Malaysia
ENVIRONMENTAL QUALITY REPORT
2011

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Kementerian Sumber Asli dan Alam Sekitar

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Foreword

It is my pleasure to present the Environmental Quality Report 2011 as required under Section 3(1)(i) of the Environmental Quality Act 1974. Besides fulfilling the mandatory requirement, it also provides an avenue to highlight the year's achievements, the successes as well as the shortcomings with the view to improvement, enhancement and maintenance of sound environmental conditions in our pursuit of national development.

The overall quality of the environment showed no significant change in 2011. Compared to 2010, there was a slight improvement in river water quality. There was a reduction in the number of polluted rivers compared with 2010. The percentage of clean rivers had increased from 51% (2010) to 59% in 2011 while the percentage of polluted rivers had decreased from 13% in 2010 to 8% in 2011. The quality of the marine environment with respect to coastal and estuarine areas was within normal variations compared with the Malaysian Marine Water Quality Criteria and Standard (MWQCS).

Based on the Air Pollutant Index (API), the overall air quality for Malaysia in 2011 was between good to moderate most of the time. However, there was a slight decrease in the number of good quality days recorded in 2011 at 55% compared to 63% in 2010. This is partly due to transboundary haze pollution as a result of forest fires from Central Sumatra and Kalimantan, Indonesia which occurred during the dry period from May to September 2011.

The need to have a safe, healthy and sustainable environment remains a challenging task, but with the support and commitment given from all parties, DOE is confident to inculcate environmental awareness and active actions that are more integrated, systematic and continuous in managing the environment.

"Environmental Conservation, Our Shared Responsibility"

With best wishes,

Halimah Hassan
Director General of Environmental Quality
Malaysia
30 July 2012

AIR QUALITY

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AIR QUALITY

AIR QUALITY MONITORING

The Department of Environment (DOE) monitors the country's ambient air quality through a network of 52 continuous monitoring stations **(Map 1.1 and Map 1.2)**. These monitoring stations are strategically located in urban, sub urban and industrial areas to detect any significant change in the air quality which may be harmful to human health and the environment.

In addition to the 52 stations in the National Continuous Air Quality Monitoring Network, manual air quality monitoring stations using High Volume Samplers were also established at 14 different sites for measuring total suspended particulates, particulate matter (PM_{10}) and heavy metals such as lead.

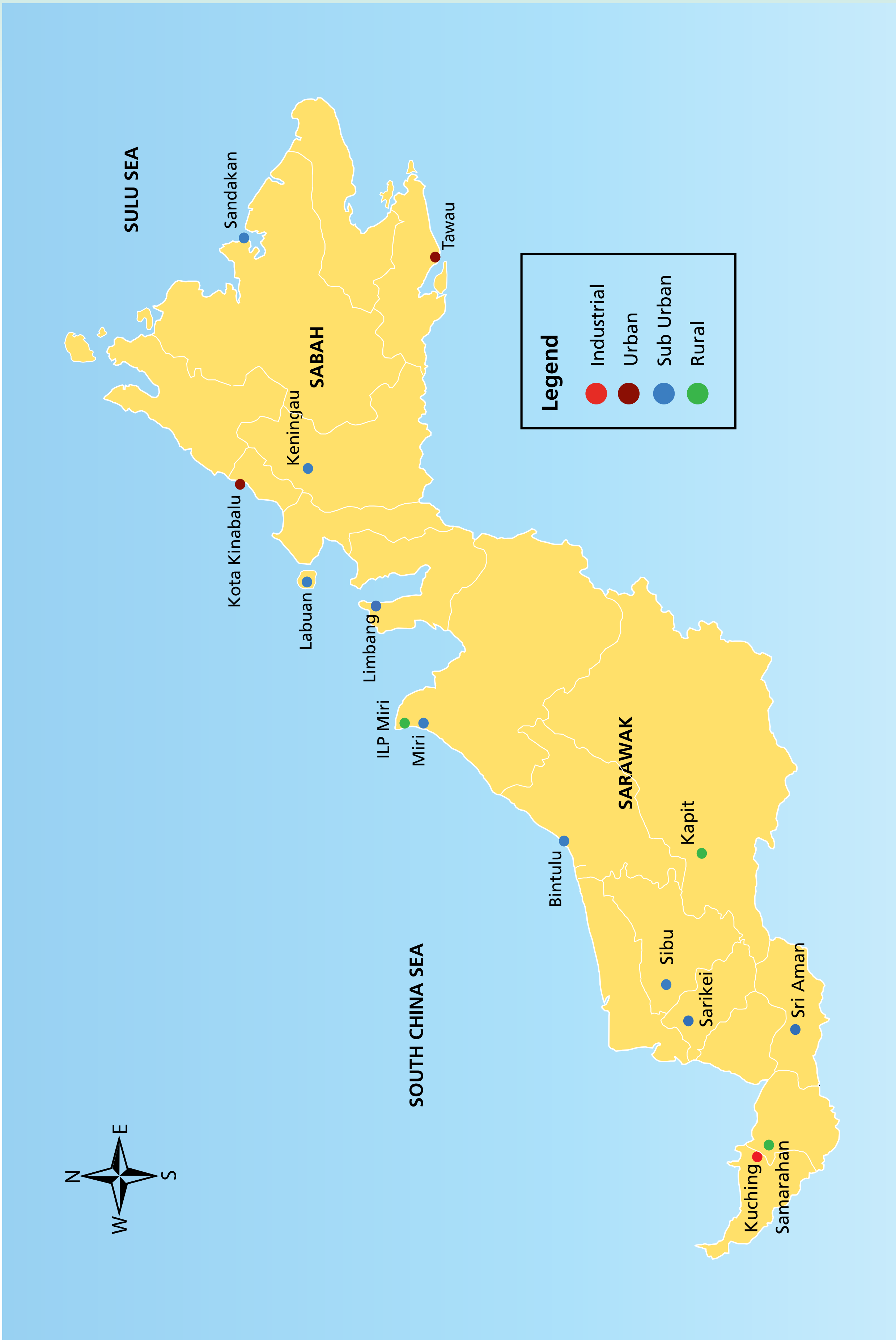
The air quality status is reported in terms of Air Pollutant Index (API). The air pollutants used in computing the API are ground level ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and particulate matter of less than 10 microns in size (PM_{10}). The API is categorized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

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

Mount Kinabalu, Sabah

Map 1.1 Malaysia: Location of Continuous Air Quality Monitoring Stations, Peninsular Malaysia, 2011



Map 1.2 Malaysia: Location of Continuous Air Quality Monitoring Stations, East Malaysia, 2011

AIR QUALITY STATUS

Based on the Air Pollutant Index (API), the overall air quality for Malaysia in 2011 was between good to moderate levels most of the time. The overall number of good air quality days decreased in 2011 (55 percent of the time) compared to that in 2010 (63 percent of the time), while remaining 44 percent at moderate level and one (1) percent at unhealthy level. However, the country experienced several short spell of haze episodes due to transboundary haze pollutions as a result of forest fires from Central Sumatra and Kalimantan, Indonesia which occurred during the dry period from May to September 2011. These had contributed to the slight deterioration of overall air quality in 2011.

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

Tasik Putrajaya

Table 1.2 Malaysia : Ambient Air Quality Guidelines

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

Note : ** mg/m^3

Besides PM_{10}, O_3 remained the pollutant of concern due to the conducive atmospheric condition and emission from motor vehicles in urban areas that enhanced its formation. These resulted in several unhealthy days recorded at various locations in the Klang Valley and in Negeri Sembilan, Perak, Kedah 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 led to a number of unhealthy days recorded in those stations located in central business areas with heavy traffic volume.

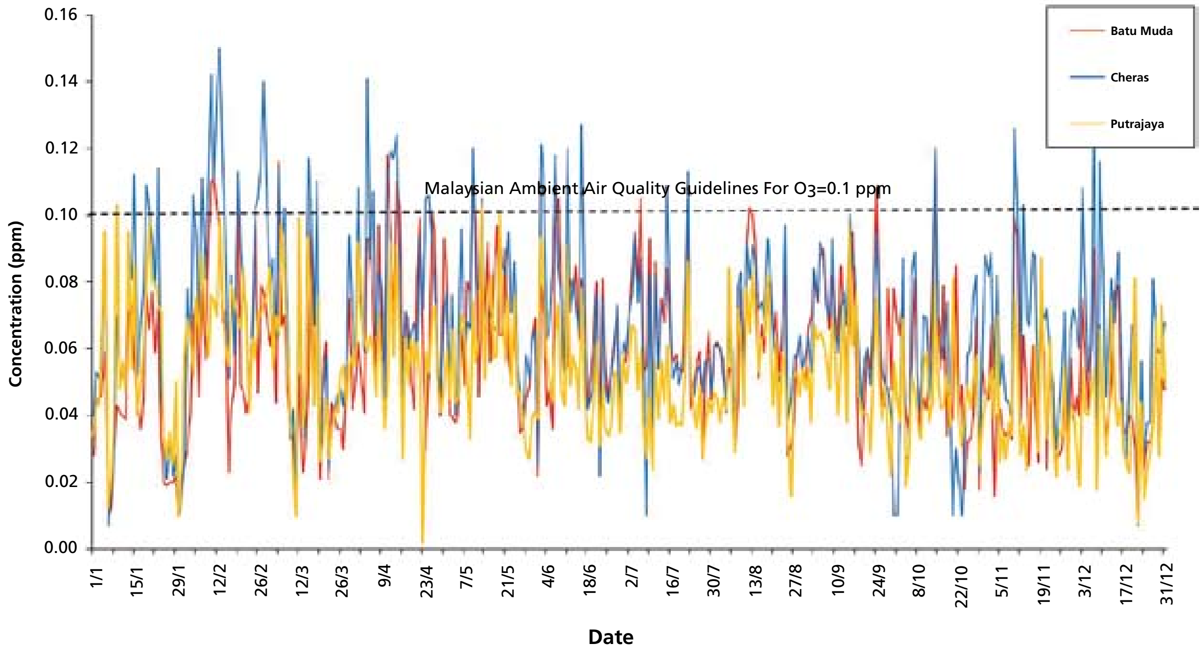


Figure 1.1 (a) Malaysia : Trend of Daily Maximum 1-hour Concentration of Ozone (O_3), Klang Valley, 2011

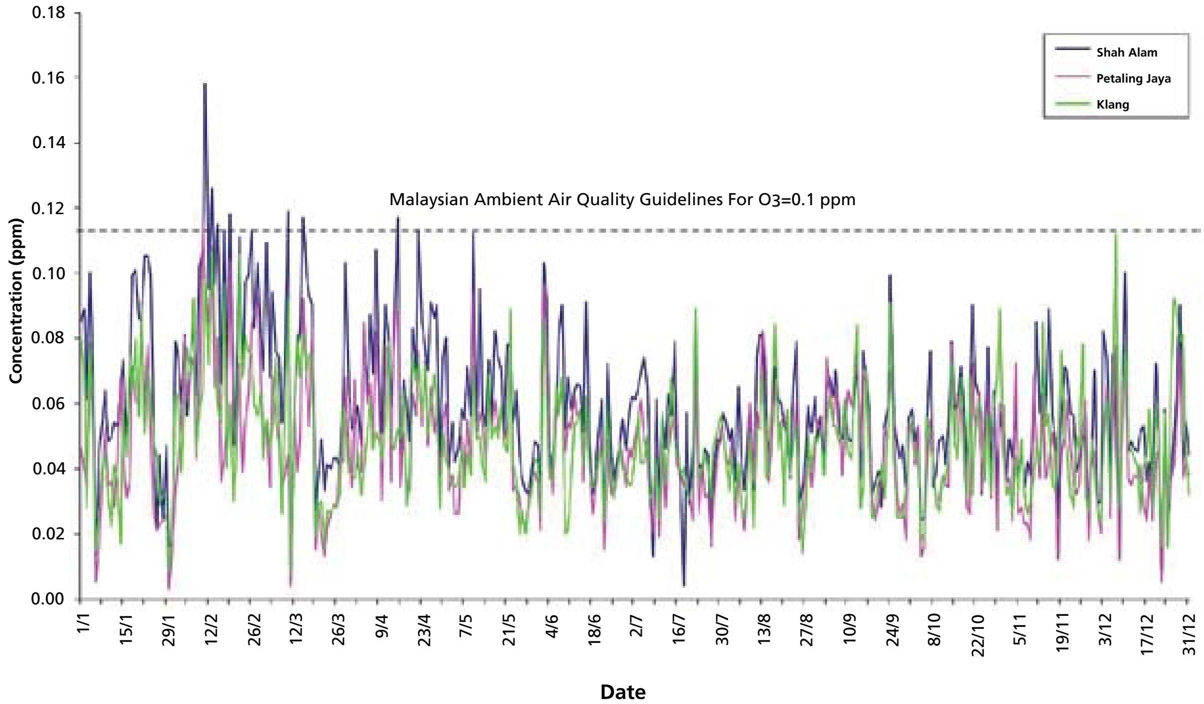


Figure 1.1 (b) Malaysia : Trend of Daily Maximum 1-hour Concentration of Ozone (O_3), Klang Valley, 2011

With respect to PM_{10}, the daily concentrations of PM_{10} in Klang slightly exceeded the guidelines value in February and May 2011, due to unfavourable hot and dry weather conditions and transboundary haze pollution. The comparison of the daily concentrations of PM_{10} in Klang for 2011 and 2010 is as illustrated in **Figure 1.1(c)**.

The overall trend of PM_{10} in the country for the year 2011 is as shown in **Figure 1.1(d)**. Besides Klang Valley, other areas which had occasionally exceeded the Malaysian Ambient Air Quality Guidelines for PM_{10} were Nilai in Negeri Sembilan, Sibu and Sri Aman in Sarawak, and these were also due to transboundary haze pollution. Apart from that, other areas were all in compliance with the Malaysian Ambient Air Quality Guidelines.

Air Quality Status in the West Coast

Klang Valley

In 2011, the air quality in the Klang Valley was good 28 percent of the time, moderate 68 percent and the remaining four (4) percent was at an unhealthy level. The most number of unhealthy days were recorded in Cheras, Kuala Lumpur (48 days) as compared to 59 days in 2010. The unhealthy days recorded were mostly due to the ground level ozone (O_3). The number of unhealthy days in Shah Alam, Putrajaya and Batu Muda had decreased in 2011 compared to in 2010. It was also recorded that the air quality in Kuala Selangor this year remained good with no unhealthy day recorded **(Figure 1.1)**. The overall air quality status in Klang Valley is shown in **Figure 1.2**.

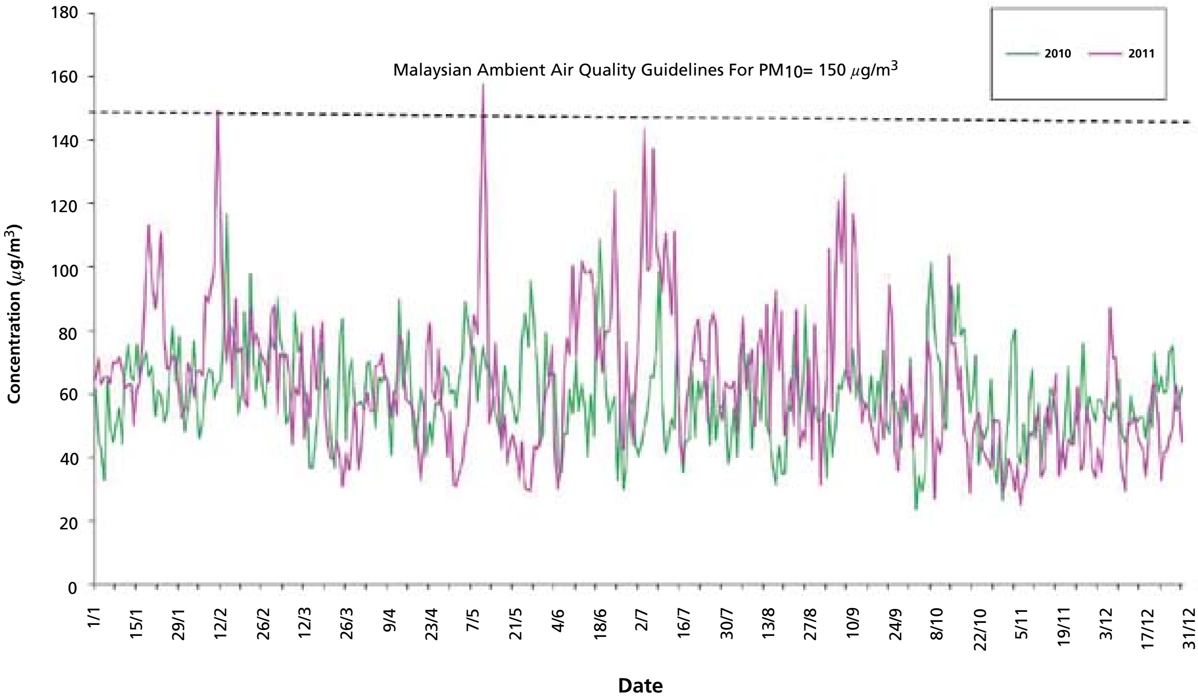


Figure 1.1 (c) : Trend of 24-hour Concentration of Particulate Matter (PM_{10}), Klang, 2010 and 2011

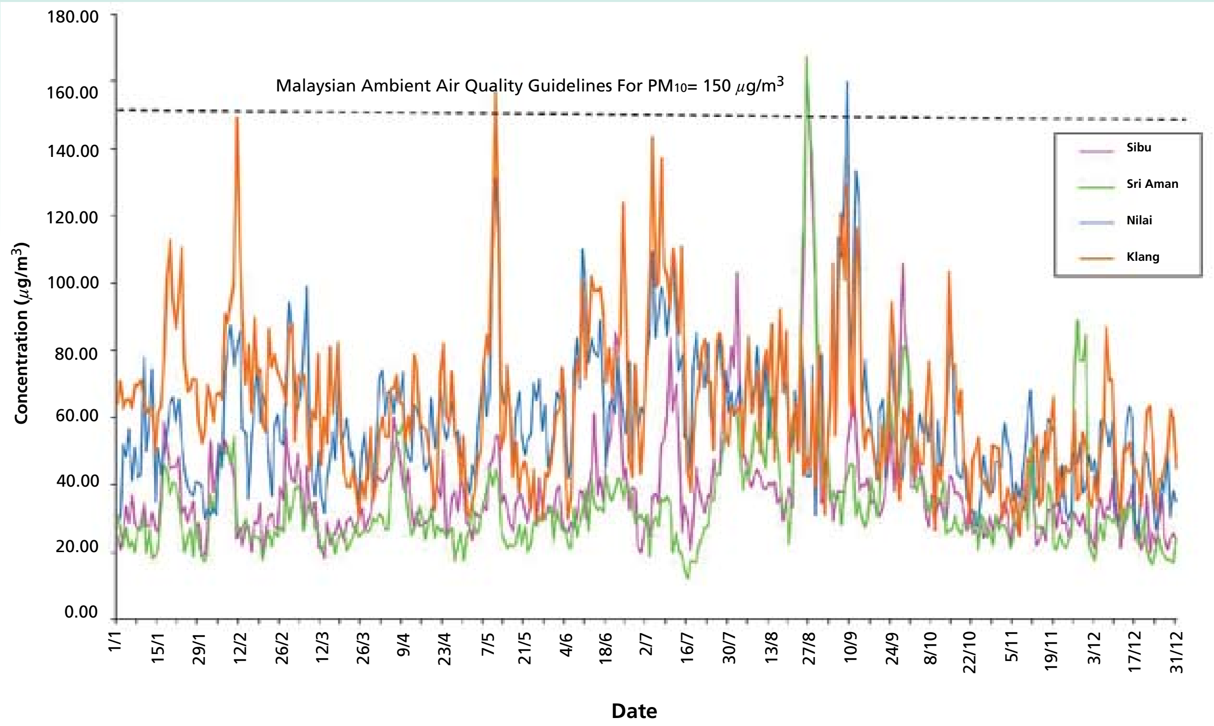
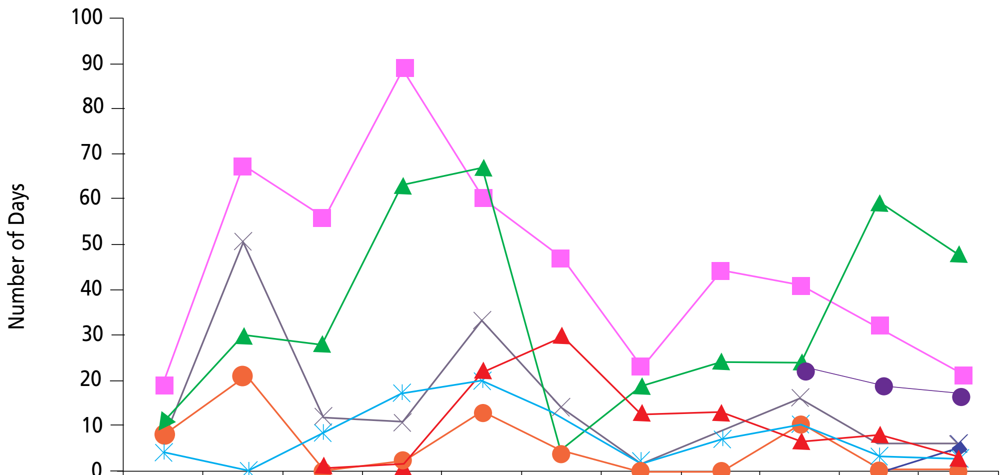


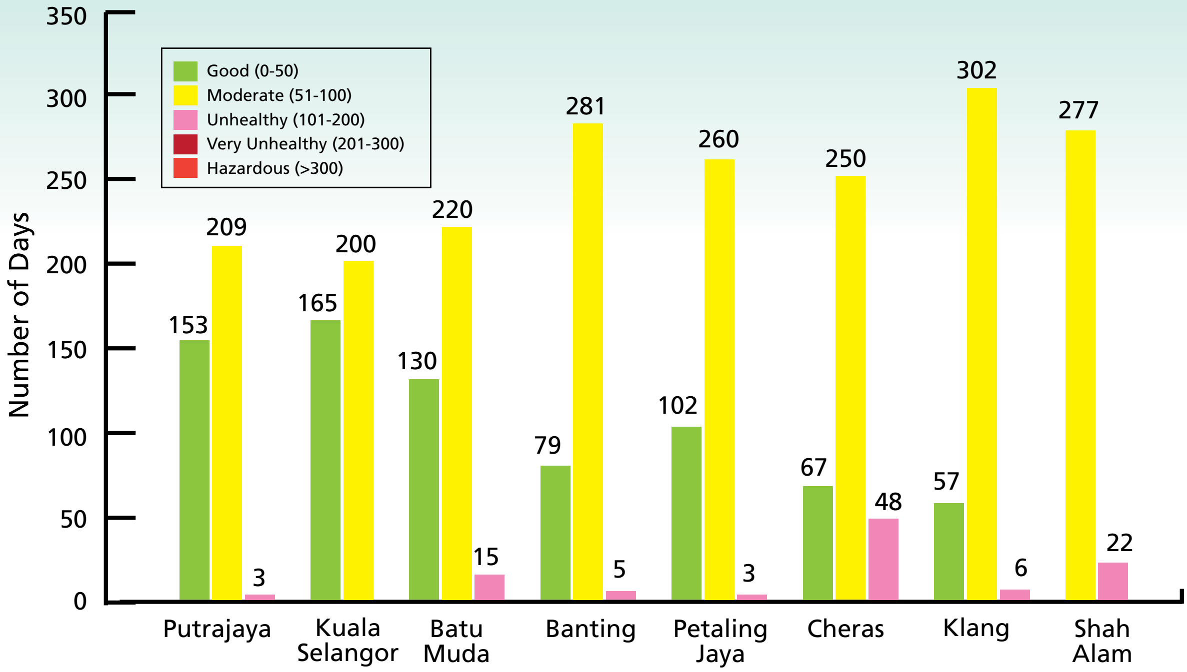
Figure 1.1 (d) Malaysia : Trend of 24-hour Concentration of Particulate Matter (PM_{10}), Malaysia, 2011



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Banting	–	–	–	–	–	–	–	–	–	0	5
Shah Alam	19	67	56	88	60	47	23	44	41	32	22
Cheras	11	30	28	63	67	5	19	24	24	59	48
Klang	7	50	12	11	33	14	2	8	16	6	6
Petaling Jaya	4	0	9	17	20	12	2	7	10	3	3
Kuala Selangor	8	21	0	2	13	4	0	0	10	0	0
Putrajaya	–	–	1	1	22	30	13	13	7	8	3
Batu Muda	–	–	–	–	–	–	–	–	21	17	15

Note: Reading based on daily Maximum API
**** Previous station in Kajang was replaced with Banting and started operation in April 2010***

Figure 1.1. Malaysia : Number of Unhealthy Days, Klang Valley, 2001 - 2011



Note: Reading based on daily Maximum API

Figure 1.2 Malaysia : Klang Valley Air Quality Status, 2011

Northern Region

The overall air quality of the northern region of the West Coast of Peninsular Malaysia (Perlis, Kedah, Pulau Pinang and Perak), was between good to moderate most of the time. However, Tanjung Malim, Alor Setar and Sungai Petani experienced occasional unhealthy hours of the day especially from mid-day to late afternoon due to high concentration of ground level ozone (O_3), while in Manjung, Perak recorded one (1) unhealthy day due to high level of particulate matter (PM_{10}) .

Southern Region

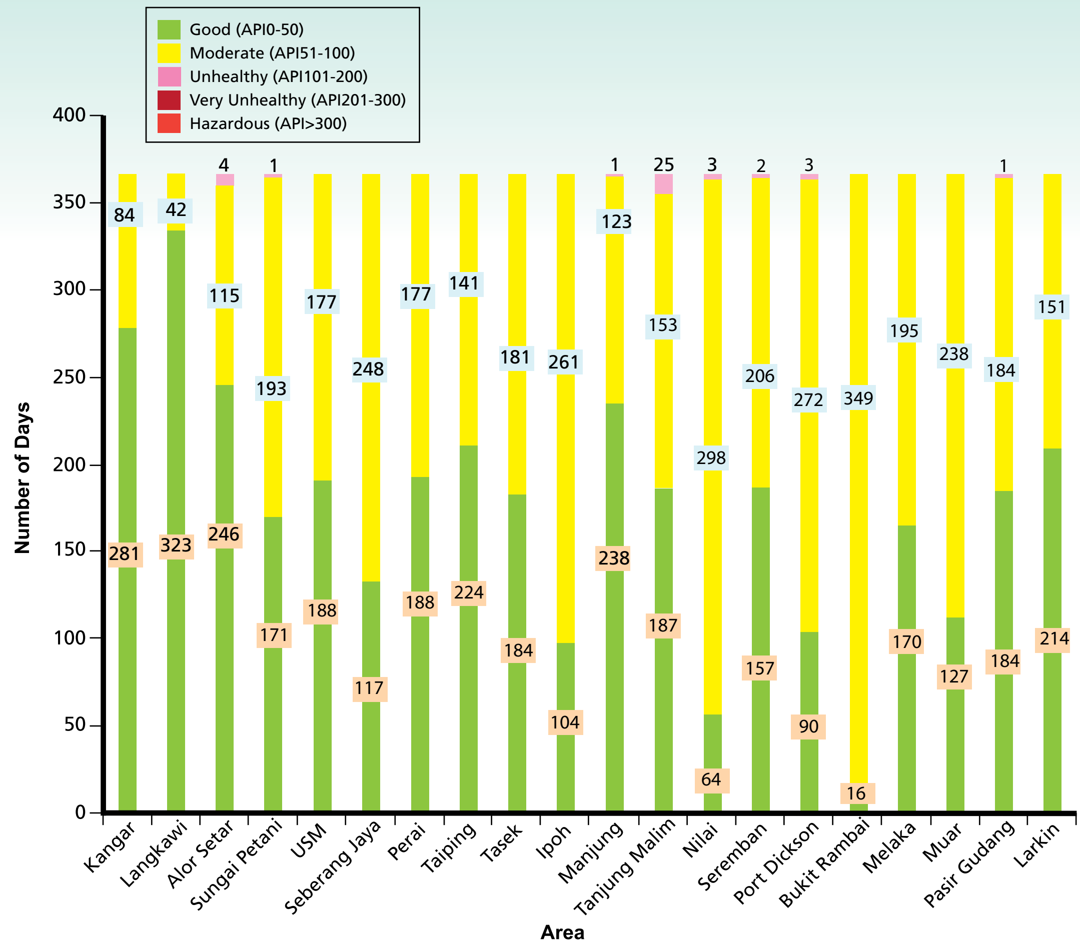
In the southern region of the West Coast of Peninsular Malaysia (Negeri Sembilan, Melaka and Johor) the air quality was also between good to moderate most of the time, with the exception of a few unhealthy days recorded in Port Dickson (3 days), Nilai (3 days), Seremban (2 days) and Pasir Gudang (1 day). The number of unhealthy days in these areas had reduced as compared to the year 2010. **Figure 1.3** shows the overall air quality status for the West Coast of Peninsular Malaysia.

Air Quality Status in the East Coast

In the East Coast of Peninsular Malaysia (Pahang, Terengganu, Kelantan and East Johor) the air quality remained between good to moderate most of the time. Only Kota Tinggi in Johor recorded (one) 1 unhealthy day due to high level of ground level ozone (O_3). The overall air quality status in the East Coast of Peninsular Malaysia is shown in **Figure 1.4**.

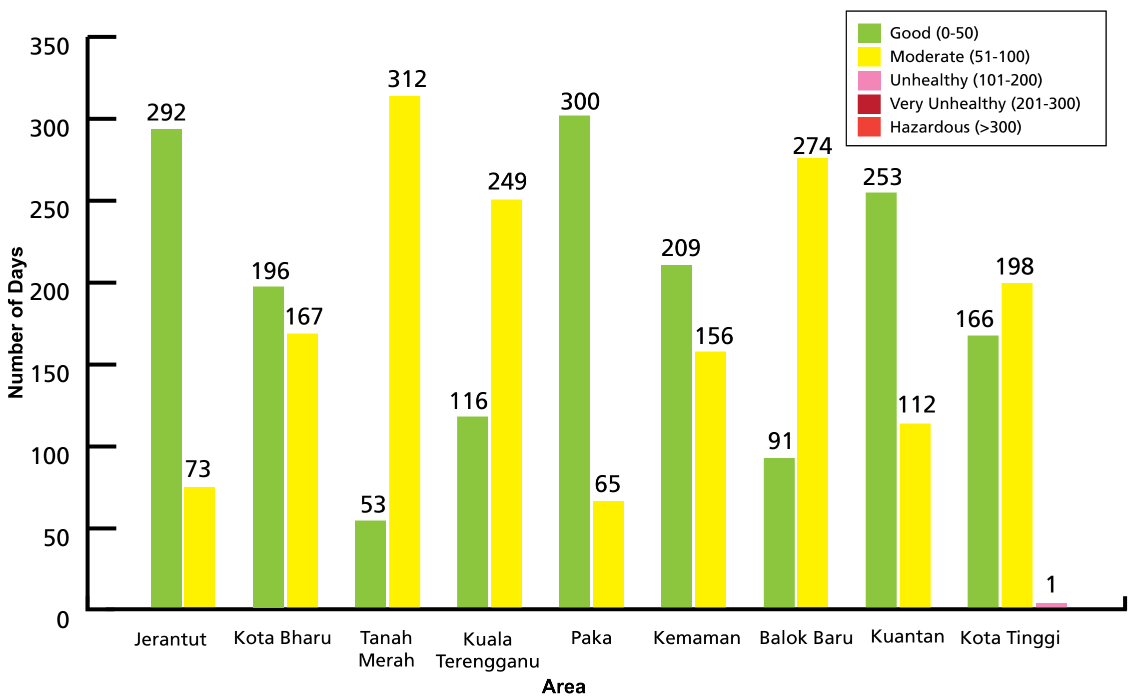
Air Quality Status in Sabah, Labuan and Sarawak

The air quality in Sabah, Labuan and Sarawak was generally good with the exception of a few unhealthy days recorded in Sri Aman (3 days) and Sibu (2 days). The unhealthy days were due to transboundary haze pollution caused by an escalated number of hotspots in Kalimantan during the hot and dry period in August 2011. The overall air quality status in Sabah, Labuan and Sarawak is shown in **Figure 1.5**.



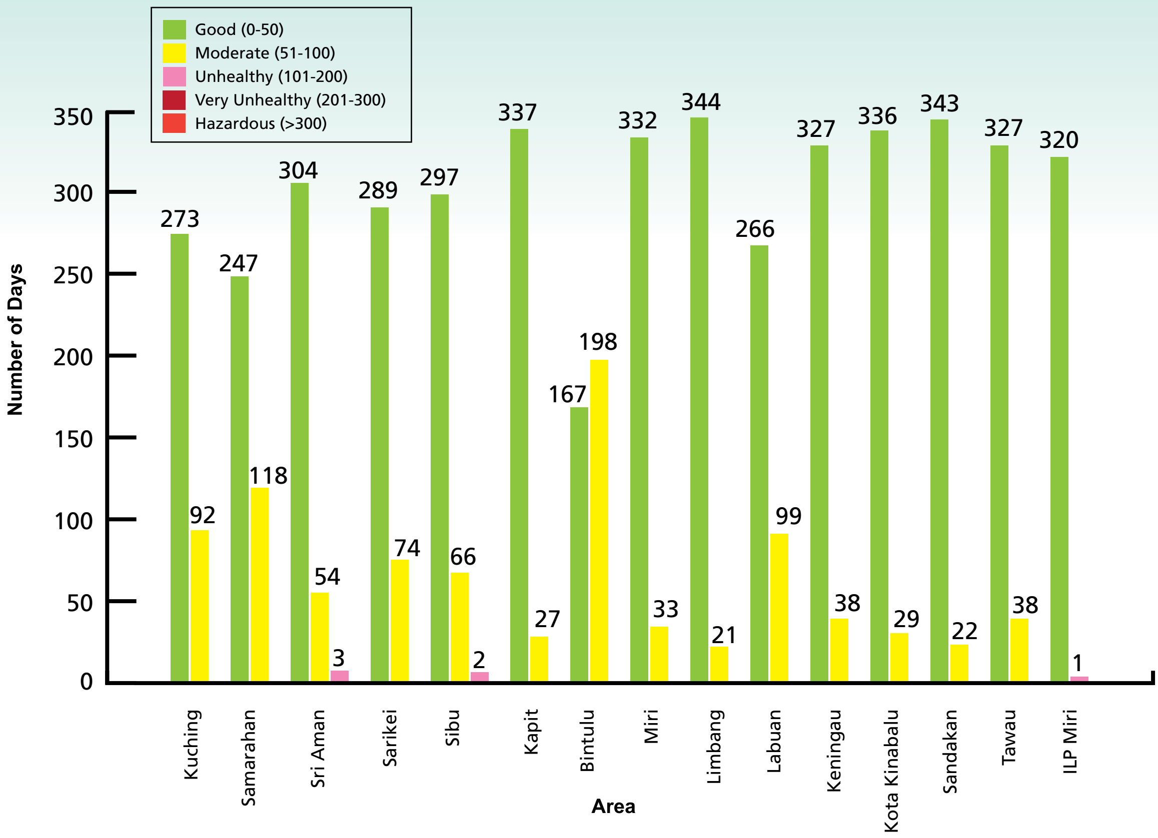
Note: Reading based on daily Maximum API

Figure 1.3 Malaysia : Air Quality Status, West Coast Peninsular Malaysia, 2011



Note: Reading based on daily Maximum API

Figure 1.4 Malaysia : Air Quality Status, East Coast Peninsular Malaysia, 2011



Note: Reading based on daily Maximum API

Figure 1.5 Malaysia : Air Quality Status in Sabah, Labuan and Sarawak, 2011

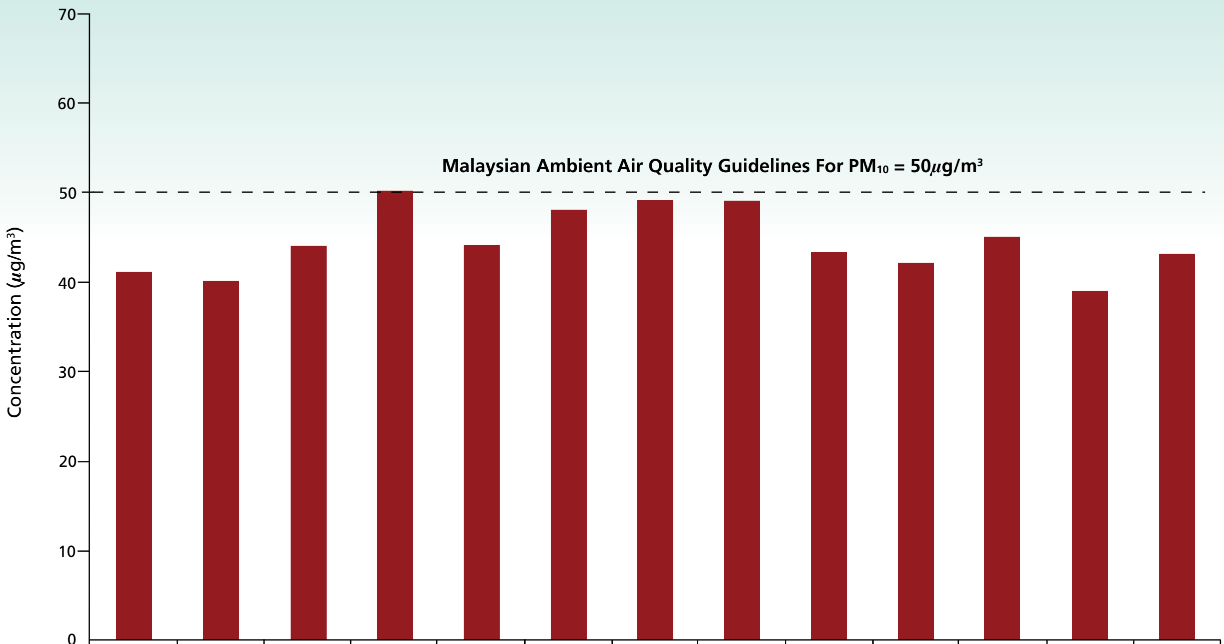
AIR QUALITY TREND

Five (5) air pollutants, namely Particulate Matter (PM_{10}), Ozone (O_3), Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2) and Carbon Monoxide (CO) were monitored continuously at 52 locations. The air quality trend for the period of 1999 to 2011 was computed by averaging direct measurements from the monitoring site on a yearly basis and cross-reference with Malaysia Ambient Air Quality Guidelines as shown in **Table 1.2**.

Particulate Matter (PM_{10})

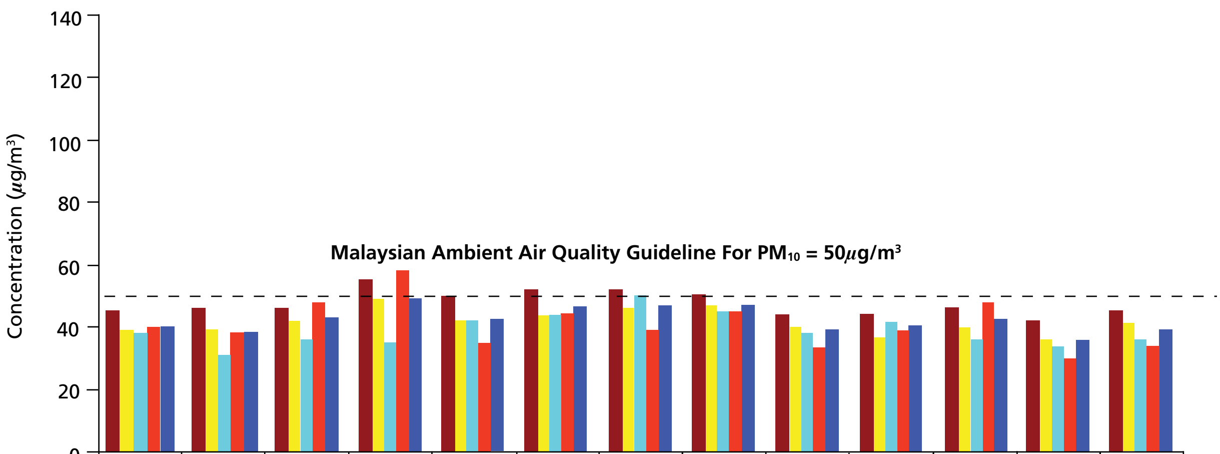
In 2011, the annual average value of PM_{10} in the ambient air was 43 µg/m³ which is below the Malaysian Ambient Air Quality Guidelines value of 50 µg/m³. There was a slight increase on the annual average of PM_{10} compared to 2010 which was 39 µg/m³. The slight deterioration of air quality was mainly contributed by the recurrence of transboundary haze pollution that had affected the West Coast of Peninsular Malaysia and Sarawak during the dry period of May to September where the number of hotspots recorded in Sumatra and Kalimantan, Indonesia had escalated during this period.

The trend of the annual average levels of PM_{10} concentration in the ambient air between 1999 and 2011 complied to the Malaysian Ambient Air Quality Guidelines as shown in **Figure 1.6**. Based on land use categories, PM_{10} concentration was in compliance with Malaysian Ambient Air Quality Guidelines as shown in **Figure 1.6(a)**.



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Concentration	41	40	44	50	44	48	49	49	43	42	45	39	43
Number of Sites	45	50	50	50	51	51	51	51	51	51	51	52	52

Figure 1.6 Malaysia : Annual Average Concentration of Particulate Matter (PM_{10}), 1999 - 2011



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Urban	45	46	46	55	50	52	52	50	44	44	46	42	45
Sub Urban	39	39	42	49	42	44	46	47	40	37	40	36	41
Background	38	31	36	35	42	44	50	45	38	42	36	34	36
Rural	40	38	48	58	35	44	39	45	33	39	48	30	34
Mean	40.5	38.5	43.0	49.3	42.3	46.0	46.8	46.8	38.8	40.5	42.5	35.5	39.0

Figure 1.6(a) Malaysia : Annual Average Concentration of Particulate Matter (PM_{10}) by Land Use, 1999-2011

Bukit Keluang Beach, Terengganu

Ground Level Ozone (O_3)

In 2011, the annual average daily maximum one-hour O_3 concentrations increased by 0.5 percent compared to 2010. However, the annual average daily maximum one-hour O_3 concentrations in ambient air for 1999 to 2011 were well below the limit of 0.1 ppm as stipulated in the Malaysian Ambient Quality Guidelines as shown in **Figure 1.7.**

Figure 1.7(a) shows the O_3 concentration for various land use categories between 1999 and 2011. Urban areas recorded higher levels of ozone due to higher traffic volume and a conducive atmospheric condition resulting in its formation.

Sulphur Dioxide (SO_2)

Generally, the trend of the annual average SO_2 concentration between 2008 and 2011 **(Figure 1.8)** remained almost constant and was well below the limit of 0.04 ppm as stipulated in the Malaysian Ambient Air Quality Guidelines. **Figure 1.8(a)** shows the annual average concentrations of sulphur dioxide for different categories of land use.

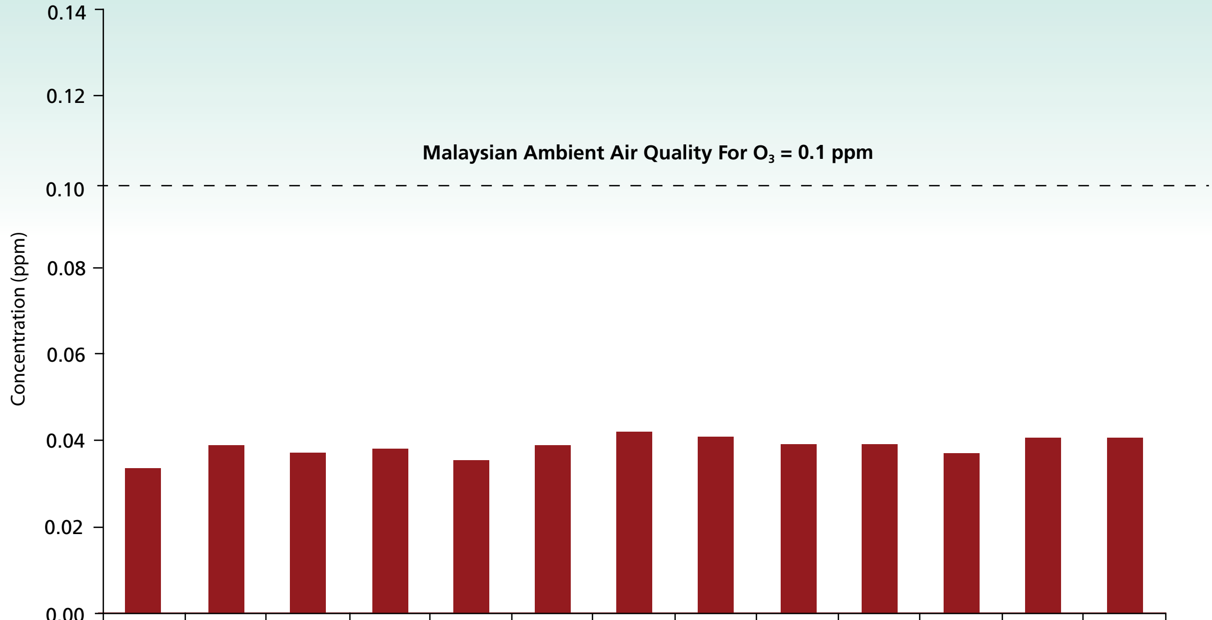
Nitrogen Dioxide (NO_2)

In 2011, there was no significant change of NO_2 concentration compared to the 2010 level. The NO_2 concentrations remained high in urban and industrial areas mainly due to a significant increase in the number of motor vehicles and combustion processes. Estimate on NO_2 emission load indicated 61 percent was from power plants while 28 percent from motor vehicles, eight (8) percent from industries and three (3) percent from other sources.

The annual average concentrations of NO_2 in the ambient air from 1999 to 2011 remained almost constant and well below the Malaysia Ambient Air Quality Guidelines. (**Figure 1.9** and **Figure 1.9(a)**).

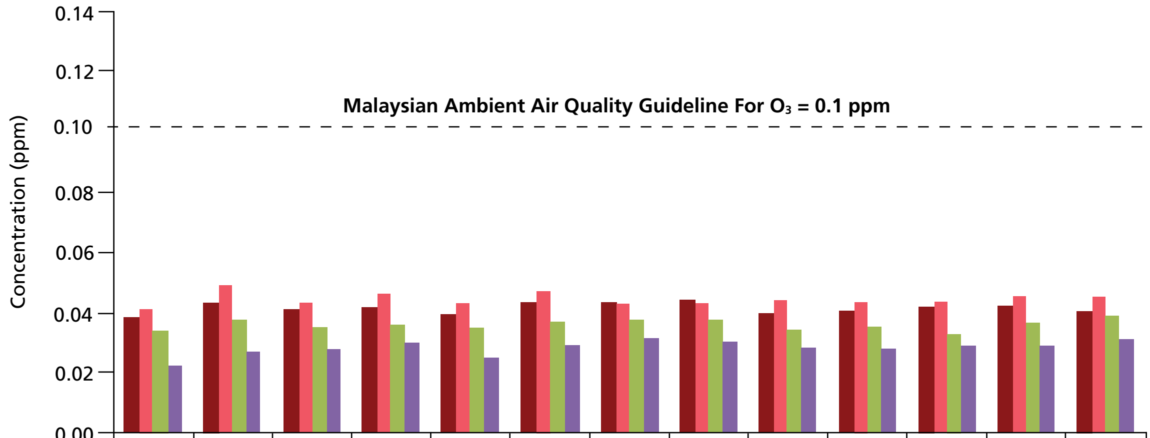
Carbon Monoxide (CO)

There was a slight deterioration of the air where CO level had increased by 4.6 percent in 2011 compared to 2010. However, the CO concentration recorded were well below the Malaysian Ambient Air Quality Guidelines limit of 9 ppm**(Figure 1.10)**. In urban areas, the concentration of CO was higher where the main source of emission was motor vehicles which contributed to 95 percent of CO emission load in 2011. **Figure 1.10(a)** shows CO concentrations for various categories of land use.



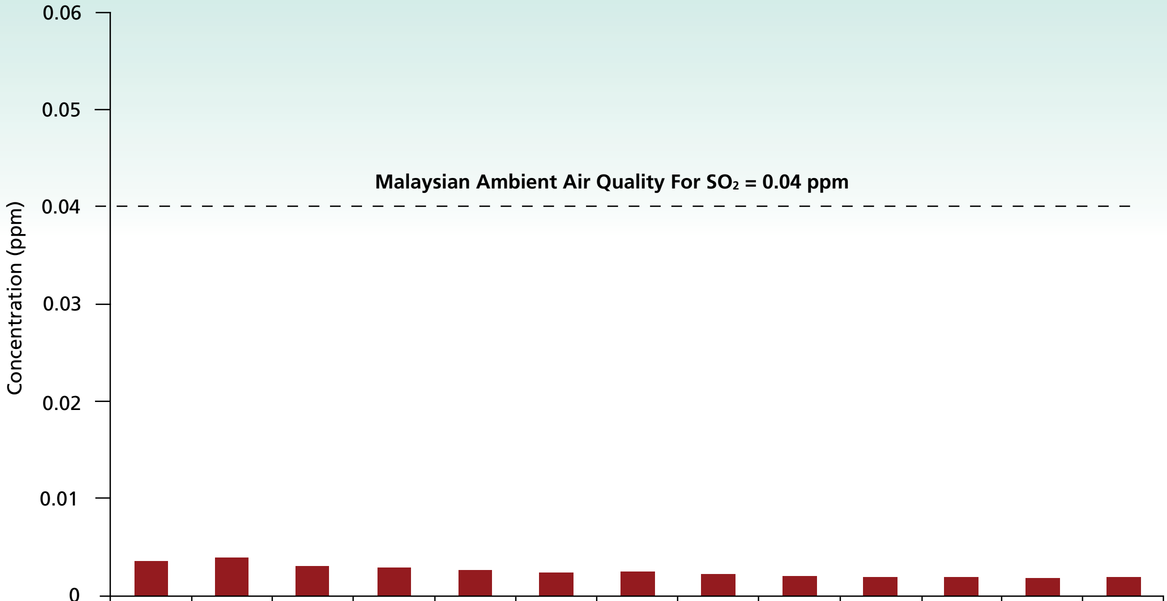
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Concentration	0.0340	0.0390	0.0370	0.0382	0.0353	0.0388	0.0421	0.0408	0.0390	0.0392	0.0368	0.0406	0.0408
Number of Sites	35	39	39	39	41	41	41	41	41	41	41	41	41

Figure 1.7 Malaysia : Annual Average Maximum 1 Hour Concentration of Ozone (O_3) 1999-2011



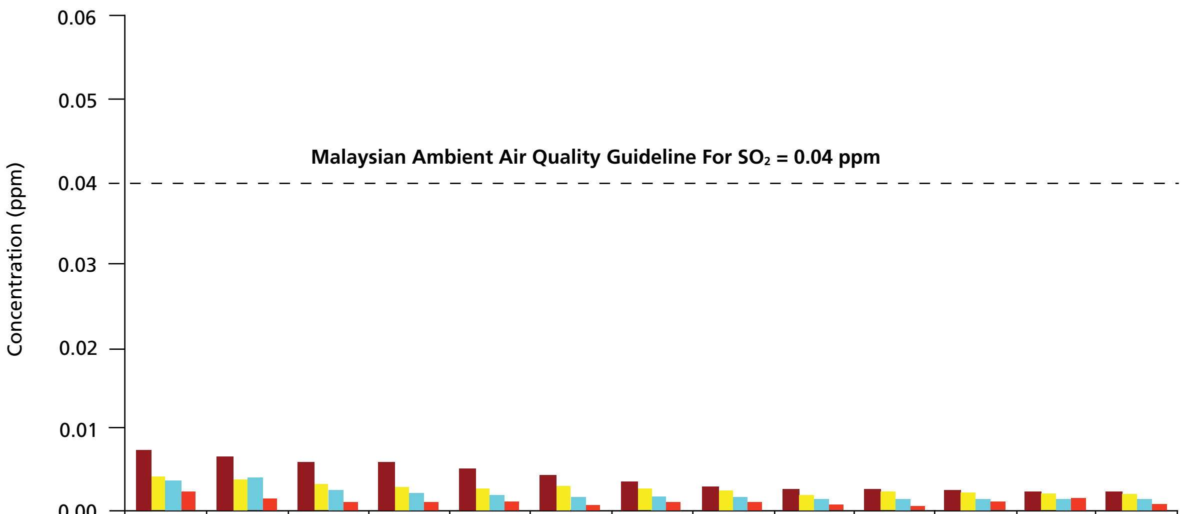
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Industrial	0.0380	0.0430	0.0405	0.0413	0.0389	0.0429	0.0431	0.0440	0.0391	0.0399	0.0418	0.0412	0.0402
Urban	0.0410	0.0490	0.0426	0.0461	0.0428	0.0471	0.0428	0.0429	0.0441	0.0435	0.0437	0.0453	0.0447
Sub Urban	0.0340	0.0370	0.0348	0.0355	0.0345	0.0363	0.0373	0.0371	0.0341	0.0351	0.0331	0.0364	0.0383
Background	0.0220	0.0270	0.0279	0.0298	0.0250	0.0287	0.0311	0.0300	0.0277	0.0278	0.0284	0.0287	0.0309

Figure 1.7(a) Malaysia : Annual Average Daily Maximum 1 Hour Concentration of Ozone (O_3) by Land Use, 1999-2011



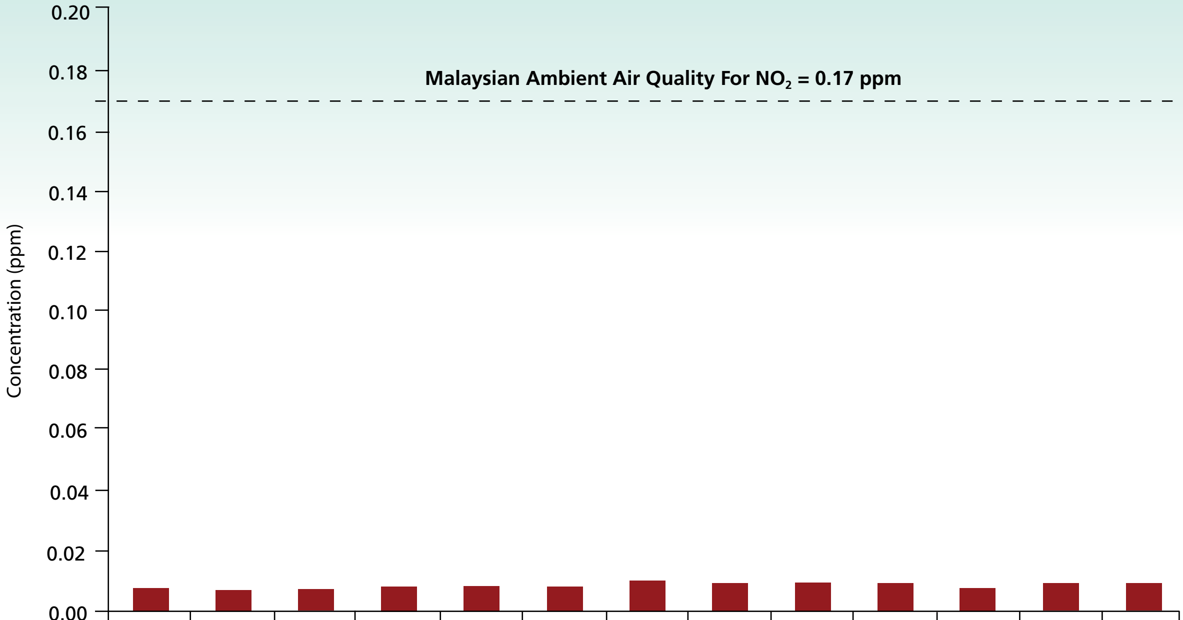
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Concentration	0.0035	0.0038	0.0030	0.0029	0.0026	0.0023	0.0024	0.0021	0.0019	0.0018	0.0018	0.0017	0.0018
Number of Sites	39	43	43	43	44	44	44	44	44	44	44	44	44

Figure 1.8 Malaysia : Annual Average Concentration of Sulphur Dioxide (SO_2), 1999-2011



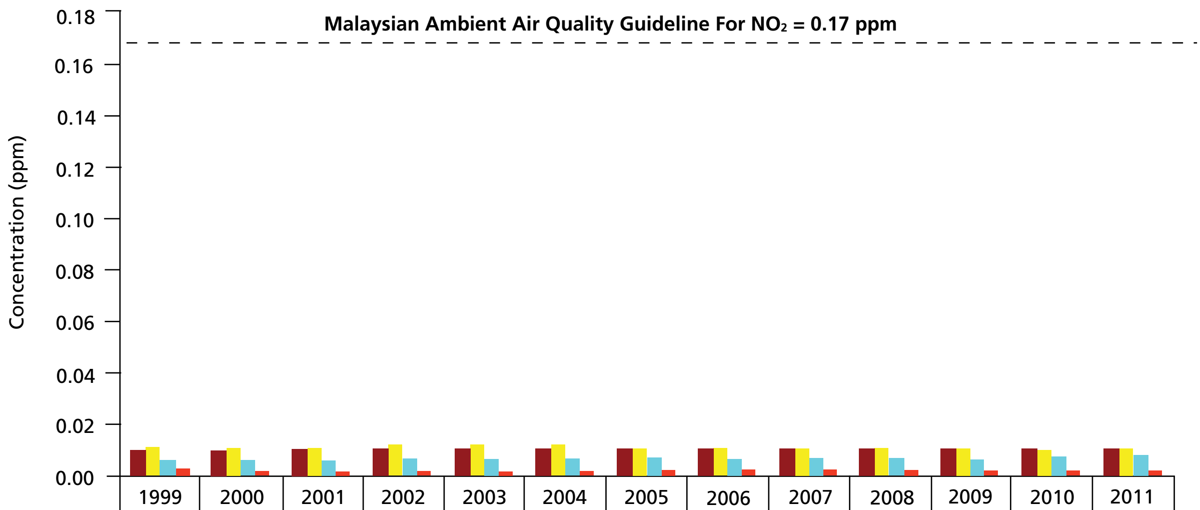
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Industrial	0.0073	0.0064	0.0057	0.0058	0.0050	0.0042	0.0034	0.0027	0.0025	0.0025	0.0023	0.0022	0.0022
Urban	0.0039	0.0037	0.0030	0.0027	0.0026	0.0029	0.0025	0.0023	0.0019	0.0022	0.0020	0.0019	0.0020
Sub Urban	0.0036	0.0038	0.0024	0.0020	0.0018	0.0015	0.0016	0.0014	0.0013	0.0013	0.0013	0.0012	0.0014
Background	0.0022	0.0013	0.0009	0.0009	0.0010	0.0006	0.0009	0.0010	0.0005	0.0004	0.0009	0.0014	0.0007

Figure 1.8(a) Malaysia : Annual Average Concentration of Sulphur Dioxide (SO_2) by Land Use, 1990 - 2011



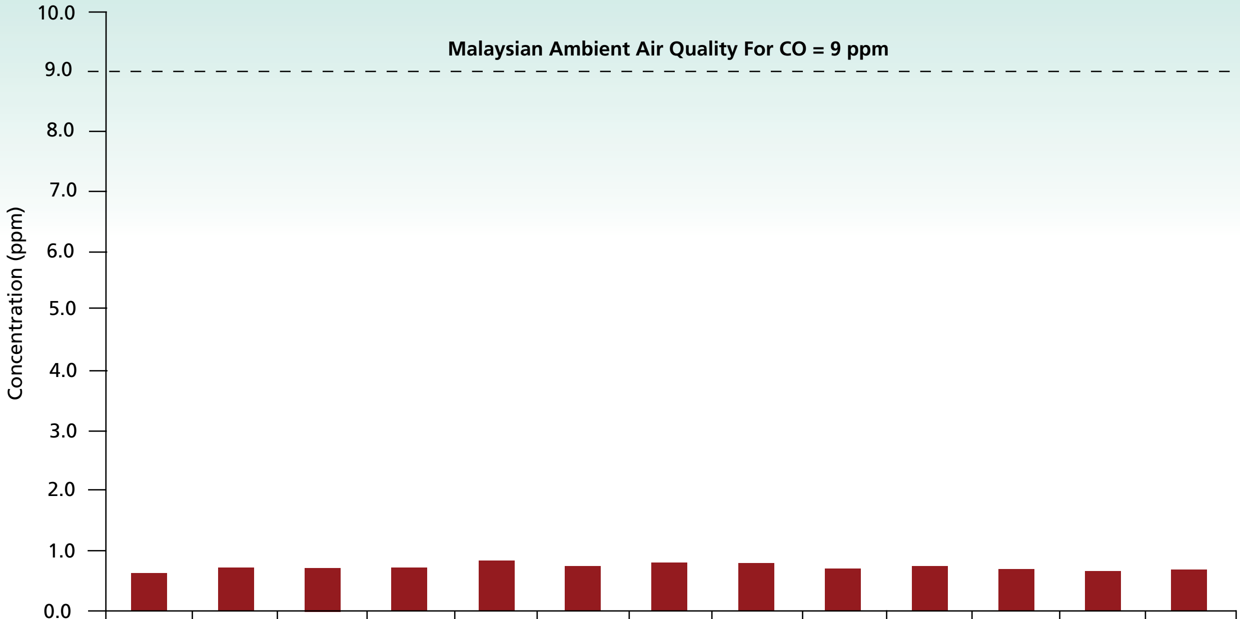
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Concentration	0.0074	0.0068	0.0073	0.0078	0.0078	0.0079	0.0095	0.0091	0.0089	0.0094	0.0073	0.0089	0.0094
Number of Sites	33	39	43	43	43	44	44	44	44	44	44	44	44

Figure 1.9 Malaysia : Annual Average Concentration of Nitrogen Dioxide (NO_2), 1999-2011



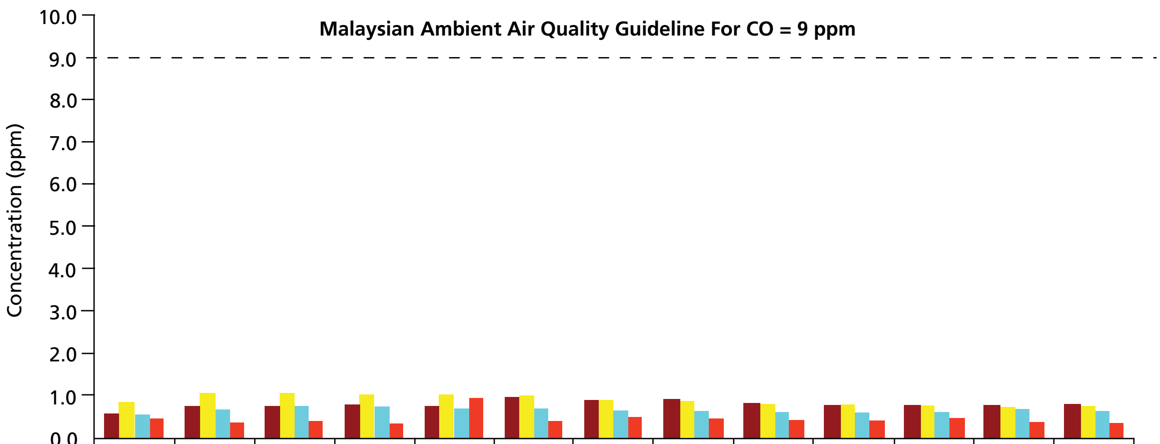
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Industrial	0.0096	0.0093	0.0105	0.0106	0.0104	0.0105	0.0105	0.0105	0.0103	0.0105	0.0100	0.0105	0.0104
Urban	0.0112	0.0104	0.0113	0.0122	0.0123	0.0122	0.0106	0.0105	0.0104	0.0115	0.0110	0.0098	0.0105
Sub Urban	0.0062	0.0062	0.0062	0.0065	0.0066	0.0068	0.0069	0.0066	0.0065	0.0066	0.0063	0.0073	0.0081
Background	0.0030	0.0014	0.0013	0.0018	0.0017	0.0020	0.0026	0.0020	0.0022	0.0020	0.0020	0.0019	0.0021

Figure 1.9(a) Malaysia : Annual Average Concentration of Nitrogen Dioxide (NO_2) by Land Use, 1999 - 2011



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Concentration	0.5860	0.7120	0.7213	0.6995	0.8325	0.7389	0.7918	0.7649	0.6973	0.7309	0.6752	0.6510	0.6809
Number of Sites	35	39	39	39	41	41	41	41	41	41	41	41	41

Figure 1.10 Malaysia : Annual Average Concentration of Carbon Monoxide (CO), 1999 - 2011



	1999	2000	2001	2002	2003	2014	2005	2006	2007	2008	2009	2010	2011
Industrial	0.5550	0.7390	0.7614	0.7676	0.7405	0.9442	0.8734	0.8830	0.7977	0.7537	0.7501	0.7439	0.7662
Urban	0.8220	1.0710	1.0091	0.9934	0.9981	0.9632	0.8636	0.8529	0.7635	0.7511	0.7288	0.6933	0.7221
Sub Urban	0.5200	0.6890	0.7169	0.7187	0.6768	0.6784	0.6335	0.6150	0.5766	0.5509	0.5775	0.6541	0.6146
Background	0.4480	0.3470	0.3978	0.3182	0.9145	0.3700	0.4582	0.4500	0.3924	0.3579	0.4379	0.3357	0.3123

Figure 1.10(a) Malaysia: Annual Average Concentration of Carbon Monoxide (CO) by Land Use, 1999 - 2011

RIVER WATER QUALITY

26	Table 2.1 Malaysia	:	Water Quality Status of Clean Rivers, 2011
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40	Figure 2.1 Malaysia	:	River Water Quality Trend (2005 - 2011)
40	Figure 2.2	:	Comparison of Cumulative Frequency for 10 CWQM Stations - Dissolved Oxygen : 1st January - 31st December 2011
41	Figure 2.3	:	Comparison of Cumulative Frequency for 10 CWQM Stations - Ammonium Ion Concentration : 1st January - 31st December 2011
41	Figure 2.4.	:	Comparison of Cumulative Frequency for 10 CWQM Stations - Turbidity : 1st January - 31st December 2011
42	Figure 2.5.	:	Comparison of Cumulative Frequency for 10 CWQM Stations - pH : 1st January - 31st December 2011
42	Figure 2.6	:	River Water Quality Trend based on BOD sub-index (2005 - 2011)
43	Figure 2.7	:	River Water Quality Trend based on AN sub-index (2005 - 2011)
43	Figure 2.8	:	River Water Quality Trend based on SS sub-index (2005 - 2011)

RIVER WATER QUALITY

RIVER WATER QUALITY MONITORING

The Department of Environment (DOE) continued with the river water quality monitoring programme in 2011 to detect changes in river water quality. 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.

In 2011, river water quality was assessed based on a total of 4,249 samples taken from 464 rivers, using 812 manual stations (MWQM) and 10 continuous water quality monitoring stations (CWQM) for the purpose of early detection of pollution influx. For the period of January to December 2011, no distinctive incidence of pollution flux was observed.

RIVER WATER QUALITY STATUS

Out of 464 rivers monitored, a total of 275 (59.3%) were found to be clean, 150 (32.3%) slightly polluted and 39 (8.4%) polluted **(Figure 2.1) (Tables 2.1, 2.2 and 2.3)**.

As in previous years, the major pollutants detected were Biochemical Oxygen Demand (BOD), Ammoniacal Nitrogen (NH_3-N) and Suspended Solids (SS). High BOD can be attributed to untreated or partially treated sewage and discharges from agro-based industries and manufacturing industries. The main sources of NH_3-N were livestock farming and domestic sewage, while the sources for SS were mainly due to earthworks and land clearing activities.

Table 2.4 shows that out of 39 polluted rivers, 22 rivers were categorized as Class III, 16 rivers as Class IV and one river as Class V.

In terms of BOD, 24 rivers were categorized as Class V and 15 rivers as Class IV.

In terms of NH_3-N, 23 rivers were categorized as Class V, 8 rivers as Class IV, 6 rivers as Class III and 2 rivers as Class II.

In terms of SS, 18 rivers were categorized as Class III, 11 rivers as Class II, 8 rivers as Class I and one river was categorized as Class IV and Class V, respectively.

CONTINUOUS WATER QUALITY MONITORING

The dissolved oxygen is an indicator of BOD strength exerted by organic pollutants. In terms of dissolved oxygen level, 98% of the data recorded at Sg. Perak were within the Class II of the National Water Quality Standard of Malaysia (NWQS), followed by Sg. Rajang (57%), Sg. Melaka (29%) and Sg. Linggi (13%). Meanwhile, less than 10% of the data recorded at Sg. Sarawak, Sg. Labu, Sg. Skudai, Sg. Selangor and Sg. Putat were within the Class II of the National Water Quality Standard of Malaysia (NWQS). Sg. Jinjang had the worst DO values with only 0.8% of the data within the Class II of the National Water Quality Standard of Malaysia (NWQS) **(Figure 2.2)**.

The ammonium is an ionized form of ammonia. The measurement of ammonium can indicate the potential to form ammonia or ammoniacal nitrogen pollutants in rivers due to pH changes. Ammonium levels at all rivers except Sg. Perak and Sg. Rajang were found to have exceeded the Class II of the National Water Quality Standard of Malaysia (NWQS) **(Figure 2.3)**.

Turbidity is used as an indicator of suspended solids in a river. All turbidity data at Sg. Melaka exceeds the Class II of the National Water Quality Standard of Malaysia (NWQS) of 50 NTU value. Meanwhile, 72% of turbidity data for Sg. Putat were within the Class II of the National Water Quality Standard of Malaysia (NWQS), followed by Sg. Jinjang (60%), Sg. Labu (53%), Sg. Perak

(53%), Sg. Selangor (20%) and Sg. Rajang (15%) **(Figure 2.4)**. Based on continuous monitoring stations, Sg Rajang and Sg Selangor were found to be the worst in terms of turbidity.

TREND IN RIVER WATER POLLUTION

The river water quality in terms of Water Quality Classification Index had shown a slight improvement in 2011. The percentage of clean rivers had increased from 51% (2010) to 59% in 2011. The percentage of polluted river had decreased from 13% in 2010 to 8% in 2011. These trends are shown in **Figure 2.1**.

In terms of BOD sub-index, the number of clean rivers had significantly decreased from 104 (2010) to 44 (2011) **(Figure 2.6)**. For AN sub-index, the number of clean rivers had increased from 147 (2010) to 174 (2011) **(Figure 2.7)**. As for SS sub-index, the number of clean rivers had slightly decreased from 334 (2010) to 293 (2011) **(Figure 2.8)**.

Heavy metals were analysed for Mercury (Hg), Arsenic (As), Cadmium (Cd), Chromium (Cr), Plumbum (Pb), and Zinc (Zn). All Pb and Zn data were within the Class IIB limits of the National Water Quality Standard of Malaysia (NWQS). Meanwhile, 99.98% of the data for Cd were within the Class IIB limits of the National Water Quality Standard of Malaysia (NWQS) followed by Cr (99.95%), As (99.93%) and Hg (99.43%).

Crystal clear water

Table 2.1 Malaysia: Water Quality Status of Clean Rivers, 2011

STATE	RIVER BASIN	RIVER	NO. OF STATIONS	WQI 2010	WQI 2011	RIVER (2011) CLASS	RIVER (2011) CATEGORY
PERLIS	PERLIS	PELARIT	1	92	91	II	C
		WANG KELIAN	1	93	91	II	C
		JERNIH	1	88	90	II	C
		NGULANG	1	74	85	II	C
		JARUM	1	81	83	II	C
KEDAH	ULU MELAKA	PETANG	1	93	95	I	C
		ULU MELAKA	1	82	82	II	C
	MERBOK	TUPAH	1	84	95	I	C
		TOK PAWANG	1	91	90	II	C
	KEDAH	JANING	1	94	94	I	C
		PEDU	1	86	87	II	C
		TEKAI	1	85	86	II	C
		PDG TERAP	3	81	82	II	C
	KISAP	KISAP	1	92	92	II	C
KEDAH/ P.PINANG	MUDA	PEGANG	1	87	95	I	C
		KETIL	2	91	94	I	C
		CHEPIR	1	90	92	II	C
		MUDA	4	89	92	II	C
		KARANGAN	1	84	90	II	C
		SEDIM	1	88	90	II	C
P.PINANG	JAWI	JUNJONG	1	94	91	II	C
	PINANG	AIR TERJUN	1	94	87	II	C
	KLUANG	ARA	2	80	87	II	C
	PERAI	KULIM	2	81	82	II	C
P.PINANG/ PERAK	KERIAN	KECHIL	1	88	90	II	C
		KERIAN	4	82	82	II	C
PERAK	PERAK	CHEPOR	1	92	95	I	C
		KINJANG	1	94	91	II	C
		PELUS	2	83	91	II	C
		KLAH	1	91	90	II	C
		CHENDERIANG	1	91	88	II	C
		SUNGKAI	2	82	88	II	C
		PERAK	8	87	87	II	C
		KAMPAR	2	87	86	II	C
		KANGSAR	1	84	86	II	C
		RAIA	2	87	86	II	C
		BIDOR	3	84	85	II	C
		BATANG PADANG	3	81	84	II	C
		KUANG	1	85	84	II	C

Table 2.1 Malaysia: Water Quality Status of Clean Rivers, 2011 (continued)

STATE	RIVER BASIN	RIVER	NO. OF STATIONS	WQI 2010	WQI 2011	RIVER (2011) CLASS	RIVER (2011) CATEGORY
	SEPETANG	JANA	1	94	93	I	C
		TRONG	1	93	92	II	C
		LIMAU	1	93	88	II	C
		BATU TEGOH	3	88	87	II	C
		TEMERLOH	2	90	87	II	C
	KURAU	ARA	2	93	91	II	C
	RAJA HITAM	NYIOR	1	94	91	II	C
	BRUAS	ROTAN	1	91	90	II	C
		DANDANG	1	90	89	II	C
		BRUAS	3	84	83	II	C
PERAK/ SELANGOR	BERNAM	INKI	1	93	95	I	C
		TROLAK	1	90	92	II	C
		BERNAM	4	86	88	II	C
		SLIM	2	86	88	II	C
SELANGOR	SELANGOR	KERLING	1	91	94	I	C
		BATANG KALI	1	92	91	II	C
		KANCHING	1	92	90	II	C
		SERENDAH	1	88	90	II	C
		SELANGOR	4	82	83	II	C
	LANGAT	LUI	1	94	90	II	C
		SEMENYIH	1	75	88	II	C
		CHUAU	2	89	87	II	C
		JIJAN	1	85	87	II	C
SELANGOR/ WPKL	KLANG	SEMELAH	1	84	90	II	C
		GOMBAK	3	80	84	II	C
N.SEMBILAN	LINGGI	BATANG PENAR	1	92	93	I	C
		PEDAS	1	81	88	II	C
		REMBAU	2	86	88	II	C
		CHEMBONG	1	82	87	II	C
		SIPUT	1	83	85	II	C
		KEPAYONG	1	78	84	II	C
		KUNDUR BESAR	1	87	84	II	C
MELAKA	MELAKA	TAMPIN	1	95	95	I	C
		KEMUNTING	1	84	89	II	C
		KERU	1	84	89	II	C
		BTG.MELAKA	2	78	87	II	C
		DURIAN TUNGGAL	1	82	81	II	C
	KESANG	CHOHONG	2	80	90	II	C
	DUYONG	GAPAM	1	86	87	II	C

Table 2.1 Malaysia: Water Quality Status of Clean Rivers, 2011 (continued)

STATE	RIVER BASIN	RIVER	NO. OF STATIONS	WQI 2010	WQI 2011	RIVER (2011) CLASS	RIVER (2011) CATEGORY
JOHOR/ N.SEMBILAN	MUAR	AIR PANAS	1	93	91	II	C
		JUASSEH	1	90	89	II	C
		GEMENCHEH	1	81	85	II	C
		MEDA	1	83	83	II	C
		LABIS	1	73	81	II	C
JOHOR	BATU PAHAT	BANTANG	1	94	92	II	C
		CHAAH	1	90	90	II	C
		MEREK	1	81	90	II	C
		LENIK	1	86	88	II	C
	ENDAU	JASIN	1	93	92	II	C
		SELAI	1	92	92	II	C
		TAMOK	1	91	88	II	C
		ENDAU	3	89	87	II	C
		KAHANG	1	84	87	II	C
		MAMAI	1	79	87	II	C
		SINGOL	1	77	84	II	C
		PALOH	1	85	81	II	C
	JOHOR	LAYANG	1	90	92	II	C
		PELEPAH	2	94	91	II	C
		PENGGELI	2	86	91	II	C
		PANTI	1	83	90	II	C
		LAYAU KIRI	1	88	88	II	C
		TELOR	1	87	88	II	C
		LINGGIU	1	84	87	II	C
		REMIS	1	84	87	II	C
		SEMANGAR	1	87	87	II	C
		TEMOH	1	90	87	II	C
		ANAK SG. SAYONG	1	74	86	II	C
		SAYONG	4	83	86	II	C
		BUKIT BESAR	1	86	85	II	C
		BELITONG	1	83	84	II	C
		JOHOR	4	83	84	II	C
		PAPAN	1	82	84	II	C
		SEBOL	1	79	84	II	C
		SELUYUT	1	78	84	II	C
		SANTI	1	77	81	II	C
		TIRAM	4	79	81	II	C
	BENUT	PARIT HJ. YASSIN	1	85	90	II	C
	PALOI	PALOI	1	82	87	II	C
	MERSING	MERSING	2	84	81	II	C

Table 2.1 Malaysia: Water Quality Status of Clean Rivers, 2011 (continued)

STATE	RIVER BASIN	RIVER	NO. OF STATIONS	WQI		RIVER (2011)	
				2010	2011	CLASS	CATEGORY
PAHANG	PAHANG	BURUNG	1	91	96	I	C
		TERANUM	1	92	95	I	C
		TERLA	1	90	94	I	C
		BERTAM	1	87	92	II	C
		HABU	1	87	92	II	C
		KELAU	1	93	91	II	C
		RINGLET	1	84	91	II	C
		TRINGKAP	1	86	91	II	C
		BENUS	2	91	90	II	C
		BERKAPOR	1	90	90	II	C
		LENGGOK	1	94	90	II	C
		T. PAYA BUNGOR	1	86	90	II	C
		TELOM	2	85	90	II	C
		TEMBELING	1	94	90	II	C
		TERAS	1	90	90	II	C
		LIPIS	3	90	89	II	C
		MARAN	1	84	89	II	C
		PERTING	1	93	89	II	C
		TAHAN	1	94	89	II	C
		TERIS	3	NA	89	II	C
		KERTAM	1	90	88	II	C
		LEPAR	3	88	88	II	C
		TANGLIR	1	89	88	II	C
		BENTONG	1	88	87	II	C
		TASIK CHINI	1	85	87	II	C
		JEMPOL	2	89	86	II	C
		LUIT	1	90	86	II	C
		TEKAL	1	83	86	II	C
		JELAI	2	84	85	II	C
		PAHANG	8	87	85	II	C
		TEKAM	2	87	85	II	C
		TRIANG	2	84	83	II	C
		KOYAN	1	85	82	II	C
		CHINI	1	79	81	II	C
		SEMANTAN	3	85	81	II	C
	ROMPIN	PUKIN	1	90	93	I	C
	KUANTAN	KENAU	1	92	90	II	C
		KUANTAN	5	89	88	II	C
		PANDAN	1	92	88	II	C
		BELAT	1	84	85	II	C
		TALAM	1	69	85	II	C
		CHARU	1	90	84	II	C

Table 2.1 Malaysia: Water Quality Status of Clean Rivers, 2011 (continued)

STATE	RIVER BASIN	RIVER	NO. OF STATIONS	WQI 2010	WQI 2011	RIVER (2011) CLASS	RIVER (2011) CATEGORY
	MERCHONG	MERCHONG	1	87	90	II	C
	ROMPIN	KERATONG	2	79	88	II	C
		PONTIAN	1	86	85	II	C
		AUR	1	89	84	II	C
	ANAK ENDAU	ANAK ENDAU	2	85	84	II	C
	BEBAR	MERBA	1	85	84	II	C
TERENGGANU	TERENGGANU	BERANG	1	91	92	II	C
		PUEH	1	84	89	II	C
		TERENGGANU	3	85	85	II	C
		TELEMONG	1	89	81	II	C
	KERTIH	KERTIH	1	86	92	II	C
	BESUT	BESUT	2	89	91	II	C
	CHUKAI	IBOK	1	82	91	II	C
		BUNGKUS	1	73	81	II	C
	DUNGUN	DUNGUN	4	91	90	II	C
	PAKA	RASAU	1	77	88	II	C
		PAKA	1	84	87	II	C
	SETIU	SETIU	2	92	88	II	C
	KEMAMAN	CHERUL	1	86	87	II	C
		KEMAMAN	2	88	86	II	C
	KLUANG	KLUANG	1	86	81	II	C
	MARANG	MARANG	1	78	81	II	C
KELANTAN	KELANTAN	KERILLA	1	92	94	I	C
		TUANG	1	92	94	I	C
		PERGAU	6	92	93	I	C
		BER	1	89	91	II	C
		BETIS	1	91	90	II	C
		GALAS	5	89	89	II	C
		NAL	2	91	89	II	C
		BEROK	3	85	88	II	C
		LEBIR	3	89	86	II	C
		NENGGIRI	3	86	86	II	C
		BELATOP	2	82	85	II	C
		KELANTAN	3	85	85	II	C
		SOKOR	1	85	85	II	C
		RELAI	1	86	83	II	C
	GOLOK	LANAS	1	93	86	II	C
		GOLOK	5	88	85	II	C
	KEMASIN	SEMERAK	2	88	85	II	C
	PENGKALAN CHEPA	KELADI	1	79	83	II	C

Table 2.1 Malaysia: Water Quality Status of Clean Rivers, 2011 (continued)

STATE	RIVER BASIN	RIVER	NO. OF STATIONS	WQI 2010	WQI 2011	RIVER (2011) CLASS	RIVER (2011) CATEGORY
SARAWAK	MIRI	PADANG LIKU	1	89	91	II	C
	LUPAR	AI	2	90	90	II	C
		SEKERANG	1	91	88	II	C
		SETERAP	1	81	81	II	C
		UNDUP	1	85	84	II	C
	LIMBANG	LIMBANG	5	85	89	II	C
	RAJANG	KANOWIT	1	85	87	II	C
		BINATANG	1	85	86	II	C
		BALOI	1	80	81	II	C
		JULAU	1	85	85	II	C
	TRUSAN	TRUSAN	1	88	86	II	C
	LAWAS	LAWAS	3	88	84	II	C
	SIMILAJAU	SIMILAJAU	2	81	82	II	C
	NIAH	SEKALOH	1	76	81	II	C
	SEMUNSAM	SEMUNSAM	1	75	81	II	C
SABAH	SUGUT	BONGKUD	1	94	95	I	C
		LOHAN	1	91	95	I	C
		SUGUT	3	92	90	II	C
		MERALI	1	94	93	I	C
	PADAS	BUNSIT	1	90	95	I	C
		LIAWAN	1	91	94	I	C
		TANDULU	1	91	94	I	C
		PANGATAN	1	81	90	II	C
		PEGALAN	3	83	88	II	C
		PADAS	3	81	85	II	C
	BINGKONGAN	BANDAU	1	92	94	I	C
		BINGKONGAN	2	92	94	I	C
		MENGGARIS	2	92	93	I	C
		TANDEK	1	86	90	II	C
	KEDAMAIAN	TEMPASUK	2	94	94	I	C
		WARIU	1	94	94	I	C
		KEDAMAIAN	1	94	93	I	C
	APAS	APAS	1	90	92	II	C
	LABOK	KINIPIR	2	92	92	II	C
		MALIAU	1	92	92	II	C
		LIWAGU	2	91	90	II	C
		TUNGUD	1	87	87	II	C
		LABOK	1	90	84	II	C
	LAKUTAN	LAKUTAN	1	89	92	II	C
	MOYOG	MOYOG	4	91	92	II	C
	SAPI	SUALONG	1	85	92	II	C
		SAPI	3	81	89	II	C

Table 2.1 Malaysia: Water Quality Status of Clean Rivers, 2011 (continued)

STATE	RIVER BASIN	RIVER	NO. OF STATIONS	WQI 2010	WQI 2011	RIVER (2011) CLASS	RIVER (2011) CATEGORY
	PAPAR	PAPAR	3	88	91	II	C
	TAWAU	TAWAU	4	82	91	II	C
	KALUMPANG	KALUMPANG	3	87	90	II	C
	MENGGA-LONG	MENGGALONG	2	85	90	II	C
	LIKAS	MENGGATAL	2	91	90	II	C
		INANAM	3	84	85	II	C
	SILABUKAN	SILABUKAN	2	84	90	II	C
	TUARAN	TUARAN	2	89	90	II	C
		SONG SAI	1	90	88	II	C
		DAMIT	2	88	85	II	C
	UMAS-UMAS	UMAS-UMAS	1	81	90	II	C
	KINABATA-NGAN	MENANGGUL	1	81	89	II	C
		KARAMUAK	1	90	88	II	C
		KINABATANGAN	3	83	87	II	C
		KOYAH	1	82	87	II	C
	MEROTAI	MEROTAI	3	85	89	II	C
	BALUNG	BALUNG	1	88	88	II	C
	BRANTIAN	BRANTIAN	1	85	88	II	C
	LINGKUNGAN	BUKAU	1	87	88	II	C
		LINGKUNGAN	1	91	87	II	C
	SEGAMA	SEGAMA	3	86	88	II	C
	TINGKAYU	TINGKAYU	2	80	88	II	C
	KIMANIS	KIMANIS	1	84	87	II	C
	SEGALIUD	SEGALIUD	2	82	87	II	C
	TENGHILAN	TENGHILAN	1	91	87	II	C
	TUNGKU	TUNGKU	2	89	87	II	C
	BENGKOKA	BENGKOKA	2	85	86	II	C
	KALABAKAN	KALABAKAN	3	81	86	II	C
	MEMBAKUT	MEMBAKUT	1	88	86	II	C
	MOUNAD	MOUNAD	2	82	86	II	C
	BONGAWAN	BONGAWAN	1	84	85	II	C
	PAITAN	PAITAN	1	83	85	II	C
	TELIPOK	TELIPOK	2	82	85	II	C

Table 2.2 Malaysia: Water Quality Status of Slightly Polluted Rivers, 2011

STATE	RIVER BASIN	RIVER	NO. OF STATIONS	WQI		RIVER (2011)	
				2010	2011	CLASS	CATEGORY
PERLIS	PERLIS	PERLIS	1	69	66	III	SP
KEDAH	KEDAH	PENDANG	1	76	80	II	SP
	MERBOK	MERBOK	1	69	74	III	SP
		BONGKOK	1	64	71	III	SP
		PETANI	1	56	65	III	SP
KEDAH/ P.PINANG	MUDA	JERUNG	1	66	72	III	SP
P.PINANG	JAWI	MACHANG BUBOK	1	79	77	II	SP
	PERAI	KELADI	1	76	75	III	SP
		JARAK	3	67	65	III	SP
	BAYAN LEPAS	TIRAM	2	74	75	III	SP
		BAYAN LEPAS	1	60	62	III	SP
	JURU	KILANG UBI	4	65	71	III	SP
		PASIR	1	51	63	III	SP
	KLUANG	RELAU	1	65	68	III	SP
P.PINANG/ PERAK	KERIAN	SELAMA	2	72	72	III	SP
PERAK	KURAU	KURAU	4	79	79	II	SP
	PERAK	KINTA	6	78	77	II	SP
		NYAMOK	1	61	74	III	SP
		KEPAYANG	2	72	71	III	SP
		SELUANG	1	64	69	III	SP
		KERDAH	1	56	68	III	SP
		PARI	1	72	68	III	SP
		SEROKAI	1	70	66	III	SP
		PINJI	2	65	64	III	SP
		TUMBOH	1	71	64	III	SP
	SEPETANG	SEPETANG	2	71	72	III	SP
	RAJA HITAM	MANJONG	2	80	70	III	SP
	WANGI	DERALIK	1	55	68	III	SP
		WANGI	1	69	63	III	SP
SELANGOR	TENGI	TENGI	3	72	77	II	SP
	LANGAT	LANGAT	7	72	75	III	SP
		PAJAM	1	75	74	III	SP
		ANAK CHUAU	1	78	72	III	SP
		BATANG NILAI	1	57	65	III	SP
	SEPANG	SEPANG	2	75	73	III	SP
	SELANGOR	SEMBAH	1	74	72	III	SP
SELANGOR/ WPKL	KLANG	BATU	3	74	77	II	SP
		KLANG	6	61	61	III	SP
N.SEMBILAN	LINGGI	LINGGI	5	73	76	III	SP
		SIMIN	1	75	75	III	SP

Table 2.2 Malaysia: Water Quality Status of Slightly Polluted Rivers, 2011 (continued)

STATE	RIVER BASIN	RIVER	NO. OF STATIONS	WQI 2010	WQI 2011	RIVER (2011) CLASS	RIVER (2011) CATEGORY
MELAKA	KESANG	KESANG	3	71	80	II	SP
	MELAKA	MELAKA	5	73	78	II	SP
		REMBIA	1	61	67	III	SP
	DUYONG	DUYONG	3	70	72	III	SP
	SERI MELAKA	SERI MELAKA	1	62	62	III	SP
JOHOR/ N.SEMBILAN	MUAR	MUAR	8	80	80	II	SP
		SEGAMAT	1	80	78	II	SP
JOHOR	BATU PAHAT	BEKOK	5	77	80	II	SP
		BERLIAN	1	74	75	III	SP
		MERPO	1	77	70	III	SP
		SEMBERONG	2	63	68	III	SP
		SIMPANG KIRI	3	63	67	III	SP
		SIMPANG KANAN	2	56	64	III	SP
		BATU PAHAT	1	54	60	III	SP
	SEDILI BESAR	DOHOL	1	81	80	II	SP
		AMBAT	1	84	79	II	SP
		PASIR PANJANG	1	64	77	II	SP
		TEMUBOR KANAN	1	84	77	II	SP
		SEDILI BESAR	5	79	78	II	SP
	SEDILI KECIL	SEDILI KECIL	2	79	80	II	SP
		ANAK SEDILI KECIL	1	75	78	II	SP
		BAHAN	2	74	74	III	SP
	ENDAU	SEMBERONG	5	81	80	II	SP
		LENGGOR	1	83	77	II	SP
		MENGKIBOL	3	69	75	III	SP
		PAMOL	1	65	73	III	SP
		JEBONG	1	65	65	III	SP
		MELATAI	1	60	65	III	SP
	JEMALUANG	JEMALUANG	2	80	78	II	SP
	JOHOR	CHEMANGAR	1	78	77	II	SP
		LEBAM	1	71	70	III	SP
		SEMENCHU	1	67	64	III	SP
	PULAI	PULAI	2	80	74	III	SP
	BENUT	ULU BENUT	1	74	74	III	SP
	PONTIAN KECIL	PONTIAN KECIL	2	73	70	III	SP
	BENUT	BENUT	4	72	69	III	SP
	SKUDAI	SKUDAI	9	68	68	III	SP
		MELANA	2	71	66	III	SP
	PONTIAN BESAR	AIR HITAM	1	68	67	III	SP
		PONTIAN BESAR	5	63	61	III	SP

Table 2.2 Malaysia: Water Quality Status of Slightly Polluted Rivers, 2011 (continued)

STATE	RIVER BASIN	RIVER	NO. OF STATIONS	WQI 2010	WQI 2011	RIVER (2011) CLASS	RIVER (2011) CATEGORY
	TEBRAU	SEBULUNG	1	56	65	III	SP
		PLENTONG	1	50	61	III	SP
	KIM-KIM	KIM-KIM	2	73	64	III	SP
PAHANG	PAHANG	JENGKA	2	80	80	II	SP
		TELANG	1	81	80	II	SP
		KUNDANG	1	76	77	II	SP
		TASIK BERA	1	82	76	III	SP
		BERA	2	78	75	III	SP
		MENTIGA	1	80	74	III	SP
		SERTING	2	68	73	III	SP
	KUANTAN	RIAU	1	76	80	II	SP
	ROMPIN	ROMPIN	4	82	80	II	SP
	CHERATING	CHERATING	1	78	76	III	SP
	BALOK	PANJANG	1	74	75	III	SP
		BALOK	2	67	66	III	SP
	BEBAR	SERAI	2	71	71	III	SP
		BEBAR	1	69	65	III	SP
	TONGGOK	TONGGOK	1	68	69	III	SP
TERENGGANU	SETIU	CHALOK	2	81	80	II	SP
	CHUKAI	CHUKAI	1	70	79	II	SP
		RUANG	1	64	71	III	SP
	IBAI	IBAI	3	76	77	II	SP
	TERENGGANU	NERUS	1	86	77	II	SP
	MERANG	MERANG	1	75	69	III	SP
	MERCHANG	MERCHANG	1	74	69	III	SP
	KEMAMAN	RANSAN	1	52	60	III	SP
KELANTAN	PENGKALAN DATU	PENGKALAN DATU	3	80	79	II	SP
	KEMASIN	KEMASIN	2	74	72	III	SP
	PENGKALAN CHEPA	PENGKALAN CHEPA	2	74	71	III	SP
		RAJA GALI	1	76	68	III	SP
		ALOR B	1	62	61	III	SP
SARAWAK	LUPAR	LUPAR	3	77	80	II	SP
	NIAH	NIAH	2	84	80	II	SP
	SARAWAK	SARAWAK KANAN	1	77	80	II	SP
		SARAWAK	6	80	79	II	SP
		SAMARAHAN	2	76	77	II	SP
		SARAWAK KIRI	1	81	77	II	SP
		SEMADANG	1	89	77	II	SP
		KUAP	1	73	75	III	SP

Table 2.2 Malaysia : Water Quality Status of Slightly Polluted Rivers, 2011 (continued)

STATE	RIVER BASIN	RIVER	NO. OF STATIONS	WQI 2010	WQI 2011	RIVER (2011) CLASS	RIVER (2011) CATEGORY
		TABUAN	1	68	75	III	SP
		MAONG KIRI	1	67	69	III	SP
		SEMENGGOH	1	70	68	III	SP
	TATAU	TATAU	1	80	80	II	SP
	BALINGIAN	BALINGIAN	2	75	79	II	SP
	SUAI	SUAI	1	71	79	II	SP
	SIBUTI	KEJAPIL	1	81	78	II	SP
		SIBUTI	2	77	76	III	SP
		KABULOH	2	61	62	III	SP
	BARAM	TUTUH	1	73	77	II	SP
		BARAM	4	77	73	III	SP
	KAYAN	KAYAN	3	72	76	III	SP
	SARIBAS	LAYAR	2	82	76	III	SP
		SARIBAS	1	69	65	III	SP
	RAJANG	RAJANG	11	74	76	III	SP
		SARIKEI	2	78	74	III	SP
		MERADONG	1	71	71	III	SP
		SALIM	1	73	71	III	SP
	KERIAN	SEBLAK	1	78	76	III	SP
		KERIAN	2	77	74	III	SP
	KEMENA	SIBIU	1	76	76	III	SP
		KEMENA	3	80	75	III	SP
	MUKAH	MUKAH	4	73	73	III	SP
	SADONG	SADONG	4	76	73	III	SP
		KARANGAN	2	75	72	III	SP
	OYA	OYA	3	78	72	III	SP
	MIRI	MIRI	2	59	65	III	SP
		DALAM	1	53	64	III	SP
		LUTONG	1	63	64	III	SP
SABAH	LIKAS	LIKAS	2	76	75	III	SP
	SEMBULAN	SEMBULAN	2	72	62	III	SP

Table 2.3 Malaysia : Water Quality Status of Polluted Rivers, 2011

STATE	RIVER BASIN	RIVER	NO. OF STATIONS	WQI		RIVER (2011)	
				2010	2011	CLASS	CATEGORY
KEDAH	KEDAH	KEDAH	1	63	59	P	III
P.PINANG	PINANG	AIR ITAM	5	53	57	P	III
		PINANG	1	52	44	P	IV
		JELUTONG	1	34	43	P	IV
		DONDANG	1	43	42	P	IV
	PERAI	PERAI	2	59	55	P	III
		PERTAMA	1	55	50	P	IV
		KEREH	2	49	45	P	IV
	JURU	JURU	2	52	54	P	III
		RAMBAI	1	44	52	P	III
	JAWI	JAWI	1	52	42	P	IV
PERAK	RAJA HITAM	RAJA HITAM	2	61	53	P	III
SELANGOR	BULOH	BULOH	4	50	58	P	III
SELANGOR/ WPKL	KLANG	JINJANG	1	58	53	P	III
MELAKA	MERLIMAU	MERLIMAU	2	58	53	P	III
JOHOR/ N.SEMBILAN	MUAR	SARANG BUAYA	1	60	59	P	III
JOHOR	BATU PAHAT	AMRAN	1	71	59	P	III
	RAMBAH	RAMBAH	2	57	59	P	III
	KAW. PASIR GUDANG	LATOH	1	58	58	P	III
		MASAI	1	60	52	P	III
		PEREMBI	1	42	48	P	IV
		BULUH	1	39	33	P	IV
		TUKANG BATU	1	33	26	P	V
	TEBRAU	PANDAN	1	54	57	P	III
		TAMPOI	1	51	57	P	III
		TEBRAU	4	66	56	P	III
		BALA	1	51	51	P	IV
		SENGKUANG	1	39	42	P	IV
	PULAI	ULU CHOH	1	76	54	P	III
	SEGGET	SEGGET	5	51	53	P	III
	KEMPAS	KEMPAS	2	57	51	P	IV
	DANGA	DANGA	2	49	49	P	IV
	PONTIAN BESAR	AYER MERAH	1	36	47	P	IV
	BENUT	PINGGAN	1	57	47	P	IV
	SANGLANG	SANGLANG	1	54	47	P	IV
	AIR BALOI	AIR BALOI	3	46	41	P	IV
KELANTAN	PENGKALAN CHEPA	ALOR LINTAH	1	45	53	P	III
SARAWAK	SIBUTI	SATAP	1	61	59	P	III
	MIRI	ADONG	1	51	59	P	III

Table 2.4: Malaysia : The polluted rivers and classes based on BOD, AN and SS, 2011

STATE	RIVER BASIN	RIVER	2011		Classes based on		
			WQI	CLASS	BOD	AN	SS
KEDAH	KEDAH	KEDAH	59	III	IV	III	III
JOHOR/ N.SEMBILAN	MUAR	SARANG BUAYA	59	III	V	III	III
JOHOR	BATU PAHAT	AMRAN	59	III	V	IV	II
JOHOR	RAMBAH	RAMBAH	59	III	V	II	III
SARAWAK	MIRI	ADONG	59	III	V	III	I
SARAWAK	SIBUTI	SATAP	59	III	V	III	I
SELANGOR	BULOH	BULOH	58	III	IV	IV	III
JOHOR	KAW. PASIR GUDANG	LATOH	58	III	IV	IV	II
P.PINANG	PINANG	AIR ITAM	57	III	IV	IV	II
JOHOR	TEBRAU	PANDAN	57	III	IV	V	I
JOHOR	TEBRAU	TAMPOI	57	III	V	V	I
JOHOR	TEBRAU	TEBRAU	56	III	IV	V	III
P.PINANG	PERAI	PERAI	55	III	IV	IV	III
P.PINANG	JURU	JURU	54	III	IV	V	III
JOHOR	PULAI	ULU CHOH	54	III	V	V	III
JOHOR	SEGGET	SEGGET	53	III	IV	V	II
PERAK	RAJA HITAM	RAJA HITAM	53	III	V	IV	II
KELANTAN	PENGKALAN CHEPA	ALOR LINTAH	53	III	IV	V	I
SELANGOR/WPKL	KLANG	JINJANG	53	III	V	V	II
MELAKA	MERLIMAU	MERLIMAU	53	III	V	V	I
P.PINANG	JURU	RAMBAI	52	III	IV	V	III
JOHOR	KAW. PASIR GUDANG	MASAI	52	III	IV	V	III
JOHOR	KEMPAS	KEMPAS	51	IV	V	V	II
JOHOR	TEBRAU	BALA	51	IV	IV	V	II
P.PINANG	PERAI	PERTAMA	50	IV	IV	IV	II
JOHOR	DANGA	DANGA	49	IV	IV	V	III
JOHOR	KAW. PASIR GUDANG	PEREMBI	48	IV	V	V	III
JOHOR	PONTIAN BESAR	AYER MERAH	47	IV	V	IV	I
JOHOR	BENUT	PINGGAN	47	IV	V	III	V
JOHOR	SANGLANG	SANGLANG	47	IV	V	II	IV
P.PINANG	PERAI	KEREH	45	IV	V	V	III
P.PINANG	PINANG	PINANG	44	IV	V	V	II
P.PINANG	PINANG	JELUTONG	43	IV	V	V	II
P.PINANG	JAWI	JAWI	42	IV	V	V	III
P.PINANG	PINANG	DONDANG	42	IV	V	V	III
JOHOR	TEBRAU	SENGKUANG	42	IV	V	V	I
JOHOR	AIR BALOI	AIR BALOI	41	IV	V	III	III

JOHOR	KAW. PASIR GUDANG	BULUH	33	IV	V	V	III
JOHOR	KAW. PASIR GUDANG	TUKANG BATU	26	V	V	V	III

	Class I
	Class II
	Class III
	Class IV
	Class V

In harmony with nature

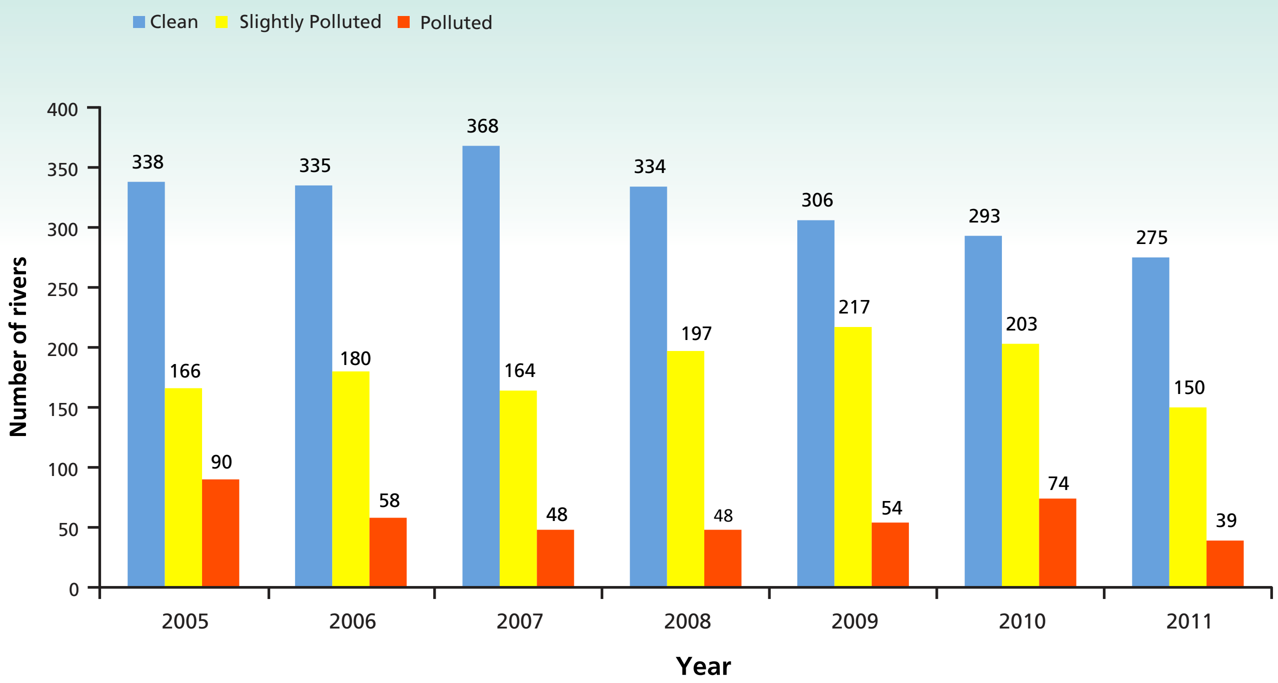


Figure 2.1 Malaysia : River Water Quality Trend (2005 - 2011)

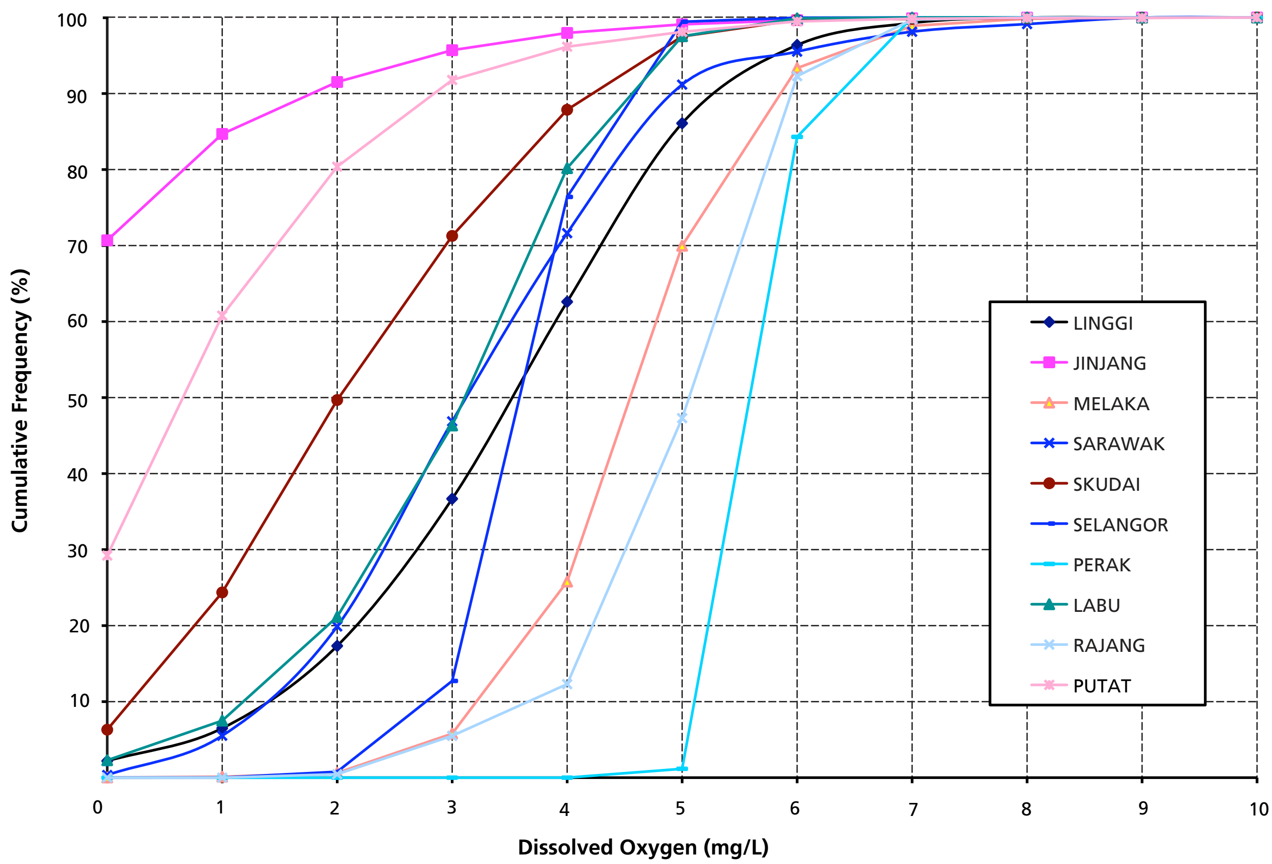


Figure 2.2 Comparison of Cumulative Frequency for 10 CWQM Stations - Dissolved Oxygen : 1st January - 31st December 2011

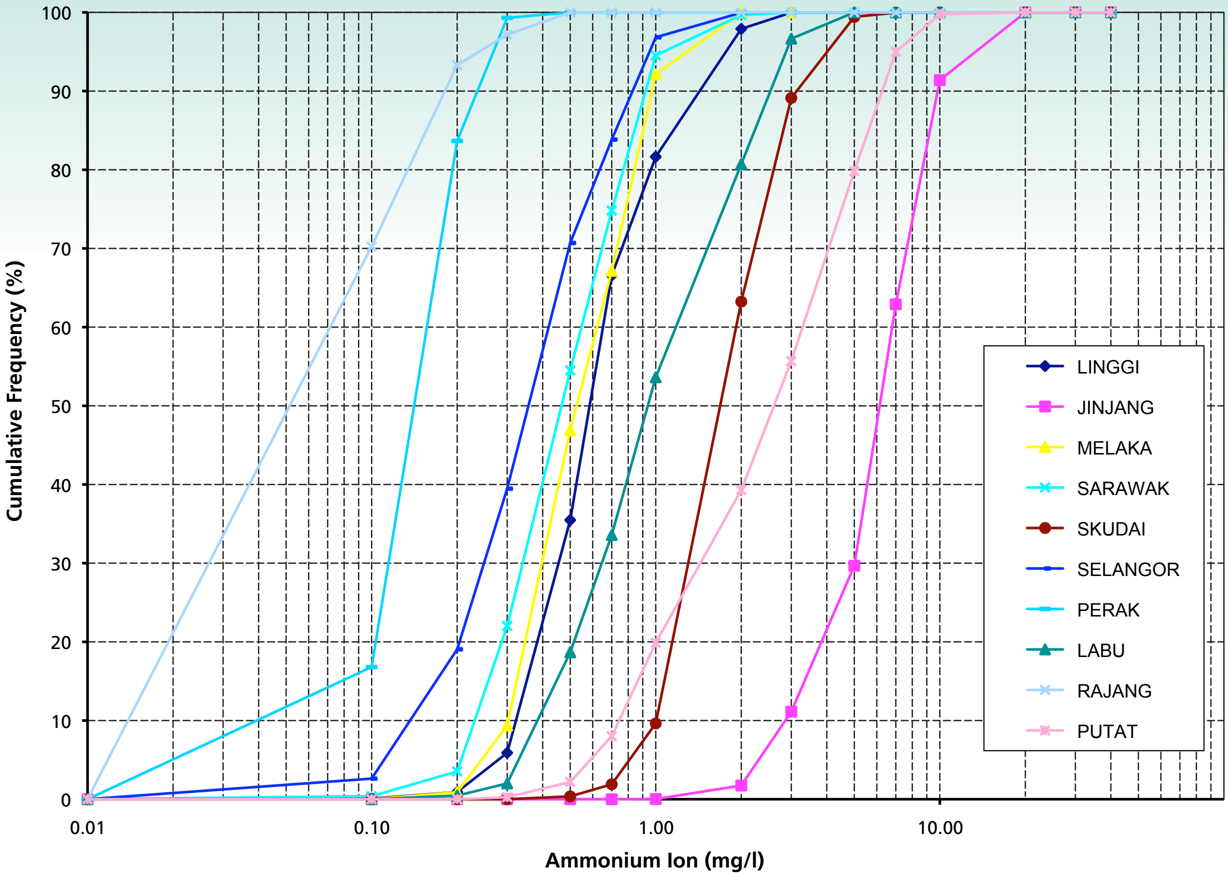


Figure 2.3 Comparison of Cumulative Frequency for 10 CWQM Stations - Ammonium Ion Concentration : 1st January - 31st December 2011

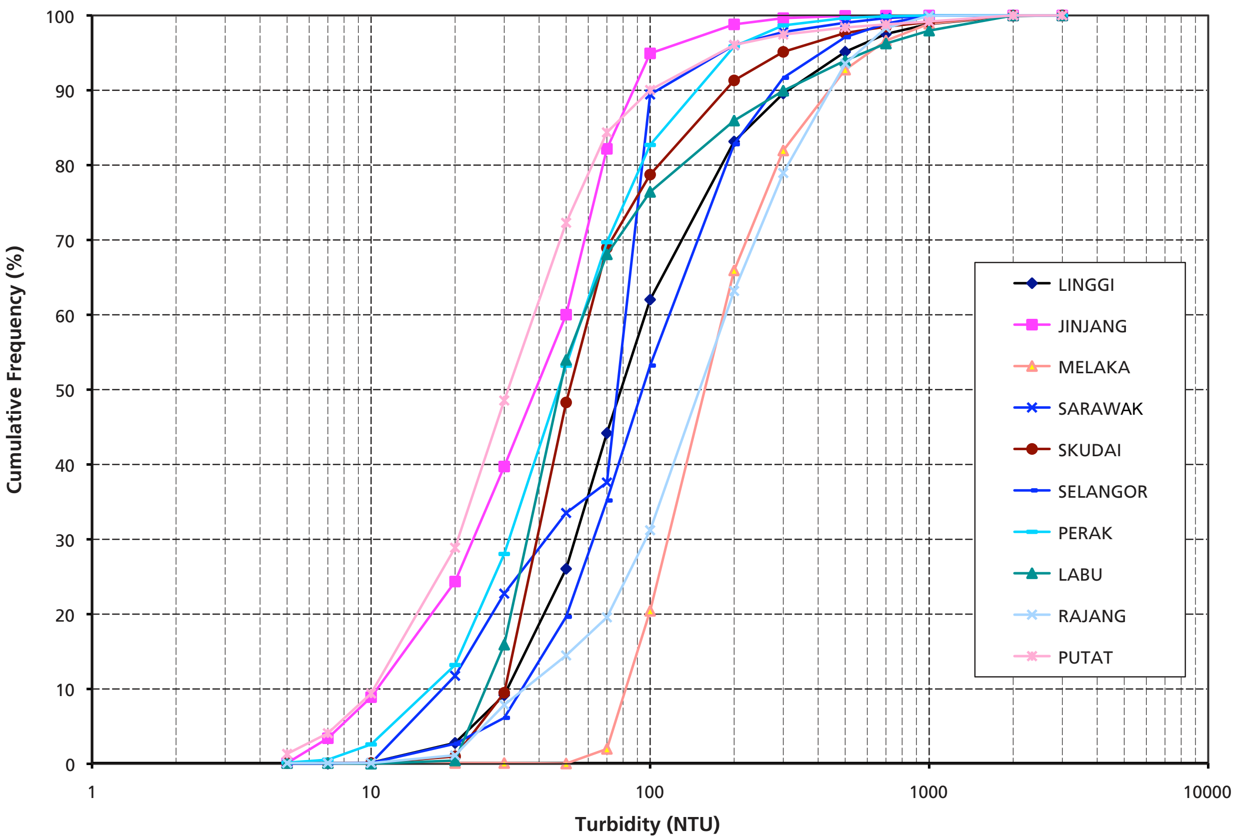


Figure 2.4. Comparison of Cumulative Frequency for 10 CWQM Stations - Turbidity : 1st January - 31st December 2011

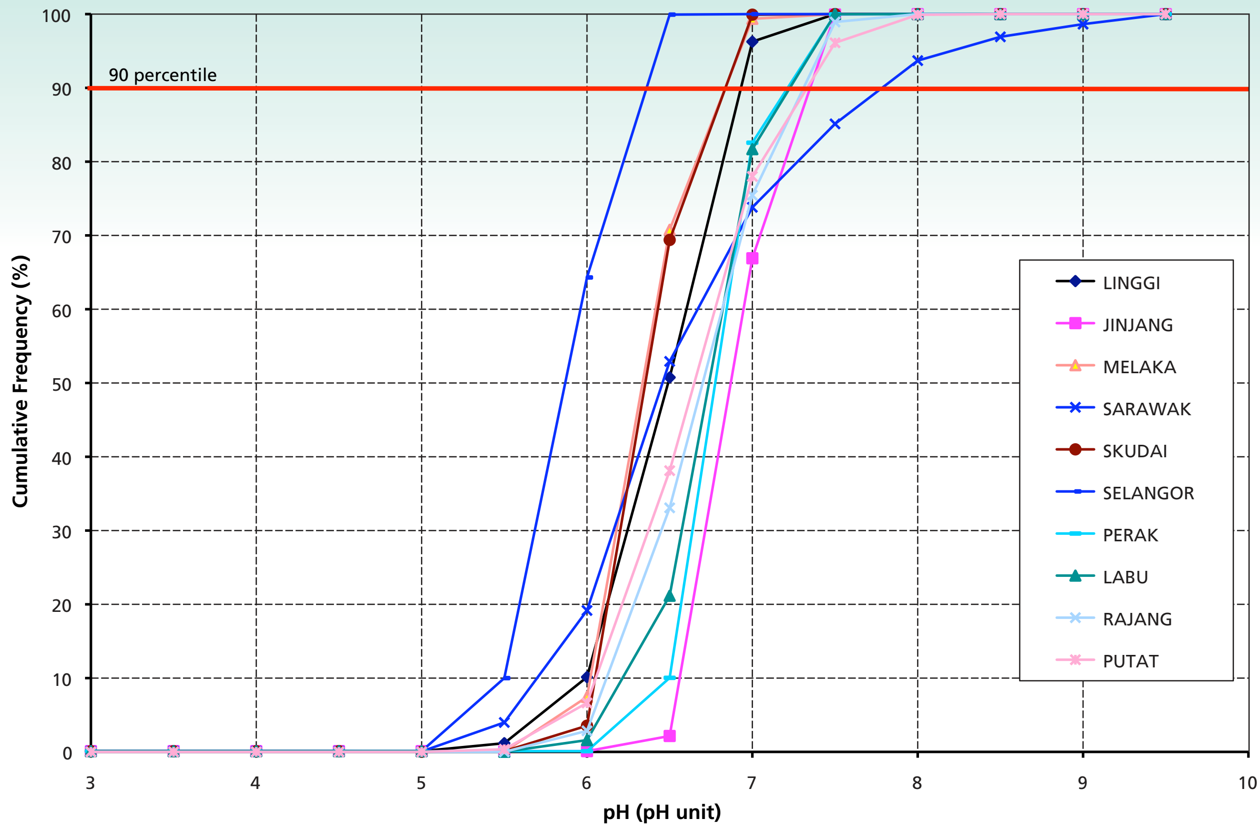


Figure 2.5. Comparison of Cumulative Frequency for 10 CWQM Stations - pH : 1st January - 31st December 2011

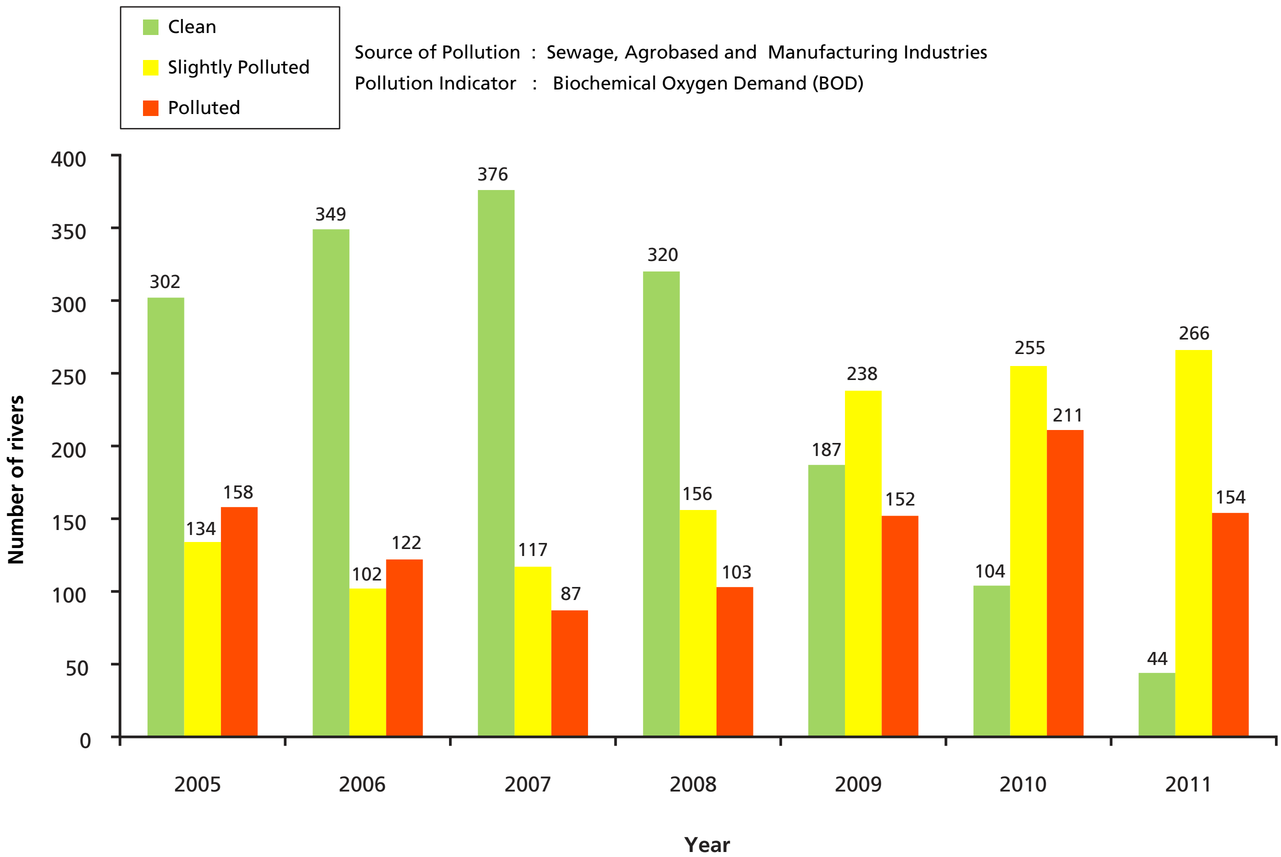


Figure 2.6 : River Water Quality Trend based on BOD sub-index (2005 - 2011)

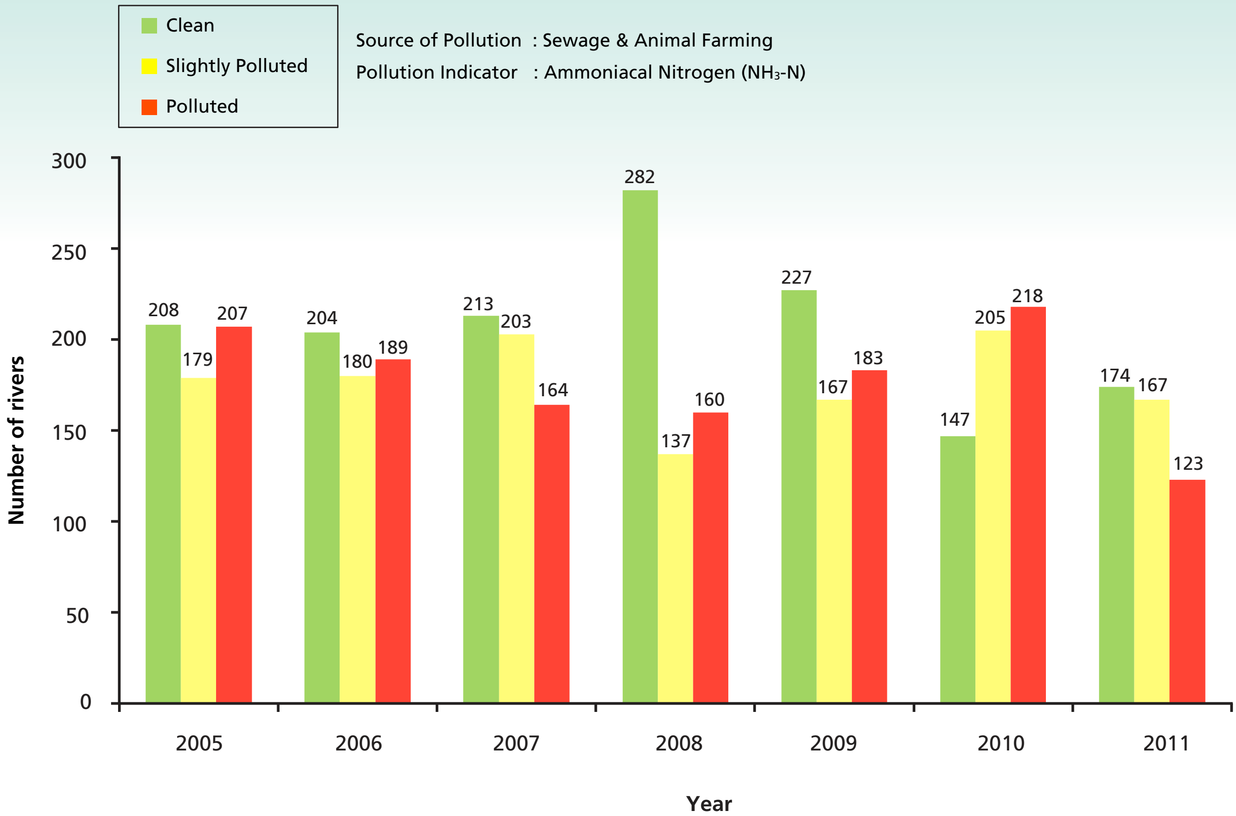


Figure 2.7 :River Water Quality Trend based on AN sub-index (2005 - 2011)

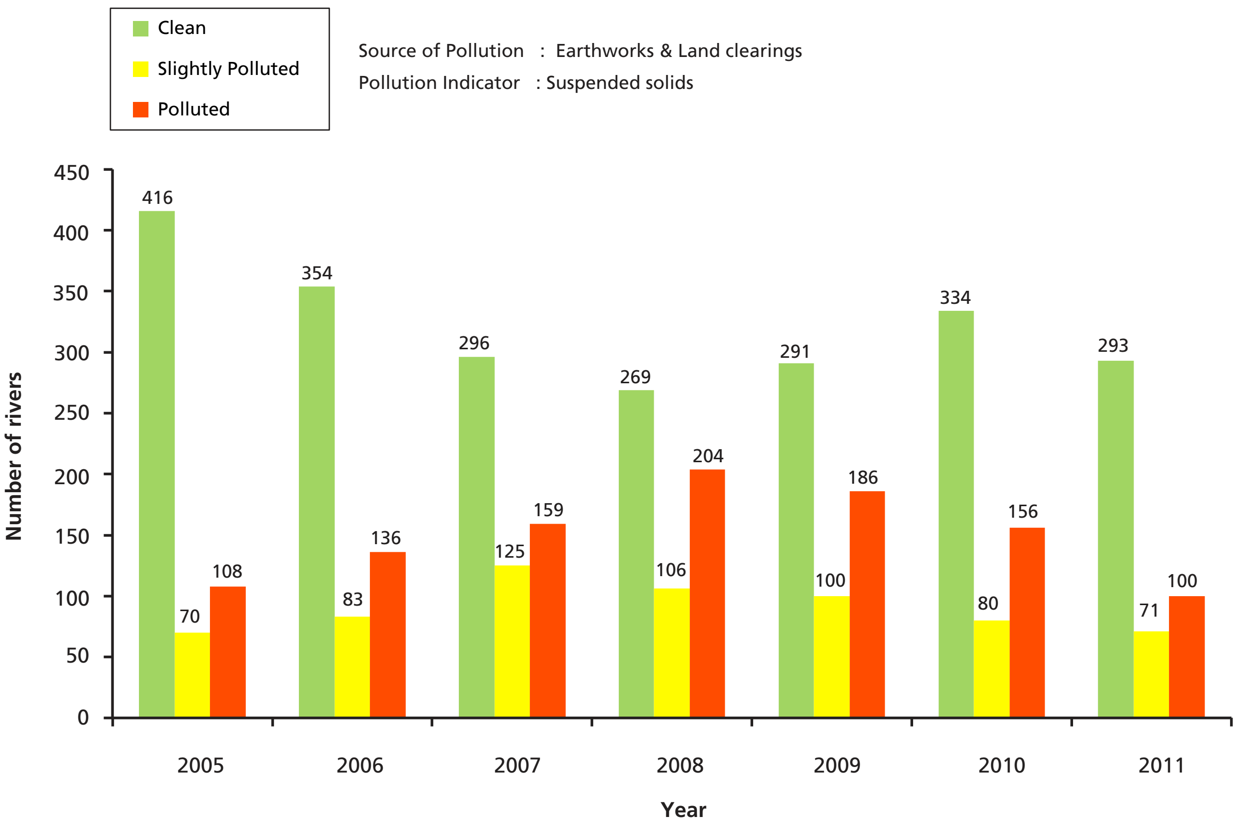


Figure 2.8 : River Water Quality Trend based on SS sub-index (2005 - 2011)

GROUNDWATER QUALITY

46	Table 3.1 Malaysia	:	Number of Groundwater Wells by Land use Category, 2011
47	Table 3.2 Malaysia	:	National Guidelines for Raw Drinking Water Quality (Revised December 2000)
48	Figure 3.1 Malaysia	:	Percentage of Compliance of Selected Contaminants by Land Use, 2011
49	Table 3.3 Malaysia	:	Percentage of Exceedance NGRDWQ by State, 2011

GROUNDWATER QUALITY

GROUNDWATER QUALITY MONITORING

Groundwater quality monitoring was carried out at 79 monitoring wells in Peninsular Malaysia, 15 wells in Sarawak and 15 wells in Sabah **(Table 3.1)** 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).

In 2011, 224 water samples were taken from these active monitoring wells and analysed for volatile organic compounds (VOCs), pesticides, heavy metals, anions, bacteria (coliform), phenolic compounds, 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 3.2)** to determine the status of its quality.

GROUNDWATER QUALITY STATUS

The assessment of groundwater quality was based on the percentage of samples exceeded the National Guidelines for Raw Drinking Water Quality (NGRDWQ) 2000 as proposed by Ministry of Health Malaysia. The range between 0% to 49% exceedances were categorized as low, 50 - 79% (moderate) and 80 - 100% (high).

In 2011, the results of monitoring showed that all stations met the NGRDWQ except for arsenics (As), iron (Fe), manganese (Mn), total coliform and phenol as shown in **(Figure 3.1)**.

The most number of samples that exceeded the NGRDWQ values were total coliform, followed by phenol, Fe , Mn and As. All samples (100%) of total coliform exceeded the guidelines values.

High phenol exceedances were recorded at certain stations located in all states.

High iron exceedances were recorded at certain stations located in all states except for Perlis.

Low manganese and arsenic exceedances were recorded at all stations in all states except for Perak and Melaka which recorded high exceedance for Mn (100%). The detailed analysis is shown in **Table 3.3**.

Table 3.1 Malaysia : Number of Groundwater Wells by Land use Category, 2011

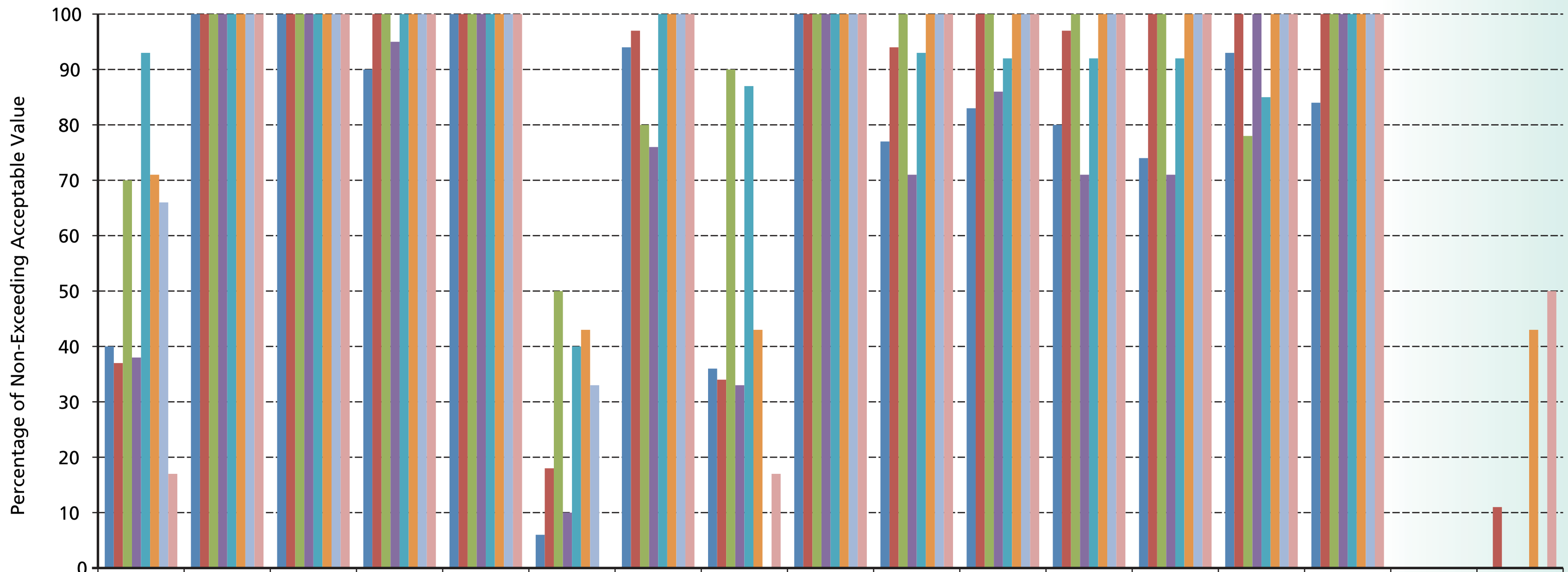
Category	Numbers of Wells
Agricultural Areas	12
Urban/Suburban Areas	11
Industrial Sites	18
Solid Waste Landfills	24
Golf Courses	7
Rural Areas	3
Ex- mining Areas (Gold Mine)	3
Municipal Water Supply	9
Animal Burial Areas	14
Aquaculture Farms	6
Radioactive Landfill	1
Resorts	1
Total	**109**

Sipadan Island, Sabah

Table 3.2 Malaysia : National Guidelines for Raw Drinking Water Quality (Revised December 2000)

Parameter	Symbol	Benchmark
Sulphate		
Hardness	SO_{4^-}	250 mg/l
Nitrate	$CaCO_3$	500 mg/l
Coliform	NO_{3^-}	10 mg/l
Manganese	—	Must not be detected in any 100 ml sample
Chromium	Mn	0.1 mg/l
Zinc	Cr	0.05 mg/l
Arsenic	Zn	3 mg/l
Selenium	As	0.01 mg/l
Chloride	Se	0.01 mg/l
Phenolics	Cl	250 mg/l
TDS	—	0.002 mg/l
Iron	—	1000 mg/l
Copper	Fe	0.3 mg/l
Lead	Cu	1.0 mg/l
Cadmium	Pb	0.01 mg/l
Mercury	Cd	0.003 mg/l
	Hg	0.001 mg/l

Source: Ministry of Health, Malaysia



	As	Hg	Cd	Cr	Cu	Fe	Pb	Mn	Zn	Se	$CaCO_3$	TDS	Cl	NO_3	SO_4	T-Coliform	Phenol
Industry	40	100	100	90	100	6	94	36	100	77	83	80	74	93	84	0	0
Landfill	37	100	100	100	100	18	97	34	100	94	100	97	100	100	100	0	11
Agriculture	70	100	100	100	100	50	80	90	100	100	100	100	100	100	100	0	0
Municipal Water Suply	38	100	100	96	100	10	76	33	100	71	86	71	71	71	100	0	0
Urbun/Suburban	93	100	100	100	100	40	100	87	100	93	92	92	92	92	100	0	0
Golf Courses	71	100	100	100	100	43	100	43	100	100	100	100	100	100	100	0	43
Rural Areas	66	100	100	100	100	33	100	0	100	100	100	100	100	100	100	0	0
Ex-mining	17	100	100	100	100	0	100	17	100	100	100	100	100	100	100	0	50

Figure 3.1 Malaysia: Percentage of Compliance of Selected Contaminants by Land Use, 2011

Table 3.3 Malaysia: Percentage of Exceedance NGRDWQ by State, 2011

State	No. of Station	Station Description	The Percentage of Exceedance NGRDWQ (%)				
			As	Fe	Mn	T-coliform	Phenol
Sabah	8	1) Labuan	0	0	0	100	0
		2) ITAC, Penampang (1)	0	100	100	100	100
		3) ITAC, Penampang (2)	0	100	100	100	100
		4) ITAC, Penampang (3)	0	100	100	100	100
		5) ITAC, Penampang (4)	0	100	100	100	100
		6) ITAC, Penampang (7)	100	100	100	100	100
		7) Inanam	0	100	100	100	100
		8) Pulau Manukan	100	0	0	100	100
Sarawak	13	1) Kemuyang no.1	0	100	100	100	100
		2) Kemuyang no. 2	0	100	0	100	100
		3) Kabong no.1	100	100	100	100	100
		4) Kabong no. 3	100	100	100	100	100
		5) Kabong no. 4	100	50	100	100	100
		6) Kuala Lawas no.1	67	67	0	100	100
		7) Kuala Lawas no. 2	67	67	67	100	100
		8) Laku	0	100	0	100	100
		9) Kg. Lusut Kanan	0	100	100	100	100
		10) Kg. Lusut Kiri	100	100	67	100	100
		11) Bau no. 1	50	100	0	100	50
		12) Bau no. 2	100	100	100	100	50
		13) Bau	100	100	100	100	0
		14) Oya no. 1	0	100	100	100	100
		15) Oya no. 2	0	100	100	100	100
Terengganu	10	1) Kerteh no.1	0	100	0	100	100
		2) Kerteh no. 2	0	100	0	100	100
		3) Telok Kalong no.1	0	100	0	100	100
		4) Telok Kalong no. 2	0	100	100	100	100
		5) Kg. Kubang Badak no.1, K.Treg	0	100	0	100	100
		6) Kg. Kubang Badak no.2, K.Treg	0	100	0	100	100
		7) Kg. Merang,Setiu	0	0	0	100	100
		8) Kg. Raja no. 1 , Besut	0	0	0	100	100
		9) Kg. Raja no. 2, Besut	0	100	100	100	100
		10) Bukit Payung, Marang	0	0	100	100	100
Pahang	9	1) Jabor	100	100	100	100	100
		2) Nenasi	0	100	100	100	100
		3) Lepar	0	100	0	100	100
		4) Agrobest no. 2, Nenasi	0	100	100	100	100
		5) Agrobest no. 3, Nenasi	0	100	100	100	100

Table 3.3 Malaysia: Percentage of Exceedance NGRDWQ by State, 2011 (continued)

State	No. of Station	Station Description	The Percentage of Exceedance NGRDWQ (%)				
			As	Fe	Mn	T-coliform	Phenol
		6) Agrobest no. 4, Nenasi	100	100	100	100	100
		7) Agrobest no. 5, Nenasi	0	100	0	100	100
		8) Agrobest no. 6, Nenasi	0	100	100	100	100
		9) Agrobest no. 7, Nenasi	100	100	0	100	100
Johor	5	1) Tg. Puteri, Pasir Gudang (MUCC)	0	100	0	100	100
		2) Tg. Puteri, Pasir Gudang	100	100	100	100	100
		3) Ulu Choh (Kolam)	100	100	100	100	100
		4) Ulu Choh (Pintu)	100	100	100	100	100
		5) Ulu Choh (Pintu)	100	100	100	100	100
Kedah	4	1) Kulim Hi-tech	0	100	100	100	100
		2) Kepala Batas	0	100	0	100	100
		3) Pulau Langkawi no.1	0	0	0	100	100
		4) Pulau Langkawi no. 2	100	100	0	100	100
Perlis	3	1) Arau no.1	0	0	0	100	100
		2) Arau no. 2	0	0	0	100	100
		3) Padang Besar	0	0	0	100	100
Kelantan	15	1) Eastern Garment MFG no.1	0	100	0	100	100
		2) Eastern Garment MFG no. 2	0	100	0	100	0
		3) Panji no.1	0	100	0	100	100
		4) Panji no. 2	0	100	0	100	100
		5) Pasir Mas	0	100	100	100	0
		6) Kampong Jembal	0	100	0	100	0
		7) Beris Lalang	0	0	0	100	0
		8) Rantau Panjang no.1	0	100	0	100	0
		9) Rantau Panjang no. 2	0	0	0	100	0
		10) Kelab Golf & Desa no.1	0	100	0	100	0
		11) Kelab Golf & Desa no. 2	0	100	0	100	100
		12) Kubang Kerian no.1	100	100	100	100	100
		13) Kubang Kerian no. 2	100	100	100	100	100
		14) Bachok no.1	0	0	100	100	0
		15) Bachok no. 2	0	100	100	100	0
Melaka	1	1) Petronas Sungai Udang	100	100	100	100	100
Perak	4	1) Batu Gajah	100	75	100	100	100
		2) Tambun	100	100	100	100	100
		3) Jalong no. 1	0	100	100	100	100
		4) Jalong no. 2	0	100	100	100	100

Table 3.3 Malaysia: Percentage of Exceedance NGRDWQ by State, 2011 (continued)

State	No. of Station	Station Description	The Percentage of Exceedance NGRDWQ (%)				
			As	Fe	Mn	T-coliform	Phenol
Kuala Lumpur	6	1) Jln. Sungai Besi no.1	100	100	100	100	100
		2) Jln. Sungai Besi no. 2	75	75	0	100	100
		3) Jln. Sungai Besi no. 3	75	0	0	100	100
		4) Taman Beringin no.1	100	100	100	100	100
		5) Taman Beringin no.1	100	100	100	100	100
		6) Royal Selangor Golf Club	0	0	0	100	0
Selangor	8	1) Sek Keb Seksyen 20,Shah Alam	100	100	100	100	100
		2) CIAST no.1, Shah Alam	0	100	0	100	100
		3) CIAST no.2, Shah Alam	0	100	100	100	100
		4) Saujana Golf Resort no.1, Subang	0	75	0	100	100
		5) Saujana Golf Resort no. 2, Subang	0	0	0	100	100
		6) Rumah India, Sepang	100	100	100	100	100
		7) TNB Sepang	0	75	0	100	100
		8) Ladang Sepang	0	75	0	100	100
Pulau Pinang	6	1) Mak Mandin no.1	100	0	100	100	100
		2) Mak Mandin no. 2	100	75	100	100	100
		3) Bayan Lepas	0	100	0	100	100
		4) Valdor (Kelapa)	100	100	100	100	100
		5) Valdor (Tengah)	0	100	0	100	100
		6) Valdor (Jalan)	0	0	100	100	100
Negeri Sembilan	3	1) Senawang	100	100	0	100	100
		2) Kualiti Alam Sdn. Bhd no.1	50	100	0	100	0
		3) Kualiti Alam Sdn. Bhd no. 2	50	100	100	100	0

Chapter 4

MARINE AND ISLAND MARINE WATER QUALITY

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MARINE AND ISLAND MARINE WATER QUALITY

MARINE WATER QUALITY MONITORING

The Department of Environment (DOE) continues with the marine water quality monitoring programme that was started in 1978 for Peninsular Malaysia and in 1985 for Sabah and Sarawak. Marine water quality monitoring continues to play an important role in determining the degree of pollution from land-based sources as well as from the sea based sources that can pose threats to the marine resources which potentially contribute to the stability and diversity of the marine ecosystem.

The marine water quality monitoring programme involved in-situ measurements and laboratory analyses for parameters as listed in **Table 4.1**.

In 2011, a total of 500 samples from 162 coastal monitoring stations and 238 samples from 78 estuary monitoring stations were collected for analysis. All samples were analysed and compared with The Malaysian Marine Water Quality Criteria and Standards (MWQCS) as shown in **Table 4.2**.

Table 4.1 Malaysia: Marine Environmental Quality Parameters Monitored, 2011

Parameter Based On In-situ Measurement	Unit
Temperature	°C
pH	-
Dissolved oxygen	% Sat
Dissolved oxygen	mg/l
Conductivity	µS/cm
Salinity	ppt
Turbidity	NTU
Tarball	g/100m

Parameter Based On Laboratory Analysis	Unit
Escherichia coli (E. coli)	MPN/100ml
Oil and Grease (O & G)	mg/l
Total suspended solids (TSS)	mg/l
Arsenic (As)	µg/l
Cadmium (Cd)	µg/l
Total Chromium (Cr)	µg/l
Copper (Cu)	µg/l
Lead (Pb)	µg/l
Mercury (Hg)	µg/l

Table 4.2 Malaysia: Marine Water Quality Criteria and Standards

No	BENEFICIAL USES / (Unit) Parameter	CLASS 1	CLASS 2	CLASS 3	CLASS E
		Preservation, Marine protected areas, Marine Parks	**Marine Life, Fisheries, Coral Reefs, Recreational and Mariculture**	**Ports, Oil & Gas Fields**	**Mangroves, Estuarine & River-mouth water**
1	Temperature (°C)	≤2 °C increase over maximum ambient	≤2 °C increase over maximum ambient	≤2 °C increase over maximum ambient	≤2 °C increase over maximum ambient
2	Dissolved Oxygen (mg/L)	>80% saturation	5.0	3.0	4.0
3	Total Suspended Solid (mg/L)	25 mg/L or ≤10% increase in seasonal average, whichever is lower	50 mg/L (25 mg/L) or ≤10% increase in seasonal average, whichever is lower	100 mg/L or ≤10% increase in seasonal average, whichever is lower	100 mg/L or ≤30% increase in seasonal average, whichever is lower
4	Oil and Grease (mg/L)	0.01	0.14	5	0.14
5	Mercury* (µg/L)	0.04	0.16 (0.04)	50	0.5
6	Cadmium* (µg/L)	0.5	2(3)	10	2
7	Chromium (VI)(µg/L)	5	10	48	10
8	Copper (µg/L)	1.3	2.9	10	2.9
9	Arsenic (III)* (µg/L)	3	20 (3)	50	20(3)
10	Lead (µg/L)	4.4	8.5	50	8.5
11	Zinc (µg/L)	15	50	100	50
12	Cyanide (µg/L)	2.0	7.0	20	7
13	Ammonia (unionized) (µg/L)	35	70	320	70
14	Nitrite (NO_2) (µg/L)	10	55	1000	55
15	Nitrate (NO_3) (µg/L)	10	60	1000	60
16	Phosphate (µg/L)	5	75	670	75
17	Phenol (µg/L)	1	10	100	10
18	Tributyltin (TBT) (µg/L)	0.001	0.01	0.05	0.01
19	Faecal Coliform (Human health protection for seafood consumption) - (MPN)	70 faecal coliform/100ml *70 E.coli/*100 ml	100 faecal coliform/100ml (70 faecal coliform/100 ml) *100 E.coli/100ml (70 E.coli/100ml)*	200 faecal coliform/100ml *200 E.coli/100ml*	100 faecal coliform/100ml (70 faecal coliform/100 ml) *100 E.coli/100ml (70 E.coli/100ml)*
20	Polycyclic Aromatic Hydrocarbon (PAHs) ng/l	100	200	1000	1000

*** MWQCS in parentheses are for coastal and marine water areas where seafood for human consumption is applicable**

Sibu Island, Johor

The marine waters around 74 islands were also monitored. These islands were categorized as development islands (3 islands); resort islands (30 islands); marine park islands (29 islands) and protected islands (12 islands). A total of 196 samples of marine water collected were analysed.

The assessment of marine water quality was based on percentage number of samples that met the MWQCS. The range between 0% to 39% were categorized as least frequent within standard or poor ; 40% to 79% as fairly frequent within standard or moderate; and 80% to 100% as most frequent within standard or good.

Total suspended solids in marine waters was used as an indicator for land-based activities such as uncontrolled land clearing for development and agriculture activities as well as coastal development. The main sources of *Escherichia coli* were animal and domestic wastes and sewage from coastal premises including hotels and restaurants while oil and grease were from discharges from ships and fisherman boats and from land-based sources. As for heavy metals they were from oil and gas activities, coastal development activities, ports and land-based discharges.

COASTAL WATER QUALITY STATUS

The marine water quality in terms of arsenic and mercury were found to be good in all coastal water monitoring stations complying with Class 2 of the Marine Water Quality Criteria and Standards (MWQCS). *Escherichia coli,* total suspended solids, chromium, cadmium, lead and oil and grease were moderate. Copper was categorized as poor for most of the coastal water monitoring stations.

Oil and grease in coastal waters of Pahang, Johor, Pulau Pinang and Sarawak were categorized as good whereas in Negeri Sembilan and Sabah were categorized as moderate. Coastal water quality in most of the other states were categorized as poor.

For total suspended solids, coastal water quality in Pulau Langkawi, Pantai Merdeka in Kedah, Negeri Sembilan and Pahang were categorized as good whereas the coastal water quality was categorized as moderate in Selangor, Terengganu, Labuan and Sabah. Coastal water quality in other states were categorized as poor.

In terms of *E. coli,* the coastal water quality in Kedah and Pahang were categorized as good while Pulau Pinang, Perak, Selangor, Negeri Sembilan, Melaka and Labuan were categorized as poor.

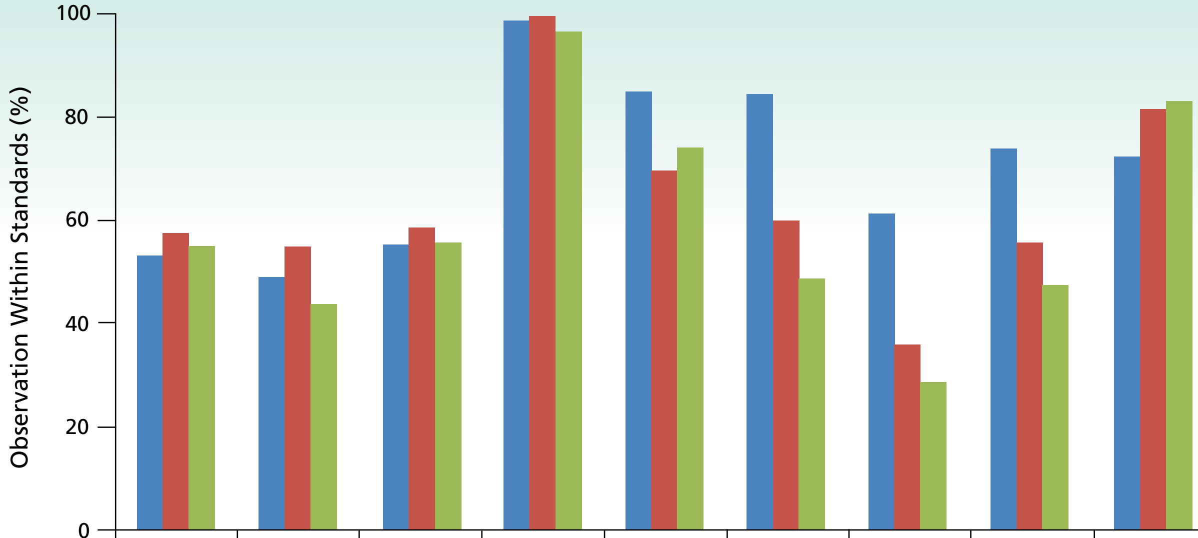
Coastal water quality in all states were categorized as good in terms of arsenic. Mercury in coastal water of Kedah, Perak, Kelantan, Labuan, Sabah, Melaka, Pulau Langkawi and Pulau Pinang were categorized as good except in Selangor which was categorized as poor. Copper in coastal waters were categorized as poor in most of the states.

The coastal water quality for the rest of the states are categorized in detail in **Table 4.3**.

Over a period of two years, 2009 to 2011, cadmium and mercury had shown an improvement in meeting the standards of the marine water quality whereas other heavy metals, total suspended solids, oil and grease and *E.coli* had deteriorated as shown in **Figure 4.1**.

Table 4.3 Malaysia: Status of Coastal Marine Water Quality By Parameters, 2011

State	No. of Station	No of Samples	Samples Within Standard (%)								
			Total Suspended Solids TSS	Oil and Grease O&G	*Escherichia coli* *E.coli*	Arsenic As	Cadmium Cd	Chromium Cr	Cuprum Cu	Plumbum Pb	Mercury Hg
Perlis	-	-	-	-	-	-	-	-	-	-	-
Pulau Langkawi	7	25	95	0	76	100	0	0	0	0	81
Kedah	1	2	100	0	100	100	0	50	0	0	100
Pulau Pinang	15	105	21	90	32	100	84	84	47	94	86
Perak	7	21	21	29	36	100	100	38	46	69	100
Selangor	4	18	62	23	15	85	100	0	0	23	38
N. Sembilan	11	40	97	47	39	100	100	12	0	27	79
Melaka	6	21	17	22	21	100	100	100	7	22	93
Johor	42	92	74	98	69	90	87	70	2	23	71
Pahang	11	60	83	100	87	92	73	2	33	23	75
Terengganu	8	18	42	11	67	100	53	25	0	56	75
Kelantan	5	10	10	30	60	100	44	17	0	40	80
W.P. Labuan	5	10	78	11	37	100	100	100	100	100	100
Sabah	24	34	59	53	76	100	94	95	100	100	100
Sarawak	16	44	10	98	64	87	100	89	65	90	79
Malaysia (Sum)	162	500									
Average of Sampling (%)			54.93	43.71	55.64	96.71	73.93	48.71	28.57	47.64	82.64



	TSS	O & G	E.coli	As	Cd	Cr	Cuprum	Pb	Hg
2009	53.7	49.0	55.4	98.6	84.7	84.4	61.3	73.9	72.4
2010	57.2	54.8	58.7	99.4	69.5	59.7	35.9	55.6	81.5
2011	55.0	43.6	55.6	96.7	74.0	48.7	28.6	47.7	82.7

Figure 4.1 Malaysia : Marine Water Quality Status in Coastal Areas, 2009-2011

ESTUARY WATER QUALITY STATUS

For arsenic pollution, the estuary water quality was found to be good for all monitoring stations as compared to Class E of the Marine Water Quality Criteria and Standards (MWQCS). Other parameters were found to be moderate except for *Escherichia coli* and copper, which were categorized as poor.

Oil and grease in estuary waters of Pulau Pinang, Negeri Sembilan, Johor and Sarawak were categorized as good whereas, in Perlis, Melaka, Kelantan and Terengganu were categorized as poor.

For total suspended solids, estuary waters in Perlis, Perak, Negeri Sembilan and Johor were categorized as good, Kelantan was categorized as poor whereas estuary waters in other states were categorized as moderate.

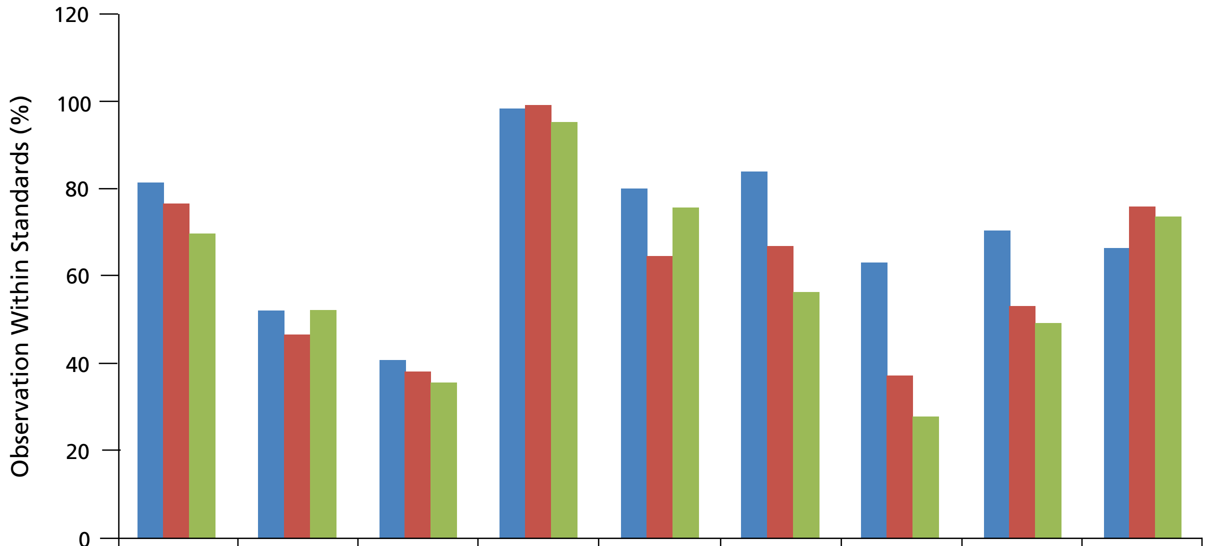
As for *E. coli*, the estuary waters in Kedah, Melaka, Terengganu, Kelantan, Sabah and Sarawak were categorized as moderate whereas, estuary waters in other states were categorized as poor.

In terms of arsenic, estuary waters in all states were categorized as good except in Sarawak which was categorized as moderate. For cadmium, estuary waters in most of the states were categorized as good except in Perlis which was categorized as poor. As for copper, estuary waters were categorized as poor in most of the states. The estuary water quality for the rest of the states are categorized in detail in **Table 4.4**.

Over a period of two years, 2009 to 2011, oil and grease and cadmium had shown an improvement in meeting the standards of the marine water quality whereas other heavy metals, total suspended solids and *E.coli* had deteriorated as shown in **Figure 4.2**.

Table 4.4 Malaysia: Status of Estuarine Marine Water Quality By Parameters, 2011

State	No. of Station	No of Samples	Samples Within Standard (%)								
			Total Suspended Solids TSS	Oil and Grease O&G	Escherichia coli E.coli	Arsenic As	Cadmium Cd	Chromium Cr	Cuprum Cu	Plumbum Pb	Mercury Hg
Perlis	2	20	100	12	37	100	0	0	0	0	62
Pulau Langkawi	-	-	-	-	-	-	-	-	-	-	-
Kedah	2	4	67	75	75	100	50	50	50	50	75
Pulau Pinang	7	47	72	83	15	100	83	93	61	97	74
Perak	6	12	100	0	25	100	100	83	17	100	100
Selangor	10	25	58	53	16	84	95	16	26	16	42
N. Sembilan	2	8	100	83	17	100	100	17	0	17	83
Melaka	5	18	40	20	55	100	95	100	0	15	80
Johor	12	30	97	100	0	90	90	86	3	5	53
Pahang	-	-	-	-	-	-	-	-	-	-	-
Terengganu	12	39	71	37	56	100	58	42	0	48	71
Kelantan	5	10	20	20	40	100	40	40	0	60	60
W.P. Labuan	-	-	-	-	-	-	-	-	-	-	-
Sabah	2	4	75	50	50	100	100	-	100	100	100
Sarawak	13	21	42	97	44	76	100	100	81	84	88
Malaysia (Sum)	78	238									
Average of Sampling (%)			70.2	52.5	35.8	95.8	75.9	57.0	28.2	49.3	74.0



	TSS	O & G	E.coli	As	Cd	Cr	Cuprum	Pb	Hg
2009	81.6	52.1	41.1	98.5	80.0	84.3	63.4	70.8	66.5
2010	77.0	46.6	38.5	99.7	64.8	67.1	37.3	53.4	76.4
2011	70.2	52.5	35.9	95.9	75.9	56.9	28.1	49.2	74.1

Figure 4.2 Malaysia : Marine Water Quality Status in Estuaries, 2009-2011

Tioman Island, Johor

ISLAND MARINE WATER QUALITY STATUS

The assessment for island marine water quality was based on Class 1 for marine park and protected islands and Class 2 for resort and development islands of the Malaysia Marine Water Quality and Standards (MWQCS). The list of island stations by category is shown in **Table 4.5**.

For *E. coli*, all marine park islands were categorized as good while all development islands, all resort and protected islands were categorized as moderate.

As for total suspended solids, all categories of island were categorized as moderate except for protected islands which were categorized as poor.

In terms of oil and grease, all categories of island were categorized as moderate.

Arsenic, cadmium and mercury pollution in resort islands were categorized as good. In terms of copper and chromium, marine park islands water was categorized as poor and copper in protected islands were categorized as poor.

The island water quality for the rest of the categorized islands are shown in **Figure 4.3**.

In terms of *E. coli* around island waters in most of the states were categorized as good except in Pulau Pinang and Negeri Sembilan which were categorized as poor.

Total suspended solids contamination around island waters of Kedah, Selangor, Johor and Pahang were categorized as good while Perak and Negeri Sembilan were categorized as moderate. Other states were categorized as poor.

In terms of oil and grease, around island waters in Pulau Pinang, Johor, Pahang and Sarawak were categorized as good while around island waters in Kedah, Selangor, Melaka, Terengganu and Kelantan were categorized as poor.

For all heavy metals, around island waters in Sabah was categorized as good. As for arsenic, island waters in all states were categorized as good except in Selangor which was categorized as moderate. In terms of copper, around island waters in most of the states were categorized as poor.

The island water quality for the rest of the states are shown in **Figure 4.4**.

Table 4.5 Malaysia : List of Island Stations By Category, 2011

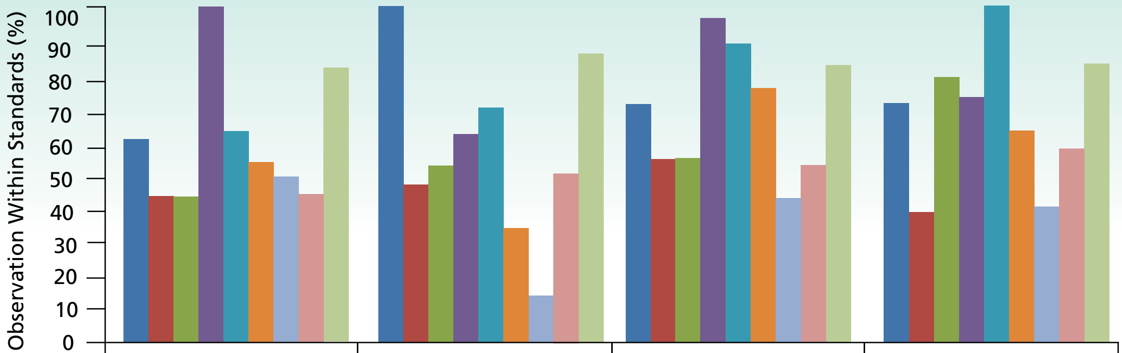
NO	STATE	NO. OF ISLAND	MONITORING STATION SITE	CATEGORY
1	KEDAH	7	PAYAR	MARINE PARK
			KACA	
			LEMBU	
			SIGANTANG	
			SINGA BESAR	RESORT
			DAYANG BUNTING	
			LANGKAWI (KUAH)	DEVELOPMENT
			LANGKAWI (TELUK EWA)	
			LANGKAWI (CHENANG)	
			LANGKAWI (TANJUNG RHU)	
2	PULAU PINANG	6	P.PINANG (BATU MAUNG)	DEVELOPMENT
			P.PINANG (GERTAK SANGGUL)	
			P.PINANG (TELUK BAHANG)	
			P.PINANG (PADANG KOTA)	
			AMAN	RESORT
			JEREJAK	
			KENDI	
			RIMAU	
			GEDONG	
3	PERAK	5	PANGKOR (TELUK GEDONG)	RESORT
			PANGKOR (PANTAI PUTERI DEWI)	
			PANGKOR LAUT	
			SEMBILAN	
			TUKUN PERAK	PROTECTED
4	SELANGOR	3	KETAM	RESORT
			ANGSA	
			LUMUT	
5	N. SEMBILAN	1	ARANG	PROTECTED

Table 4.5 Malaysia : List of Island Stations By Category, 2011 (continued)

NO	STATE		MONITORING STATION SITE	CATEGORY
6	MELAKA	3	BESAR	RESORT
			UPEH	
			UNDAN	
7	JOHOR	8	SETINDAN	RESORT
			BABI TENGAH	
			SIBU TENGAH	
			DAYANG	MARINE PARK
			NANGA BESAR	
			PEMANGGIL	
			KUKUP	PROTECTED
			PISANG	
8	PAHANG	8	TIOMAN	MARINE PARK
			TIOMAN (KG. SALANG)	
			SERI BUAT	
			CEBEH	
			TULAI	
			LABAS	
			SEMBILANG	
			SEPUI	
			TOKONG BAHARA	
9	TERENGGANU	9	GUMIA	RESORT
			LANG TENGAH	MARINE PARK
			PERHENTIAN BESAR (SOUTH)	MARINE PARK
			PERHENTIAN BESAR (WEST)	MARINE PARK
			PERHENTIAN KECIL	MARINE PARK
			REDANG (NORTH)	MARINE PARK
			REDANG (SOUTH)	MARINE PARK
			PINANG	MARINE PARK
			EKOR TEBU	MARINE PARK
			LIMA	MARINE PARK
			KAPAS	MARINE PARK

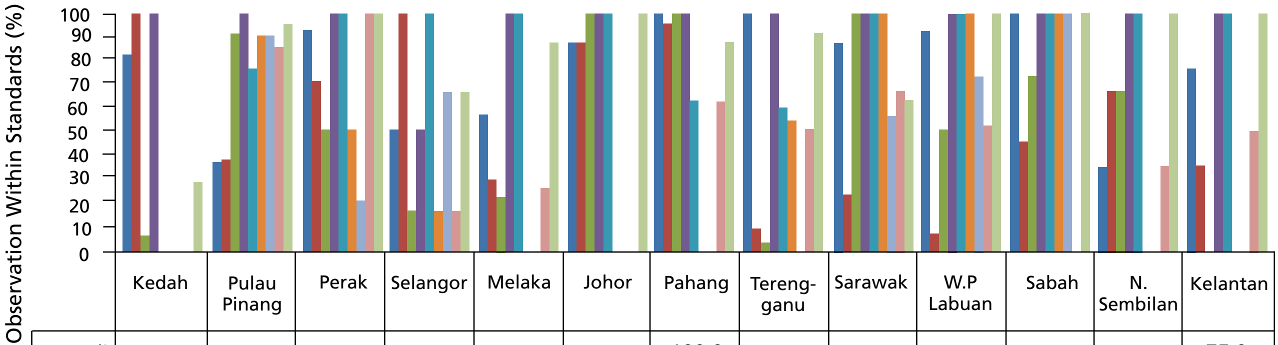
Table 4.5 Malaysia : List of Island Stations By Category, 2011 (continued)

NO	STATE		MONITORING STATION SITE	CATEGORY
10	KELANTAN	2	PANJANG	PROTECTED
			KUNDUR	
11	W.P. LABUAN	4	LABUAN (KG. POHON BATU)	DEVELOPMENT
			LABUAN (WATER FRONT)	
			LABUAN (KG. LUBUK TEMIANG)	
			LABUAN (RANCHA-RANCHA)	
			KURAMAN	MARINE PARK
			RUSUKAN BESAR	
			RUSUKAN KECIL	
12	SABAH	17	GAYA	RESORT
			MABUL	
			SIPADAN (NORTH)	
			SIPADAN (WEST)	
			MANUKAN	
			TIGA	
			KAPALAI	
			LIGITAN	
			MOLLEANGAN BESAR	
			BANGGI	
			BALAMBANGAN	
			MANTANANI BESAR	
			SAPI	MARINE PARK
			KALAMPUNIAN BESAR	
			SILINGAN	PROTECTED
			GULISAN	
			BAKUNGAN KECIL	
13	SARAWAK	3	SATANG	PROTECTED
			TALANG-TALANG KECIL	
			TALANG-TALANG BESAR	



	DEVELOPMENT	MARINE PARK	RESORT	PROTECTED
E-Coli	59.4	100.0	69.9	70.0
TSS	40.9	45.0	53.2	36.4
O&G	40.9	51.9	53.3	78.3
As	100.00	61.54	96.15	72.22
Cd	61.9	69.23	88.46	100
Cr	52.38	30.91	75.00	61.11
Cu	47.62	10.77	41.03	38.89
Pb	42.86	50	50.82	56.25
Hg	80.95	86.15	82.35	82.35

Figure 4.3 : Percentage Observation Within Standard of Island Marine Water Quality by Category, 2011



	Kedah	Pulau Pinang	Perak	Selangor	Melaka	Johor	Pahang	Tereng-ganu	Sarawak	W.P Labuan	Sabah	N. Sembilan	Kelantan
E-Coli	82.6	37.9	93.3	50.0	56.5	87.5	100.0	100.0	87.5	92.9	100.0	33.3	75.0
TSS	100.0	38.1	70.0	100.0	29.2	87.5	95.8	9.1	22.2	7.1	35.3	66.7	33.3
O&G	7.1	90.5	50.0	16.7	22.7	100.00	100.00	4.5	100.00	50.0	70.6	66.7	0.0
As	100.00	100.00	100.00	50.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Cd	0.00	76.19	100.00	100.00	100.00	100.00	62.50	59.09	100.00	100.00	100.00	100.00	100.00
Cr	0.00	90.48	50.00	16.67	0.00	0.00	0.00	54.55	100.00	100.00	100.00	0.00	0.00
Cu	0.00	90.48	20.00	66.67	0.00	0.00	0.00	0.00	55.56	71.45	100.00	0.00	0.00
Pb	0.00	85.71	100.00	16.67	25.00	0.00	62.50	50.00	66.67	42.86	0.00	33.33	50.00
Hg	28.57	95.24	100.00	66.67	87.50	100.00	87.50	90.91	62.50	100.00	100.00	100.00	100.00

Figure 4.4 : Percentage Observation Within Standard of Island Marine Water Quality by State, 2011

Perhentian Island, Terengganu

STATUS OF MARINE WATER QUALITY STATIONS

The assessment of the marine water quality stations status for the 10 best coastal, estuaries and islands was conducted by examining the analytical results against the Malaysian Marine Water Quality and Standard (MWQCS) for TSS, Oil and Grease and *E.coli*. **Table 4.6** shows the 10 best coastal and estuarine water quality and **Table 4.7** shows the 10 best islands water quality.

Table 4.6 Malaysia: 10 Best Coastals and Estuaries, 2011

State	Location	Category
Pulau Pinang	Pantai Miami	Coastal
	Luar Pantai Teluk Bahang	Coastal
Negeri Sembilan	Pantai Cermin	Coastal
Pahang	Pantai Teluk Cempedak	Coastal
	Pantai Cherating	Coastal
	Pantai Sepat	Coastal
Sarawak	Pantai Likau	Coastal
	Pantai Pandan	Coastal
	Kuala Sungai Santubong	Estuary
Terengganu	Tioxide Utara (Kg. Bukit Kijang, Kijal)	Estuary

Table 4.7 Malaysia: 10 Best Islands, 2011

State	Location	Category
Kedah	Dayang Bunting	Resort
Perak	Tukun Perak	Protected
Pulau Pinang	Rimau	Resort
	Kendi	Resort
Pahang	Tioman (Teluk Salang)	Marine Park
	Cebeh	Marine Park
Sarawak	Talang-Talang Besar	Protected
Johor	Pemanggil	Marine Park
	Nanga Besar	Marine Park
	Sibu Tengah	Resort

POLLUTION SOURCES INVENTORY

68	Figure 5.1 Malaysia	:	Composition of Water Pollution Sources by BOD Loading, 2011
69	Figure 5.2 Malaysia	:	Distribution Of Bod Load By Selected River Basins, 2011
70	Figure 5.3 Malaysia	:	Industrial Air Pollution Sources by State, 2011
71	Figure 5.4 Malaysia	:	Number of Registered Vehicles in 2010 and 2011 (Source: Road Transport Department, Malaysia, 2011)
71	Figure 5.5 Malaysia	:	Number of in Use Vehicles in 2010-2011 (Source : Road Transport Department, Malaysia, 2011)
72	Figure 5.6 Malaysia	:	Air Pollutant Emission Load from All Sources, 2010-2011 (Sources : From National Energy Balance 2009)
73	Figure 5.7 Malaysia	:	SO_2 Emission by Sources (Metric Tonnes), 2011
73	Figure 5.8 Malaysia	:	Particulate Matter (PM) Emission Load by Sources (Metric Tonnes), 2011
74	Figure 5.9 Malaysia	:	NO_2 Emission by Sources (Metric Tonnes), 2011
74	Figure 5.10 Malaysia	:	CO Emission by Sources (Metric Tonnes), 2011
75	Figure 5.11 Malaysia	:	Air Pollutant Emission Load from Motor Vehicles, 2010-2011
76	Table 5.1 Malaysia	:	Quantity of Scheduled Wastes Generated by Category, 2011
78	Figure 5.12 Malaysia	:	Quantity of Scheduled Wastes Generated by Category, 2011
79	Figure 5.13 Malaysia	:	Distribution of Scheduled Wastes Generated By State, 2011
80	Figure 5.14 Malaysia	:	The Trend of Scheduled Waste Management from 2007-2011
80	Table 5.2 Malaysia	:	Facilities Handling Scheduled Wastes, 2011
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POLLUTION SOURCES INVENTORY

POLLUTION LOAD

Biological Oxygen Demand Load

The estimated Biochemical Oxygen Demand (BOD) load in 2011 was 1,393,528 kg/day which had increased by 4.8% compared to 2010 (1,021,576 kg/day). Sewage remained the largest contributor which load of 1,067,235 kg/day (77%), followed by pig farming 202,293 kg/day (14%), agro-based industries 73,664 kg/day (5%) and manufacturing industries 50,336 kg/day (4%) as shown in **Figure 5.1**.

Compared to other river basins in the country, Klang River Basin (Federal Territory of Kuala Lumpur and State of Selangor) received the highest BOD Load (238,266 kg/day), followed by Perak River Basin (State of Perak) 73,708 kg/day, Langat River Basin (Federal Territory of Putrajaya and State of Selangor) 70,266 kg/day, Jawi River Basin (State of Pulau Pinang) 31,674 kg/day and Skudai River Basin (State of Johor) 26,130 kg/day. The BOD loading of the top ten river basins is as shown in **Figure 5.2**. The amount of BOD load entered each of the rest of rivers basins was estimated to be less than 16,800 kg/day.

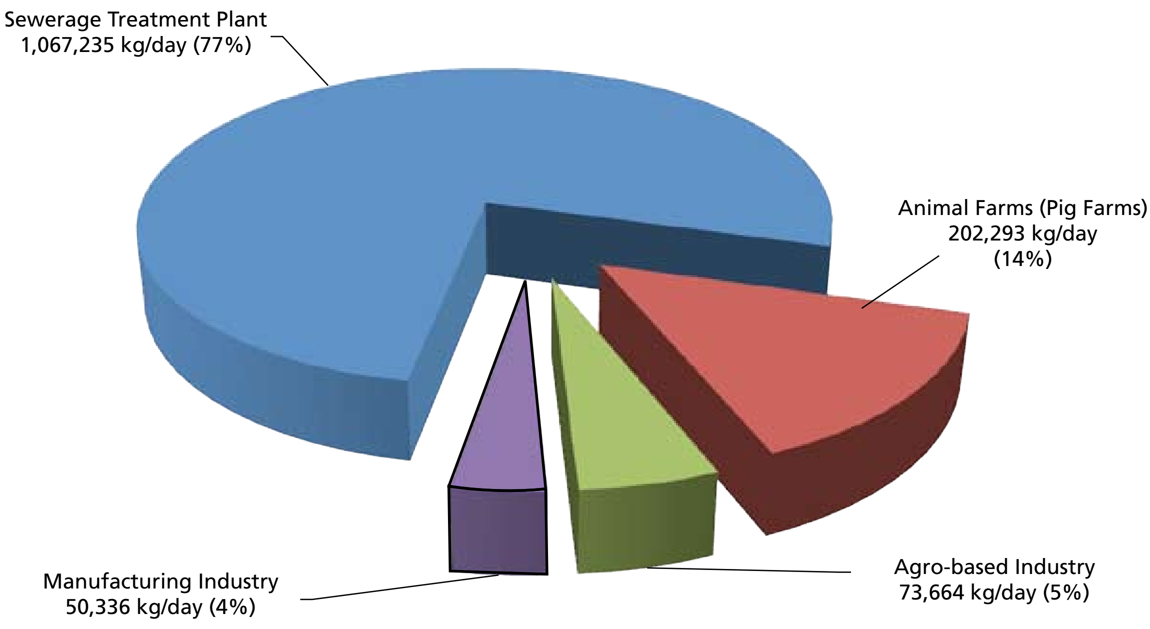

Figure 5.1 Malaysia : Composition of Water Pollution Sources by BOD Loading, 2011

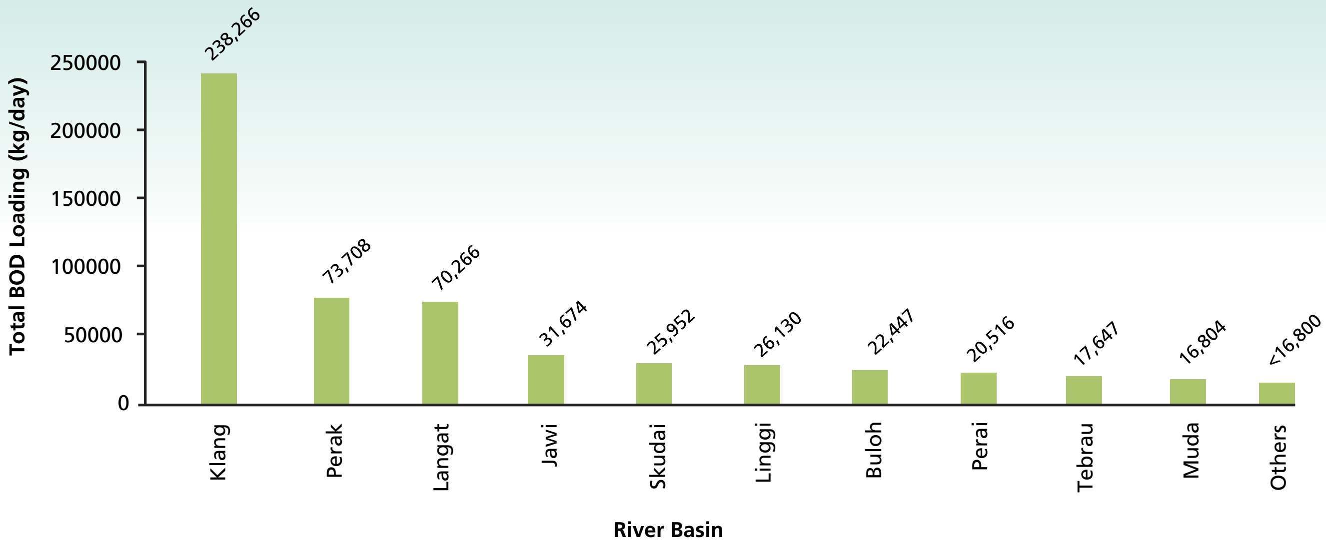

Figure 5.2 Malaysia : Distribution of BOD load by river basins, 2011

Tasik Temenggor, Perak

SOURCES OF AIR POLLUTION

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

In 2011, the Department of Environment had fully utilised the pollution sources data inventory system known as SIMPAS (Environmental Pollution Inventory Information System). As of December 2011, a total of 15,583 industrial sources were recorded to be subjected to the Environmental Quality (Clean air) Regulations, 1978. The distribution of industrial sources by states is as shown in **Figure 5.3**. The highest number of stationary pollution sources was in Johor (3,787: 24.3%) followed by Selangor (3,161: 20.3%) and Sarawak (1,634: 10.5%).

As for the past years motor vehicles remained as one of the major contributor of air pollution especially in urban areas. In 2011, there was an overall increase in the number of motor vehicles registered. The number of registered passenger cars increased by 6.65%, taxis by 6.33%, motorcycles 5.76%, buses 3.81%, and goods vehicles 3.26% in 2011 compared to 2010. The number of registered vehicles in Malaysia as reported by the Department of Road Transport for the year 2010 and 2011 is as shown in **Figure 5.4**. The number of in-use or active vehicles on the road namely passenger cars, motorcycles, goods vehicles and taxis increased by 6.30%, 5.78%, 1.09%, and 0.56% respectively while the number of in use buses decreased by 6.13% compared to 2010 **(Figure 5.5)**.

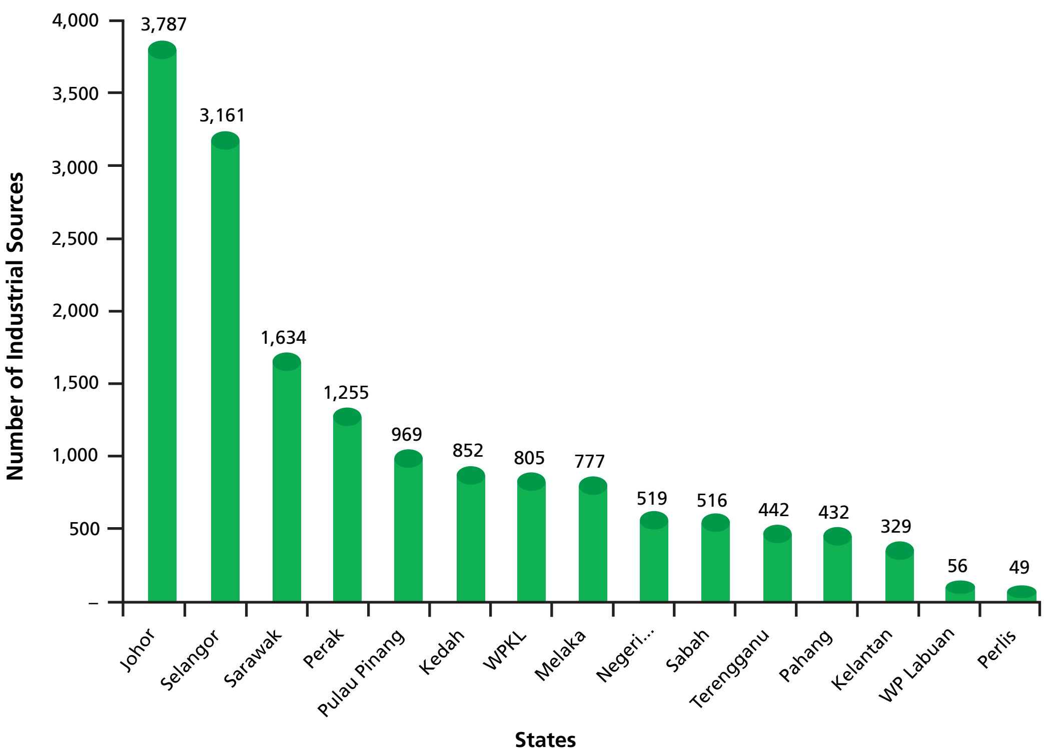

Figure 5.3 Malaysia : Industrial Air Pollution Sources by State, 2011

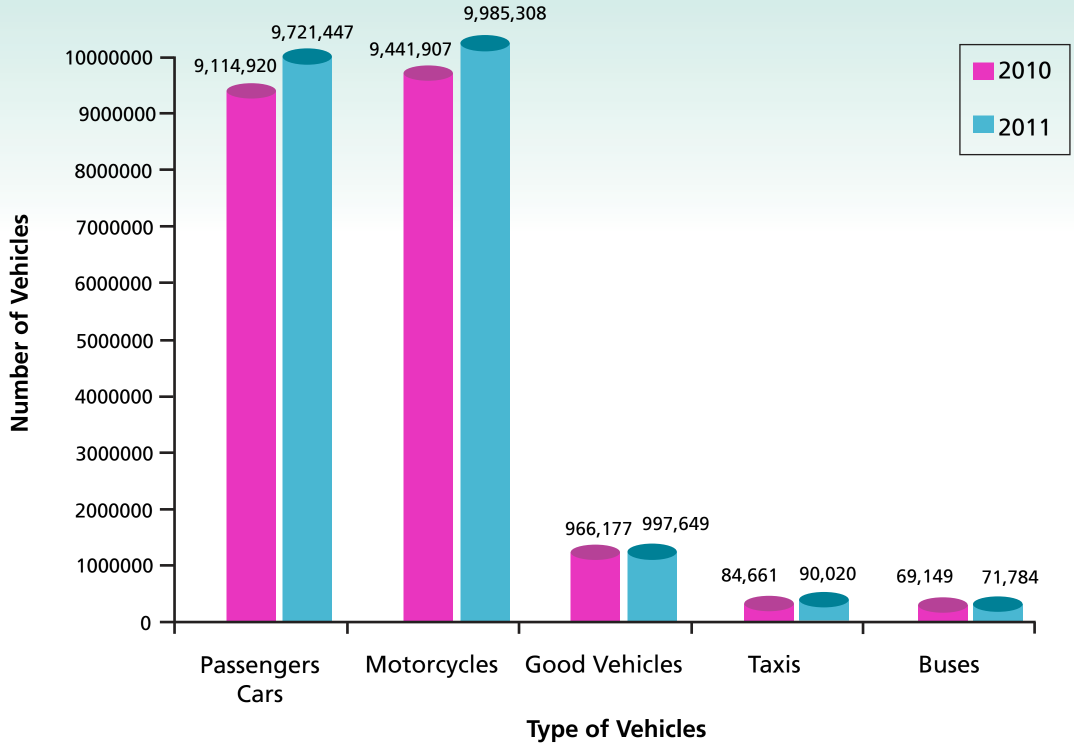

Figure 5.4 Malaysia : Number of Registered Vehicles in 2010 and 2011
(Source: Road Transport Department, Malaysia, 2011)

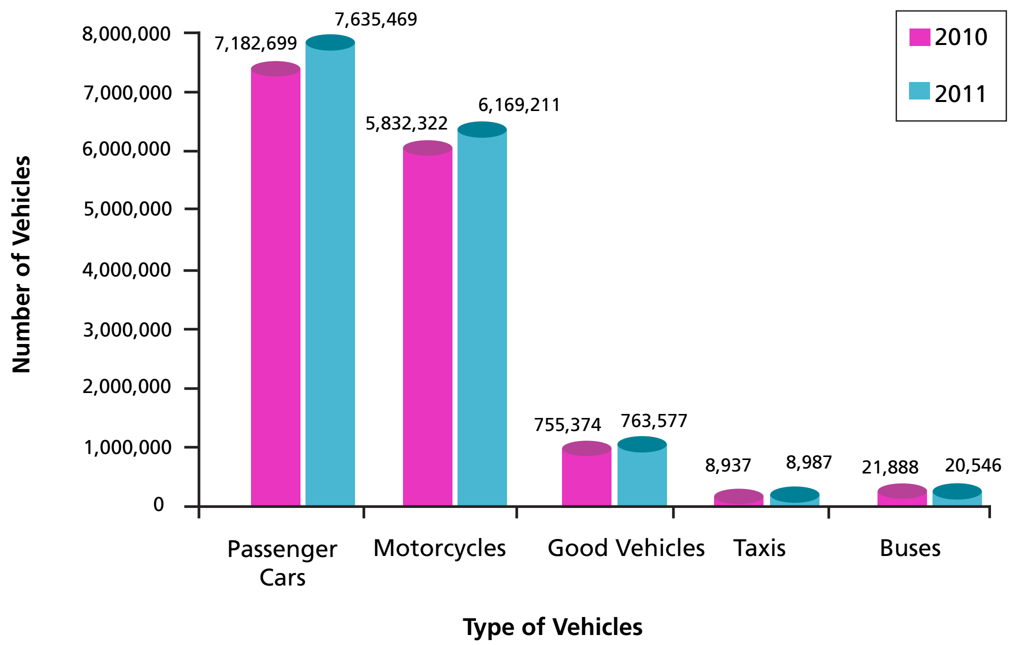

Figure 5.5 Malaysia : Number of in Use Vehicles in 2010-2011
(Source : Road Transport Department, Malaysia, 2011)

AIR POLLUTANT EMISSION LOAD

Overall Emission Load

It was estimated that in 2011 the combined air pollutant emission load accumulated to 1,759,248 metric tonnes of carbon monoxide (CO); 770,099 metric tonnes of nitrogen oxides (NO_2); 190,075 metric tonnes of sulphur dioxide (SO_2) and 27,719 metric tonnes of particulate matter (PM). A comparison of the combined air pollutant emission load in 2010 and 2011 is shown in **Figure 5.6**. Except for PM, there was an increase in emission load for CO, NO_2 and SO_2 compared to 2010. The increase of 4.6 percent in CO emission load was due to an increase in the number of in-use or active motor vehicles in 2011 while an increase in emission load for NO_2 and SO_2 could be due to additional number of power and heat generation plant in operation (Sources: National Energy Balance 2009).

Emission Load by Sources

Power plants contributed the highest SO_2 emission load (46%), followed by industries (16%), motor vehicles (7%) and others (31%) **(Figure 5.7)**. As for PM the highest contributor was industries (42%) followed by power plants (25%), motor vehicles (17%) and others (16%) **(Figure 5.8)**. As shown in **Figure 5.9** the highest contributor of NO_2 was power plants (61%) followed by motor vehicles (28%), industries (8%) and others (3%). Motor vehicles remain the highest contributor of CO (95%) **(Figure 5.10)**.

The estimated annual air pollutant emission load HC, CO, PM, NO_2 and SO_2 from motor vehicles for 2010 and 2011 is shown in **Figure 5.11**. In 2011, the emission load of HC and CO was estimated to be 392,301 metric tonnes and 1,670,996 metric tonnes respectively. Except for PM, there was an increase in emission load for HC, CO, NO_2 and SO_2 as compared to 2010.

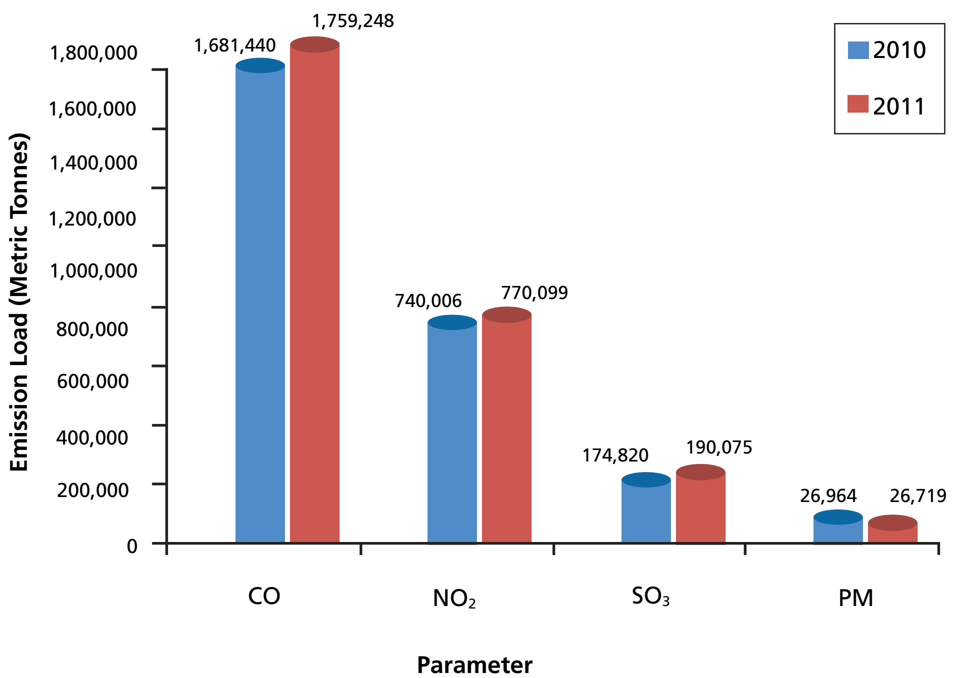

Figure 5.6 Malaysia : Air Pollutant Emission Load from All Sources, 2010-2011
(Sources : From National Energy Balance 2009)

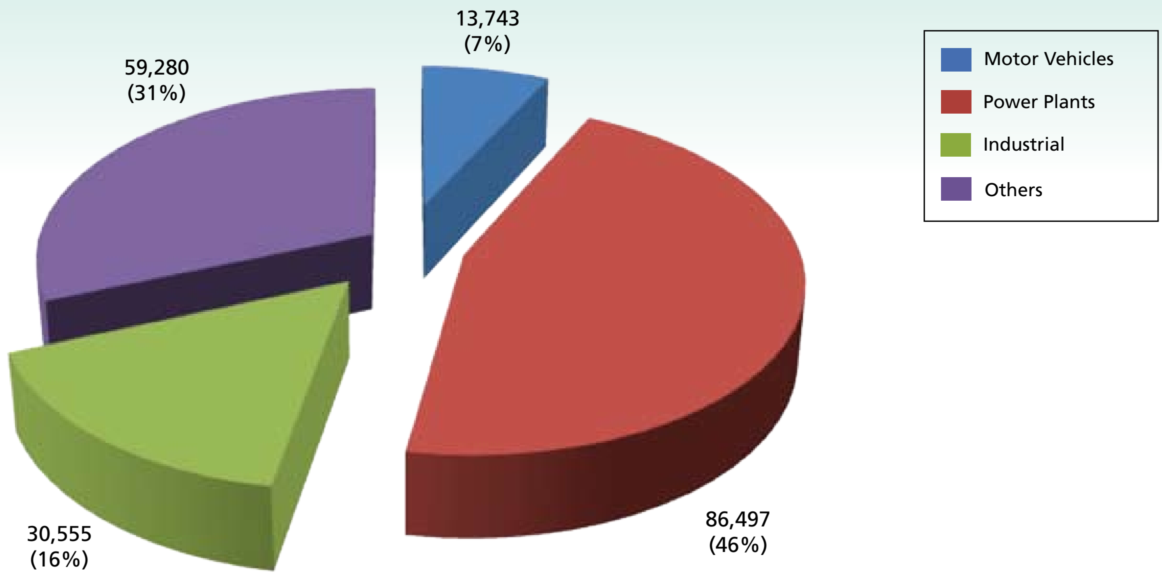

Figure 5.7 Malaysia : SO_2 Emission by Sources (Metric Tonnes), 2011

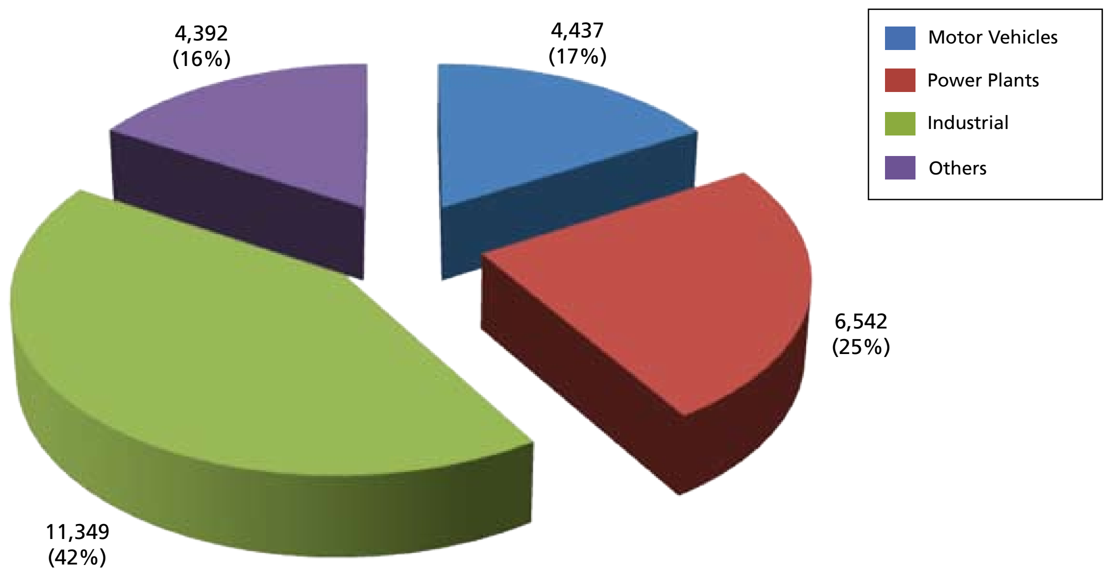

Figure 5.8 Malaysia : Particulate Matter (PM) Emission Load by Sources (Metric Tonnes), 2011

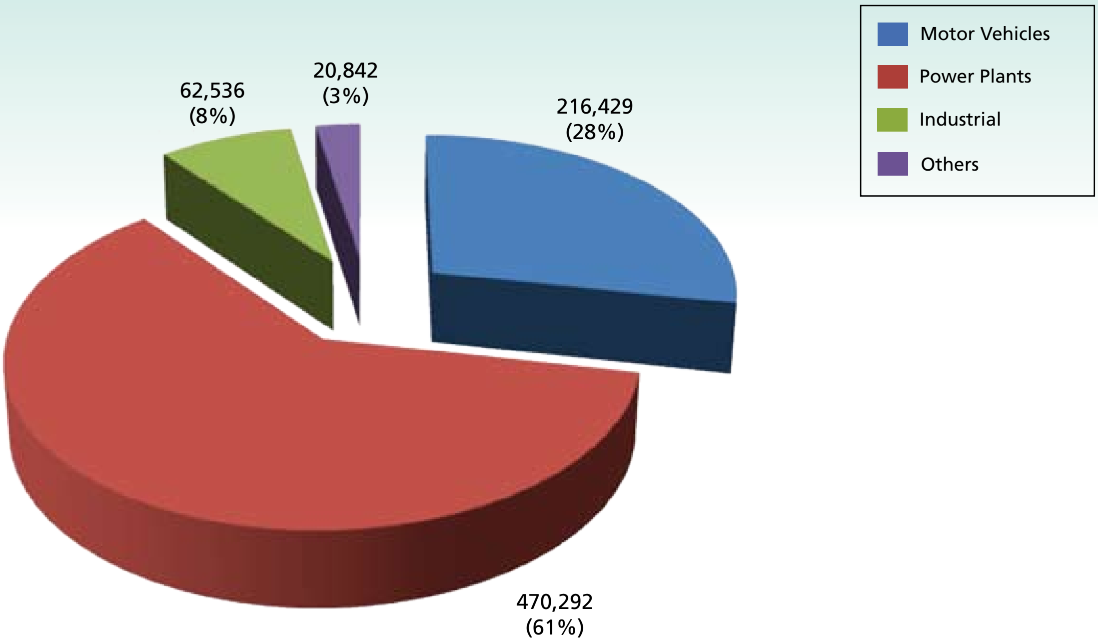

Figure 5.9 Malaysia : NO_2 Emission by Sources (Metric Tonnes), 2011

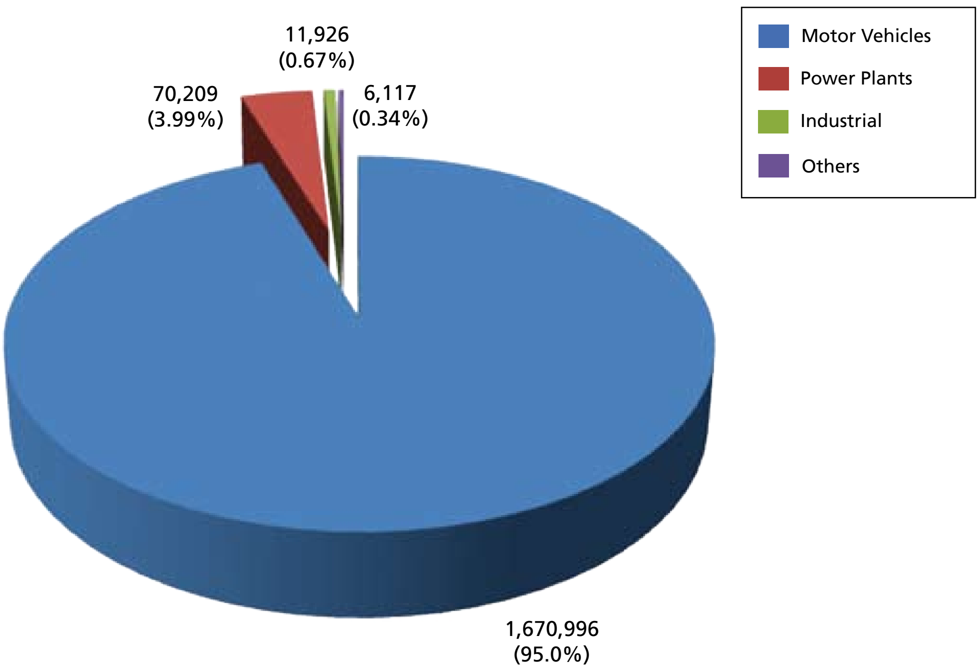

Figure 5.10 Malaysia : CO Emission by Sources (Metric Tonnes), 2011

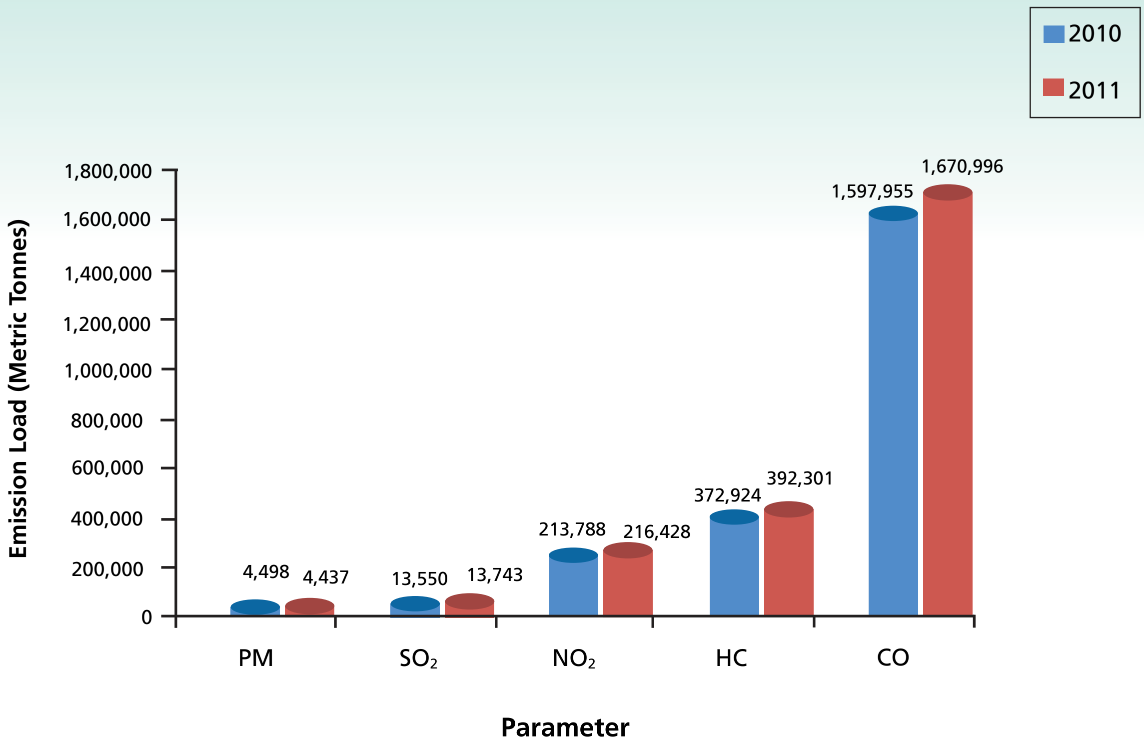

Figure 5.11 Malaysia : Air Pollutant Emission Load from Motor Vehicles, 2010-2011

SCHEDULED WASTES INVENTORY

A total of 3,281,569.21 metric tonnes of scheduled wastes were generated in Malaysia in 2011. This represents an increased of 6.29% as compared to 3,087,496.84 metric tonnes generated in 2010. In 2011, it was found that dross/slag/clinker/ash, gypsum, mineral sludge, heavy metal sludge and e-waste were the main categories of waste generated in the country **(Table 5.1)**. **Figure 5.13** shows that the state of Johor generated the largest amount of scheduled wastes (21.3%), followed by Terengganu (18.7%), Selangor (13.1%), Negeri Sembilan (12.3%), Pulau Pinang (12%) whilst the other 10 states generated a total of 22.6%.

Of the total waste produced in 2011, 1,659,537.67 metric tonnes (50.57%) were managed under the special management approval as stipulated under Regulation 7, Environmental Quality (Scheduled Wastes) Regulations, 2005 **(Table 5.2)**. This represents an increased of 37.54% as compared to 1,206,568 metric tonnes in 2010. These wastes were mostly from power stations (57.61%), sludge from drinking water treatment plants (27.03%) and the remaining 15.36% from other sources.

A total of 939,730.83 metric tonnes of waste were being recovered locally and internationally. 937,769.83 metric tonnes (28.58%) of scheduled wastes were recovered at local off-site recovery facilities and 1,961.00 metric tonnes (0.06%) were exported for recovery in other countries according to the Basel Convention procedures **(Table 5.2)**. This shows an increased of 7.09% of waste being recovered as compared to 877,489.38 metric tonnes in 2010.

A total of 151,979.5 metric tonnes (4.6%) of waste were treated and disposed, at Kualiti Alam Sdn. Bhd (119,684.03 MT), Trinekens (Sarawak) Sdn. Bhd. (14,500.00 MT) and 17,795.47 metric tonnes of clinical wastes were incinerated at licensed off-site facilities **(Table 5.2)**. This shows a decreased of 6.54% from a total of 162,616.25 metric tones of scheduled waste disposed in 2010.

Table 5.1 Malaysia : Quantity of Scheduled Wastes Generated by Category, 2011

No	Waste Category	Waste Code	Quantity of Waste	
			MT/Year	Percentage (%)
1	Dross / Slag / Clinker / Ash	SW 104, 107, 406	370,789.09	22.86
2	Gypsum	SW 205	278,139.00	17.15
3	Mineral Sludge	SW 427	207,445.01	12.79
4	Heavy Metal Sludge	SW 204, 105, 108	173,837.06	10.72
5	E-Waste	SW 110	152,722.04	9.42
6	Oil & Hydrocarbon	SW 305, 306, 307, 308, 309, 310, 311, 312, 314, 315, 415	133,260.91	8.22
7	Clinical/Pharmaceutical	SW 404, 403, 405	44,674.52	2.75
8	Batteries	SW 102,103	41,246.65	2.54
9	Acid & Alkaline	SW 206, 401, 414	38,152.48	2.35
10	Used Container / Oil Filter	SW 409	36,706.83	2.26
11	Spent Solvent	SW 322, 323	30,976.89	1.91
12	Paper & Plastic	SW 410	23,332.03	1.44
13	Ink & Paint Sludge	SW 416, 417, 418	19,224.56	1.19
14	Residue	SW 501	18,118.39	1.12
15	Rubber Sludge	SW 321	16,130.66	0.99
16	Mixed Wastes	SW 422, 421	10,708.41	0.66
17	Phenol/Adhesive/Resin	SW 325, 319, 303	7,904.42	0.49
18	Catalyst	SW 202	6,229.05	0.38
19	Others	NA	5,505.33	0.34
20	Arsenic	SW 101	2,131.57	0.13
21	Chemical Waste	SW 430, 429	1,327.61	0.08
22	Contaminated Land/Soil	SW 408	1,072.87	0.07
23	Photographic Waste	SW 423	587.63	0.04
24	Contaminated Active Carbon	SW 411	510.03	0.03
25	Pesticide	SW 426	487.10	0.03
26	Mercury	SW 109	434.18	0.03
27	Asbestos	SW 201	194.11	0.01
28	Thermal Fluids	SW 327	178.00	0.01
29	Sludge Contain Cyanide	SW 412	5.09	0.00
	Total		**1,622,031.54**	**100.00**

An estimated 340,460.16 metric tonnes (10.37%) were treated on-site; 189,861.05 metric tonnes (5.79%) were stored on-site within allowable time period at waste generators' premises pending disposal and recovery **(Table 5.2)**. Two (2) landfarms and 21 on-site waste incinerators had been licensed by DOE to allow for on-site treatment and incineration respectively.

Of the total wastes being recovered at local off-site recovery facilities, 39.1% are electronic and electrical wastes followed by dross/ash/slag/catalyst (12.4%) whilst oil/mineral sludge/spent coolant (9.4%), acid/alkaline (6.9%), and heavy metal sludge/ rubber (7.4%) **(Table 5.4)**.

A total of 404 off-site recovery facilities have been licensed by the department to recover various categories of scheduled wastes. The most issued licensed facilities according to categories of waste are electronic and electrical wastes (158 facilities) followed by dross/ash/slag/catalyst (50 facilities) oil/mineral sludge/spent coolant (38 facilities), and acid/alkaline (28 facilities), heavy metal sludge/ rubber (30 facilities), used container/contaminated waste/ink/paint/lacquer (37 facilities), solvent (23 facilities) whilst four (4) other wastes categories totaling of 40 facilities are as shown in **Table 5.4**.

Proper labelling and storage of scheduled wastes

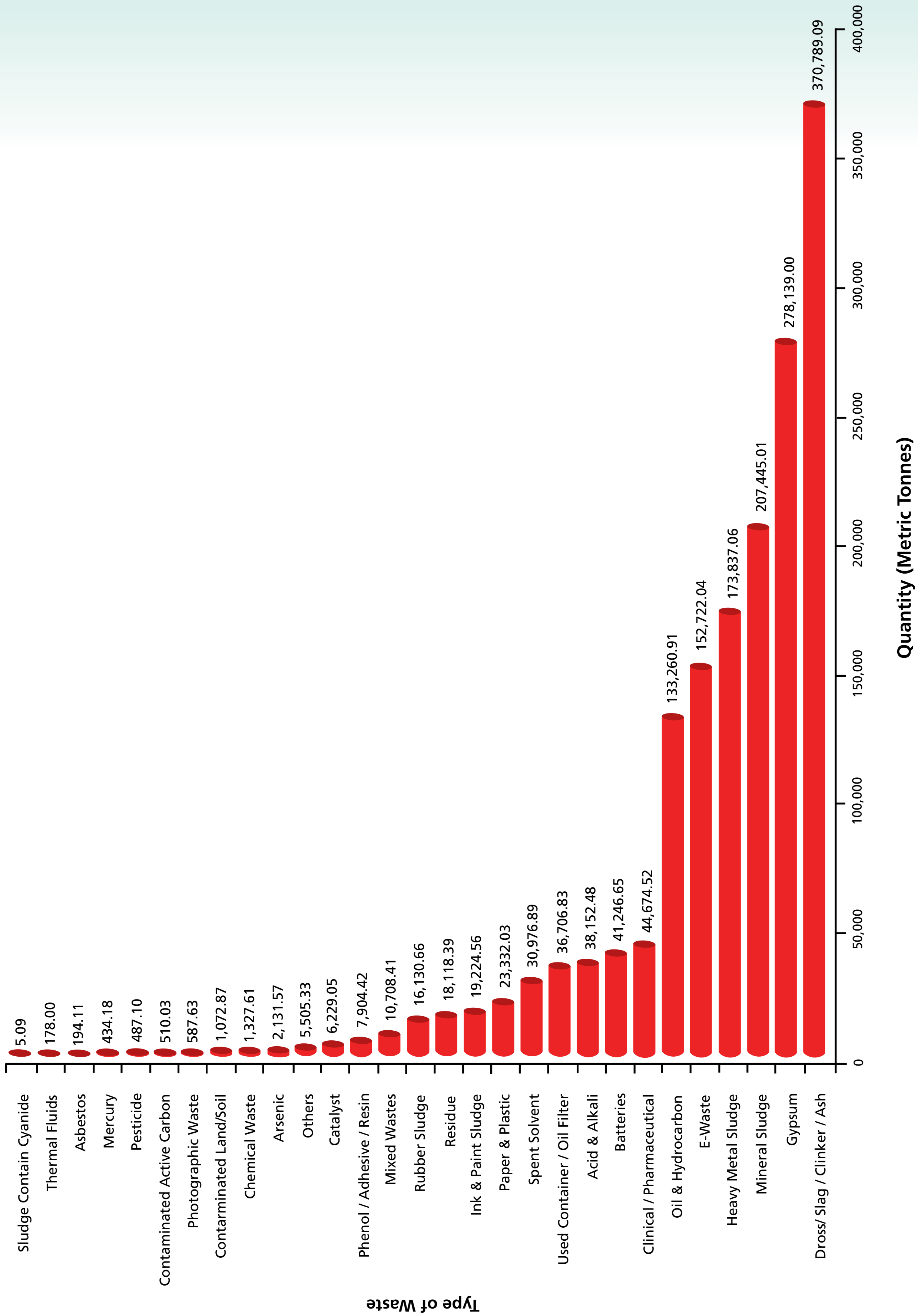

Figure 5.12 Malaysia : Quantity of Scheduled Wastes Generated by Category, 2011

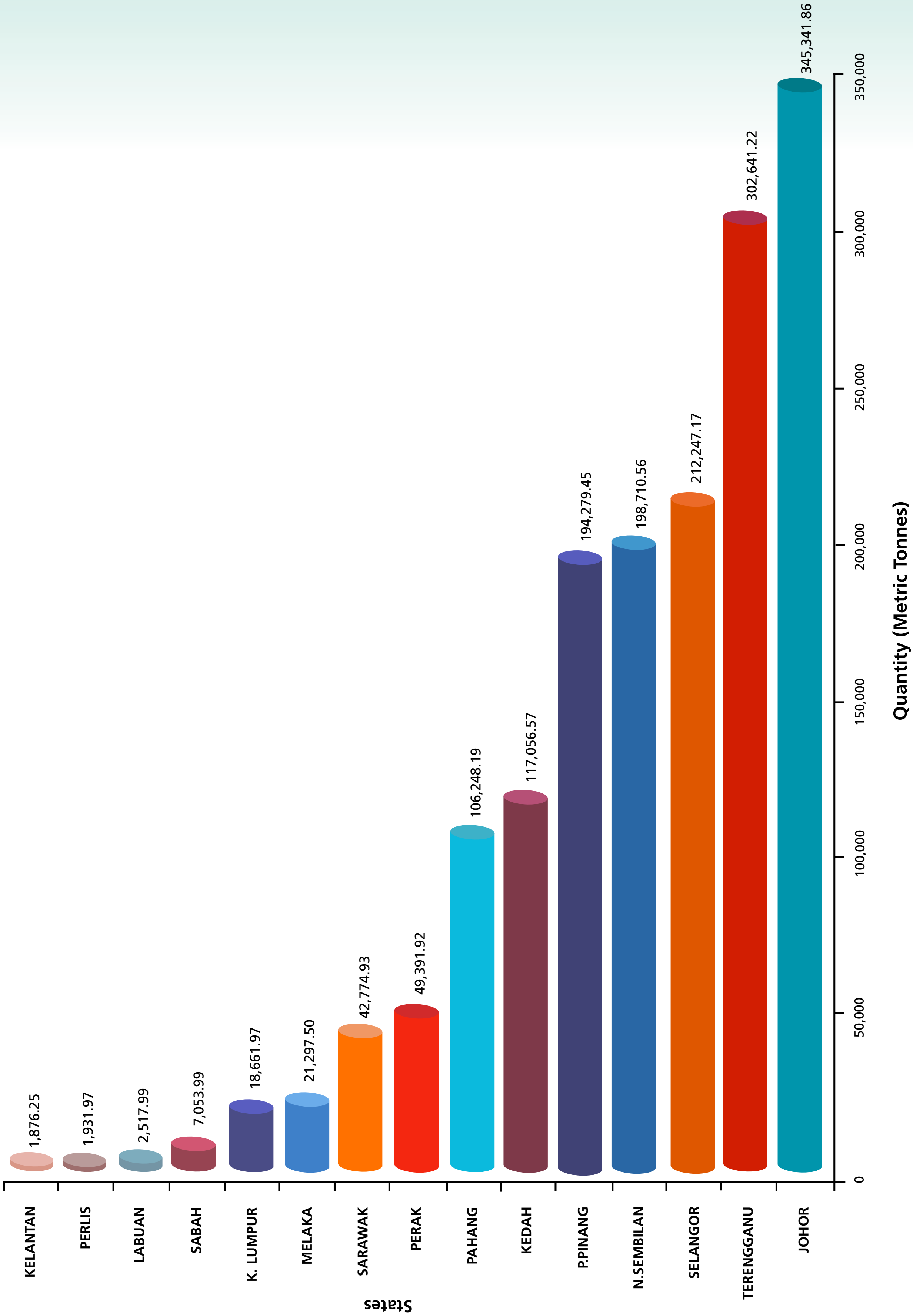

Figure 5.13 Malaysia : Distribution of Scheduled Wastes Generated By State, 2011

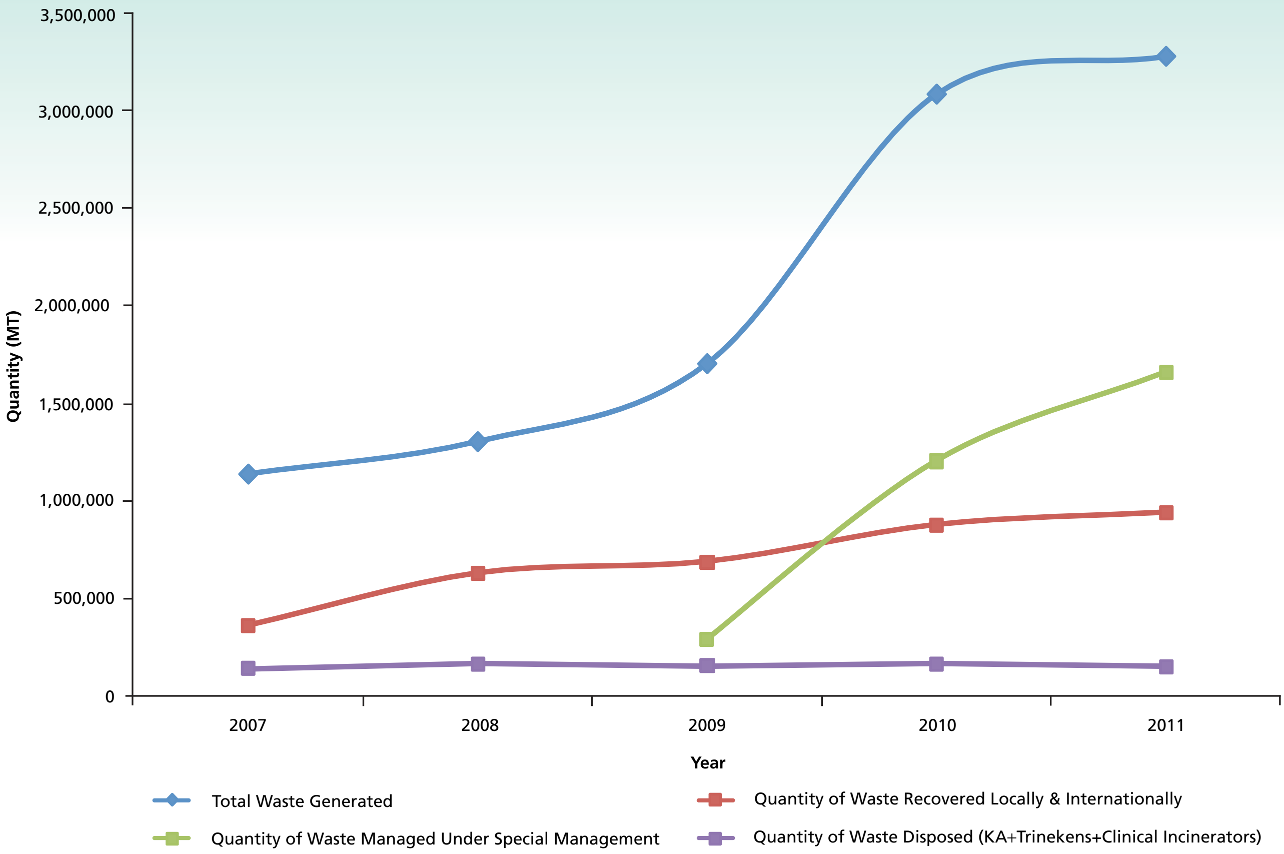

Figure 5.14 Malaysia : The Trend of Scheduled Waste Management from 2007-2011

Table 5.2 Malaysia : Facilities Handling Scheduled Wastes, 2011

No.	Facility	Tones	Percentage (%)
1	Special Management	1,659,537.67	50.57
2	Local Off-site Recovery Facilities	937,769.83	28.58
3	On-site Treatment	340,460.16	10.37
4	On-site Storage	189,861.05	5.79
5	Kualiti Alam Sdn. Bhd	119,684.03	3.65
6	Off-site Clinical Waste Incinerators	17,795.47	0.54
7	Trinekens (Sarawak) Sdn. Bhd.	14,500.00	0.44
8	Foreign Facilities (Export)	1,961.00	0.06
Total		**3,281,569.21**	**100.00**

Table 5.3 Malaysia : Generated Scheduled Waste Managed Under Special Management, 2011

No	Waste Category	Waste Code	Source	Tonnes	Percent (%)	Method of Disposal
1	Heavy Metal Sludge	SW 204	Drinking Water Treament Plant	448,580.00	27.03	Sanitary Landfill
			Industry	153,266.23	9.24	
2	Fly Ash	SW 104	Coal - Fired Power Plant	956,077.83	57.61	Reuse as raw material for product
			Industry	25,090.94	1.51	
3	Gypsum	SW 205	Industry	66,068.57	3.98	Sanitary Landfill
4	Glue	SW 303	Industry	97.5	0.01	Reuse as raw material for product
5	Petroleum By - Product	SW 322	Industry	656.65	0.04	Recovered
6	Waste Containing Formaldehyde, Resin, Discarded Epoxy Powder	SW 320, 325, 418	Industry	6,412.19	0.39	Sanitary Landfill
7	Discarded Pharmaceutical Product, Discarded Toner, Discarded Product	SW 405, 417, 429	Industry	124.53	0.01	Sanitary Landfill
8	Ash of Paper Sludge	SW 406	Industry	2,825.63	0.17	Sanitary Landfill
9	Rubber Coagulum Waste	SW 321	Industry	334.00	0.02	Reuse as raw material for product
10	Spent Mixed Oil	SW 421	Industry	3.60	0.00	Reuse as releasing agent for mould cement
Total				**1,659,537.67**	**100**	

Table 5.4 Malaysia: Off-site Recovery Facilities and Quantity of Waste Handling, 2011

Waste Category	Recovery Facility	Handling Percentage (%)
Electronic and Electrical Wastes	158	39.1
Dross / Ash / Slag / Catalyst	50	12.4
Oil / Mineral Sludge / Spent Coolant	38	9.4
Acid / Alkaline	28	6.9
Heavy Metal Sludge / Rubber	30	7.4
Used Container / Contaminated Waste / Ink / Paint / Lacquer	37	9.2
Solvent	23	5.7
Photographic	10	2.5
Phenol / Adhesive / Resin	15	3.7
Battery	7	1.7
Gypsum	8	2.0
Total	**404**	**100.0**

The categories of wastes sent to the licensed premises (Kualiti Alam Sdn Bhd and Trinekens (Sarawak) Sdn Bhd) for final disposal are sludge containing one or several metals, mixed wastes, dust/slag/dross or ash containing arsenic/mercury and spent inorganic acid. They were either incinerated, treated physically and chemically, solidified or disposed off in secured landfill depending on the type of wastes and their characteristics. As shown in **Figure 5.15**, most of the wastes sent to Kualiti Alam Sdn Bhd and Trinekens Sdn Bhd are being landfilled (50%) followed by incineration (34%), physically and chemically treated (6%) and treated solidified (10%).

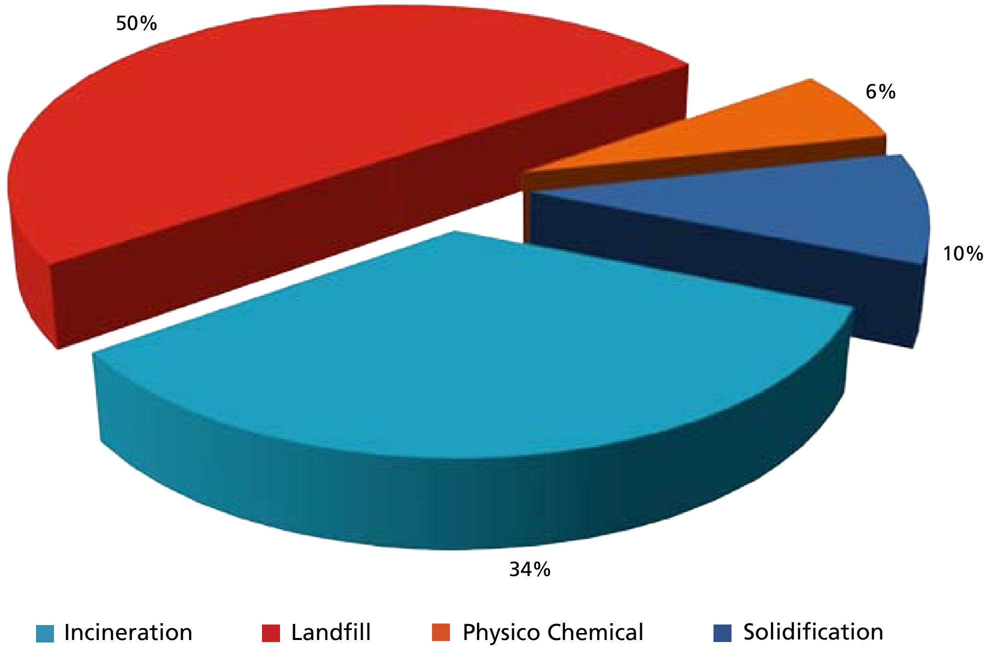

Figure 5.15 Malaysia: Types of Treatment and Disposal of Waste, 2011

ANNEX

84 National Water Quality Standards For Malaysia

85 National Water Quality Standards For Malaysia

85 Water Classes And Uses

86 DOE Water Quality Classification Based On Water Quality Index

86 DOE Water Quality Index Classification

87 WQI Formula And Calculation

ANNEX

NATIONAL WATER QUALITY STANDARDS FOR MALAYSIA

PARAMETER	UNIT	CLASS				
		I	IIA/IIB	III#	IV	V
Al	mg/l	NATURAL LEVELS OR ABSENT	-	(0.06)	0.5	LEVELS ABOVE IV
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	
Mn	mg/l		0.1	0.1	0.2	
Hg	mg/l		0.001	0.004 (0.0001)	0.002	
Ni	mg/l		0.05	0.9*	0.2	
Se	mg/l		0.01	0.25 (0.04)	0.02	
Ag	mg/l		0.05	0.0002	-	
Sn	mg/l		-	0.004	-	
U	mg/l		-	-	-	
Zn	mg/l		5	0.4*	2	
B	mg/l		1	(3.4)	0.8	
Cl	mg/l		200	-	80	
Cl_2	mg/l		-	(0.02)	-	
CN	mg/l		0.02	0.06 (0.02)	-	
F	mg/l		1.5	10	1	
NO_2	mg/l		0.4	0.4 (0.03)	-	
NO_3	mg/l		7	-	5	
P	mg/l		0.2	0.1	-	
Silica	mg/l		50	-	-	
SO_4	mg/l		250	-	-	
S	mg/l		0.05	(0.001)	-	
CO_2	mg/l		-	-	-	
Gross-α	Bq/l		0.1	-	-	
Gross-β	Bq/l		1	-	-	
Ra-226	Bq/l		< 0.1	-	-	
Sr-90	Bq/l		< 1	-	-	
CCE	µg/l		500	-	-	-
MBAS/BAS	µg/l		500	5000 (200)	-	-
O & G (Mineral)	µg/l		40; N	N	-	-
O & G (Emulsified Edible)	µg/l		7000; N	N	-	-
PCB	µg/l		0.1	6 (0.05)	-	-
Phenol	µg/l		10	-	-	-
Aldrin/Dieldrin	µg/l		0.02	0.2 (0.01)	-	-
BHC	µg/l		2	9 (0.1)	-	-
Chlordane	µg/l		0.08	2 (0.02)	-	-
t-DDT	µg/l		0.1	(1)	-	-
Endosulfan	µg/l		10	-	-	-
Heptachlor/Epoxide	µg/l		0.05	0.9 (0.06)	-	-
Lindane	µg/l		2	3 (0.4)	-	-
2,4-D	µg/l		70	450	-	-
2,4,5-T	µg/l		10	160	-	-
2,4,5-TP	µg/l		4	850	-	-
Paraquat	µg/l		10	1800	-	-

Notes :

* = At hardness 50 mg/l $CaCO_3$
# = 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*	μS/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 * I x – 2 I	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