2008

66 Table 5.5 Malaysia : 10 Best Island Monitoring Sites, 2008

chapter 5

Marine & Island Marine Water Quality

MARINE WATER QUALITY MONITORING

Marine water quality monitoring plays an important role in determining the degree of pollution from land-based sources as well as from sea-based sources 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 started in 1978 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 2008 a total of 1070 samples from 229 monitoring stations were collected for analysis as shown in **Table 5.3**. The most number of samples that exceeded the IMWQS were total suspended solids (63.5%), followed by *Escherichia coli* (55.1%) and oil and grease (47.9%). **Figure 5.1** shows the trend of marine water quality contaminants from 2006 to 2008. There was an increase in total suspended solids, oil and grease, *E.coli*, mercury, arsenic and total chromium levels and a decrease in copper, cadmium and lead compared to the previous year.

Table 5.1 Malaysia: Marine Environmental Quality Parameters

In-situ Measurement	Unit	Parameter (Laboratory Analysis)	Unit
Temperature	°C	*Escherichia coli (E. coli)*	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	Plumbum (Pb)	mg/l
		Mercury (Hg)	mg/l

Table 5.2 Malaysia: Interim Marine Water Quality Standards

Parameter (Laboratory Analysis)	Unit	Standards
Escherichia coli (E. coli)	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

Total suspended solids remained a significant contaminant of marine water with all the samples collected from Perlis and Kedah exceeded the IMWQS. Sabah, Pahang and Labuan had the least number of samples (10%) exceeding the standard (**Table 5.3**).

For oil and grease contamination, Perak recorded the highest percentage (97%) exceeding the IMWQS, followed by Kelantan (89%) and Selangor (80%), while Sabah and Labuan were free from oil and grease contamination. *E. coli* contamination was recorded highest in Perlis (95%) and lowest in Pahang (16 %).

Heavy metals pollution was comparatively low in the marine waters. Lead (Pb) was the most prominent heavy metal detected in the marine waters with 15.3 percent exceeding the IMWQS followed by mercury (13.0%) and copper (4.7%). Lead pollution was found in Perak (73%), Kelantan (63%) and Terengganu (61%).

Total suspended solids in the marine waters can be attributed to run – off from land-based activities such as uncontrolled land clearing for development and agriculture activities as well as coastal development.

Recreational beach (DOE Photo Library)

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 from land-based uncontrolled industrial discharges.

ISLAND MARINE WATER QUALITY STATUS

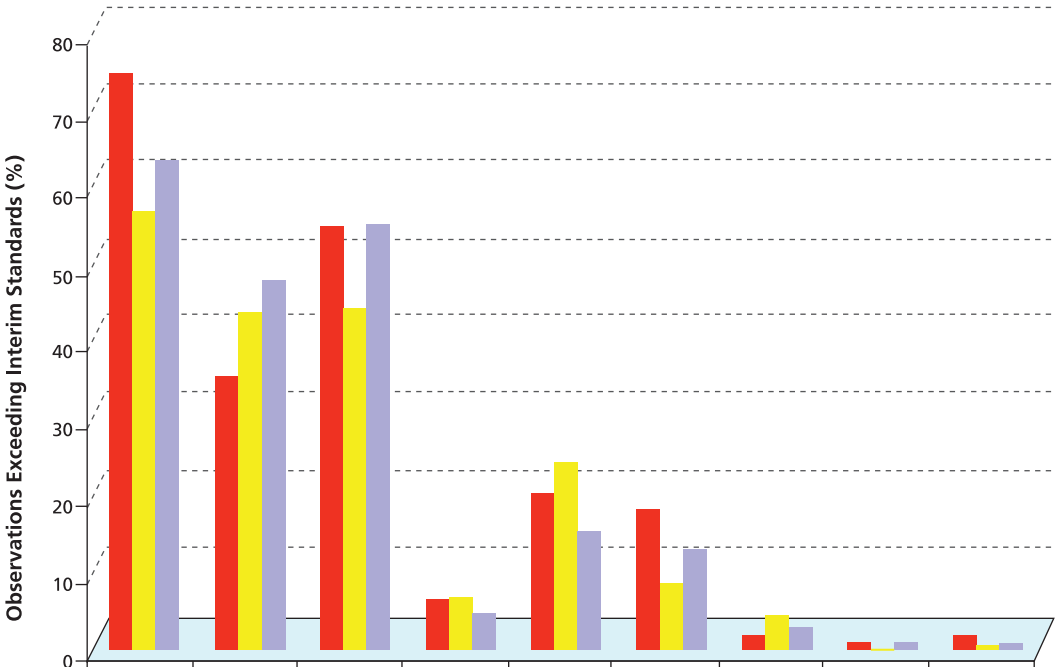
The waters around 71 islands were monitored in 2008 that were categorised as development islands (3 islands), resort islands (25 islands), marine park islands (38 islands) and protected islands (5 islands). A total of 364 samples were collected and analysed. The main pollutants analysed were total suspended solids, *E. coli* and oil and grease.

E. coli recorded the highest number of samples exceeding the IMWQS in all the islands monitored. In development islands 48.5 percent exceeded the interim standards followed by resort islands 24.7 percent, protected islands 6.3 percent and marine parks 4.7 percent. Development islands and resort islands recorded total suspended solids exceeding the standards by 22.2 and 4.8 percent respectively while marine parks and protected islands recorded no contamination. For oil and grease contamination, development islands recorded the highest percentage

Table 5.3 Malaysia: Status of Marine Water Quality Parameters Exceeding Standards (%), 2008

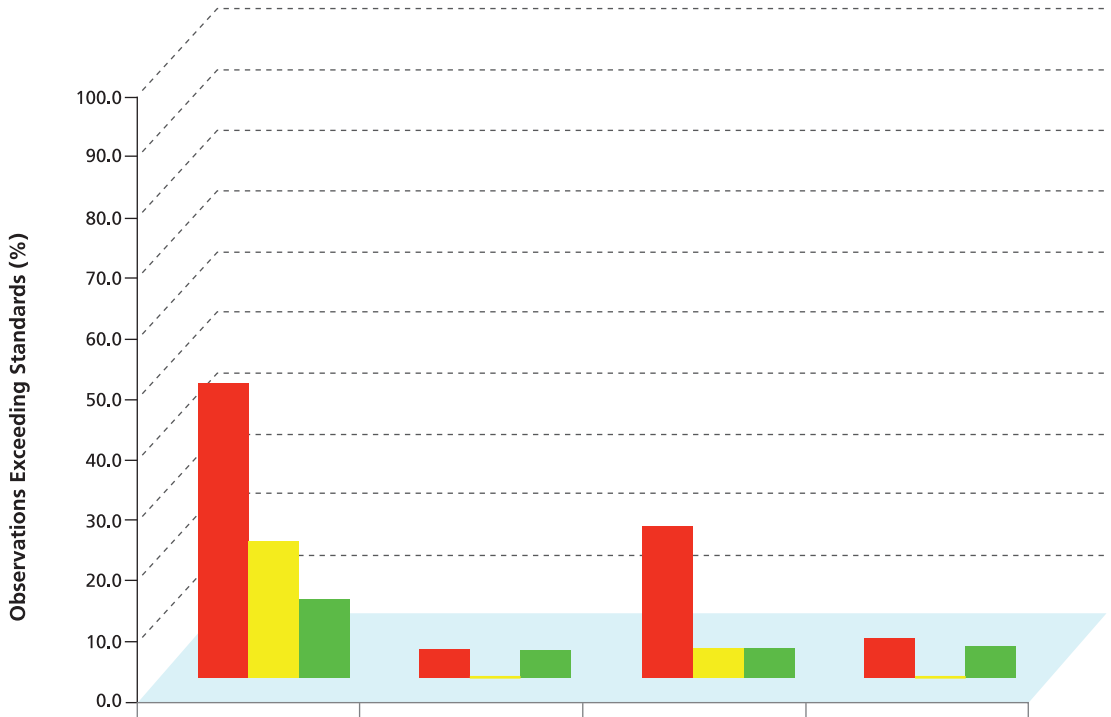
			Parameter Exceeding Interim Standards (%)								
State	No. of Station	No of Sample	Total Suspended Solids	Oil and Grease	*Escherichia coli*	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury
Perlis	2	22	100	65	95	0	0	0	0	0	20
Pulau Langkawi	7	42	93	47	29	0	0	0	0	0	0
Kedah	3	18	100	50	67	0	0	0	0	8	25
Pulau Pinang	22	175	83	69	87	0	0	0	9	6	5
Perak	13	68	58	97	44	0	14	2	58	73	NA
Selangor	14	73	94	80	81	0	0	0	0	0	12
N. Sembilan	13	78	95	72	70	0	0	0	0	0	15
Melaka	8	48	98	4	77	0	0	NA	0	0	5
Johor	51	168	34	10	74	0	0	0	3	0	3
Pahang	11	80	6	28	16	0	0	0	0	0	33
Terengganu	19	76	24	60	47	0	13	8	0	61	5
Kelantan	10	40	68	89	60	15	15	0	0	63	33
W.P. Labuan	5	15	0	0	33	NA	0	0	0	7	0
Sabah	26	104	3	0	26	0	0	0	0	5	0
Sarawak	25	63	95	49	19	0	0	0	0	8	28
Malaysia (Sum)	229	1070	TSS	O & G	E.coli	As	Cd	Cr	Cu	Pb	Hg
Average (%)			63.5	47.9	55.1	1.1	2.8	0.7	4.7	15.3	13.0

Note : NA = Not available



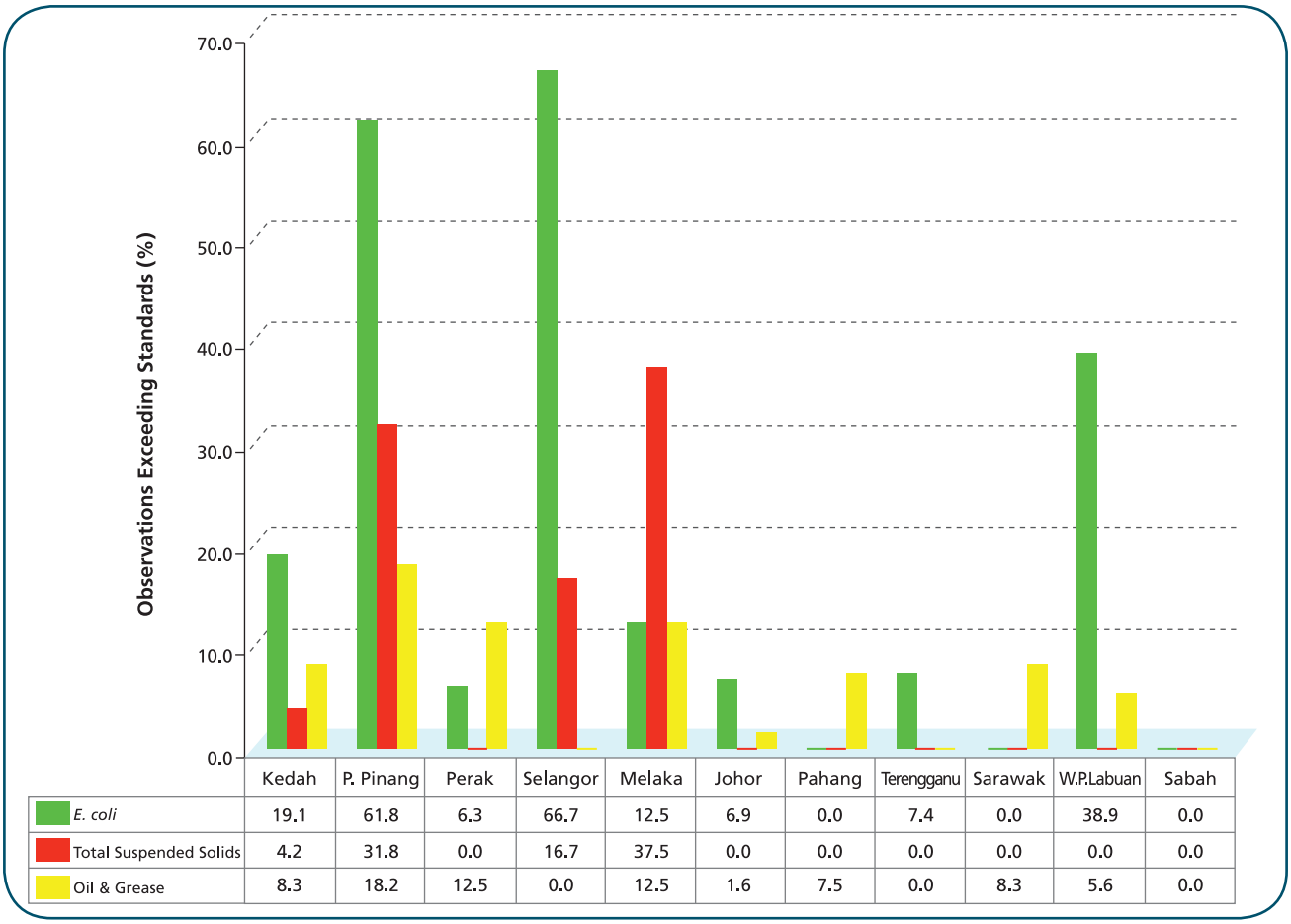
	Total Suspended Solids	Oil & Grease	*E. coli*	Copper	Lead	Mercury	Cadmium	Arsenic	Total Chromium
2006	74.7	35.4	54.9	6.4	20.3	18.2	1.9	0.9	1.9
2007	56.9	43.6	44.1	6.7	24.2	8.5	4.5	0.0	0.6
2008	63.5	47.9	55.1	6.7	15.3	13.0	2.8	1.1	0.7

Figure 5.1 Malaysia : Marine Water Quality Status, 2006 - 2008



	Development	Marine Park	Resort	Protected
E - coli	48.5	4.7	24.7	6.3
Total Suspended Solids	22.2	0.0	4.8	0.0
Oil - Grease	12.5	4.3	4.8	5.0

Figure 5.2 Malaysia : Island Marine Water Quality Status, 2008



	Kedah	P. Pinang	Perak	Selangor	Melaka	Johor	Pahang	Terengganu	Sarawak	W.P.Labuan	Sabah
E. coli	19.1	61.8	6.3	66.7	12.5	6.9	0.0	7.4	0.0	38.9	0.0
Total Suspended Solids	4.2	31.8	0.0	16.7	37.5	0.0	0.0	0.0	0.0	0.0	0.0
Oil & Grease	8.3	18.2	12.5	0.0	12.5	1.6	7.5	0.0	8.3	5.6	0.0

Figure 5.3 Malaysia : Status of Island Marine Water Quality by State, 2008

(12.5%) exceeding the standards followed protected islands (5%), resort islands (4.8%) and marine parks (4.3%) (**Figure 5.2**).

As shown in **Figure 5.3**, *E. coli* contamination was highest in Selangor marine waters where 66.7 percent of the samples exceeded the standard of 100 MPN/100 ml whilst all samples for Pahang, Sarawak and Sabah were below the standards. As for total suspended solids, Melaka recorded the highest samples exceeding the standards at 37.5 percent. However, total suspended solids for islands in Johor, Pahang, Terengganu, Sarawak, Sabah and Labuan were in compliance. Oil and grease was detected in Pulau Pinang with 18.2 percent of samples monitored exceeded the interim standards, followed by Melaka and Perak (12.5%) and Kedah and Sarawak (8.3%). Selangor, Terengganu and Sabah were free of oil and grease pollution.

TARBALL MONITORING

Tarball residues on beaches are usually caused by oily discharges from fishing boats as well as passing vessels. In 2008 it was found that all the 131 monitoring stations were free from tarball pollution.

ASSESSMENT OF MARINE WATER QUALITY STATIONS

The marine water quality data were analysed further to indicate the monitoring sites with the best marine water quality. **Table 5.4** shows the 10 best coastal and estuarine water quality and **Table 5.5** shows the 10 best islands water quality.

Table 5.4 Malaysia: 10 Best Coastal and Estuary Monitoring Sites, 2008

State	Sites	Category
Pahang	• Pantai Cherating	Coastal
	• Pantai Sepat	Coastal
	• Pantai Teluk Cempedak	Coastal
Sabah	• Borneo Golf Seawater	Coastal
	• Pantai Kg. Lamak, Lahad Datu	Coastal
	• Pantai Manis, Papar	Coastal
	• Pantai Melinsung, Papar	Coastal
	• Pantai Sabandar, Tuaran	Coastal
	• Pantai Teluk Brunei 4	Coastal
	• Pantai Ulu Tungku	Coastal

Coastal Fishing Activity (DOE Photo Library)

Table 5.5 Malaysia: 10 Best Island Monitoring Sites, 2008

State	Sites	Category
Johor	• Sibu Besar	Marine Park
	• Sibu Tengah	Resort
Kedah	• Lembu, Langkawi	Marine Park
	• Payar, Langkawi	Marine Park
Pahang	• Seri Buat	Marine Park
Sabah	• Gaya	Resort
	• Sipadan	Resort
	• Mabul	Resort
Terengganu	• Pinang	Marine Park
	• Redang	Marine Park

Clean Sandy Beach, Redang Island, Terengganu (DOE Photo Library)

Chapter 6

POLLUTION SOURCES INVENTORY

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69 Figure 6.2 Malaysia : Distribution of Industrial Water Pollution Sources (Agro-based and Manufacturing Industries) by State, 2008

70 Figure 6.3 Malaysia : Distribution of Sewage Treatment Plants by State, 2008 Source : IWK Sdn. Bhd.

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74 Figure 6.9 Malaysia : NO_X Emission by Sources (Metric Tonnes) 2008

75 Figure 6.10 Malaysia : CO Emission by Sources (Metric Tonnes) 2008

75 Figure 6.11 Malaysia : Air Pollutant Emission Load from Motor Vehicles, 2007-2008

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79 Table 6.3 Malaysia : Quantity of Scheduled Wastes Generated by Industry, 2008

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81 Table 6.4 Malaysia : Facilities Handling Scheduled Wastes, 2008

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80 Figure 6.15 : Types of Treatment And Disposal of Waste by Kualiti Alam Sdn. Bhd.,2008

chapter 6

Pollution Sources Inventory

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 and surface runoffs.

The Department of Environment (DOE) maintains mainly records of point sources. In 2008, 17,633 water pollution point sources were recorded. These comprise of sewage treatment plants (9,524: 54.01% inclusive of 668 Network Pump Stations), manufacturing industries (6,830: 38.73%), animal farms (788: 4.48%) and agro-based industries (491: 2.78%) 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 2008. A total of 7,321 sources were identified with Johor having the highest number of water pollution sources (1,790: 24.45%).

Data from the Veterinary Department of Malaysia shows that there were 1.75 million standing pig population in 2008. This was an increase of 0.6 percent compared to 2007 where the standing pig population was 1.74 million. Correspondingly, the number of pig farms increased from 779 in 2007 to 788 farms in 2008.

Indah Water Konsortium Sdn. Bhd. (IWK) managed mainly public sewage treatment plants that were handed over by Local Authorities only in Peninsular Malaysia and Labuan. The number of sewage treatment plants under the management of IWK increased from 9,337 plants in 2007 to 9,524 in 2008. Selangor had the largest number of sewage treatment plants (2,715: 28.5%), followed by Perak (1,422: 14.9%), Johor (1,061: 11.1%) and Negeri Sembilan (945: 9.9%) (**Figure 6.3**).

BOD LOAD

In terms of BOD load, domestic treated and partially treated sewage remained the largest contributor with an estimated load of 944,533.80 kg/day. The

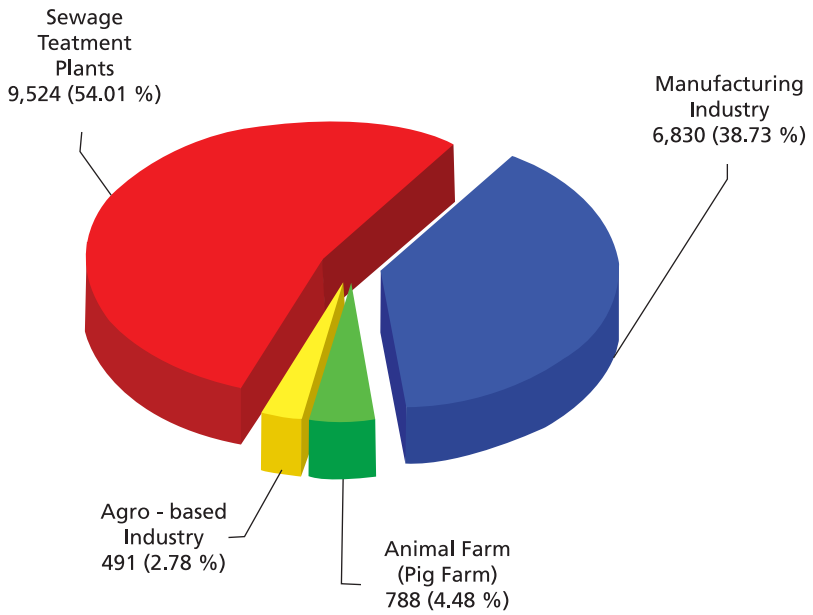

Figure 6.1 Malaysia : Composition of Water Pollution Sources by Sector, 2008

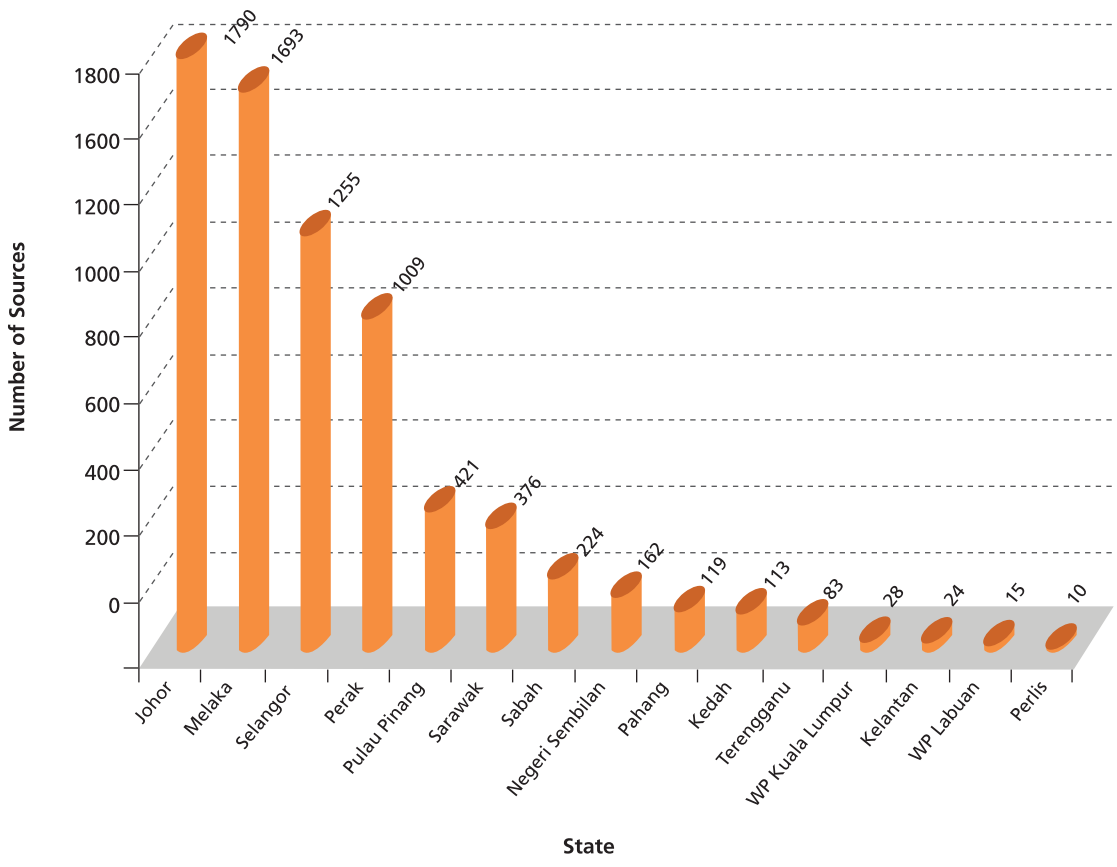

Figure 6.2 Malaysia : Distribution of Industrial Water Pollution Sources
(Agro-based and Manufacturing Industries) by State, 2008

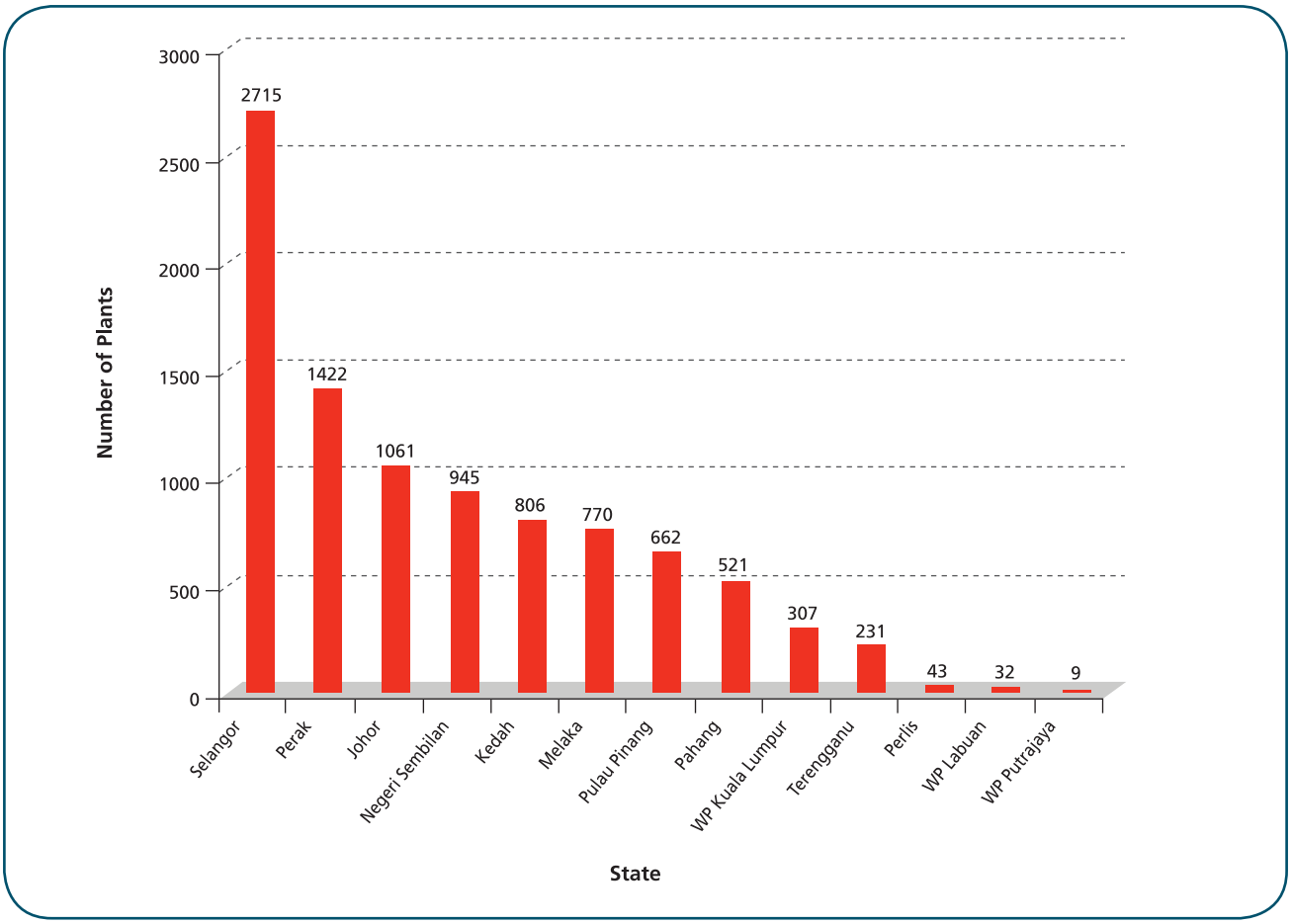

Figure 6.3 Malaysia : Distribution of Sewage Treatment Plants by State, 2008
Source : IWK Sdn. Bhd.

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

State	No. of STP	Total PE	Flow (m^3/day)	BOD Load (kg/day)
Selangor	2,715	6,579,871	1,480,471	370,117.74
Perak	1,422	1,300,646	292,645	73,161.34
Johor	1,061	1,370,605	308,386	77,096.53
Negeri Sembilan	945	996,659	224,248	56,062.07
Kedah	806	626,258	140,908	35,227.01
Melaka	770	623,622	140,315	35,078.74
Pulau Pinang	662	1,554,709	349,810	87,452.38
Pahang	521	332,668	74,850	18,712.58
WP Kuala Lumpur	307	3,195,659	719,023	179,755.82
Terengganu	231	69,165	15,562	3,890.53
Perlis	43	21,839	4,914	1,228.44
WP Labuan	32	42,309	9,520	2,379.88
WP Putrajaya	9	77,702	17,483	4,370.74
Total	**9,524**	**16,791,712**	**3,778,135**	**944,533.80**

Note : STP = Sewage Treatment Plant
PE = Population Equivalent
Source : IWK Sdn. Bhd

other major contributors were pig farming (226,929.17 kg/day) and agro-based manufacturing industries (76,186.36 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 2008.

SOURCES OF AIR POLLUTION

Industries including power stations, motor vehicles and open burning activities remain the major sources of air pollution in the country.

In 2008 a total of 22,971 industrial sources were identified to be subjected to Environmental Quality (Clean Air) Regulations, 1978. The breakdown of industrial sources by states is as shown in **Figure 6.4.** The highest number of stationary pollution sources was in Johor (8,141: 35.4%) followed by Selangor (4,127: 18.0%) and Perak (2,956: 12.9%).

As for the past years, motor vehicles remain the major contributor of air pollution especially in urban areas. In 2008, there was an overall increase in the number of motor vehicles registered. The number of registered passenger cars increased by 8.0 percent, motorcycles by 7.3 percent, goods vehicles by 5.1 percent, taxis by 3.9 percent and buses by 3.1 percent in 2008 compared to 2007. The number of registered vehicles in Malaysia for the year 2007 and 2008 is as shown in **Figure 6.5.** However, the number of in-use or active vehicles on the road namely taxis, busses and goods vehicles decreased significantly by 87 percent, 32 percent and 51 percent respectively in 2008 compared to the previous year. This could be due to an increased in fuel price in 2008.

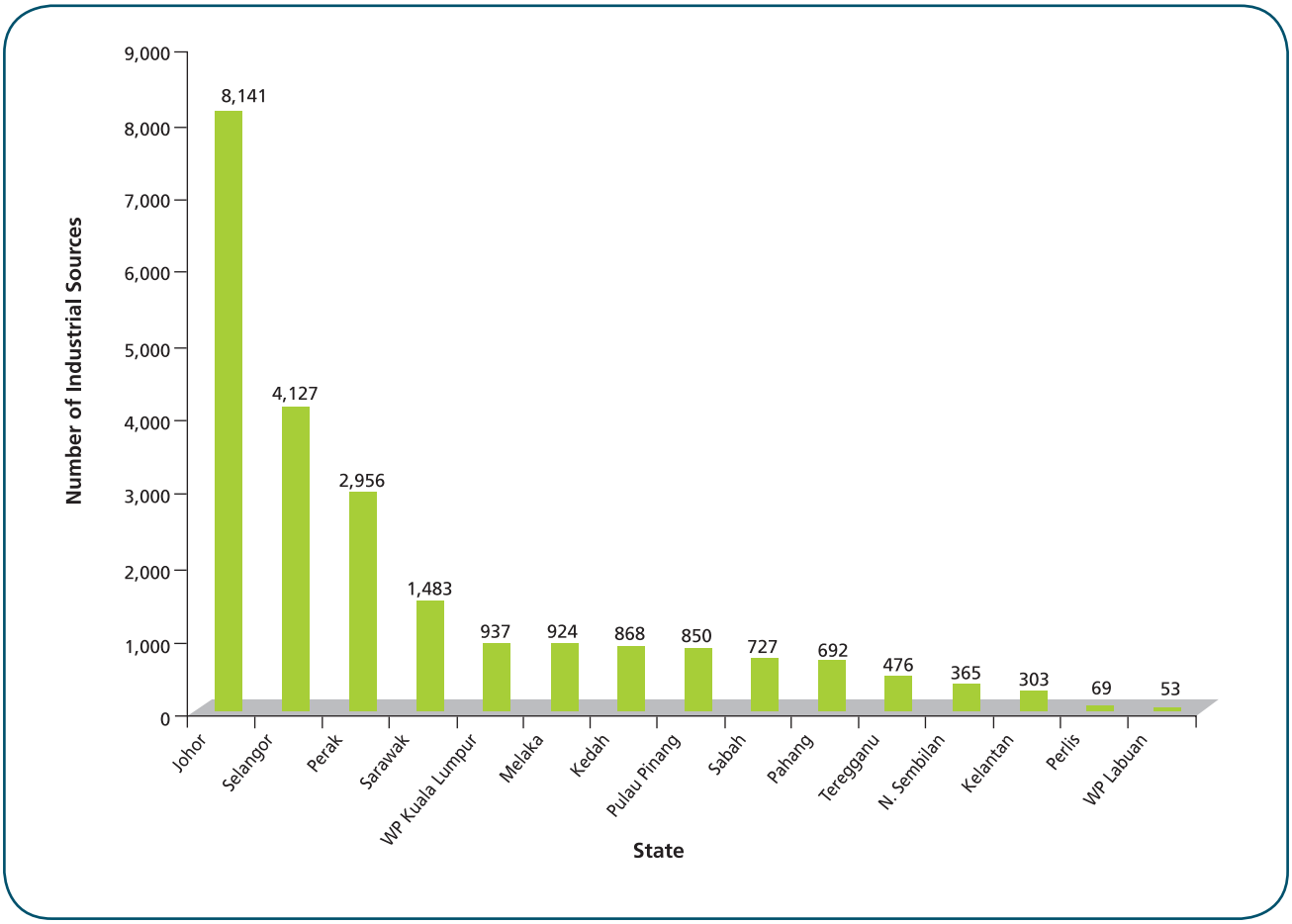

Figure 6.4 Malaysia : Industrial Air Pollution Sources by State, 2008

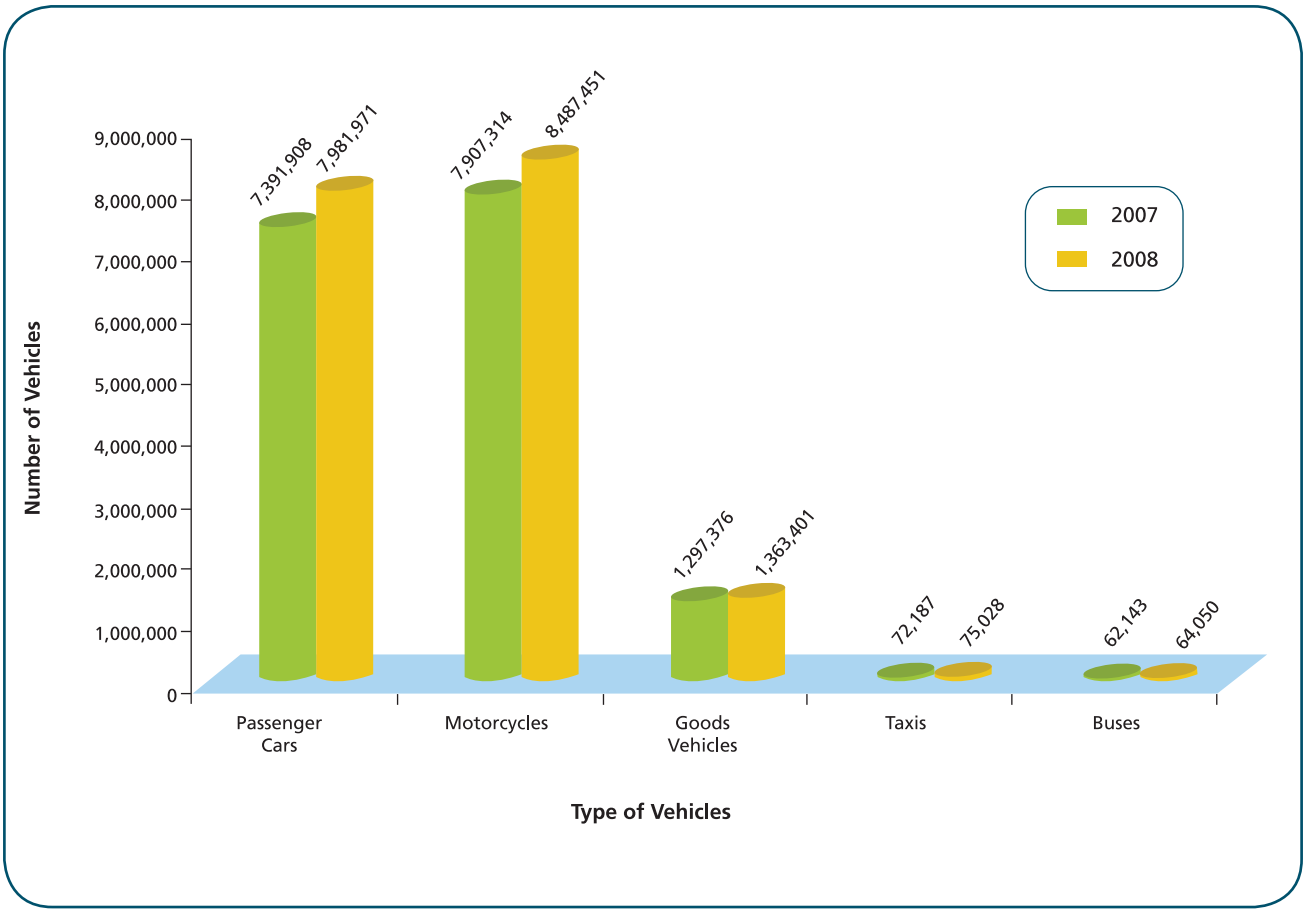

Figure 6.5 Malaysia : Number of Registered Vehicles in 2007 and 2008
(Source : Road Transport Department, Malaysia, 2008)

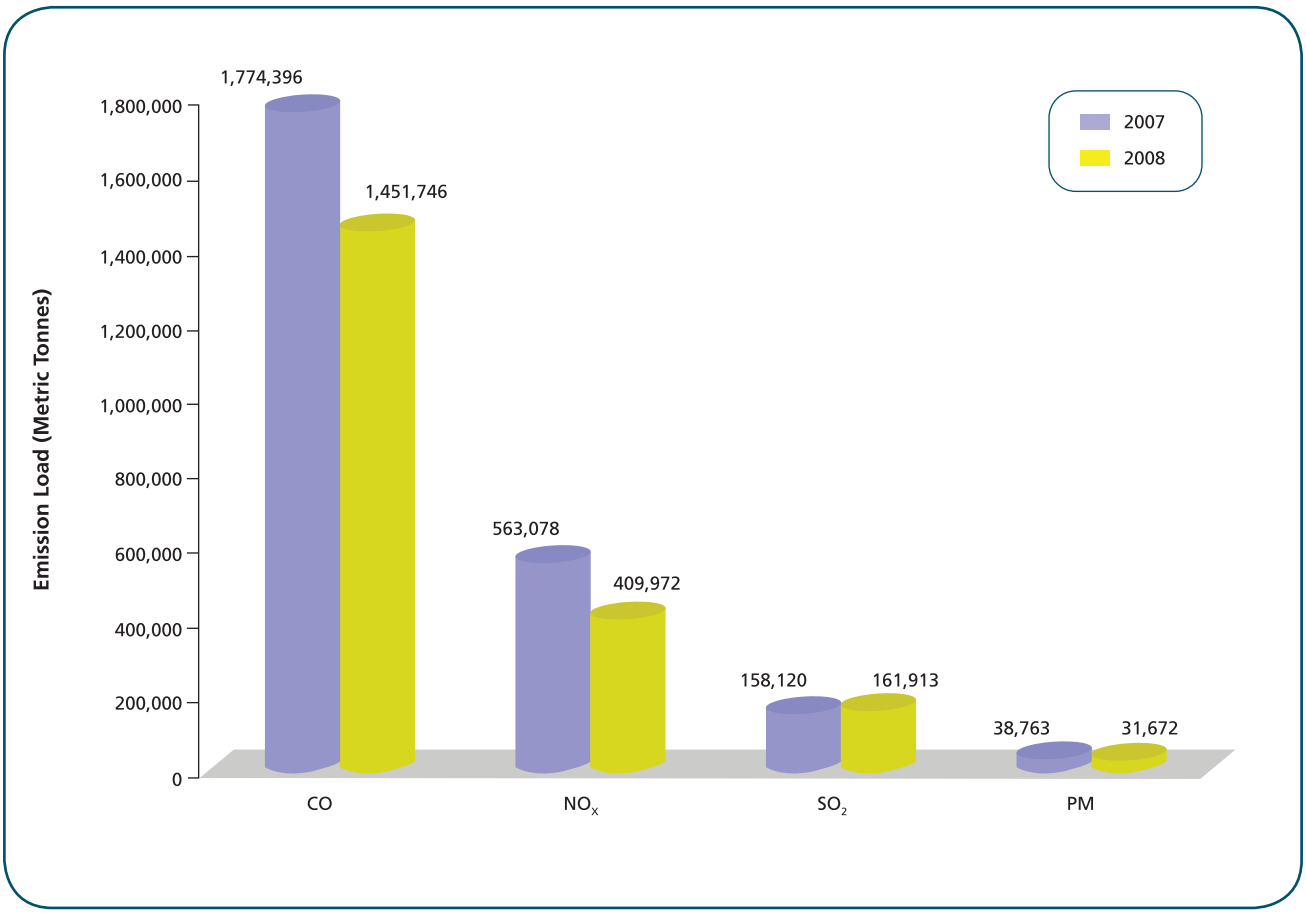

Figure 6.6 Malaysia : Air Pollutant Emission Load from All Sources, 2007-2008
(Sources : From National Energy Balance 2006)

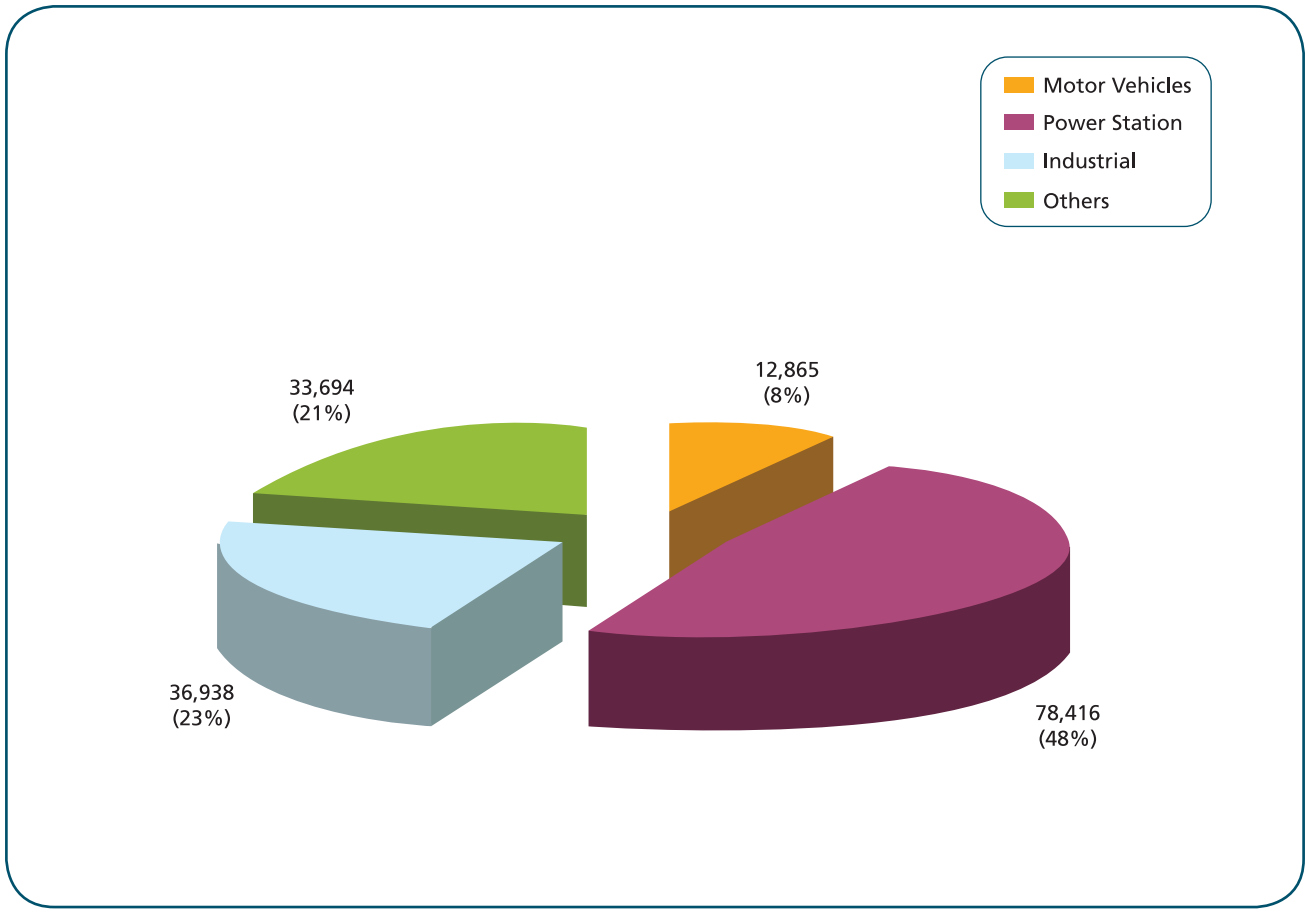

Figure 6.7 Malaysia : SO_2 Emission by Sources (Metric Tonnes), 2008

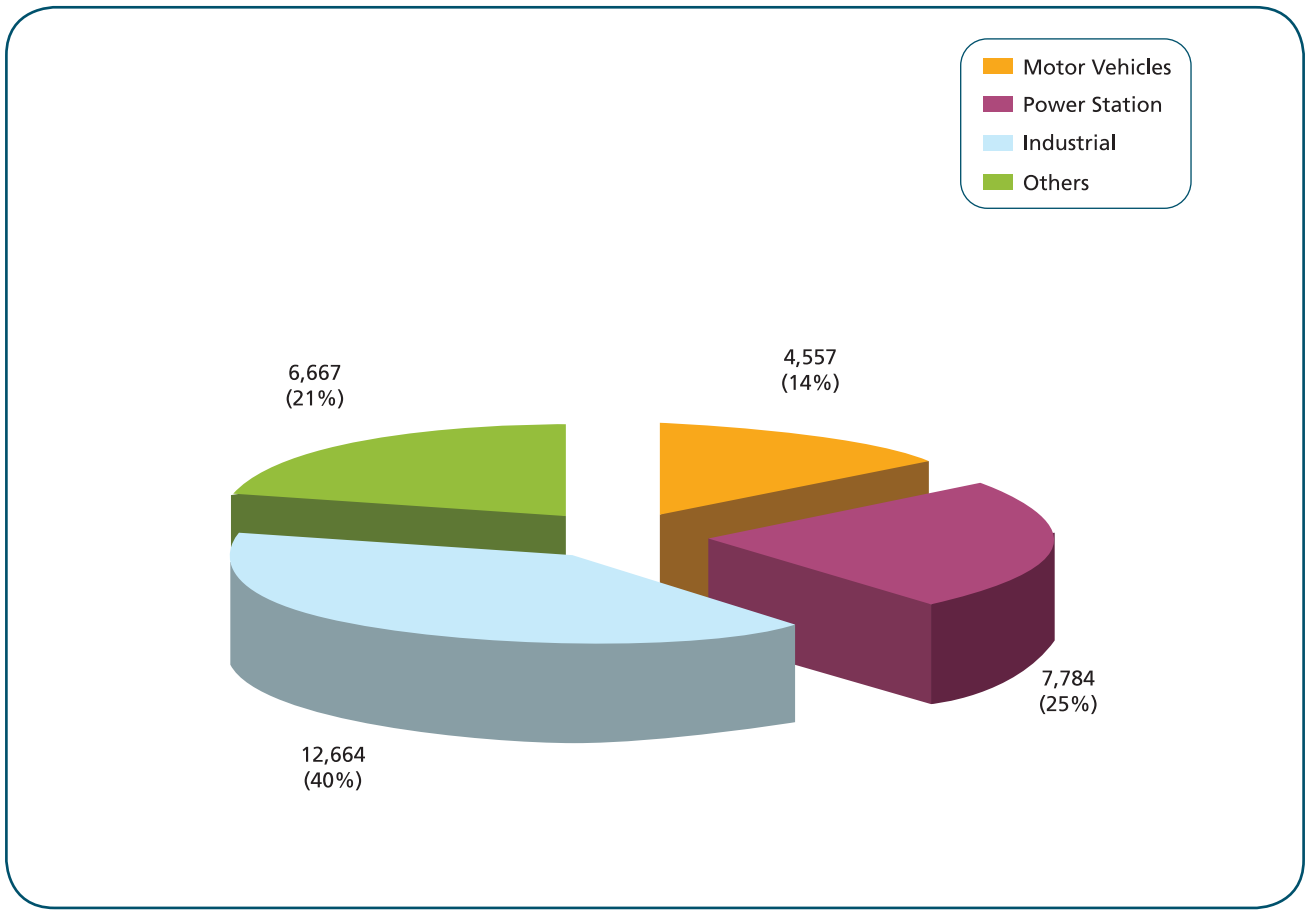

Figure 6.8 Malaysia : Particulate Matter (PM) Emission Load by Sources (Metric Tonnes), 2008

AIR POLLUTANT EMISSION LOAD

Overall Emission Load

It is estimated that in 2008 the combined air pollutant emission load was 1,451,746 metric tonnes of carbon monoxide (CO); 409,972 metric tonnes of nitrogen oxides (NO_X); 161,913 metric tonnes of sulphur dioxide (SO_2) and 31,672 metric tonnes of particulate matter (PM). A comparison of the combined air pollutant emission load in 2007 and 2008 is shown in **Figure 6.6**. Except for SO_2 there was a decrease in emission load for CO, NO_X and PM compared to 2007. The increase of 2.4 percent in SO_2 emission load was due to an increase in the number of industrial sources while the decrease in emission load for CO, NO_X and PM in 2008 was due to a decrease in the number of in-use or active motor vehicles.

Emission Load By Sources

Power stations contributed the highest SO_2 emission load (48%), industries (23%), motor vehicles (8%) and others (21%) (**Figure 6.7**). As to PM the highest contributor was industries (40%) followed by power stations (25%), motor vehicles (14%) and others (21%) (**Figure 6.8**). As shown in **Figure 6.9** the highest contributor of NO_X was from motor vehicles (49%). Similarly the highest contributor of CO was also from motor vehicles at 97.1%, whilst power stations contributed 1.6%, industries contributed 1.1% and others contributed 0.2% (**Figure 6.10**).

The estimated annual air pollutant emission loads of HC, CO, PM, NO_2 and SO_2 from motor vehicles for 2007 and 2008 is shown in **Figure 6.11**. In 2008, the emission load of CO, HC, NO_2, SO_2 and PM were estimated to be 1,410,134 metric tonnes, 336,537 metric tonnes, 203,235 metric tonnes, 12,865 metric tonnes and 4557 metric tonnes respectively. Generally there was a decrease in emission load from motor vehicles in 2008 compared to 2007.

SCHEDULED WASTES INVENTORY

Based on the notification on scheduled wastes received by the Department of Environment (DOE), a total of

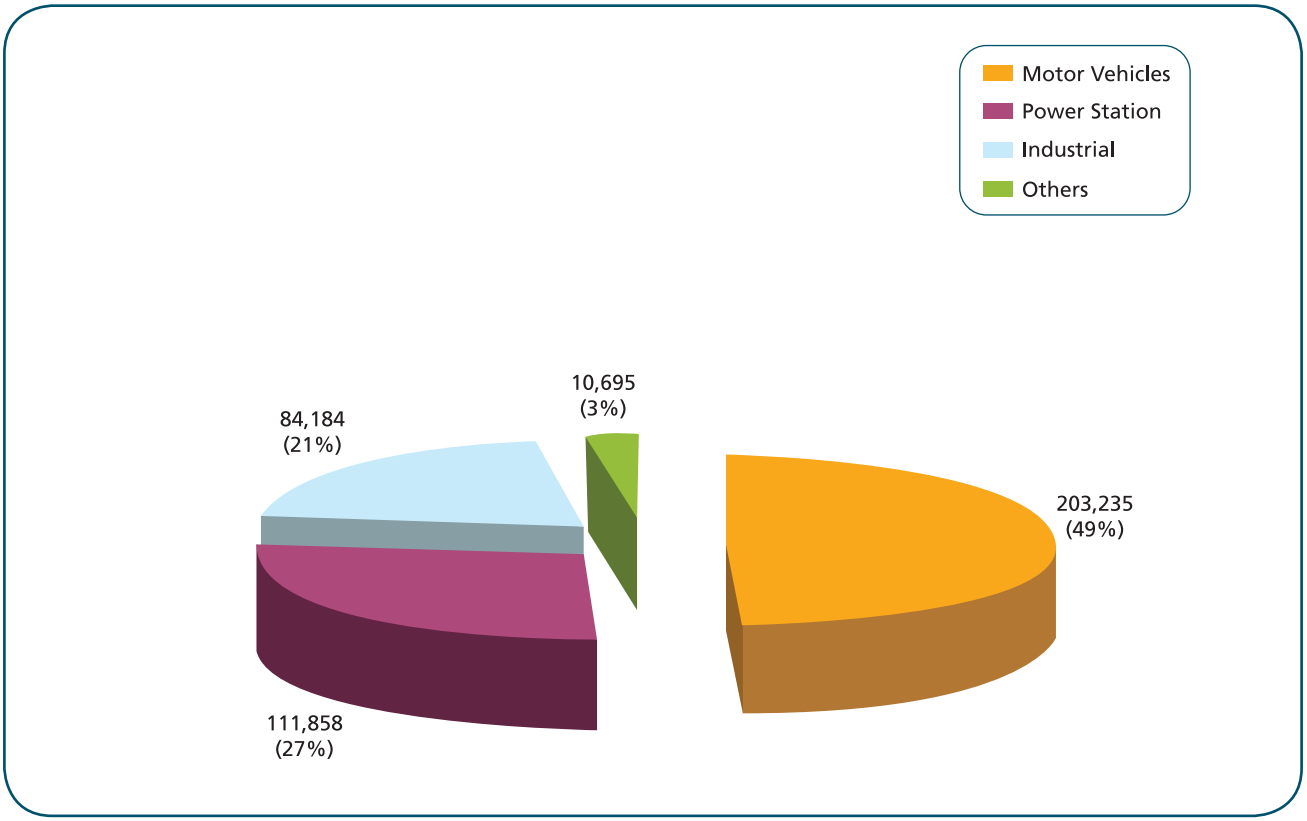

Figure 6.9 Malaysia : NO_X Emission by Sources (Metric Tonnes) 2008

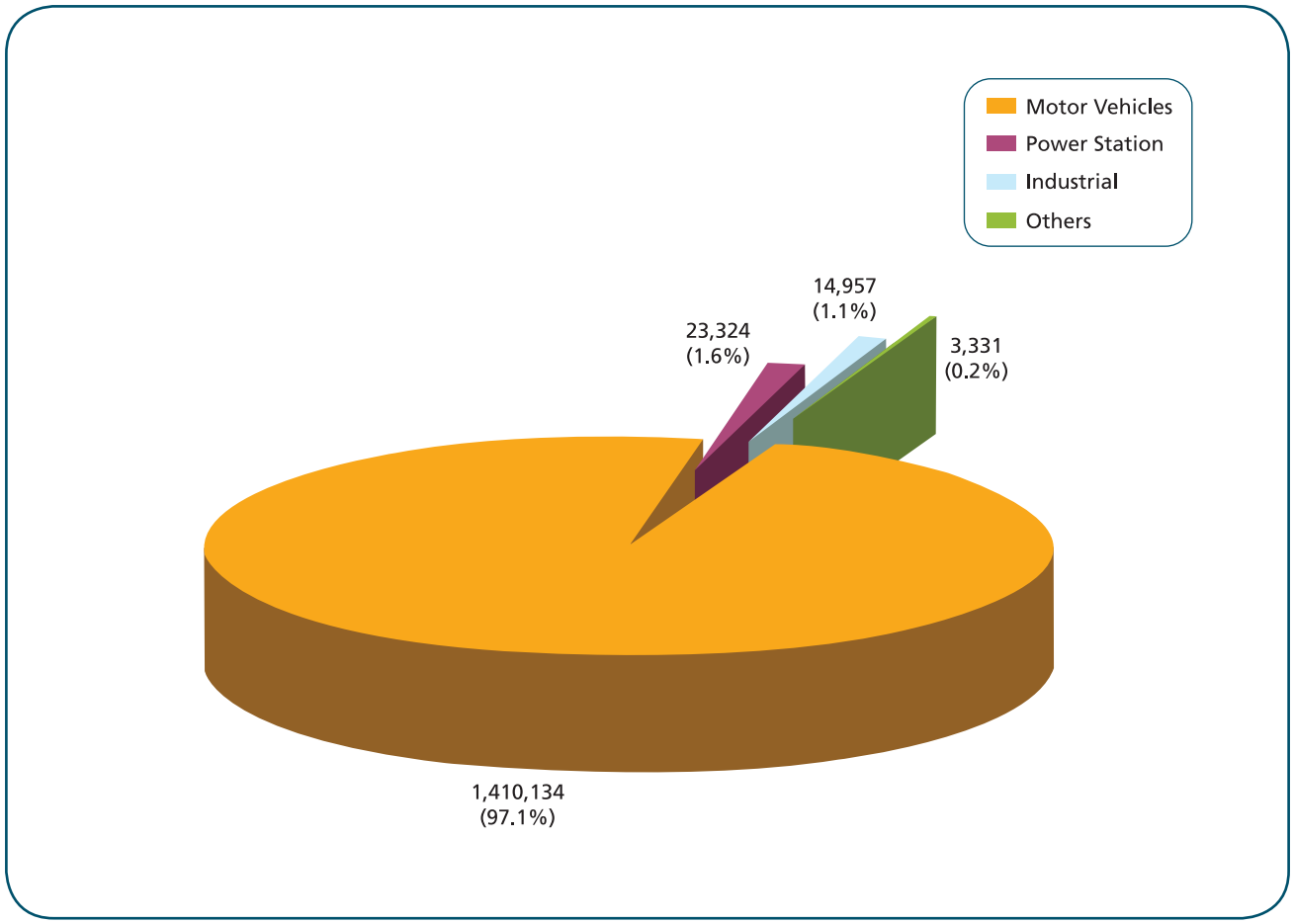

Figure 6.10 Malaysia : CO Emission by Sources (Metric Tonnes) 2008

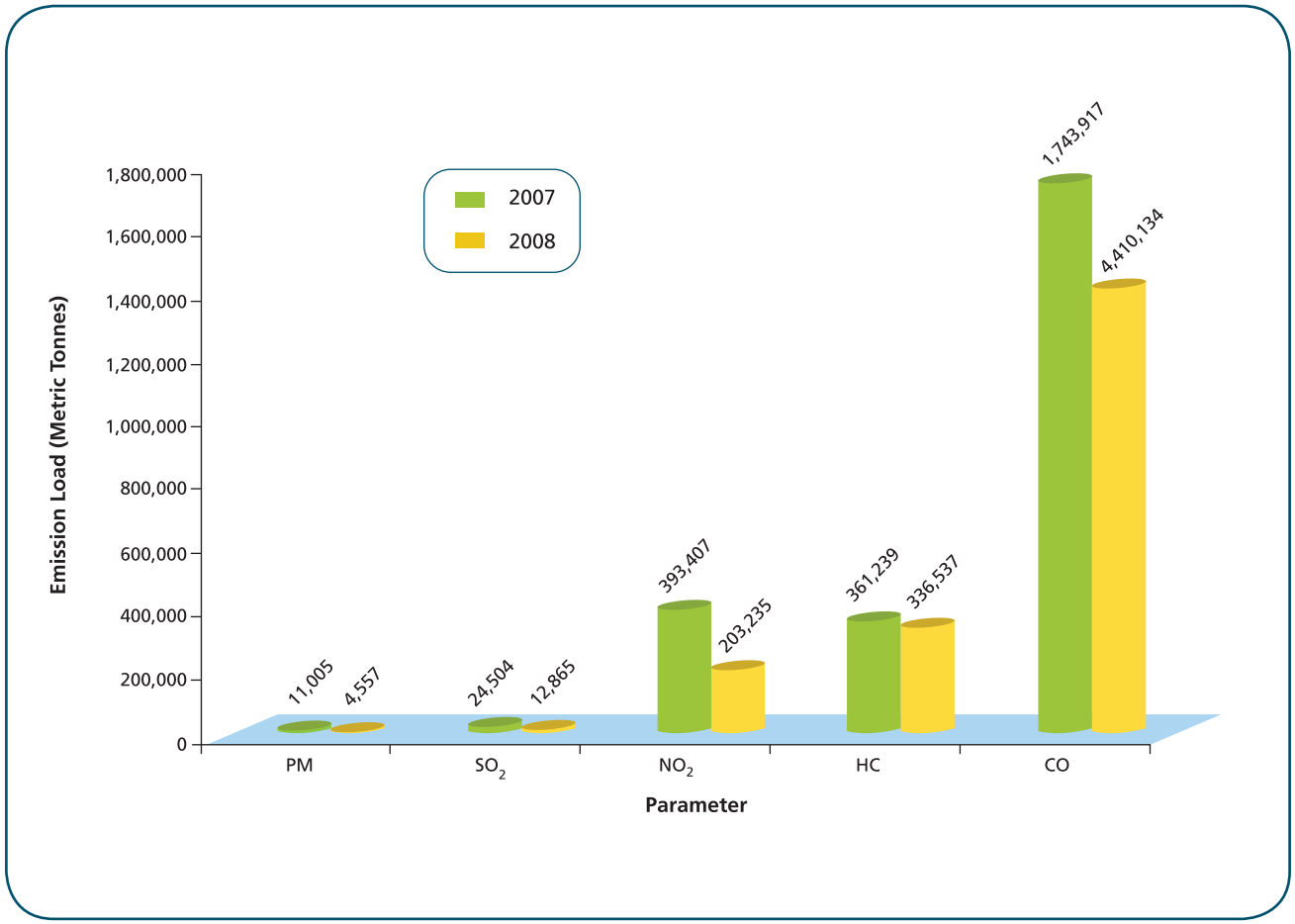

Figure 6.11 Malaysia : Air Pollutant Emission Load from Motor Vehicles, 2007-2008

1,304,898.77 metric tonnes of scheduled wastes were generated in 2008 as compared to 1,138,839.491 metric tonnes in 2007.

In 2008, gypsum, dross/slag/clinker, oil and hydrocarbon, mineral sludge, e-waste and heavy metal sludge 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 6.12, 6.13** respectively.

Terengganu generated the largest amount of scheduled wastes (24.7%), followed by Johor (24%), Selangor (18.8%) and Perak (14.5%). Distribution of scheduled wastes generated by state is shown in **Figure 6.14**.

Of the total wastes produced, 137,371.50 metric tonnes (10.5%) were treated and disposed at Kualiti Alam Sdn. Bhd., 13,940.33 metric tones (1.1%) were treated and disposed at Trinekens (Sarawak) Sdn. Bhd., 14,140.05 metric tonnes (1.1%) of clinical wastes were incinerated at licensed off-site facilities; 5,720.00 metric tonnes (0.4%) were exported for recovery purposes, 624,361.12 metric tonnes (47.8%) of scheduled wastes were recovered at off-site facilities and an estimated 484,747.54 metric tonnes (37.1%) were treated on-site and 24,618.23 metric tonnes (1.9%) were stored on-site at waste generators' premises (**Table 6.4**). Three landfarms for on-site treatment and 18 on-site waste incinerators had been licensed by DOE.

Of the 624,361 metric tones of wastes being recovered at local off-site recovery facilities, 23.4% are dross/ slag/ clinker followed by electronic and electrical wastes (21.1%) and oil & mineral sludge (17.2%). A total of 341 off-site recovery facilities have been licensed by the department (**Table 6.5**).

The categories of wastes sent to Kualiti Alam Sdn Bhd were dross/ slag/ clinker wastes, mixed wastes, ink & paint sludges, rubber sludges, alkaline waste, oily waste, contaminated soil, catalyst and metal hydroxide wastes. They were either incinerated, physically and chemically treated, solidified or disposed off in secured landfill (**Figure 6.15**).

Electronic Waste: Computer Components (DOE Photo Library)

Table 6.2 Malaysia : Quantity of Scheduled Wastes Generated by Category, 2008

NO.	CATEGORY OF WASTE	QUANTITY OF WASTE	
		(MT / Year)	PERCENTAGE (%)
1	Gypsum	366,771.99	28.11
2	Dross / Slag / Clinker	208,319.53	15.96
3	Oil & Hydrocarbon	129,701.99	9.94
4	Mineral Sludge	107,122.05	8.21
5	E-Waste	102,808.53	7.88
6	Heavy Metal Sludge	91,730.67	7.03
7	Used Containers	38,876.04	2.98
8	Acid & Alkali	38,179.66	2.93
9	Spent Solvent	38,062.81	2.92
10	Batteries	34,283.59	2.63
11	Mixed Wastes	33,928.70	2.60
12	Clinical/Pharmaceutical	26,967.95	2.07
13	Ink & Paint Sludge	18,695.78	1.43
14	Contaminated Paper & Plastic	17,270.40	1.32
15	Rubber Sludge	15,512.02	1.19
16	Residue	13,544.07	1.04
17	Others	6,627.73	0.51
18	Phenol/Adhesive/Resin	6,184.99	0.47
19	Catalyst	5,225.53	0.40
20	Contaminated Land / Soil	1,324.77	0.10
21	Chemical Waste	1,169.75	0.09
22	Contaminated Active Carbon	934.42	0.07
23	Asbestos	668.94	0.05
24	Mercury	465.31	0.04
25	Photographic Waste	418.77	0.03
26	Sludge Contain Cyanide	84.78	0.01
27	Pesticide	12.26	0.00
28	Peroxide Agent	5.73	0.00
	TOTAL	**1,304,898.77**	**100.00**

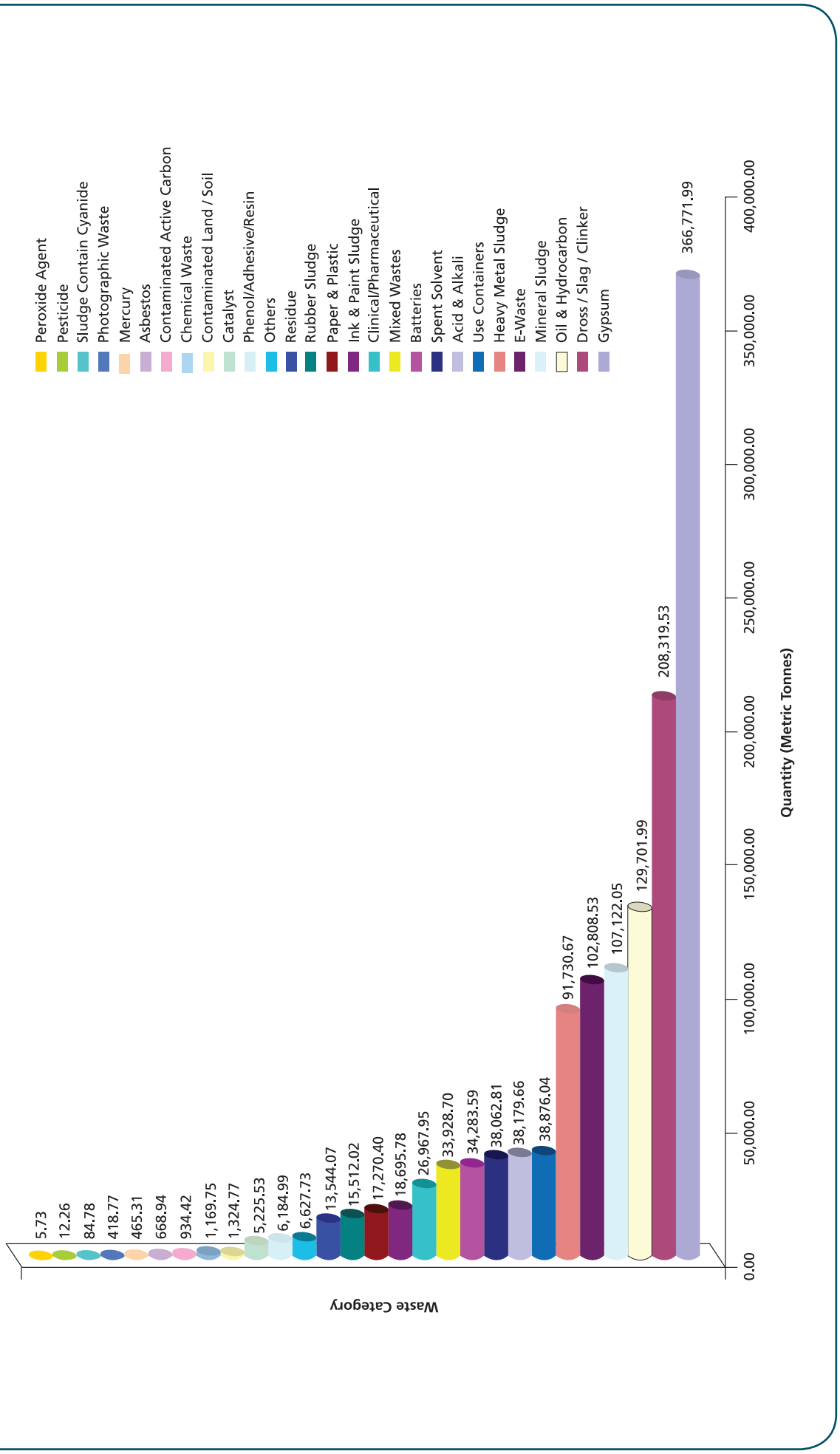

Figure 6.12 Malaysia : Quantity of Scheduled Waste Generated by Category, 2008

Table 6.3 Malaysia: Quantity of Scheduled Wastes Generated by Industry, 2008

NO.	CATEGORY OF WASTE	QUANTITY OF WASTE	
		(MT / Year)	PERCENTAGE (%)
1	Chemical	527,925.57	40.46
2	Electronic / Electrical	174,812.53	13.40
3	Metal / Engineering	168,758.11	12.93
4	Automotive/Workshop	86,672.79	6.64
5	Water Treatment Plant / Power Station	77,344.28	5.93
6	Licensed Facilities	51,970.33	3.98
7	Paper Based	36,983.41	2.83
8	Printing & Packaging	31,095.50	2.38
9	Shipping	31,464.02	2.41
10	Petroleum / Oleo chemical	24,150.73	1.85
11	Industrial Gas	20,212.01	1.55
12	Rubber Based	18,029.75	1.38
13	Solar	16,055.74	1.23
14	Hospital/Pharmaceutical	12,367.68	0.95
15	Batteries	7,640.77	0.59
16	Food	3,947.40	0.30
17	Textile	3,704.32	0.28
18	Mineral / Ceramic / Tiles / Plaster	2,488.34	0.19
19	Wood Based	2,327.91	0.18
20	Glass / Crystal	2,067.48	0.16
21	Resin & Adhesive	1,062.68	0.08
22	Others	875.75	0.07
23	Plastic	794.77	0.06
24	Cement Based	706.82	0.05
25	Laundry	602.88	0.05
26	Photographic	270.96	0.02
27	Hotel	235.33	0.02
28	Quarry	187.91	0.01
29	Asbestos	143.01	0.01
	TOTAL	**1,304,898.77**	**100.00**

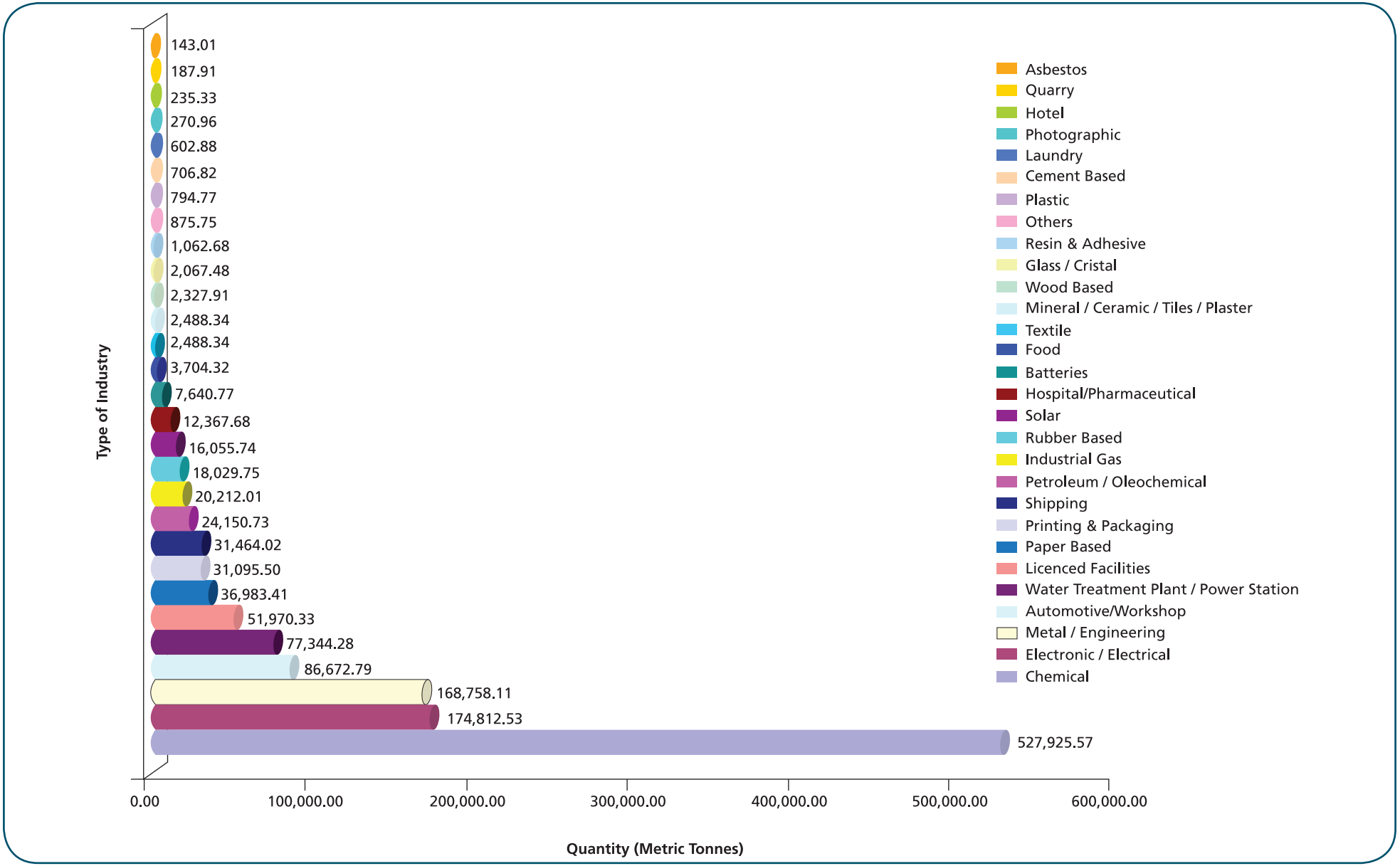

Figure 6.13 Malaysia : Quantity of Scheduled Waste Generated by Industry, 2008

Table 6.4 Malaysia : Facilities Handling Scheduled Wastes, 2008

NO.	FACILITY	TONNES	PERCENTAGE (%)
1	Local Off-site Recovery Facilities	624,361.12	47.85
2	On-site Treatment	484,747.54	37.15
3	Kualiti Alam Sdn. Bhd	137,371.50	10.53
4	On-site Storage	24,618.23	1.89
5	Off-site Clinical Waste Incinerators	14,140.05	1.08
6	Trinekens (Sarawak) Sdn. Bhd.	13,940.33	1.07
7	Foreign Facilities (Import/Export)	5,720.00	0.44
	TOTAL	**1,304,898.77**	**100.00**

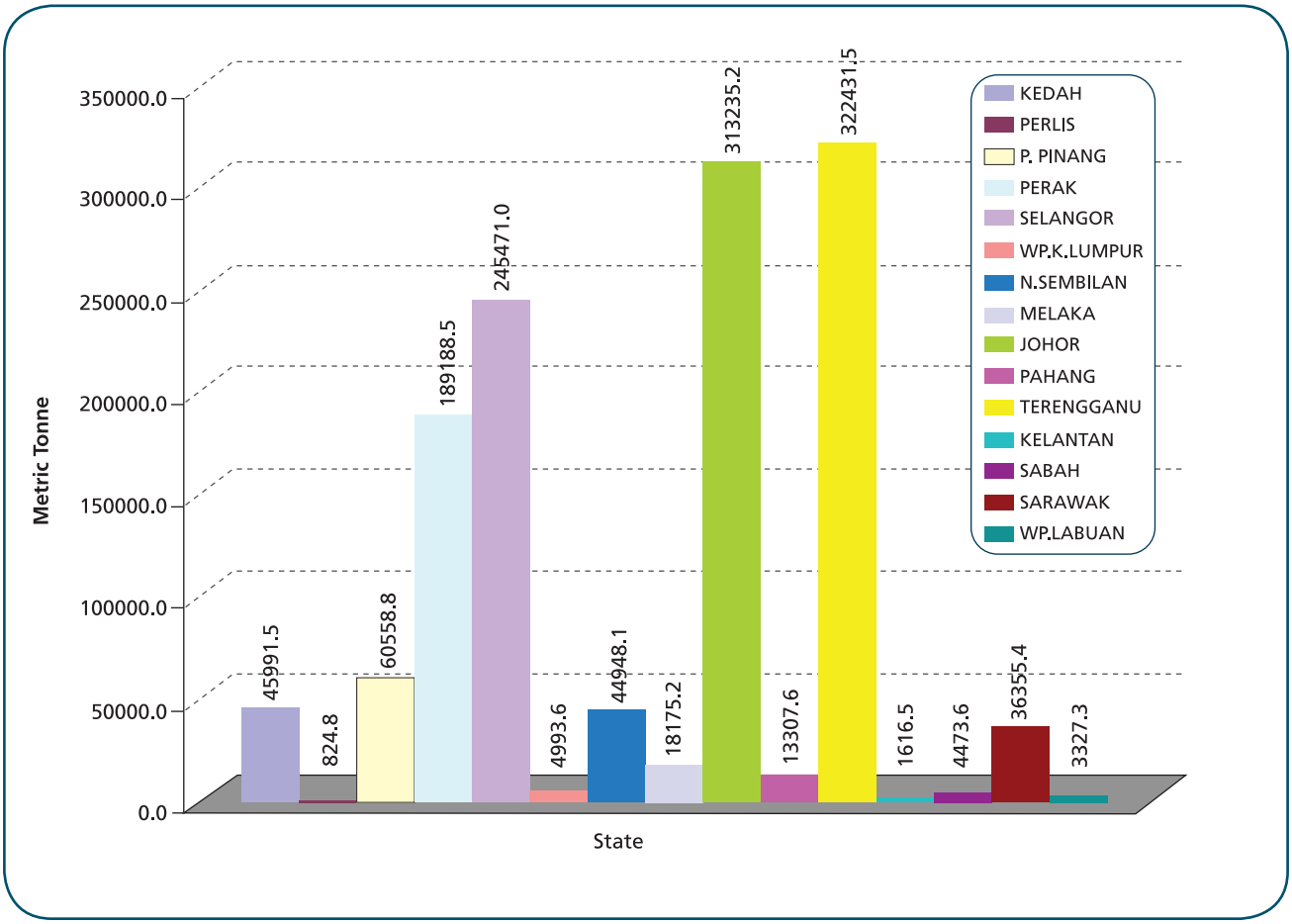

Figure 6.14 Malaysia : Distribution of Scheduled Wastes Generated By State, 2008

Table 6.5 Malaysia : Off-site Recovery Facilities and Quantity of Waste Handling, 2008

WASTE CATEGORY	RECOVERY FACILITY	HANDLING PERCENTAGE %
Electronic and Electrical Wastes	141	21.1
Dross/ Slag/ Clinker	39	23.4
Oil & Mineral Sludge	29	17.2
Acid and Alkali	29	6.3
Heavy Metal Sludge/ Rubber	28	8.3
Used containers/ Contaminated Waste/	26	10.2
Ink/ Paint/ Lacquer		5.2
Solvent	21	
Photographic Waste	9	0.1
Phenol/ Adhesive/ Resin	8	0.2
Used batteries	7	6.7
Gypsum	4	1.3
TOTAL	**341**	**100**

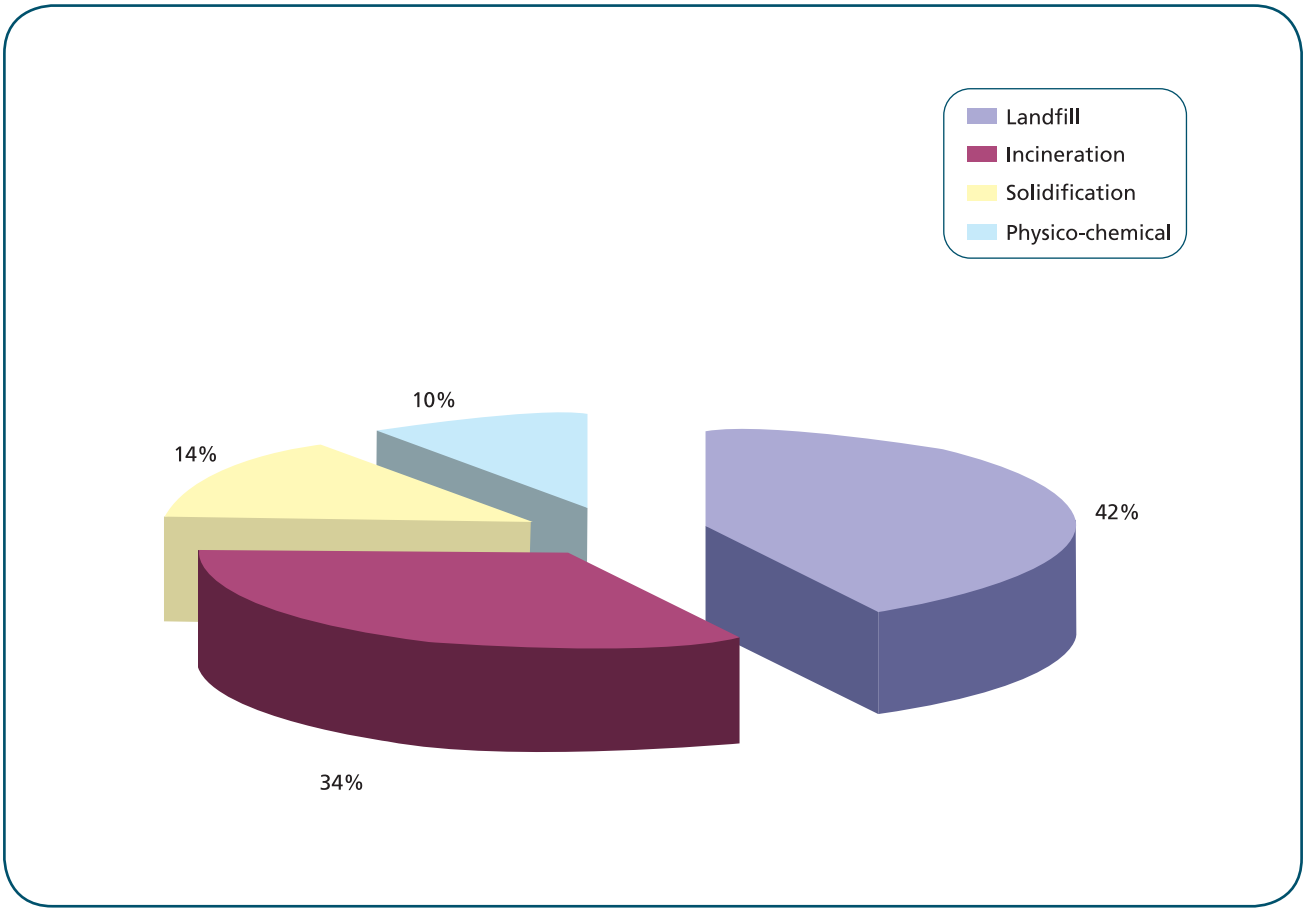

Figure 6.15 : Types of Treatment And Disposal of Waste by Kualiti Alam Sdn. Bhd.,2008

ANNEX

84 National Water Quality Standards for Malaysia

85 DOE Water Quality Index Classification

85 Water Classes and Uses

86 DOE Water Quality Classification Based on Water Quality Index

86 WQI Formula and Calculation

National Water Quality Standards For Malaysia

PARAMETER	UNIT	CLASS				
		I	IIA/IIB	III#	IV	V
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_2	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_2	mg/l	L	0.4	0.4 (0.03)	-	
NO_3	mg/l	S	7	-	5	
P	mg/l		0.2	0.1	-	
Silica	mg/l	O	50	-	-	
SO_4	mg/l	R	250	-	-	
S	mg/l		0.05	(0.001)	-	
CO_2	mg/l	A	-	-	-	
Gross-_	Bq/l	B	0.1	-	-	
Gross-_	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 CaCO3*
 # = 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	IV	V
Ammoniacal Nitrogen	mg/l	0.1	0.3	0.3	0.9	2.7	> 2.7
Biochemical Oxygen Demand	mg/l	1	3	3	6	12	> 12
Chemical Oxygen Demand	mg/l	10	25	25	50	100	> 100
Dissolved Oxygen	mg/l	7	5 - 7	5 - 7	3 - 5	< 3	< 1
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	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	> 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_3-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 * SIpH)

where;

SIDO = Subindex DO (% saturation)
SIBOD = Subindex BOD
SICOD = Subindex COD
SIAN = Subindex NH_3-N
SISS = Subindex SS
SIpH = Subindex pH
$0 \leq WQI \leq 100$

BEST FIT EQUATIONS FOR THE ESTIMATION OF VARIOUS SUBINDEX VALUES

Subindex for DO (in % saturation)

SIDO = 0 for $x \leq 8$
SIDO = 100 for $x \geq 92$
$SIDO = -0.395 + 0.030x^2 - 0.00020x^3$ for $8 < x < 92$

Subindex for BOD

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

Subindex for COD

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

Subindex for NH_3-N

SIAN = 100.5 - 105x for $x \leq 0.3$
SIAN = 94 * exp(-0.573x) - 5 * | x – 2 | for $0.3 < x < 4$
SIAN = 0 for $x \geq 4$

Subindex for SS

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

Subindex for pH

$SIpH = 17.2 - 17.2x + 5.02x^2$ for $x < 5.5$
$SIpH = -242 + 95.5x - 6.67x^2$ for $5.5 \leq x < 7$
$SIpH = -181 + 82.4x - 6.05x^2$ for $7 \leq x < 8.75$
$SIpH = 536 - 77.0x + 2.76x^2$ for $x \geq 8.75$

Note: means multiply with*

NOTES

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