FORWARD

The National Environment Agency (NEA) was established on 1 July 2002.

The NEA took over the operational functions of environmental protection and public health from then Ministry of the Environment (ENV) so that ENV could focus on strategic and policy planning. For better synergy, the Meteorological Services Department, which used to be part of the Ministry of Transport was integrated into NEA.

As a statutory board, NEA has greater administrative autonomy and flexibility, making it more nimble and innovative in the discharge of its responsibilities. NEA is also better placed to promote ownership of the environment among the people, private and public (3P) sectors.

Within NEA, the Environmental Protection Division (EPD)'s role is to ensure that Singaporeans continue to enjoy a quality living environment for generations to come. It will continue to implement programmes to monitor, reduce and prevent environmental pollution. In addition, it will spearhead new initiatives to enhance sustainable development. Its key goals in resource conservation will include waste minimisation, recycling and energy efficiency.

This is the fifth Annual Report of EPD of NEA and it outlines the programmes implemented and targets achieved in 2006.

CONTENTS

HIGHLIGHTS OF 2006

The ambient air quality remained good for the year, except for a few days in October and November which were affected by transboundary smoke haze from the Indonesian land and forest fires.

Singapore's ambient air quality compares favourably with major cities of the world. As our industry base expands and vehicle population increases, we have ensured that the sources of air pollution are kept in check and the quality of our ambient air remains good. Air quality is often cited as one of the key factors contributing to a world-class living environment, as evidenced by Singapore's consistent high ranking for overall quality of the environment among Asian countries for the past 6 years in the surveys conducted by the Political and Economic Risk Consultancy Survey.

The water quality of inland and coastal waters remained good and supported aquatic life.
As part of our continuing effort to reduce the ambient PM2.5 level in our air, the EURO IV emission standard for diesel vehicles was implemented with effect from 1 October 2006.

On 26 October 2006, NEA announced the implementation of the Chassis Dynamometer Smoke Test (CDST) as a standard requirement during mandatory periodic inspection for all diesel-driven vehicles, in place of the free acceleration smoke test (FAST). The CDST requirement during periodic inspection took effect on 1 January 2007.

Waste recycling is a key thrust of the NEA's strategy to reduce waste. Participation rate by households in the National Recycling Programme increased from 54% in 2004 to 59 % (about 6 in 10 households) in 2006. The percentage of condominiums with waste recycling programmes increased from 24% in 2004 to 43% in 2006. Schools participating in the Recycling Corner programme increased from 50% in 2004 to 84 % in 2006.

During the year, NEA has been appointed as Singapore's Designated National Authority (DNA) for Clean Development Mechanism (CDM) projects under the Kyoto Protocol (KP). The CDM under the KP is a mechanism that allows greenhouse gas emission reductions from projects implemented in non-Annex I countries to be used to offset emissions in Annex I countries. Such projects, if implemented in Singapore, would generate carbon credits known as Certified Emissions Reductions or CERs, which are tradable. Hence, any company in Singapore that is able to reduce its greenhouse gas emissions may be able to earn CERs and thereby benefit from the CDM. NEA's role is to ensure that CDM projects to be implemented locally meet national sustainable development (SD) criteria. The DNA will issue the letters of approval (LoA) to projects that meet the SD criteria.

A Climate Change Awareness Programme was launched on 22 April 2006 by the Singapore Environment Council (SEC) with support from NEA, to raise public awareness on climate change issues. The focus of the year-long programme was to inform the public about the link between energy use and greenhouse gas emissions and how this could lead to global warming. The programme also aims to highlight and encourage the public to adopt simple changes in lifestyles and habits to be more energy efficient.

HIGHLIGHTS OF 2006

In 2006, Singapore became the 32nd country to join the Renewable Energy and Energy Efficiency Partnership (REEEP). REEEP is an international alliance of governments, NGOs and businesses dedicated to accelerating and expanding the global market for renewable energy and energy-efficient technologies. The REEEP membership reinforces Singapore's commitment towards global climate protection and to sustainable development. Singapore looks forward to the sharing of best practices with other partner countries and in working with them and REEEP on the promotion of energy efficiency and renewable energy in the region

On 5 October 2006, Minister for the Environment and Water Resources, Dr Yaacob Ibrahim, graced the groundbreaking ceremony of Singapore's fifth Waste-to-Energy Plant – Keppel-Seghers Tuas Waste-to-Energy Plant. This is the first Waste-to-Energy Plant built under the Public Private Partnership Scheme. When completed in Year 2009, it will provide incineration services to the NEA under a 25-year Incineration Services Agreement.

In July 06, a renewable energy system comprising a wind turbine and solar panels was successfully installed and commissioned to generate electricity to light up the southern tip of the Semakau landfill. This has enabled night activities such as stargazing, barbecuing and camping to be carried out at Semakau Landfill.

The opening of Semakau Landfill for recreational activities has enhanced the vibrancy of marine leisure activities and environmental protection awareness of Singaporeans. It is now a popular destination for students and members of the public to learn and appreciate the waste management system and environmental protection policies of Singapore.

NEA also collaborated with the tertiary institutions to conduct R&D to support NEA's strategic objectives. To date, 56 joint R&D projects have been approved under the Memoranda Of Understanding (MOU) with the Nanyang Technological University (NTU) and the National University of Singapore (NUS). Of these 48 have been completed. In 2006, 2 projects were approved under the MOU with local universities NTU/NUS in areas of clean energy & energy efficiency and pollution control.

Under the Innovation for Environmental Sustainability (IES) Fund, over $ 2 million were committed in 2006 to support four projects in the areas of clean energy & energy efficiency and pollution control. Examples of the new projects are (i) installation of a Trigeneration plant to generate electricity, steam and chilled water in a single process, and (ii) biocatalytic scrubber for low water solubility volatile organic compound (VOC) fumes treatment.

In 2006, NEA continued its job re-creation efforts. Through the "1000 for 1000" initiative, NEA had created 1,635 jobs paying more than $1,000 a month in the environmental sectors, focusing on 5 environmental sectors, namely Hawker Centre Cleaning, Street Cleaning, Waste Recycling, Pest Management and Pollution Control.

INTRODUCTION

Singapore developed its industrial base and achieved high economic growth within a short span of three decades. In tandem with Singapore's rapid economic growth and industrialisation, programmes were also implemented, at a very early stage, to protect the environment.

The success of these environmental protection programmes is evident today and Singapore has an environment that compares favourably with the best cities in the world. Levels of major pollutants in the ambient air are within the United States Environmental Protection Agency (USEPA) standards when not affected by transboundary smoke haze from regional land and forest fires. All inland waters in Singapore support aquatic life.

To ensure that rapid economic growth and industrialisation would not be at the expense of the environment, the Anti-Pollution Unit (APU) and the Ministry of the Environment (ENV) were formed in 1970 and 1972 respectively to protect the environment. APU was subsequently merged with ENV in 1986. ENV was renamed as the Ministry of the Environment and Water Resources (MEWR) in September 2004 and its operational functions were taken over by its two statutory boards viz. the National Environment Agency (NEA) and the Public Utilities Board (PUB). The two statutory boards protected the environment and environmental health by planning, developing and operating sewerage, drainage and solid waste disposal facilities, controlling air and water pollution, hazardous chemicals and toxic wastes, and providing environmental public health services and public health education.

The Environmental Protection Division (EPD) of NEA has been tasked to formulate programmes and chart NEA's course into the next decade. Since 1 October 2003, EPD has taken on new responsibilities and the departments in EPD have been restructured to carry out the new functions. These responsibilities include areas such as international, regional and bilateral cooperation and industry and manpower development.

EPD comprises the following departments:

a) Pollution Control Department (PCD)

b) Resource Conservation Department (RCD)

c) Waste Management Department (WMD)

The organisation chart of EPD is in **Appendix 1**.

PCD is tasked with the overall responsibility for air, water and noise pollution control; and hazardous substances, toxic waste control and nuclear safety and security issues. It has the responsibility of monitoring ambient air and inland and coastal water quality. It is also responsible for the formulation and implementation of joint programmes to mitigate transboundary pollution with the neighbouring countries. The organisation chart of PCD is in **Appendix 2**.

RCD is responsible for promoting waste minimisation and recycling in order to reduce the waste disposed of at the incineration plants and landfill. It is also responsible for promoting energy efficiency and the use of clean energy to minimise the emissions of carbon dioxide and air pollutants. The organisation chart of RCD is in **Appendix 3.**

INTRODUCTION

WMD is tasked with the responsibility for providing refuse disposal services (incineration plants and landfill) and for licensing general waste collectors and regulating refuse collection for the domestic and trade premises. It also provides technical assistance to Environmental Health Department (EHD) and Hawkers Department (HD) and vehicle maintenance services to all departments in NEA. The organisation chart of WMD is in **Appendix 4**.

1

Environmental Planning and Building Development Control

ENVIRONMENTAL PLANNING AND BUILDING DEVELOPMENT CONTROL

Environmental Land Use Planning

Environmental problems can be prevented through proper land use planning and the imposition of appropriate controls. NEA, therefore, adopts an integrated approach in the planning control of new developments. This is to ensure that environmental considerations and factors are incorporated at the land use planning, development control and building control stages, so as to minimise pollution and to mitigate pollution impact on surrounding land use.

The Urban Redevelopment Authority (URA), which is the land use planning authority in Singapore, consults the Central Building Plan Unit (CBPU) of the Planning and Development Department (PDD) on land use planning issues. The Jurong Town Corporation (JTC), Housing & Development Board (HDB) and private sector developers also consult CBPU on the allocation of industrial premises.

CBPU assesses and evaluates the hazard and pollution impacts of the proposed industries to ensure that they do not pose unmanageable health and safety hazards and pollution problems. A proposed factory will only be allowed to be set up if it is sited in an appropriate industrial estate and can comply with pollution control requirements.

During the year, CBPU processed 7,839 plans for residential and industrial developments. In addition, CBPU processed 4,895 applications for allocation of industries in JTC, HDB and private industrial estates. A breakdown of residential and industrial development plans and applications for allocation of industrial premises processed by CBPU is in **Tables 1, 2** and **3**.

Major Planning Proposals

During the year, CBPU evaluated the Quantitative Risk Assessment (QRA) studies of 24 chemical plants. The proposals were supported as they could comply with the siting and technical requirements.

Consultation on Building Developments

Technical requirements on environmental matters are imposed at the Building Plan (BP) stage so that the proposals would be designed to comply with environmental requirements and guidelines.

For industries, the building plans are checked at the BP stage to ensure that the necessary pollution control equipment and facilities are incorporated.

Upon completion of a project, the Qualified Person (QP) applies to CBPU for clearance of either the Temporary Occupation Permit (TOP) or the Certificate of Statutory Completion (CSC).

When compliance with the imposed technical requirements has been confirmed through site inspections, CBPU issues TOP/CSC clearance on behalf of the technical departments (Sewerage, Drainage, Environmental Health and Pollution Control Departments).

During the year, CBPU processed 7,477 building plans and detailed plans, and issued 3,601 TOP/CSC clearances

ENVIRONMENTAL PLANNING AND BUILDING DEVELOPMENT CONTROL

Provision of Drainage and Sewerage Interpretation Plans

CBPU provides drainage and sewerage information for property transactions and building developments.

During the year, CBPU processed 28,893 applications for Drainage Interpretation Plans and Sewerage Interpretation Plans.

Table 1
Planning Consultations on Land Use

Classification	Total
Proposed Site for Public Housing Development	182
Proposed Site for Private Housing Development	2252
Proposed Site for Industrial Development	329(2)
Proposed Site for Flatted Factory Development	10
Proposed Extension/Retention of Use of Existing Premises	167
Proposed Use/Change of Use of Trade/Industrial Premises	764(68)
Proposals for Petrol Stations	13
Additions & Alterations	2308(4)
Miscellaneous	1814(16)
Total	**7839(90)**

Note: Figures in brackets represent the number of consultations not supported by CBPU.

Table 2

Planning Consultations for Scheduled Premises

Scheduled Premises	Total
Concrete/Cement works	4
Chemical works	10
Plants using scheduled oil-fired boilers (steam generating capacity of 2300 kg or more per hour)	4
Storage of more than 100 tonnes of one or more chemicals	8
Abrasive blasting works	9
Total	**35**

Table 3
Breakdown of Consultations on Factory Allocation

Type Of Industry	Total
Engineering works	1756 (16)
Shipbuilding/repairing	16
Food	311(1)
Timber-based products	287(11)
Paper products	7
Electrical and electronic products	75
Textile and garment	33(1)
Plastic	57 (1)
Printing and publishing	62
Jewellery, watch and clock	10
Building and construction	71(1)
Concrete and cement	13
Chemical	249 (5)
Rubber processing & rubber products	5
Photograph & optical goods	5
Ferrous & non-ferrous metal works	96
Leather goods & footwear	11
Miscellaneous	1831(4)
Total	**4895(40)**

Note: Figures in brackets represent the number of consultations not supported by CBPU.

2

Pollution Control

POLLUTION CONTROL

Air Pollution Control

Overview

The ambient air quality remained good for most of the days in the year. The levels of major pollutants such as sulphur dioxide, nitrogen dioxide, carbon monoxide, ozone and respirable suspended particles were within the acceptable limits prescribed by the United States Environmental Protection Agency (USEPA). There were a few days in October and November when our ambient air quality was affected by transboundary smoke haze from the Indonesian land and forest fires. During the period, there were 28 days when the air quality was in moderate range and 3 days in unhealthy range. The last time Singapore air quality in the unhealthy range was in 1997.

The Environmental Pollution Control Act and its Regulations

Air pollution in Singapore is regulated under the Environmental Pollution Control Act and its Regulations. The Environmental Pollution Control (Air Impurities) Regulations 2000, which came into force on 1 January 2001, stipulate revised air emission standards for air pollutants. The purpose of revised standards is to reduce the air emissions from industries so that our ambient air quality continues to remain good. The standards are listed in **Appendix 5** .

Industries, which have the potential to cause serious air pollution, are classified as Scheduled Premises under the Environmental Pollution Control Act. The list of Scheduled Premises is in **Appendix 6**. The owner or occupier of Scheduled Premises is required to obtain a Licence from PCD before commencement of operation. PCD grants the Licence only after all pollution control requirements have been complied with.

Compliance Testing And Checking At Factories

PCD carries out regular inspections on industrial and non-industrial premises to ensure compliance with pollution control requirements.

During the year, 18,585 inspections were conducted on industrial premises (e.g. factories, trade premises, etc) and 3,530 inspections on non-industrial premises (e.g. farms, domestic premises, etc.).

Under PCD's source emission testing scheme, industries are required to conduct source emission tests to ensure that they monitor their emissions regularly, and take remedial measures to comply with the prescribed air emission standards. During the year, 204 companies were required to conduct source emission tests. Altogether, they conducted a total of 1,284 tests comprising 402 isokinetic tests and 882 tests on gaseous emission. Of these, 6 failed the prescribed standards. Enforcement action was taken against the offenders and they were required to take remedial action to comply with the prescribed standards.

During the year, PCD also conducted 523 fuel analyses and smoke observations of chimneys. Of these, 1 failed to comply with the prescribed standards. The offender was prosecuted and required to take remedial action.

POLLUTION CONTROL

Air Pollution Control Equipment

Industries are required to install air pollution control equipment to comply with emission standards. During the year, CBPU approved the installation of 105 pieces of air pollution control equipment. The types of control equipment approved are in **Table 4**.

Table 4
Air Pollution Control Equipment Approved

Equipment	No. Approved	Total No. as at 2006
Bag filter dust collector	54	1272
Inertial collector	3	195
Electrostatic precipitator	1	30
Scrubber	24	863
Smoke density meter	4	128
Miscellaneous	19	1020
Total	**105**	**3508**

Control Of Fuel-Burning Equipment

Fuel-burning equipment uses either gaseous fuel or fuel oil. The main air pollutants arising from fuel-burning are sulphur oxides and smoke. The emission of sulphur oxides is controlled by limiting the sulphur content in the fuel.

Industries located in designated industrial estates are required to use fuels containing not more than 1% sulphur by weight. Industries on Jurong Island and Tuas industrial estate can use natural gas, a clean fuel which is available there. Those located near housing estates or residential premises are required to use cleaner fuels, e.g. ultra low sulphur diesel or town gas. In addition, the height of chimneys and the exit velocity of the flue gases are checked by PCD to ensure proper dispersion of flue gases.

Operators of industrial boilers with a steam generating capacity of 2,300 kg/h or more are required to monitor their smoke emissions. Smoke density meters are installed in the chimneys to continuously monitor the smoke intensity to ensure compliance with the Ringelmann No. 1 standard. During the year, 39 pieces of new fuel-burning equipment were approved by CBPU. They included 18 boilers, 10 ovens, 6 furnaces and 5 incinerators. .

POLLUTION CONTROL

Open Burning

Open burning of waste materials gives rise to serious air pollution. In Singapore, open burning of trade and industrial refuse such as construction wastes, is prohibited under the Environmental Pollution Control (Prohibition on the Use of Open Fires) Order, 1999. Most open burning incidents occur at construction sites where timber waste and construction debris are burnt illegally to save on disposal costs. During the year, a total of 3 open burning incidents were detected and action was taken to prosecute the offenders.

Control Of Fugitive Odorous Emissions

Fugitive or residual emission of odorous substances can be a major source of smell nuisance from factories. These factories are required to install odour control equipment to minimise the nuisance.

Complaints And Incidents Of Air Pollution

During the year, PCD received 875 complaints on pollution, of which 47 were incidents of air pollution. The main causes of these incidents were poor maintenance, improper operation and/or overloading of air pollution control equipment.

PCD required the owners or occupiers to take immediate remedial action to ensure compliance with the allowable emission limits. A breakdown of air pollution complaints and incidents in 2005 and 2006 is given in **Table 5**.

Table 5
Complaints And Incidents Of Air Pollution

Type Of Air Pollution	No. Of Complaints		No. Of Incidents	
	2006	2005	2006	2006
Odour	434	445	9	17
Fumes/Dust	199	171	8	25
Smoke/Soot	242	162	30	17
Others	0	2	0	2
Total	**875**	**780**	**47**	**61**

POLLUTION CONTROL

Control Of Vehicular Emissions

Control Of Smoky Vehicles

PCD is responsible for carrying out enforcement operation against smoky vehicles on roads. In 2006, a total of 6,001 motor vehicles and 6,229 motorcycles were booked and fined for emitting excessive smoke. A breakdown of the survey results and number of enforcements of smoky vehicles in Singapore in 2005 and 2006 is given in **Table 6** and **Table 7** respectively.

Vehicle Emission Standards

With the continuing growth of vehicle population in Singapore, total emissions from vehicles have to be kept in check through the implementation of stringent emission standards for new vehicles. Over the years, NEA has tightened the emission standards in tandem with advances in vehicle technology. With effect from 1 January 2001, all new vehicles registered for use in Singapore must comply with the Euro II emission standards. With effect from 1 July 2003, all motorcycles/scooters must comply with the exhaust emission standard as specified in the European Directive 97/24/EC before they can be registered for use in Singapore.

In Singapore, diesel vehicles contribute to about 50% of the total PM2.5 emissions. To bring down the PM2.5 levels in Singapore to within acceptable standards, the NEA implemented the Euro IV emission standard for all new diesel vehicles registered from 1 October 2006 onwards. The emission standards are summarised in **Table 8**.
In addition, in-use vehicles are required to undergo mandatory periodic inspections. These vehicles are tested for compliance with regulations on in-use vehicle emission. This is to ensure the proper maintenance of engines and efficacy of catalytic converters.

To provide vehicle owners with a better standard of maintenance, PCD had initiated the formation of an industry-led Motor Industry Certification Board (MICB) (Singapore) for the administration of the Certification Scheme for Motor Workshop on 1 September 2000. Under this scheme, certificates are awarded only to motor workshops with trained mechanics, proper equipment and procedures, and quality assurance checks for the maintenance of diesel-driven vehicles to prevent black smoke emission. To date, more than 30 workshops have been certified under the scheme.

The chassis dynamometer smoke test (CDST) has been used to test diesel vehicles that have been booked for smoke emission in Singapore since 1 September 2000. Results have shown that the CDST is an effective test for weeding out smoky diesel vehicles. With effect from 1 January 2007, all diesel-driven vehicles are required to undergo the CDST during their mandatory periodic inspections, in place of the existing free-acceleration smoke test (FAST). The CDST is a more representative test method as compared to the FAST, as it measures smoke emission level of a diesel-driven vehicle under actual driving conditions. The CDST system is able to place a diesel vehicle under simulated “load” conditions to measure its smoke emission during on-the-road driving. This is a more accurate reflection of the actual performance of a diesel-driven vehicle on the road.

POLLUTION CONTROL

Up to 31 December 2006, 69,361 vehicles were sent for CDST testing and an average of about 75% of the vehicles tested was able to pass the CDST on the first attempt.

Control Of Automotive Fuel Quality

The quality of fuel used by vehicles in Singapore is controlled because of its impact on vehicular emissions. Unleaded petrol was introduced in January 1991 and leaded petrol was phased out on 1 July 1998. To reduce smoke emission from diesel vehicles, the permissible sulphur content in diesel was reduced from 0.3% to 0.05% by weight on 1 March 1999. Smoke emission from diesel-driven vehicles is harmful as the fine particulate matter present in smoke has a significant health impact on people. The reduction of the sulphur content in diesel had paved the way for the introduction of the more stringent Euro II emission standards on 1 January 2001. A further reduction of the sulphur content in diesel to 0.005% by weight was effected in December 2005 to pave the way for the smooth implementation of Euro IV emission standard for new diesel vehicles, which took effect from 1 October 2006.

CNG Vehicles

Natural gas is a cleaner source of energy than petrol or diesel. Vehicles powered by natural gas emit little or no pollutants such as fine particulates, sulphur dioxide, carbon monoxide and hydrocarbons. Natural gas vehicles also emit less carbon dioxide than petrol-driven or diesel-driven vehicles. The use of natural gas vehicles will therefore reduce the emission of air pollutants as well as carbon dioxide.

In April 2002, NEA and its project partners, SembGas and SBS Transit, launched the first CNG refuelling station on Jurong Island and the pilot project to introduce CNG buses in Jurong.

Between March 2003 to March 2004, taxi companies have also conducted a pilot project involving road tests on 10 CNG taxis. SMART Taxi Company registered and deployed 102 CNG Mercedes taxis by December 2006 with plans to operate more CNG taxis in the future . NEA approved $2 million under IES Fund to support SMART in its project to set up CNG refuelling stations on mainland Singapore.

CNG refueling station in Jurong Island

Mercedes CNG Taxis

Tax Incentives

In 2005, the government revised the various tax incentives to promote the early introduction of Euro IV diesel vehicles, CNG vehicles and green vehicles. The incentives are summarised in the table below:

Vehicle Type	Tax incentives / changes for vehicles registered from			
	1 June 2004 to 31 December 2005	1 January 2006 to 30 September 2006	1 October 2006 to 31 December 2007	1 January 2008 to 31 December 2009
CNG, Hybrid and Electric Passenger Cars	ARF rebate of 20% OMV 20% road tax rebate (CNG and electric cars) and 10% road tax rebate (hybrid cars) until 31 Dec 2005	ARF rebate of 40% OMV	ARF rebate of 40% OMV	ARF rebate of 40% OMV
Euro IV Diesel Passenger Cars	Special tax equivalent to 6 times its road tax until 31 Dec 2005 Special tax equivalent to 4 times its road tax from 1 Jan 2006	Special tax equivalent to 4 times its road tax	Special tax equivalent to 4 times its road tax	Special tax equivalent to 4 times its road tax
CNG Taxis	ARF rebate of 100% OMV 20% road tax rebate until 31 Dec 2005 Special tax exempt until 31 Dec 2009	ARF rebate of 80% OMV Special tax exempt until 31 Dec 2009	ARF rebate of 40% OMV Special tax exempt until 31 Dec 2009	ARF rebate of 40% OMV Special tax exempt until 31 Dec 2009
Euro IV Diesel Taxis	ARF rebate of 100% OMV	ARF rebate of 80% OMV	ARF rebate of 40% OMV	No ARF rebate
CNG Buses & Commercial Vehicles (CVs)	ARF rebate of 5% OMV 20% road tax rebate (CNG vehicles) until 31 Dec 2005, pegged to that of petrol-driven equivalents as of 1 Jan 2006*	ARF rebate of 5% OMV Road tax pegged to that of petrol-driven equivalents	ARF rebate of 5% OMV Road tax pegged to that of petrol-driven equivalents	ARF rebate of 5% OMV Road tax pegged to that of petrol-driven equivalents
Hybrid and Electric Buses & Commercial Vehicles (CVs)	No rebate	Road tax pegged to that of petrol-driven equivalents	Road tax pegged to that of petrol-driven equivalents	ARF rebate of 5% OMV Road tax pegged to that of petrol-driven equivalents
Euro IV Diesel Buses & CVs	ARF rebate of 5% OMV	ARF rebate of 5% OMV	ARF rebate of 5% OMV	No ARF rebate

* Road tax of petrol-driven buses and commercial vehicles are 20% lower than their diesel-driven equivalents. Thus, effectively there is no change to the road tax payable by CNG buses and commercial vehicles from 2005 to 2006.

Table 6
Survey Results of Smoky Vehicles on Singapore Roads

Origin & Type Of Smoky Vehicle	% of Smoky Vehicles in 2005	% of Smoky Vehicles in 2006
Singaporean		
(i) Motor vehicles	0.4 %	0.4%
(ii) Motorcycles	0.7 %	0.7%
Malaysian		
(i) Motor vehicles	1.7 %	1.6 %
(ii) Motorcycles	3.0 %	3.0%

Table 7
Enforcement of Smoky Vehicles on Singapore Roads

Origin & Type Of Smoky Vehicle	No. of Enforcement in 2005	No. of Enforcement in 2006
Singaporean		
(i) Motor vehicles	3,589	3,314
(ii) Motorcycles	4,414	3,834
Malaysian		
(i) Motor vehicles	2,767	2,671
(ii) Motorcycles	3,236	2,411

Table 8
Summary Of Emission Standards For Motor-Vehicles

Type of Vehicle	Emission Standard	Implementation
Petrol-driven vehicles	All new petrol-driven vehicles are required to comply with the EC Directive 96/69/EEC.	1 January 2001
Diesel-driven vehicles	All new diesel-driven passenger cars are required to comply with the EC Directive 96/69/EEC.	1 January 2001
	All new light commercial vehicles 3.5 tonnes or below are required to comply with the EC Directive 96/69/EC.	1 January 2001
	All new heavy duty vehicles exceeding 3.5 tonnes are required to comply with the EC Directive 91/542/EEC Stage II.	1 January 2001
	EU Directive 98/69/EC-B(2005) for vehicle 3.5 tonnes or below (EURO IV)	
	EU Directive 1999/96/EC-B1(2005) for vehicles greater than 3.5 tonnes (EURO IV)	1 October 2006
Motorcycles & scooters	All new motorcycles and scooters are required to comply with the EC Directive 97/24/EC.	1 July 2003

POLLUTION CONTROL

Water Pollution Control

Overview

Water quality of the inland and coastal waters remained good. All inland waters supported aquatic life.

Acts And Regulations

The Environmental Pollution Control Act (EPCA) and the Sewerage and Drainage Act (SDA) and their regulations are used to control the discharge of wastewater from domestic, industrial, agricultural and other premises into public sewers and watercourses. The Environmental Pollution Control (Trade Effluent) Regulations (TER) and the Sewerage and Drainage (Trade Effluent) Regulations stipulate the standards for trade effluent discharged into watercourses and public sewers respectively. The discharge standards stipulated in both the regulations are in **Appendix 7**.

Industries may apply for permission to discharge trade effluent, which contain biodegradable pollutants, as measured by biochemical oxygen demand (BOD) and total suspended solids (TSS), into the public sewers on payment of a tariff when the BOD and TSS exceed the stipulated limits in the TER. The current schedule of trade effluent tariffs is in **Appendix 8**. Apart from the above two parameters (BOD and TSS), industries must comply with the discharge standards of the TER for all other parameters. Where necessary, they shall install on-site treatment plants to treat their effluent to the stipulated standards.

Industries generating large quantities of acidic effluent are required to install a pH monitoring and shut-off control system to prevent the discharge of acidic effluent into the public sewer. This helps to protect the sewerage system against corrosion and damage.

In general, industries with the potential to cause pollution are located in designated industrial estates such as Jurong/Tuas Industrial Estates, which are outside water catchments and served by public sewers. Only clean or light industries are allowed within water catchments but must be sited in proper industrial estates served by public sewers.

Sampling Of Trade Effluent

During the year, PCD collected 260 trade effluent samples for analysis. Of these, 4 samples or about 1.5 % failed to comply with the stipulated standards. PCD required the offenders to take measures to prevent recurrence and initiated enforcement action against those found exceeding the standards.

Trade Effluent Treatment Facilities

Industries are required to install pre-treatment facilities to treat their trade effluent that exceeds the limits of discharge stipulated in the TER. The pre-treatment plants would have to be installed prior to the commissioning of the factories.

During the year, CBPU approved 42 trade effluent treatment facilities. A breakdown of the treatment facilities approved is in **Table 9**.

Table 9
Trade Effluent Treatment Facilities Approved

Treatment Facility/Method	No. Approved in 2006	Total No. as at 2006
Oil interceptor	19	1037
Balancing tank	2	399
Sedimentation	0	206
Neutralisation	11	305
Chemical	9	635
Activated sludge oxidation	1	20
Biological filtration	0	23
Ion exchanger/RO	0	1
Activated carbon adsorption	0	17
Total	**42**	**2643**

Emergency Response Plan For Oil/Chemical Spills On Land

During the year, there was no major incident of chemical spill on land.

Complaints And Incidents Of Water Pollution

PCD received 116 complaints of water pollution during the year, of which 9 were substantiated. Most of the incidents were due to illegal discharge or spillage of industrial wastewater or chemical/oil into drains. PCD required the offenders to clean up the pollution and legal action was taken against them for causing pollution.

A breakdown of the water pollution complaints and incidents in 2005 and 2006 is in **Table 10**.

Table 10
Complaints and Incidents of Water Pollution

Type Of Water Pollution	No. of Complaints		No. of Incidents	
	2006	2005	2006	2005
Chemical/Oil	37	62	5	15
Industrial wastewater	52	54	3	4
Farm wastes	0	0	0	0
Domestic wastewater	20	8	1	1
Others	7	7	0	0
Total	116	131	9	17

Hazardous Substances and Toxic Wastes Control

Overview

PCD controls the import, transport, sale, storage and use of hazardous substances. PCD also controls the disposal of toxic industrial wastes. The controls implemented ensure the safe and proper management of hazardous substances and toxic industrial wastes in Singapore.

Besides regulatory controls, PCD also works with international organisations, relevant government agencies and industry groups to organise seminars and briefings to help companies and traders manage hazardous substances and toxic industrial wastes safely.

Hazardous installations, which store hazardous substances in bulk quantities, are also required to carry out safety audits to systematically identify and rectify weaknesses in their management systems and practices of handling hazardous substances.

POLLUTION CONTROL

Hazardous Substances Control

The import/export, transport, sale, storage and use of hazardous substances are controlled under the Environmental Pollution Control Act and the Environmental Pollution Control (Hazardous Substances) Regulations.

Any person or company planning to engage in such activities must obtain a Hazardous Substances Licence or Permit from PCD. The chemicals controlled under the Environmental Pollution Control Act are listed in **Appendix 9**.

During the year, PCD issued **659** Hazardous Substances Licences and **951** Hazardous Substances Permits. PCD also processed electronically **70,590** inward/outward declarations for the import/export of chemicals and chemical products through the TradeNet computerised network system.

Also, under the Environmental Pollution Control (Hazardous Substances) Regulations, PCD's approval is required for the transportation of hazardous substances in quantities exceeding the limits stipulated in the Regulations. The specified limits for each hazardous substance are listed in **Appendix 10**.

During the year, PCD issued **193** transport approvals. Requirements on packaging, maximum allowable load, route, timing and emergency plans were imposed to ensure the safe transportation of hazardous substances.

Surprise road checks were also conducted jointly with the Land Transport Authority and the Singapore Civil Defence Force (SCDF) to ensure that companies transporting hazardous substances complied with the safety requirements imposed.

During the year, PCD conducted **999** surprise inspections to audit the records of hazardous substances kept by the holders of Hazardous Substances Licences and Permits. Of these, **58** were not in order. PCDissued written warnings to **55** offenders and gave a verbal warning to 1 offender.

Application of Hazardous Substances Licence/Permit via the Internet

Applicants can submit an electronic application via the Internet, and check the status of their electronic applications at their own convenience.
The website address is: http://app1.env.gov.sg/pcls/controller?event=WELCOME

All the necessary guidance and information for filling up the electronic application are available on-line to applicants. Applicants need not travel to PCD to collect application forms, seek clarification or submit application forms.

Training For Tanker Drivers

Drivers of road tankers and tank containers carrying hazardous substances and dangerous petroleum products are required to undergo a special one-day training course jointly organised by Singapore Civil Defence Force (SCDF) and PSA Institute. Those who have successfully completed the course is granted a HAZMAT Transportation Driver Permit (HTDP). All drivers conveying controlled hazardous substances listed in the Environmental Pollution Control (Hazardous Substances) Regulations are required to possess a HTDP that is valid for 2 years. They are also required to undergo a one-day course every 2 years as a form of refresher training for the renewal of their HTDP.

POLLUTION CONTROL

Toxic Industrial Wastes Control

The Environmental Public Health (Toxic Industrial Waste) Regulations require all toxic industrial waste collectors to be licensed. Approval is also required to transport toxic industrial wastes exceeding the quantities stipulated in the Regulations.

The types of toxic industrial wastes controlled under the Regulations are listed in **Appendix 11**.

During the year, PCD granted and renewed licences to 159 toxic industrial waste collectors to carry out treatment, reprocessing and disposal of toxic wastes. PCD also required licensed toxic waste collectors to obtain approval to transport toxic industrial wastes that exceeded specified quantities.

Control of Tanker Cleaning Activities

Since 4 April 1993, Singapore has implemented a scheme to tighten control on tanker cleaning activities and the disposal of sludge and slop oil generated from tanker cleaning activities. Under the scheme, the Maritime and Port Authority (MPA) will only issue permits to contractors registered with PCD to carry out tanker cleaning activities in designated areas.

Sludge and slop oil generated from tanker cleaning activities are required to be sent to approved reception facilities for treatment and disposal.

Also under the scheme, any ship or vessel entering Singapore in a "clean condition" for repairs would be allowed entry only if it could show proof that the sludge from its tanker cleaning activities had been disposed of at approved facilities.

During the year, 41 companies were registered to carry out tanker cleaning activities. About 25,600 tonnes of oily sludge were sent to the approved reception facilities for treatment and disposal.

Collection Of Industrial Waste Chemicals

The main types of industrial waste chemicals include waste solvents, spent etchants, acids, alkalis and expired chemicals. PCD encourages the reuse, recycle and recovery of waste chemicals to reduce the amount of wastes that require treatment and disposal.

During the year, licensed collectors collected about 413,000 tonnes of waste chemicals from local industries.

POLLUTION CONTROL

Control of Biohazardous Wastes

Biohazardous wastes from hospitals and polyclinics are segregated at source and stored in colour-coded plastic bags. The wastes are then put in secured containers and collected by 2 licensed biohazardous waste disposal companies for disposal in dedicated high temperature incinerators.

For the year 2006, about 17,200 cubic metres of biohazardous wastes were collected and disposed of locally by licensed biohazardous waste disposal companies.

Nuclear Science and Technology Unit (NSTU)

Singapore signed the International Atomic Energy Agency (IAEA)'s Additional Protocol (AP) to the Comprehensive Safeguard Agreement (CSA) in September 2005. The Additional Protocol is a supplementary agreement that builds on the agreements that non-nuclear-weapon state parties to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) have individually concluded with the IAEA. It was developed in 1997 to strengthen IAEA's ability to verify non-nuclear-weapon state parties' compliance with the NPT. The Ministry of the Environment and Water Resources (MEWR) and NEA have been appointed as the Lead Agency and the National Authority on the AP, respectively.

NEA is a member of the Working Group on the Implementation of the Additional Protocol (IMAP), chaired by MEWR, comprising members from AGC, MTI, Customs, HSA, MHA and MFA to oversee the relevant preparations leading to Singapore's ratification of the AP. A team of IAEA experts visited Singapore from 4-8 December 2006 to provide guidance and assistance in our preparatory works.

NEA also served as the Regional Co-operative Agreement (RCA) Coordinator for Singapore and the national focal point to IAEA's Technical Cooperation Department (TCD). The Regional Co-operative Agreement is an intergovernmental agreement for East Asia & Pacific region, under the auspices of the

IAEA, in which the Government Parties undertake efforts to promote and co-operate on research, development (R&D) and training projects in nuclear science and technology.

An NEA delegation visited IAEA in September 2006 to discuss the details of a Technical Cooperation (TC) Project to develop Singapore's human resource in the area of Nuclear Science and Technology. IAEA had in December 2006 approved the TC Project for implementation in 2007-2008.

The topic of nuclear safety and security is relatively new to the NEA, and we would greatly benefit from inputs and guidance from experts in the field. It is in this context that NEA wishes to set up an Advisory Committee on Nuclear Science and Technology.

POLLUTION CONTROL

Terrain Decontamination

Terrain decontamination is a new capability which the NEA is building up. In the event a toxic chemical is released, the Singapore Civil Defence Force (SCDF) will carry out the initial response to save lives and mitigate the source of release which may also involve preliminary site decontamination to contain the affected area. Once the area is secure, NEA will move in to carry out terrain decontamination to restore the affected area to normalcy as soon as possible.

Environmental Noise Management

Industrial Noise Control

PCD controls noise from factories by siting them in designated industrial estates and where appropriate, requiring them to implement noise abatement measures to comply with allowable boundary noise limits. PCD conducts regular checks on factories to ensure noise control equipment is operated and maintained properly. The boundary noise limits for factory premises are at **Appendix 12**.

During the year, PCD received 388 complaints of noise pollution from factories, of which 12 were substantiated incidents. The main causes of these incidents were improper siting of mechanical equipment and/or poor maintenance of mechanical equipment. The owners or occupiers were required to take remedial action to reduce noise to comply with the allowable noise limits.

Traffic Noise from Expressways

NEA strategy is to reduce traffic noise from expressways through the use of cost-effective measures.

In land-scarce and highly urbanised Singapore, some degree of traffic noise pollution is inevitable. NEA, together with the Ministry of Transport (MOT) and the Ministry of National Development (MND), use the following cost-effective measures to alleviate the problem:

a) tightening noise emission standards for vehicles;
b) using noise-absorptive porous asphalt material for road surfacing;
c) siting multi-storey carparks, electrical substations or other non-residential structures to screen traffic noise from new residential buildings;
d) setting a minimum set back distance for new residential buildings from expressways; and
e) designing new flat layouts such that living rooms and bedrooms are located away from traffic noise

POLLUTION CONTROL

Construction Noise Control

PCD enforces The Environmental Pollution Control (Control of Noise at Construction Sites) Regulations to control noise pollution from construction sites. On 1 October 2001, the Regulations were amended to incorporate more stringent permissible noise limits for noise generated at night. The noise limits are applicable to construction sites that commenced on or after 1 October 2001 and are within 150 m of residential premises. The permissible noise limits for construction sites are at **Appendix 13**.

The regulations require contractors to schedule their construction activities and to take noise abatement measures to comply with the permissible noise limits. However, the Regulations do not restrict the working days or hours of construction sites.

During the year, PCD received 6,160 complaints of noise pollution against construction sites. Of these, 267 complaints against 92 construction sites were substantiated, i.e. the noise levels had exceeded the permissible noise limits. The main cause of these substantiated cases was from concreting work carried out late

at night. The contractors were prosecuted and reminded to reschedule their activities to ensure compliance with the permissible noise limits.

3

Environmental Monitoring

ENVIRONMENTAL MONITORING

Overview

Singapore has, over the years, managed to maintain an impressive environmental record despite the increase in industrialisation and urbanisation.

Our success in keeping the environment clean and safe is partly due to regular monitoring and assessment of the quality of ambient air and water. The results have helped in the development and review of pollution control measures.

PCD outsourced its laboratory-based functions of environmental quality monitoring to the private sector in 2006. This is in line with the Government's Best Sourcing initiative for the public sector to market-test non-core functions and outsource those that the private sector can deliver more cost-effectively.

Ambient Air Monitoring

The ambient air quality in Singapore is routinely monitored through the Telemetric Air Quality Monitoring and Management System (TAQMMS).

The system, which comprises 13 remote air monitoring stations linked to a Central Control System (CCS) via dial-up telephone lines, provides an efficient means of obtaining air quality data. The locations of the monitoring stations are shown in **Chart 1**.

Eleven of the stations monitor ambient air quality and two stations measure roadside air quality. Automatic analysers and equipment are deployed at the stations to measure the concentrations of major air pollutants such as sulphur dioxide, oxides of nitrogen, carbon monoxide, ozone and respirable suspended particles (PM10).

In 2006, the air quality on some days was affected by transboundary smoke haze from Indonesian land and forest fires. The PM10 levels exceeded the USEPA 24-hour standard on 3 days due to the impact of the transboundary smoke haze. The overall average levels of sulphur dioxide, nitrogen dioxide, carbon monoxide and ozone were within the ambient air quality standards established by the United States Environmental Protection Agency (USEPA). The USEPA ambient air quality standards are summarised in **Appendix 14** .

The Pollutant Standards Index (PSI), an indicator of air quality developed by the USEPA, was 'Good' for 85 %, 'Moderate' for 14 % and 'Unhealthy' for 1 % of the days measured during 2006 as shown in **Table 11** . The last time the PSI went into the "unhealthy" range was in 1997.

Chart 1
Location of Air Quality Monitoring Stations

Table 11
Summary of Pollutant Standards Index (PSI)

Year	Days	No. of Days in which the PSI was Classified as			Percentage		
		Good (0-50)	Moderate (51-100)	Unhealthy (101-200)	Good (0-50)	Moderate (51-100)	Unhealthy (101-200)
2006	365	311	51	3	85%	14%	1%
2005	365	322	43	0	88%	12%	0

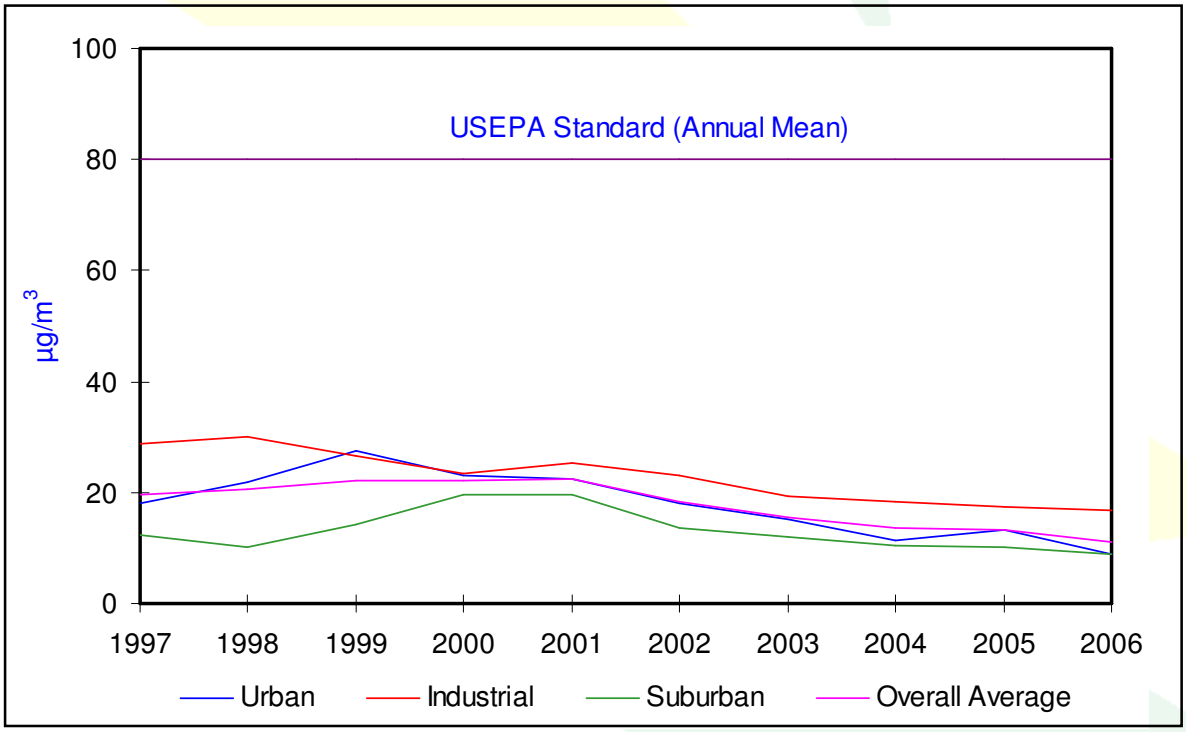
Sulphur Dioxide

Sulphur dioxide is an undesirable by-product from the combustion of sulphur-containing fuels and to a lesser extent, from petroleum refining processes.

Prolonged exposure to high concentrations of sulphur dioxide increases the risk of contracting respiratory diseases.

The annual average levels of sulphur dioxide are shown in **Chart 2**. In 2006, the annual average level was 11 µg/m^3, which was within the USEPA standard of 80 µg/m^3.

Chart 2
Annual Average Levels Of Sulphur Dioxide



Nitrogen Dioxide

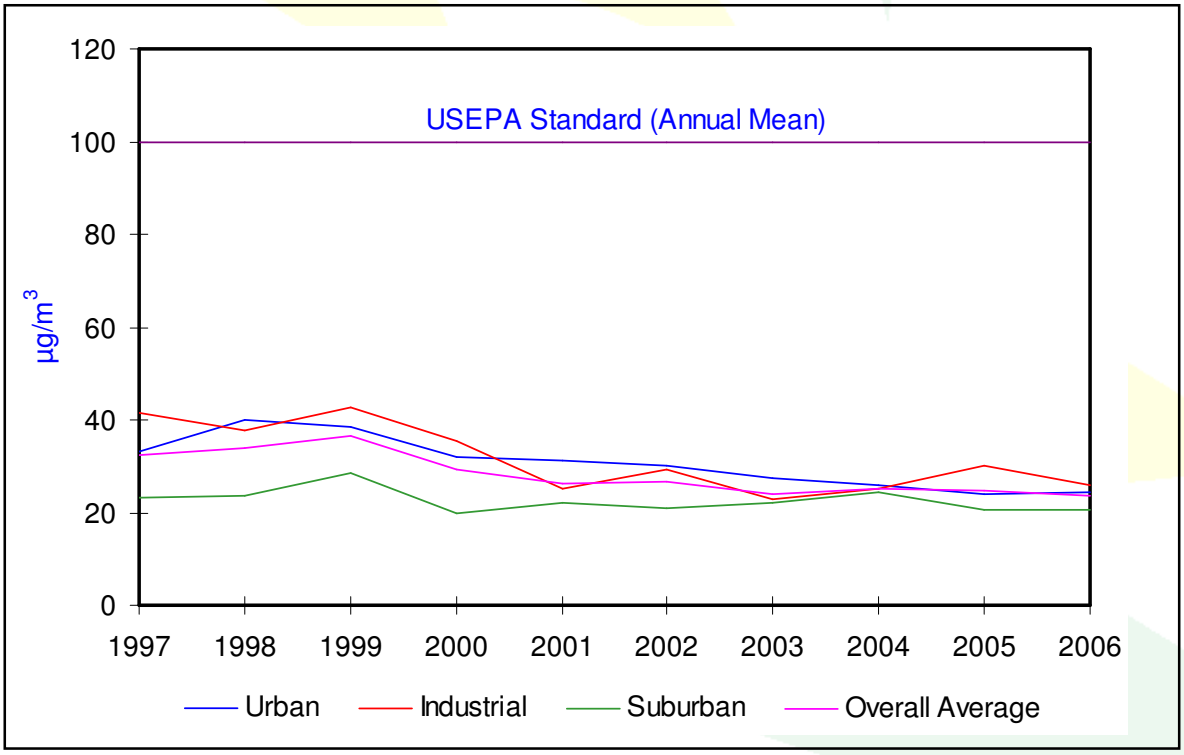
Nitric oxide accounts for most of the nitrogen oxides emitted by man-made sources. Nitric oxide is oxidised in the atmosphere to form nitrogen dioxide.

High levels of nitrogen dioxide increase the risk of respiratory infection and impair lung functions in asthmatics.

The annual average levels of nitrogen dioxide in the ambient air are shown in **Chart 3**.

In 2006, the annual average level of nitrogen dioxide was 24 µg/m^3, well within the USEPA standard of 100 µg/m^3.

Chart 3
Annual Average Levels of Nitrogen Dioxide



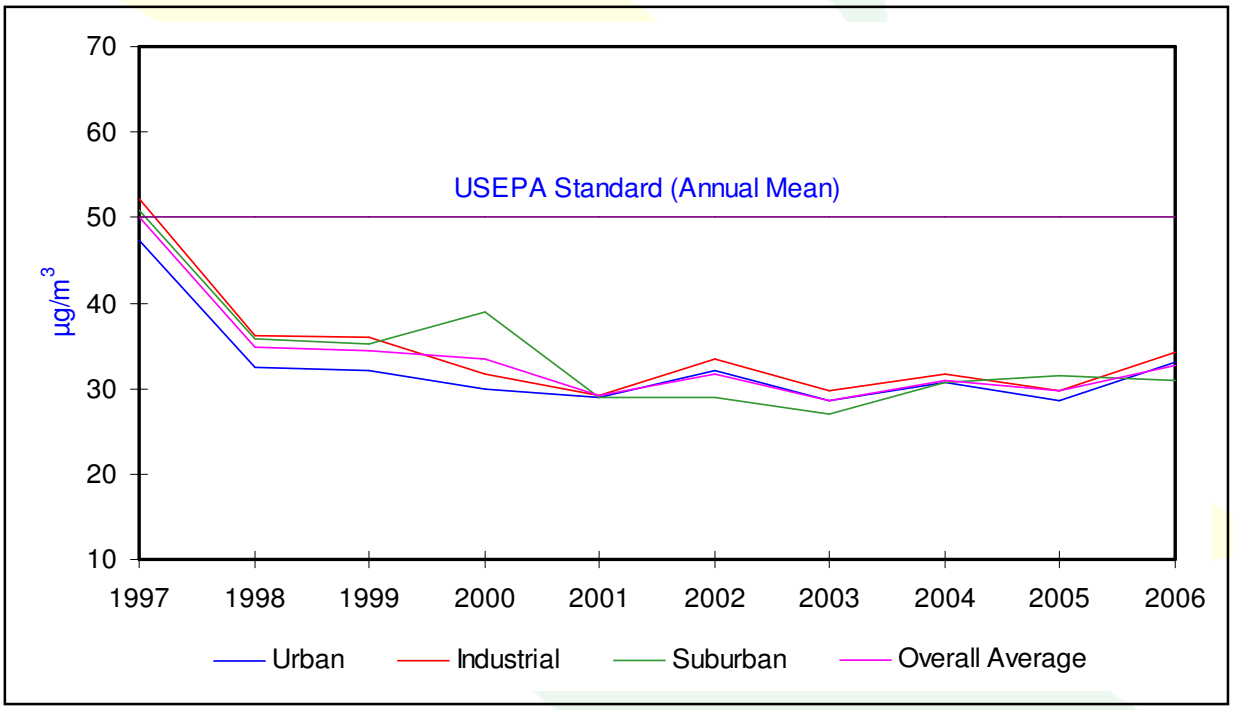
Respirable Suspended Particles (PM10)

Respirable suspended particles (or PM10) refer to particulate matter of size 10 µm and below. These particles have health implications as they are able to penetrate into the deeper regions of the respiratory tract. When present in very high amounts, the particles cause breathing and respiratory problems, and aggravate existing respiratory and cardiovascular diseases.

The 2006 PM10 level of 33 µg/m^3 was within the USEPA standard of 50 µg/m^3. **Chart 4** shows the annual average levels of PM10 in the ambient air

Chart 4

Annual Average Levels of Respirable Suspended Particles (PM10)



(Note: 1997 and 2006 PM10 levels were affected by transboundary smoke haze from plantation and forest fires in Indonesia)

Low-Level Ozone

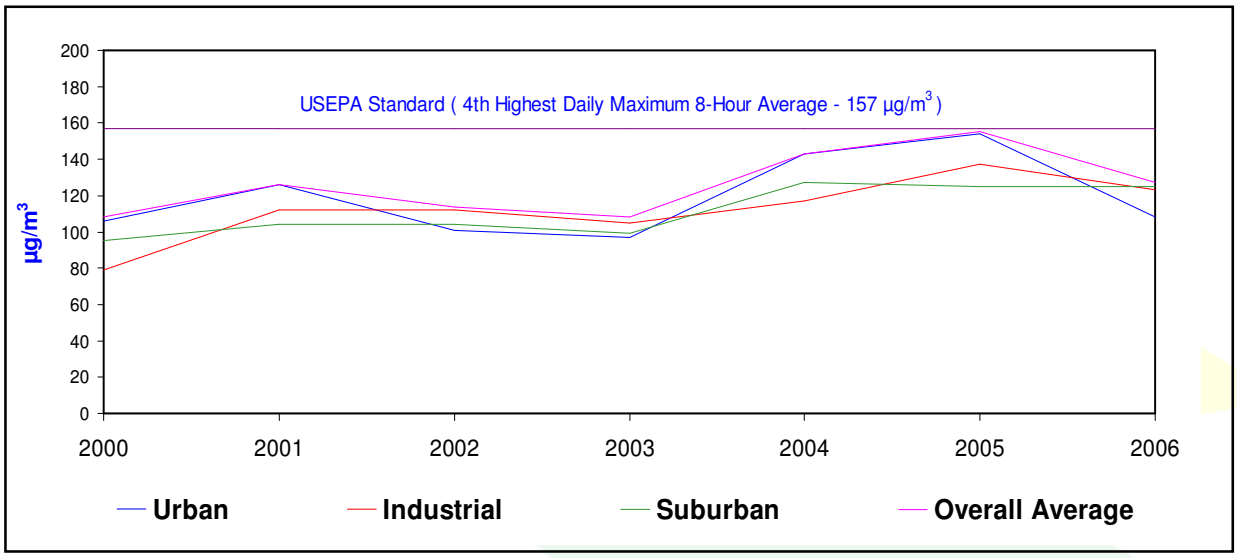
Ozone in the stratosphere is desirable as it protects life on earth by absorbing much of the harmful ultraviolet radiation from the sun.

However, ozone occurring in the lower atmosphere is a health hazard. Ozone can severely irritate eyes, mucous membranes and the respiratory system in humans as well as cause damage to plants.

Low-level ozone may be produced by the complex reactions of nitrogen oxides and volatile organic compounds catalysed by actinic radiation, or may result from the intrusion of stratospheric ozone into the troposphere.

In 2006, the 8-hour average ozone level was within the USEPA standard of 157 µg/m^3 . The trends of the ozone levels are shown in **Chart 5**.

Chart 5
Average Ozone Levels



(Note: Chart shows 4th highest daily maximum 8-hr averages)

Carbon Monoxide

Carbon monoxide is a colourless and odourless gas with a higher affinity than oxygen for the haemoglobin in the blood. Hence, when it is inhaled, it can deprive body tissues of oxygen.

Exposure to moderate levels of carbon monoxide may cause nausea and impair vigilance. In excessive doses, it can cause death through asphyxiation.

The sources of carbon monoxide range from vehicular emissions, cigarette smoke to incomplete combustion of fuels. Vehicular emission usually accounts for most of the carbon monoxide in the air.
Carbon monoxide is measured at both ambient and roadside air monitoring stations. The 2006 ambient 8-hour average carbon monoxide level was 0.5 mg/ m^3 and the 2nd maximum 8-hour average level was 2.6 mg/m^3. This level was well within the USEPA standard of 10 mg/m^3 for the 2nd maximum 8-hour average. The roadside 8-hour average levels of carbon monoxide are shown in **Table 12**.

Table 12
Roadside Average Carbon Monoxide Levels (mg/m^3) in 2006

Monitoring Station	Time Interval (Hours)					
	0000 - 0800		0800 - 1600		1600 – 2400	
	2006	2005	2006	2005	2006	2005
Chin Swee	0.8	0.8	0.8	0.8	0.9	0.9
Ngee Ann Polytechnic	1.2	1.1	1.0	0.9	1.2	1.0

Pollution From Vehicles

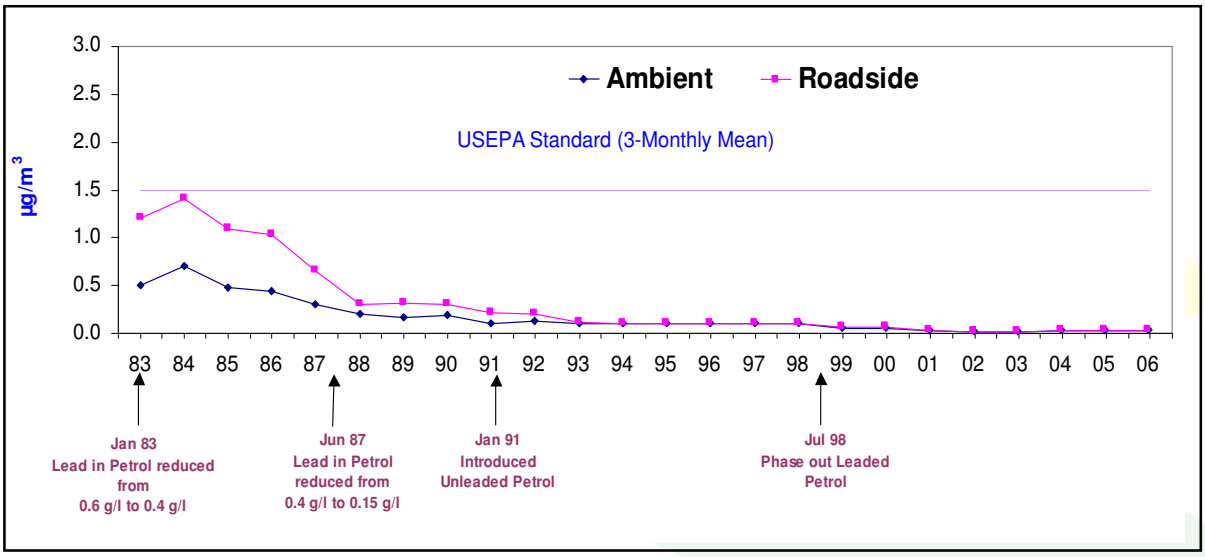
Lead compounds, such as tetra-ethyl lead and tetra-methyl lead, have for many years been added to petrol as anti-knock agents. The combustion of leaded petrol results in the emission of lead particulates into the air. If imbibed in large quantities, lead can cause irreversible damage to the brain and other organs.

Foetuses and children are particularly sensitive to the deleterious effects of lead as their nervous systems are still developing.

Lead levels in petrol had progressively been reduced since the 1980s and, in January 1991, unleaded petrol was introduced in Singapore. On 1 July 1998, leaded petrol was phased out.

The efficacy of these measures in reducing lead concentrations in the air is evident from **Chart 6**. From roadside levels of as high as 1.4 µg/m^3 in 1984, the lead levels have stabilised at around 0.1 µg/m^3 since 1992. The lead levels remained at < 0.1 µg/m^3 in 2006. The USEPA standard for three-monthly average lead level is 1.5 µg/m^3.

Chart 6
Lead Levels (1983 to 2006)



ENVIRONMENTAL MONITORING

Water Monitoring

Overview

PCD regularly monitors the water quality of various inland water bodies and coastal areas. The monitoring points are shown in **Charts 7** and **8**.

Water Quality in Water Catchment Areas

The water quality of 33 streams and 14 ponds in the water catchment areas is monitored quarterly.

Water quality of the 14 reservoirs within the water catchment areas is jointly monitored by PCD and PUB.

The water quality, based on the measured levels of dissolved oxygen (DO), biochemical oxygen demand (BOD) and total suspended solids (TSS) remained good in 2006 The monitoring data are shown in **Table 13** .

Water Quality in Non-Water Catchment Areas

Water quality of the 20 rivers and streams in non-water catchment areas is monitored quarterly. Physical, chemical and microbiological parameters are analysed to assess the water quality. Results of the monitoring, as given in **Table 13**, revealed that the water quality of the rivers and streams was good.

Chart 7

Locations of Non-Catchment and Seawater Sampling Points

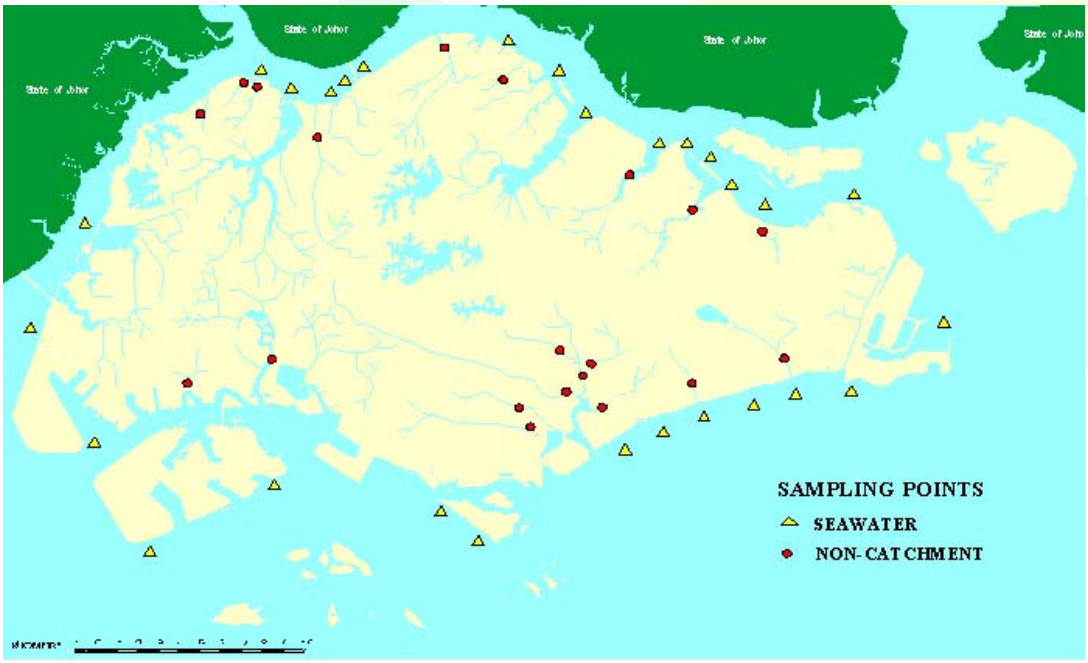


Chart 8
Locations of Catchment Sampling Points

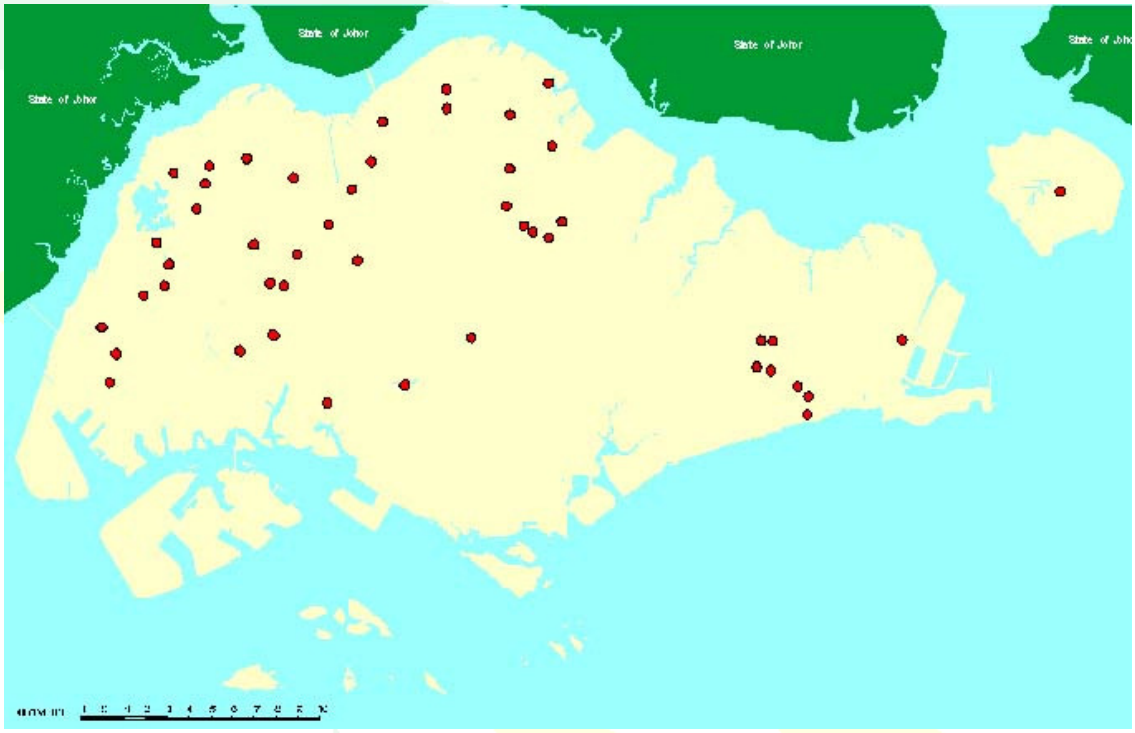


Table 13
Monitoring Results of Inland Waters

Parameter Monitored		Water Catchment Streams (Percentage Of Time)	Non-Water Catchment Rivers/Streams (Percentage Of Time)
Dissolved Oxygen (> 2 mg/l)	2006	100 %	94 %
	2005	100 %	95 %
Biochemical Oxygen Demand (< 10 mg/l)	2006	100 %	89 %
	2005	95 %	92 %
Total Suspended Solids (< 200 mg/l)	2006	99 %	100 %
	2005	98 %	100 %

Monitoring Of Coastal Waters

Water samples are collected monthly from 16 sampling points along the Straits of Johor and 12 sampling points along the Straits of Singapore. These samples are subjected to physical, chemical and microbiological examinations.

Table 14 gives the monitoring results for the coastal waters.

Table 14
Monitoring Results of Coastal Waters

Parameter		Straits of Johor East (Percentage of Time)	Straits of Johor West (Percentage of Time)	Straits of Singapore (Percentage of Time)
Faecal Coliform Count	2006	92 %	70 %	93 %
(<1,000 per 100 ml)	2005	93 %	79 %	100 %

4

Resource Conservation

RESOURCE CONSERVATION

Strategies

While Singapore enjoyed strong economic growth over the past 30 years, the amount of waste disposed of increased six times. At that rate, we would need to build a new incineration plant every 5-7 years and a new landfill the size of the offshore Semakau Landfill every 25-30 years. This is not sustainable.

Our strategies for sustainable waste management and moving towards a zero-waste and zero-landfill society are summarized as follow:

a) Prevent waste through waste minimisation at source.

b) Reuse and recycle incinerable waste that would otherwise be sent to the incineration plants;

c) Reduce waste volume through waste-to-energy incineration;

d) Reuse and reduce non-incinerable waste otherwise sent to the landfill

Energy fuels the growth of our economy. Every aspect of modern life in Singapore, from our home to our workplace to our shopping malls, is derived from or driven by energy in one way or another. However, almost all of our energy needs come from fossil fuel, which is finite and non-renewable. Furthermore, we have to import all our energy needs. Ultimately, the burning of fossil fuels to meet our energy needs results in the emission of air pollutants and carbon dioxide, a greenhouse gas known to contribute to climate change.

The goals set out to mitigate the impacts of energy use are as follows:

a) To be energy efficient – i.e. to get the maximum output from the consumption of energy

b) To be carbon efficient – i.e. to get the maximum energy output from every unit of fossil fuel burned

c) To be eco efficient – i.e. to minimise impact on the environment from the emissions of particulates and other pollutants when fossil fuels are burned.

Overview on Waste Minimisation and Recycling Programmes

State of Waste Recycling

Since the early 1990s, Singapore has been actively promoting waste minimisation and recycling to reduce the waste disposed of at the incineration plants and landfill. In 2006, the overall rate of recycling increased to 51 % as compared to 49 % in 2005.

Table 15 provides the details on the waste disposal and recycling rates for 2006.

Table 15
Waste Statistics and Recycling Rates for 2006

Waste Type	Waste Disposed of (tonne)	Total Waste Recycled (tonne)	Total Waste Output (tonne)	Recycling Rate (%)
Food waste	498,000	44,700	542,700	8
Paper/Cardboard	544,900	571,400	1,116,300	51
Plastics	579,000	77,800	656,800	12
Construction Debris	15,000	604,000	619,000	98
Wood/Timber*	142,000	81,700	223,700	37
Horticultural* Waste	144,000	87,000	231,000	38
Ferrous Metals	68,500	657,400	725,900	91
Non-ferrous Metals	16,000	70,700	86,700	82
Used Slag	53,600	417,000	470,600	89
Sludge	126,800	0	126,800	0
Glass	56,600	6,400	63,000	10
Textile/Leather	87,700	4,100	91,800	4
Scrap Tyres	4,500	19,400	23,900	81
Others (stones, ceramics & rubber)	227,000	15,300	242,300	6
Total:	2,563,600	2,656,900	5,220,500	51

* Includes 34,000 tonnes used as fuel in cogen plant

Waste Management and Recycling Industry

There are some 450 companies in the waste management and recycling industry in Singapore. They range from small operators to multi-national companies. Most of the companies are in the waste collection business with the rest involved in the waste sorting and recycling business.

The Waste Management and Recycling Association of Singapore (WMRAS), was established on 8 August 2001. It has about 70 members. The association plays an important role in helping the local waste management and recycling industry to grow and develop.

In 2006, WMRAS together with the Asian Productivity Organisation (APO) and SPRING co-organised the Eco-Product International Fair (EPIF) 2006, which was held from 31 October to 2 November 2006. This was the first time the EPIF had come to Singapore. The fair had more than 100 exhibitors from 14 countries and attracted over 34,000 visitors.

WMRAS would also be organising the International Solid Waste Association (ISWA) Congress 2008 in Singapore. ISWA is headquartered in Copenhagen, Denmark. This would be the second time an ISWA Congress is held in Asia. WMRAS also participated in various programmes such as NEA's Clean & Green Week, and Recycling Day 2006.

Eco-Product International Fair 2006

RESOURCE CONSERVATION

National Recycling Programme

In April 2001, the NEA launched the National Recycling Programme (NRP) for households in Housing & Development Board (HDB) and private residential estates. Under this programme, public waste collectors (PWCs) licensed by NEA provide fortnightly door-to-door collection of recyclables. Each household is provided with either a recycling bag or bin to store their recyclables such as waste paper, metal drink cans, glass bottles, old clothing, drink cartons and plastic bottles. Residents put out their recycling bags or bins outside their doors for collection on scheduled collection days.

This was followed in October 2002 by the introduction of the Quality of Service (QOS) standards and permit system for a reliable and consistent recyclable collection service. A permit is attributed to each of the 22 precincts to ensure orderliness in collection. In order to ensure that permit holders meet the standards, demerit points are issued for any lapse in their service standards. NEA officers conduct audit checks on the performance of the permit holders.

The programme has achieved a participation rate of 59% in 2006, up from 33% in 2002.

To complement the NRP and in response to feedback from residents, NEA had worked with PWCs and Town Councils to introduce at least one set of centralised recycling depositories for every five blocks of HDB flats. As at end 2006, approximately 600 sets of recycling depositories had been deployed.

Centralised Recycling depositories in HDB estates

RESOURCE CONSERVATION

Recycling Day 2006

Recycling Day 2006 was an annual event involving the government, private sector and the community designed to raise awareness and support for Singapore's recycling efforts. It was held on 23 September 2006 at four locations. The main event was held at the Promenade at Blk 728 Clementi West St 2. Minister for the Environment and Water Resources, Dr Yacoob Ibrahim launched the event. The three other satellite locations were strategically spread out across the island for a broader outreach to the community at Bishan Community Club, the basketball court at Blk 840 Tampines St 82, and Pioneer Secondary School.

Minister for the Environment and Water Resources, Dr. Yaacob Ibrahim launched Recycling Day 2006 @ the Promenade Blk 728 Clementi West St 2

Among the highlights was an initiative by Tetra Pak to recycle drinks and beverage cartons. This first initiative launched under the upcoming Singapore Packaging Agreement, has the potential to boost Singapore's recycling efforts significantly as some 500 tonnes of beverage cartons are discarded every year in Singapore alone.

Interesting activities on Recycling Day 2006:
"Flip, Flat, Flatten" contest and Build the Tallest Drink Carton Sculpture

Other activities on Recycling Day 2006 included the "Be a Champion Recycler" contest where residents exchanged recyclables for a chance to win a top prize of a $300 voucher. A Preschooler Colouring contest and workshop, a 3R poster design contest, a "Flip, Flap, Flatten" contest, and a "be spotted using the centralised recycling bins" contest comprised the other fringe activities designed to encourage the heartlanders to practise recycling in fun-filled ways.

Recycling Programme in Condominiums

Condominiums, where Management Corporations decide whether to have recycling programmes, were still lagging being in providing recycling facilities. RCD continued to work with Managing Agents, Management Corporations and recycling companies to implement recycling programmes within condominium grounds. This was to complement the existing network of public centralised recycling bins that help serve neighbouring clusters of small and medium size condominiums.

As of December 2006, the percentage of condominiums with recycling programmes has increased from 24% in 2004 to 43% in 2006. They included 6 "clusters of condominiums" which had shared recycling facilities.

In order to rationalise the situation and in response to rising calls from condominium residents to have the same level of access to recycling facilities as other households in the country, work began with partners such as Association of Management Corporations in Singapore, Neighbourhood Committees, Singapore Institute of Surveyors Valuers, etc. to get more condominiums and private apartment developments to roll out recycling facilities voluntarily, with the view to mandate recycling should the need arise eventually.

Recycling Programme at Schools

Recognising that starting recycling young was crucial for sustainability, a structured waste recycling programme for schools was launched by NEA together with recycling companies and the Singapore Environment Council (SEC) on 12 September 2002. The recycling programme involves the setting up of recycling areas in schools where recycling bins for paper, cans, and plastic are placed at designated areas called Recycling Corners. Educational materials are also made available at the Recycling Corners to raise awareness on waste minimisation and recycling among students. Talks, activities, and surveys organised by NEA and SEC were conducted to sustain the recycling programme. The percentage of schools with the recycling programme has increased from 30% in 2003 to 84% in 2006.

Recycling Corner

The PWCs launched various recognition and incentive schemes to encourage schools to recycle waste. For example, reward points were given for recyclables collected, and these can be exchanged for items such as printers and stationery. In September 2004, a PWC, Altvater-Jakob, launched their recognition and incentive scheme called SMART (Students Must Always Recycle Trash) programme. The SMART programme also gives recognition to the best performing schools. In 2006, another PWC, SembWaste, launched a programme called RECESS (Recycling is Championed and Encouraged by Students in Schools) to encourage and acknowledge the recycling efforts of students and teachers.

Recycling Bins at Public Places

Recyclable waste such as flyers, newspapers, drink cans and plastic bottles are also generated in large quantities at public places. To supplement the National Recycling Programme, NEA has been working with various partners to provide recycling bins at public places with high human traffic such as Orchard Road, Chinatown, Raffles Place, Holland Village, hawker centres, food courts, industrial estates, institutions, HDB estates, community centres and outside MRT stations. The presence of recycling bins serves also to remind the public of recycling. By end 2006, there were approximately 3,400 recycling bins set up in public places.

Public Recycling Bins

RESOURCE CONSERVATION

Recycling at Industrial Estates

An estate-wide waste recycling programme for flatted factories in Jurong Town Corporation's (JTC) industrial estates was launched by Minister, MEWR on 28 November 2003. The programme provided a practical way for small and medium size factories occupying high-rise factory buildings to recycle waste. In this programme, recycling bins were placed at convenient locations such as the lift lobbies of each block at the estate for factories to deposit recyclable wastes. In addition, designated areas have been set up at bin centres within the estate for wooden pallets for reuse or recycling. JTC has implemented the recycling programme to all 21 JTC flatted industrial estates.

A guidebook on waste minimisation for industries was developed to help companies reduce waste through more efficient and effective use of resources, reusing and recycling.

Waste Recycling Projects

A project proposed by SembEnviro was approved for funding under the Innovation for Environmental Sustainability (IES) Fund. This project involved the development of a separate chute system for recyclables in high-rise apartment blocks.

Reducing Waste at Source

The NEA collaborated with the SEC and the major supermarket chains to organise a campaign to reduce wastage of plastic bags. Minister for the Environment and Water resources launched the campaign "Why waste plastic bags? Choose Reusable Bags!" on 11 February 2006 at Parkway Parade Shopping Centre.

RESOURCE CONSERVATION

Singapore Packaging Agreement

A Task Force co-chaired by the NEA, SEC and the Packaging Council of Singapore (PCS) and comprising members of the industry, was set up to develop a Packaging Agreement. The aims of the Packaging Agreement are to reduce packaging waste for consumer products and to raise awareness and educate the public on waste minimization. The Task Force would complete the development of the Packaging Agreement by mid-2007.

Climate Change / Energy Conservation

Singapore's climate change efforts are focused on improving our energy efficiency and our carbon intensity (tonnes carbon dioxide per $GDP). Singapore has set a target to reduce carbon intensity (tonnes carbon dioxide per $GDP) by 25% between 1990-2012.

In 2005, Singapore's total carbon dioxide (CO_2) emissions were estimated at 40,377[1] kilo tons. Our carbon intensity in 2005 was 26% lower than the 1990 level. Singapore's approach to mitigate greenhouse gas emissions is to promote energy efficiency and clean energy, including renewable energy.

National Climate Change Committee

The National Climate Change Committee (N3C) is an inter-agency committee with 3P (People, Private and Public sector) representation. It seeks to integrate the promotion of energy efficiency and the use of clean energy sources with the reduction of emissions of air pollutants and carbon dioxide from the production of energy.

The N3C aims to address climate change by:

a) Promoting greater energy efficiency and less carbon-intensive energy in key sectors;
b) Raising awareness amongst the people, private and public sectors on the impacts and opportunities arising from climate change, and the actions they can take;
c) Building competency in Singapore to better respond to climate change such as through promoting research and development of low-carbon technologies;
d) Understanding Singapore's vulnerability to climate change and facilitating the adaptation actions needed.

RCD coordinates and facilitates the N3C's programmes and provides secretariat support to the N3C and its Sub-committees and Workgroups.

[1] Provisional data

Climate Change Initiatives

a) Clean Development Mechanism (CDM)

The CDM under the Kyoto Protocol (KP) is a mechanism that allows greenhouse gas emissions reductions from projects implemented in non-Annex I[2] countries to be used to offset emissions of Annex I countries. Such projects, if implemented in Singapore, would generate carbon credits known as Certified Emissions Reductions or CERs, which are tradable. Hence, any company in Singapore that is able to reduce its greenhouse gas emissions may be able to earn CERs and thereby benefit from the CDM.

NEA has been appointed as Singapore's Designated National Authority (DNA) for CDM projects under the KP. NEA's role is to ensure that CDM projects to be implemented locally meet national sustainable development (SD) criteria. The DNA will issue the letter of approval (LoA) to projects that meet the SD criteria. More information about Singapore's DNA can be found at http://www.nccc.gov.sg/cdm/cdm.shtm

Since early 2006, RCD has been working to promote greater awareness among companies about the economic opportunities of CDM. NEA organised a 1-day seminar on the economic opportunities of CDM in May 2006. NEA also worked with agencies such as IE Singapore to organise a 1-day seminar on CDM and emissions trading in July 06, and a 1-day CDM forum and roundtable jointly with EDB for the semiconductor industry in November 2006.

b) Climate Change Awareness Programme

To advocate the public on ways to save energy and money, a Climate Change Awareness Programme (CCAP) was launched on 22 April 2006. The CCAP is spearheaded by the Singapore Environment Council (SEC) and aims to raise awareness among households and motorists on the basic principles of climate change as well as to show Singaporeans how through simple and painless habits, they can save energy, save money and reduce greenhouse gas emissions. Examples of these habits are given below.

[2] Under the KP, there are 2 categories of Parties – Annex I and non-Annex I. Annex I Parties are countries which have greenhouse gas emission reduction targets to meet between 2008-2012. The non-Annex 1 countries do not have such targets. Singapore is a non-Annex 1 country.

Simple Steps to Energy Savings Around the Home

1. Use an electric fan instead of an air-conditioner where possible as an air-conditioner consumes 10 times more energy than an electric fan. Save $1020 a year[3].

2. When using an air-conditioner, set the temperature at 25ºC instead of 21ºC for the maximum comfort at the minimum cost. Save $310 a year.

3. Buy energy-labelled air-conditioners and refrigerators with more green ticks. The more ticks on the label the more efficient the appliance. Save $880 a year.

4. Use energy efficient light bulbs instead of incandescent ones. Save $230 a year.

5. Switch off electrical appliances – TVs, DVD or VCD players, computers, printers, hi-fi stereos – at the main power source, instead of leaving them on standby mode. Save $90 a year.

Note: Based on electricity tariff of about $0.20 per unit (kWh)

Energy Efficiency Initiatives

(a) Energy Efficiency Improvement Assistance Scheme

The $10 million Energy Efficiency Improvement Assistance Scheme (EASe) is a co-funding scheme administered by NEA to incentivise companies in the manufacturing and building sectors to carry out detailed studies on their energy consumption and identify potential areas for energy efficiency improvement.

Under EASe, funding of up to 50% of the cost for such appraisals, subject to a cap of $200,000, can be made available to any Singapore-registered company with a building or manufacturing facilities in Singapore.

Since its inception in April 2005, the scheme has seen a good take-up rate, with 54 applications approved as at end 2006. The approved applications came from 17 manufacturing plants and 37 buildings. The improvements in energy efficiency arising from the studies will benefit the companies in terms of energy savings and help to reduce carbon dioxide (CO_2) emission. A total of $1.16 million has been approved for the 54 energy studies which are estimated to generate total energy savings of 220 GWh or $12.9 million per year when the energy efficiency measures are implemented. The total reduction in carbon dioxide emission from these projects is estimated to be about 111 kilo-tonnes of CO_2 per year.

[3] Assuming the use of 3 fans in place of a system-3 air-conditioner

(b) Energy Labelling Scheme

NEA, together with the Singapore Environment Council (SEC), introduced energy labelling of household electrical appliances in April 2002 to raise awareness among consumers of the need for energy efficiency and to encourage them to switch to energy efficient household appliances. Under this voluntary scheme, energy efficiency information on air-conditioners and refrigerators, which account for about 50% of a typical household energy bill, are provided on Energy Labels.

To-date, 99 air-conditioner and 83 refrigerator models are labelled under the scheme. Mandatory energy labelling of air-conditioners and refrigerators will be introduced from 1 July 2007.

(c) Fuel Economy Labelling Scheme

The labelling scheme is a voluntary labelling scheme administered by SEC to promote fuel-efficient cars. As of December 2006, 84 car models were issued with the Fuel Economy Label, representing 17% of the car models in the market.

This year, the Green Transport Day was expanded to the Green Transport Week (GTW). GTW 2006 was organized by SEC, in partnership with NEA and was launched on 20 August 2006 with a leisure cycling session at Changi Village by Dr Amy Khor, Senior Parliamentary Secretary, Ministry of the Environment and Water Resources.

Other activities held during GTW 2006 to promote the use of public transport and efficient driving habits includes:

a) Launch of the 3rd edition of the Green Transport Guide
b) "Spot the Fuel-Efficient Car" Decal Contest
c) Green Transport Pledges
d) The Incredible ECO Chase
e) Green Transport Carnival at *Scape

SPS Dr Amy Khor (2nd from right) and Chairman, A/P Simon Tay (1st from right), at the launch of GTW 06.

(d) Energy Smart Buildings Scheme

Jointly developed by NEA and the Energy Sustainability Unit of the National University of Singapore, the Energy Smart Buildings Scheme gives recognition to buildings in the top 25 per cent of their category for achieving exemplary energy efficiency without compromising the indoor environmental quality.

The objectives of the Scheme are as follows:

a) to accord recognition to buildings with exemplary energy performance, without compromising indoor environment quality;

b) to encourage building owners and professionals to give due consideration for building energy efficiency during the design, development and management stages of a building; and

c) to provide a quantitative and objective measure by which building owners can set energy performance targets and track their progress in improving their energy efficiency.

For a start, the Scheme targeted office buildings. The first recipients of the award were Environment Building, Revenue House, SIA Computer Centre, JTC Summit, Alexandra Point, Fuji Xerox Tower, City House and Republic Plaza.

The scheme will be further extended to include hotels, shopping complexes and hospitals.

(e) Public Sector Pilot Project

RCD has been assisting eight public sector agencies to call tenders for the provision of energy saving performance contracting services under the Public Sector Economy Drive.
Six of the public sector agencies, namely Ministry of the Environment and Water Resources (MEWR), Ministry of Finance (MOF), Ministry of Manpower (MOM), Singapore General Hospital (SGH), Monetary Authority of Singapore (MAS) and Changi General Hospital (CGH) have called tenders.

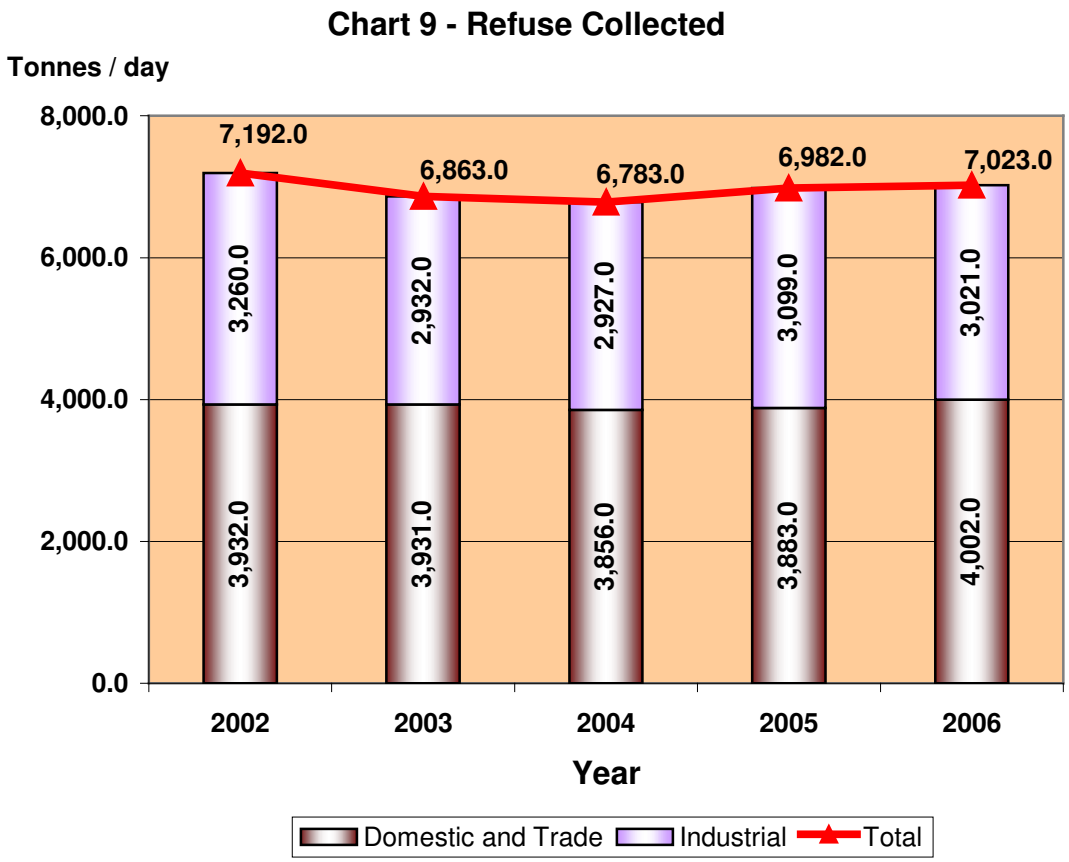
(f) Awareness Building and Education

RCD organised a Forum on Resource Efficiency and Climate Change Mitigation for Semiconductor Industry on 10 November 2006 at Regent Hotel. The main purpose of this forum wa to create greater awareness and confidence in senior management of wafer fabrication and semiconductor companies about the economics and environmental impacts of resource efficiency and climate change mitigation. Amongst the speakers were representatives from Rocky Mountain Institute (RMI), Dr Joel Swisher and Mr. Peter Rumsey.

Solid Waste Management

With limited land available for waste disposal, NEA's policy for solid waste management necessitates the reduction of volume of waste that goes to the landfill by incineration of all incinerable waste (that are not recovered, reused or recycled) at Singapore's four Waste-to-Energy Plants. The remaining waste, which are not incinerable such as sludge, silt, shipyard waste, construction waste and incineration ashes, are disposed of at the offshore Semakau Landfill. The ratio of refuse incinerated to that land-filled is about 90:10.

A daily average of 7,023 tonnes of refuse per day was collected in 2006, an increase of only 0.5% as compared to the amount of refuse collected per day in 2005. This small increase was attributed to NEA's active promotion of waste minimisation in all sectors of the industry and community to target at the source of waste generation and also through NEA's recycling initiatives. The amount of refuse collected per day from 2002 to 2006 is shown in **Chart 9**.



RESOURCE CONSERVATION

Solid Waste Collection System

The huge amounts of municipal solid waste generated daily necessitated the setting up of a highly efficient system for proper collection and disposal. Over the years the waste management system in Singapore has evolved into one of the most efficiently operated refuse collection services in the region.

Public Waste Collection Scheme

Seven of the nine Public Waste Collector (PWC) Licences expired in 2006 and new licences were awarded via an open tendering process for the provision of refuse collection services to residential and trade premises in Singapore. The other two licenses were awarded in 2004. The refuse collection fees were lower for the majority of the residents under the new contracts. The pre-qualified waste collection companies that were successful in their bids for the PWC Licence were also required to participate in the National Recycling Programme (NRP) by providing door-to-door collection services for recyclable materials from households in their sectors.

The public waste collection areas in Singapore are divided into nine geographical sectors as shown in the map in **Chart 10**, while the PWCs for the 9 sectors and the expiry date of their respective licences are listed in **Table 16**.

Chart 10

Privatised Refuse Collection Services – 9 Geographical Sectors

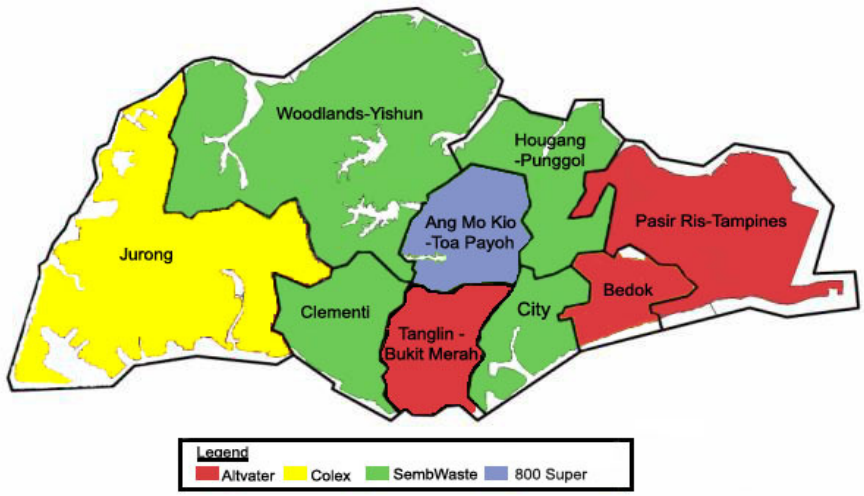


Table 16
The Public Waste Collectors for the 9 Sectors

No	Sector	PWC	Licence Expiry Date
1	Pasir Ris – Tampines	Altvater Jakob Pte Ltd	30 June 2011
2	Bedok	Altvater Jakob Pte Ltd	31 October 2011
3	Jurong	Colex Holdings Ltd	31 March 2013
4	Clementi	SembWaste Pte Ltd	30 June 2013
5	City	SembWaste Pte Ltd	30 September 2013
6	Ang Mo Kio – Toa Payoh	800 Super Waste Management Pte Ltd	31 December 2013
7	Hougang-Punggol	SembWaste Pte Ltd	28 February 2014
8	Woodlands – Yishun	SembWaste Pte Ltd	31 May 2014
9	Tanglin – Bukit Merah	Altvater Jakob Pte Ltd	31 August 2014

Licensed General Waste Collectors

WMD licenses and monitors the collection of refuse by licensed general waste collectors, who mainly serve commercial and industrial premises. It is an offence for any person or company to collect or transport waste as a business without a valid General Waste Collector Licence. Licensed general waste collectors may refer to 'The Code of Practice for Licensed General Waste Collectors' for work protocols and guidelines on good practices in the waste collection business. The Code of Practice is available in the website at http://app.nea.gov.sg/cms/htdocs/category_sub.asp?cid=101

Application of General Waste Collector Licence

On-line-application for the General Waste Collector Licence is available at https://licences.business.gov.sg/SHINE/sop/WebPageHandler?p=OASIS&pn=SelectLicences&LicenceID=80

RESOURCE CONSERVATION

REFUSE DISPOSAL FACILITIES

Singapore's fifth Waste-to-Energy Plant – Keppel-Seghers Tuas Waste-to-Energy Plant held its groundbreaking ceremony on 5 October 2006. The plant is expected to start operation in 2009 and will provide incineration services to NEA for a 25-year period under the Design-Build-Own-Operate (DBOO) scheme. It will be able to handle 800 tonnes of refuse per day when it is completed in 2009 and it will replace the Ulu Pandan Waste-to-Energy Plant that is nearing the end of its operational lifespan. NEA's solid waste disposal facilities comprises three other existing Waste-to-Energy Plants – Tuas Waste-to-Energy Plant, Senoko Waste-to-Energy Plant and Tuas South Waste-to-Energy Plant, as well as an offshore landfill at Pulau Semakau.

Keppel-Seghers Tuas Waste-to-Energy Plant

A total of 2.56 million tonnes of waste was disposed of at the refuse disposal facilities in 2006, or about 7,024 tonnes per day. Approximately 2.33 million tonnes or 90.8% of the refuse was incinerated while the remaining refuse was landfilled. **Table 17** shows the amount of refuse disposed of at the landfill and the Waste-to-Energy Plants over the last 10 years.

The total effective incineration capacity of the four existing Waste-to-Energy Plants is 8,200 tonnes per day, which is sufficient to handle all incinerable wastes currently generated in Singapore.

Table 17
Refuse Disposed of at Authorised Sites (1997 – 2006)

Year	Landfill ('000 tonnes)	Waste-to-EnergyPlants ('000 tonnes)	Total Refuse Disposed Of ('000 tonnes)
1997	1,051.3	1,745.0	2,796.3
1998	958.1	1,884.1	2,842.2
1999	756.2	2,036.3	2,792.5
2000	357.2	2,440.1	2,797.3
2001	251.3	2,550.9	2,802.2
2002	204.3	2,421.3	2,625.6
2003	193.8	2,311.2	2,505.0
2004	219.6	2,263.0	2,482.6
2005	270.1	2,278.6	2,548.7
2006	234.5	2,329.1	2,563.6

About 954 million kWh of electricity was produced from the waste heat of the incineration process and this represented about 2 to 3% of the total electricity generated in Singapore.

The quantity of scrap metal recovered in 2006 amounted to 14,000 tonnes. These were sold to a local steel mill for reprocessing into steel products mainly for the construction industry.

Air Pollution Control Measures at Waste-to-Energy Plants

The Waste-to-Energy Plants are equipped with advanced air pollution control equipment such as dry lime reactors, electrostatic precipitators and catalytic bag filters to ensure compliance with the emission standards stipulated in the Environmental Pollution Control (Air Impurities) Regulations 2000.

In May 2006, Tuas Waste-to-Energy Plant completed the installation of a new flue gas treatment plant, a catalytic bag filter system which was more effective in pollutant removal than the previous plant. The installation of the treatment plant started in January 2004 and was completed at a cost of $32 million. It has two treatment lines with each line comprising a reagent injection system, a fabric filter, a honey-combed catalyst section and an induced draught fan.

Semakau Landfill – A Landfill with a Difference

234,469 tonnes of non-incinerable waste and 534,719 tonnes of incineration ash were not the only 'visitors' to the Semakau Landfill in 2006. A total of 5,795 students, members of public and foreigners visited Semakau Landfill to learn about waste management in Singapore while another 1,223 visitors participated in various activities organised by the four interest groups as shown in **Table 18**.

Briefing during an educational visit at Semakau Landfill

Table 18
Breakdown of interest groups with activities on Semakau Landfill

Activity	No. of trips	No. of visitors
Intertidal Walk by Raffles Museum of Biodiversity Research (RMBR)	22	897
Sport Fishing by Sport Fishing Association of Singapore (SFAS)	11	152
Bird Watching by Nature Society Singapore (NSS)	8	99
Stargazing by The Astronomical Society of Singapore (TASOS) that organised its first stargazing trip on 18 Nov 06	3	75

Intertidal Walk *(Picture courtesy of RMBR)*

RESOURCE CONSERVATION

A renewable energy system comprising wind turbine and solar panel was installed in July 2006 to generate electricity for lighting up the southern tip of Semakau Landfill so that the public could carry out night recreational activities such as stargazing, camping and barbecuing.

Renewable Energy System

Lighting up of idyllic southern tip of Semakau Landfill

Semakau Landfill is also internationally recognised as having an effective environmental management system. The operation and maintenance of the installation was recognised as being environmentally friendly with its re-certification to the ISO 14001:2004 Standard. The re-certification was carried out with accreditation by the United Kingdom Accreditation Service (UKAS) for the Tuas Marine Transfer Station / Semakau Landfill and took effect from 23 May 2006.

5

International Cooperation

INTERNATIONAL COOPERATION

Overview

EPD works closely with the International Relations Department (IRD) of Policy and Planning Division, NEA on the efforts to safeguard Singapore's environmental interests internationally. NEA's active participation in international environmental fora helped to strengthen Singapore's environmental cooperation with regional countries and international organisations. This has enhanced Singapore's standing on matters relating to environmental policies, management and technology in the international arena.

Bilateral Cooperation

Malaysia

The Malaysia-Singapore Joint Committee on the Environment Working Group (MSJCE WG), formed under the auspices of the MSJCE, is co-chaired by CEO of NEA and Director-General of Department of Environment, Malaysia.

The MSJCE WG held its 5th meeting on 24-25 April 2006 in Singapore. The meeting discussed environmental issues that are of mutual concern to the two countries. These included the control of vehicular emissions, water quality in the Straits of Johor and the Skudai River catchments and emergency response plans to deal with chemical spills at the Second Crossing and along Johor Straits East.

5th MSJCE Working Group Meeting held on 24-25 April 2006 in Singapore.

INTERNATIONAL COOPERATION

Indonesia

The Indonesia-Singapore Working Group (ISWG) on the Environment was formed to support the Indonesia-Singapore Environment Partnership (ISEP) and to develop joint programmes and activities under this bilateral partnership initiative.

The 4th Meeting of the ISWG was held on 17 May 2006 in Bogor, Indonesia. The Meeting was co-chaired by CEO, NEA and Assistant to Minister for Global Environment Affairs, Ministry of Environment, Indonesia. The meeting discussed various areas of collaboration and projects such as capacity building under the ISWG.

Under the ambit of ISWG, NEA conducted a "Study Visit on Good Environmental Governance in Sustainable Development and Solid Waste Management" for 13 Indonesian officials from 27 February to 4 March 2006.

Brunei

The Brunei-Singapore Joint Committee on the Environment Working Group (BSJCE WG) was formed under the auspices of Brunei-Singapore Joint Committee on the Environment (BSJCE) to provide technical support to the BSJCE.

The inaugural Meeting of the BSWG was held on 26 June 2006 in Singapore. The meeting was co-chaired by DGEP, NEA and Director, Department of Environment, Parks & Recreation, Ministry of Development, Brunei. The meeting discussed various collaborative activities and information exchange on environmental and water-related issues.

Regional Cooperation

ASEAN Working Group on Multilateral Environment Agreements (AWGMEA)

NEA participated in the 10th meeting of the AWGMEA that was held on 18 –20 May 2006 in Bogor, Indonesia.

The 10th meeting of the AWGMEA enabled ASEAN member countries to better understand the current concerns of other ASEAN member countries regarding the various MEAs, namely the United Nations Framework Convention on Climate Change, Montreal Protocol on Substances that Deplete the Ozone Layer, Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal, Rotterdam Convention on Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade and Stockholm Convention on Persistent Organic Pollutants. It also enabled ASEAN member countries to exchange information and experience on dealing with MEA-related issues.

INTERNATIONAL COOPERATION

ASEAN Working Group on Environmentally Sustainable Cities (AWGESC)

Since its inception in 2003, Singapore has been chairing the ASEAN Working Group on Environmentally Sustainable Cities (AWGESC). A total of 24 cities in ASEAN are currently participating in the ASEAN Initiative on Environmentally Sustainable Cities, established under the AWGESC.

The 4th AWGESC held on 7-8 June 2006, Brunei Darussalam, was attended by 8 ASEAN member countries, ASEAN Sec and representatives from international organisations, including GTZ, UNEP-ROAP, UNU-IAS, USAID. The Meeting agreed on the list of key environmental indicators for Clean Air, Clean Water and Clean Land that was developed at the Workshop in December 2005 in Jakarta. The Meeting also discussed and agreed on the modalities for the ASEAN ESC Award.

4th AWGESC Meeting held on 7-8 June 2006 in Brunei Darussalam.

ASEAN Senior Officials on the Environment (ASOEN)

Senior NEA officials attended the Meeting of the 17th ASEAN Senior Officials on the Environment (ASOEN) held in Mandalay, Myanmar, from 5-7 September 2006. One of the key outcomes of the meeting was the release of a press statement by the ASEAN Secretariat on the regional efforts taken to mitigate the land and forest fires and haze during the dry season.

INTERNATIONAL COOPERATION

Sub-Regional Fire-Fighting Arrangements (SRFA) for Sumatra and Borneo

The 18th and 19th Joint Meeting on the Sub-regional Fire-fighting arrangements (SRFA) for Sumatra and Borneo were held on 7 April 2006, Palangka Raya, Central Kalimantan, Indonesia and 21-22 August 2006 in Kuala Lumpur, Malaysia respectively.

Senior officials from Brunei Darussalam, Indonesia, Malaysia, Singapore and Thailand attended the meetings. The meetings provided opportunities for the officials to be updated on the latest weather and smoke haze situation, as well as review the progress made in implementing the ASEAN Regional Haze Action Plan.

Sub-Regional Ministerial Meeting (SRMM)

Arising from the occurrence of regional haze episode in August – November 2006, the Sub-Regional Ministerial Meeting (SRMM) on Transboundary Haze Pollution, comprising Brunei Darussalam, Indonesia, Malaysia, Singapore and Thailand, was urgently convened on 13 October 2006 in Pekanbaru, Indonesia to allow the Environment Ministers to discuss immediate measures to address the problem. The Meeting agreed to the formation of a Ministerial Steering Committee (MSC) that would comprise the Environment Ministers of Brunei Darussalam, Indonesia, Malaysia, Singapore and Thailand. The MSC would report progress of the implementation of Plan of Action (PoA) to tackle the land and forest fires in Indonesia to the ASEAN Leaders at the ASEAN Summit.

Ministerial Steering Committee (MSC)

The Ist MSC Meeting was convened on 9 November 2006 in Cebu, Philippines. A new Technical Working Group (TWG), comprising senior officials from the five countries, was formed to provide support to the MSC in implementing the details outlined in the PoA.

In response to Indonesia's call for regional countries' assistance, Singapore agreed to collaborate with Muaro Jambi, a regency in Jambi province and one of the identified fire-prone districts, to enhance the local government's capacities in dealing with the land and forest fires. Under the collaboration, Singapore will assist Muaro Jambi to develop a Masterplan, focussing on prevention measures, to deal with the fires. Under the Masterplan, Singapore will also help Muaro Jambi develop fire-prevention programmes and projects.

ASEAN Ministerial Meeting on the Environment (AMME)

Dr Amy Khor, the Senior Parliamentary Secretary (SPS) of MEWR led a delegation including NEA senior officials to the 10th AMME held on 10 November 2006 in Cebu, Philippines. One of the key issues of discussion was the transboundary haze pollution. The 10th AMME was concluded with a press release reiterating ASEAN's commitment and resolve to tackle the regional haze problem.

INTERNATIONAL COOPERATION

RCA National Representatives Meeting and General Conference

The Regional Cooperative Agreement (RCA) is an intergovernmental agreement for East Asia & Pacific region, under the auspices of the International Atomic Energy Agency (IAEA), in which member countries undertake to promote and co-ordinate projects in nuclear science and technology. NEA serves as Singapore's National RCA Representative.

The 28th RCA National Representatives Meeting (NRM) was held in Bangkok, Thailand from 27 - 31 March 2006. NEA represented Singapore at the NRM. The meeting reviewed the implementation status of various RCA projects and deliberated on the procedural and organizational rules governing the implementation of RCA projects.

The 35th RCA General Conference Meeting was held in Vienna, Austria on 15 September 2006. The meeting discussed the draft RCA Medium Term Strategy. During the meeting, Singapore reaffirmed its support and commitment to continue hosting scientific visits/fellowship attachments in Singapore under the Technical Cooperation Programme.

International Conventions

Climate Change

Climate change or global warming is one of the major global environmental challenges of our time. There is general scientific agreement that greenhouse gas emissions from human activities have contributed to climate change effects such as rising global temperatures, rising sea levels and extreme weather.
Singapore's commitment to climate change is consistent with our good record on environmental issues. Singapore has been a signatory to the UN Framework Convention on Climate Change (UNFCCC) since 1997 and acceded to the Kyoto Protocol (KP) of the UNFCCC on 12 April 2006. NEA has been appointed as Singapore's Designated National Authority (DNA) for Clean Development Mechanism (CDM) projects under the KP. The CDM of the KP allows greenhouse gas emission reductions from projects implemented in non-Annex I countries, such as Singapore, to be used to offset emissions of Annex I countries, such as Japan and the EU. According to the UNFCCC Secretariat, CDM can potentially achieve worldwide emission reductions of more than one billion tonnes by the end of 2012, thus showing that it is a useful tool for sustainable development.

INTERNATIONAL COOPERATION

Protection of the Ozone Layer

Singapore has been a party to the Montreal Protocol since 5 January 1989. On 2 March 1993, Singapore acceded to the London Amendment to the Montreal Protocol and more recently, the Copenhagen Amendment and the Montreal Amendment on 22 September 2000.

The Montreal Protocol deals with control measures and phase-out schedules for various Ozone Depleting Substances (ODS) such as chlorofluorocarbons (CFCs), Halons and methyl bromide. Some of these ODS, namely CFCs, Halons, carbon tetrachloride and methyl chloroform, have already been phased out in Singapore. In addition, industries that are currently using hydrochlorofluorocarbons (HCFCs) or methyl bromide are encouraged to replace them with non-ozone depleting substitutes wherever practicable.

The control measures implemented by Singapore are summarised in **Table 19**.

Table 19
Summary of Measures to Phase Out Ozone-Depleting Substances

Date	Measure
5 October 1989	Quota Allocation System implemented for Chlorofluorocarbons (CFCs).
5 February 1991	Prohibit the import and manufacture of non-pharmaceutical aerosol products and polystyrene sheets/products containing controlled CFCs.
1 January 1992	(a) Prohibit the use of Halon 1301 for new fire-protection systems. (b) Prohibit the import of Halon 2402.
1 January 1993	Prohibit the import of new air-conditioning and refrigeration equipment using CFC 11 and CFC 12.
1 January 1994	Prohibit the import of Halon 1211 and Halon 1301.
15 April 1994	Prohibit the import of fire-extinguishers filled with Halon 1211.
1 January 1995	All new cars must be equipped with non-CFC air-conditioning systems.
1 April 1995	Prohibit the import of HBFCs.
1 January 1996	Prohibit the import of CFCs, carbon tetrachloride and 1,1,1-trichloroethane (methyl chloroform).
1 January 2002	Freeze the consumption of Methyl Bromide (MeBr) for non-quarantine and pre-shipment (non-QPS) applications.[4]

[4] Note: Quarantine applications - Include treatments to prevent the introduction, establishment, and/or spread of quarantine pests, or to ensure their official control.
Pre-shipment applications — These include non-quarantine methyl bromide applications within 21 days prior to export that are required to meet the official requirements of the importing or exporting countries.

INTERNATIONAL COOPERATION

The import and export of ODS are regulated under the Environmental Pollution Control Act (EPCA) and the Environmental Pollution Control (ODS) Regulations 2000. Under the Act and its Regulations, a licence is required for the import and/ or export of ODS listed in the Schedule of the Act and its Regulations **(Appendix 15)**.

In addition, PCD controls the import, possession for sale, sale or offer for sale of any ODS through licences granted by PCD for such purposes under the EPCA. During the year, PCD issued 24 Hazardous Substances Licences for the import and export of ODS, and electronically processed 1,409 inward and outward declarations for the import and/or export of ODS through the TradeNet computerised network system.

Control on Export, Import and Transit of Hazardous Wastes (Basel Convention)

Singapore acceded to the Basel Convention on 2 January 1996. The Hazardous Waste (Control of Export, Import and Transit) Act and its Regulations were enacted and came into operation on 16 March 1998. The Act and its Regulations enable Singapore to fulfil its obligations under the Basel Convention. Under the Act and its Regulations, any person wishing to export, import or transit any hazardous waste scheduled under the Basel Convention is required to apply for a permit from PCD.

During the year, PCD processed and issued 8 import, 27 export and 54 transit permits under the Basel Convention.

Control of Persistent Organic Pollutants

The Stockholm Convention seeks to control and ultimately eliminate the release of persistent organic pollutants (POPs) into the environment. It sets out control measures on the production, import, export, disposal, and use of 10 commercially produced POPs (8 pesticides and 2 industrial chemicals) and 2 unintentional by-products (furans and dioxins) from waste incinerators and chemical plants. The Stockholm Convention entered into force on 17 May 2004, ninety days after France submitted the fiftieth instrument of ratification, acceptance, approval or accession to become a Party to the Stockholm Convention on 17 February 2004.

Singapore has banned the use of the 10 commercially produced POP chemicals in Singapore well in advance of the deposition of its instruments of ratification and accession with the Secretary-General of the United Nations in New York on 24 May 2005. The Convention entered into force for Singapore on 22 Aug 2005 (i.e. the 90th day after the date of deposit of the instruments). Singapore has already taken measures to limit the emission of furans and dioxins from our incineration plants. In keeping with internationally accepted practices to control such emissions, we have introduced air emission standards under the EPC (Air Impurities) Regulations 2000 to limit dioxins and furans releases.

INTERNATIONAL COOPERATION

Control on International Trade in Hazardous Chemicals and Pesticides (The Rotterdam Convention on Prior Informed Consent Procedure)

The Rotterdam Convention on Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade seeks to regulate the international trade of 27 highly dangerous pesticides and industrial chemicals using the Prior Informed Consent (PIC) procedure. The Convention had entered into force on 24 February 2004 and the list, after further review, now contains 39 hazardous industrial chemicals and pesticides.

None of the chemicals, except Ethylene Oxide (ETO), is produced in Singapore. The ETO produced is exported for approved medical and clinical sterilisation uses only.

On 24 May 2005, Singapore deposited its instruments of ratification and accession with the Secretary-General of the United Nations in New York. Similar to Stockholm Convention, the Rotterdam Convention entered into force for Singapore on 22 Aug 2005. PCD is the Designated National Authority for the control of the import and re-export of these 39 highly dangerous pesticides and chemicals. PCD will only grant a licence to a company to import and re-export any of the 39 controlled chemicals if it abides by the PIC procedure.

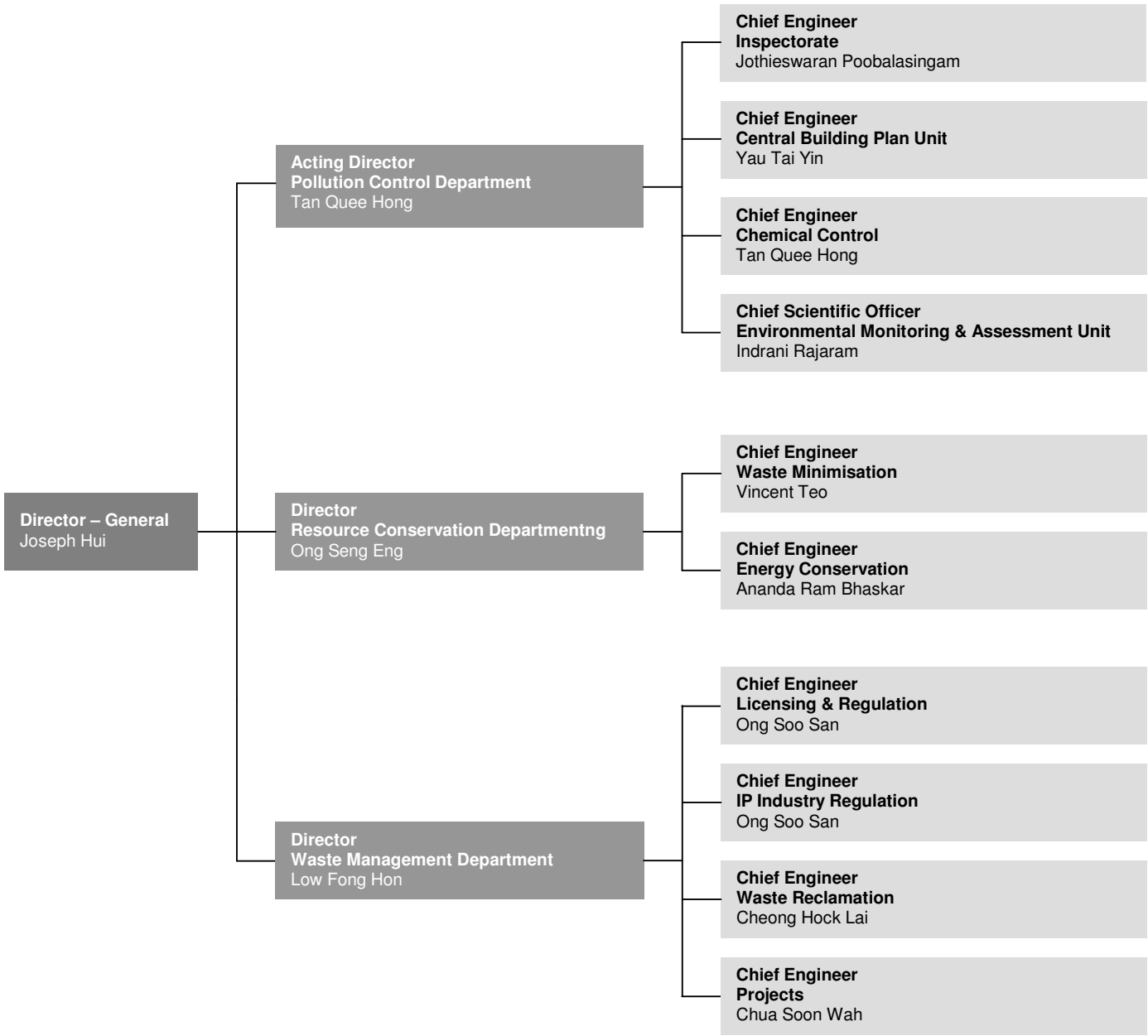
During the year, PCD approved 7 applications of export of chemicals controlled under the Rotterdam Convention. The exports were granted in accordance with the PIC procedure under the Rotterdam Convention.

6

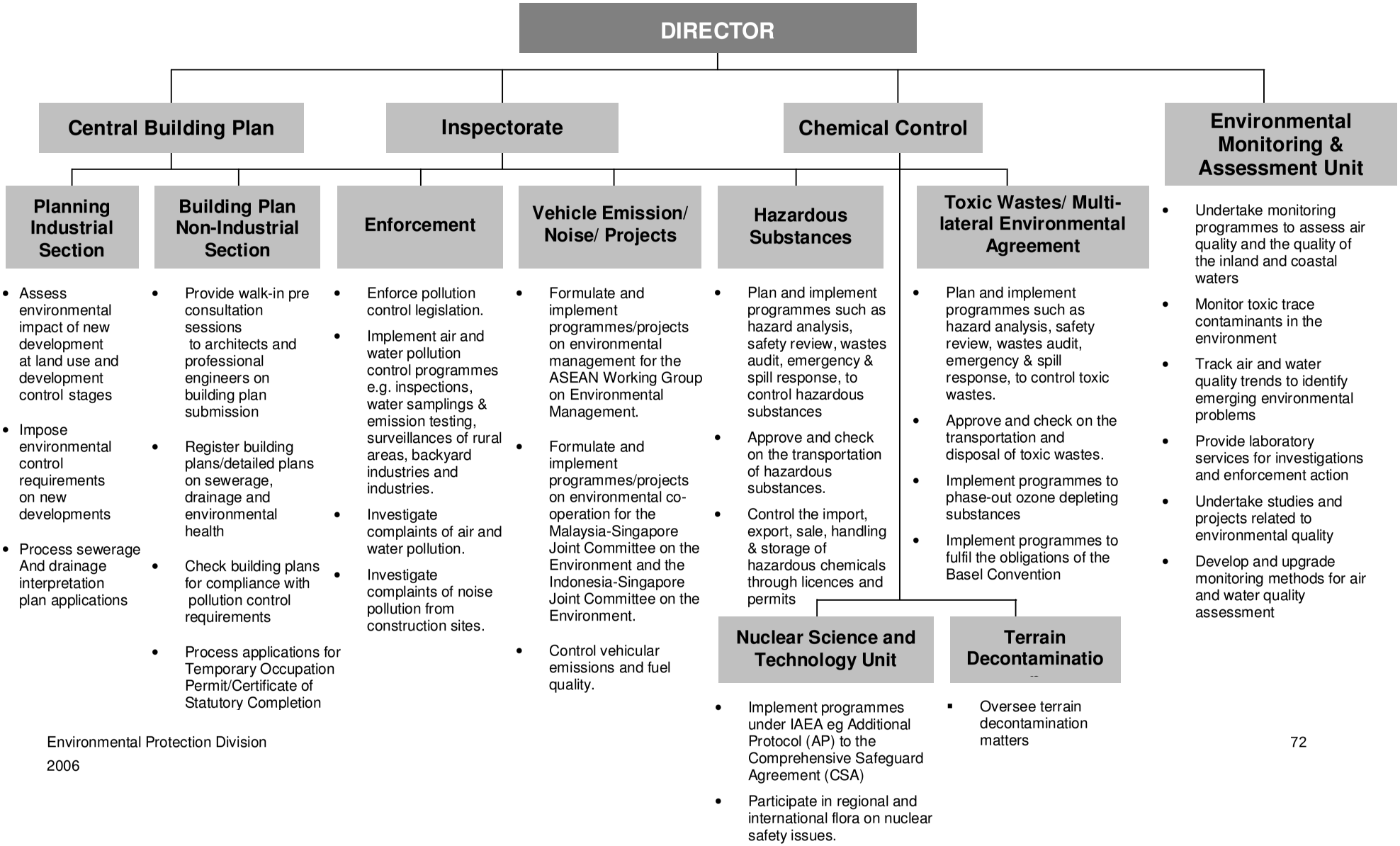
Appendices

APPENDIX 1

ORGANISATION CHART
ENVIRONMENTAL PROTECTION DIVISION

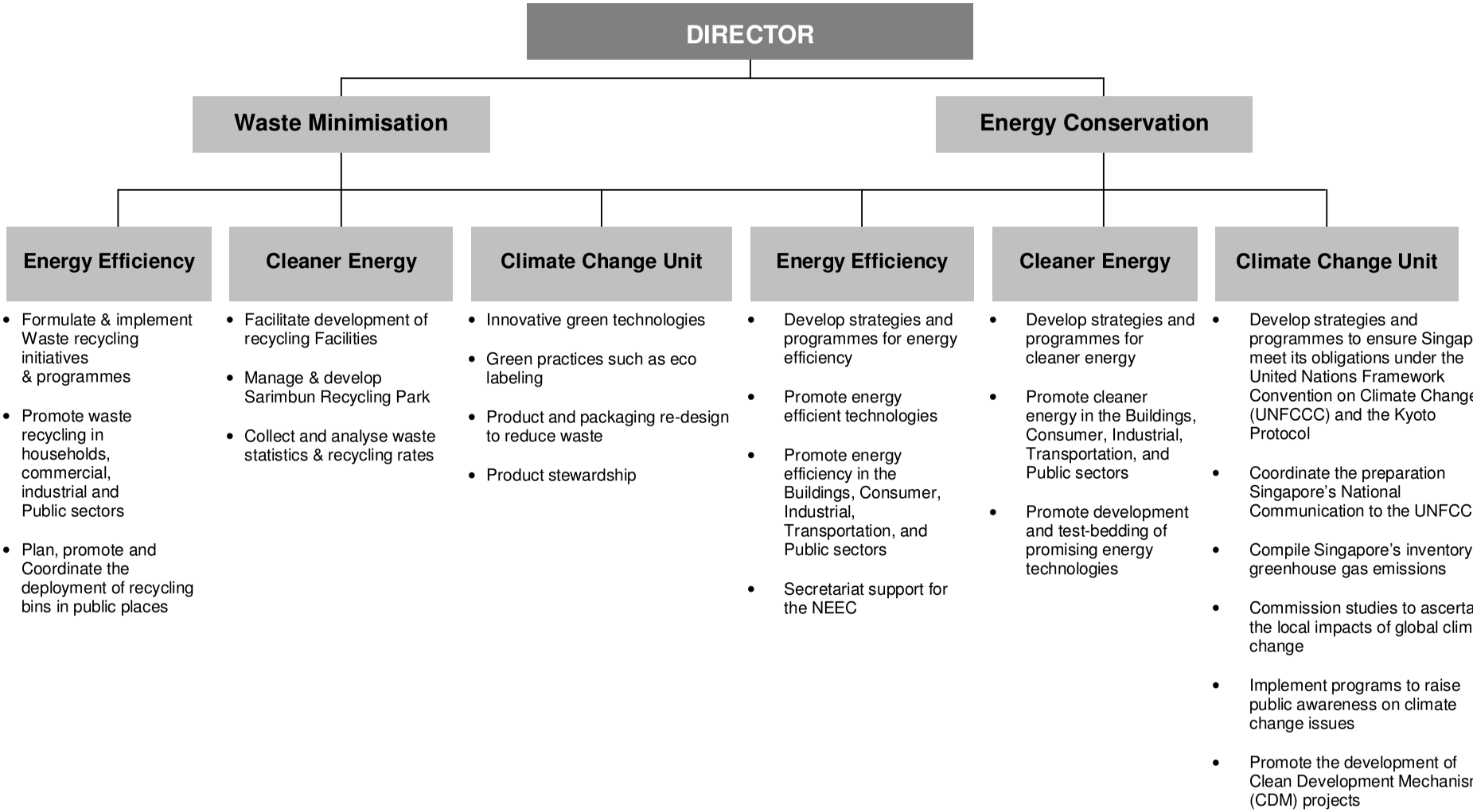


ORGANISATION CHART OF POLLUTION CONTROL DEPARTMENT

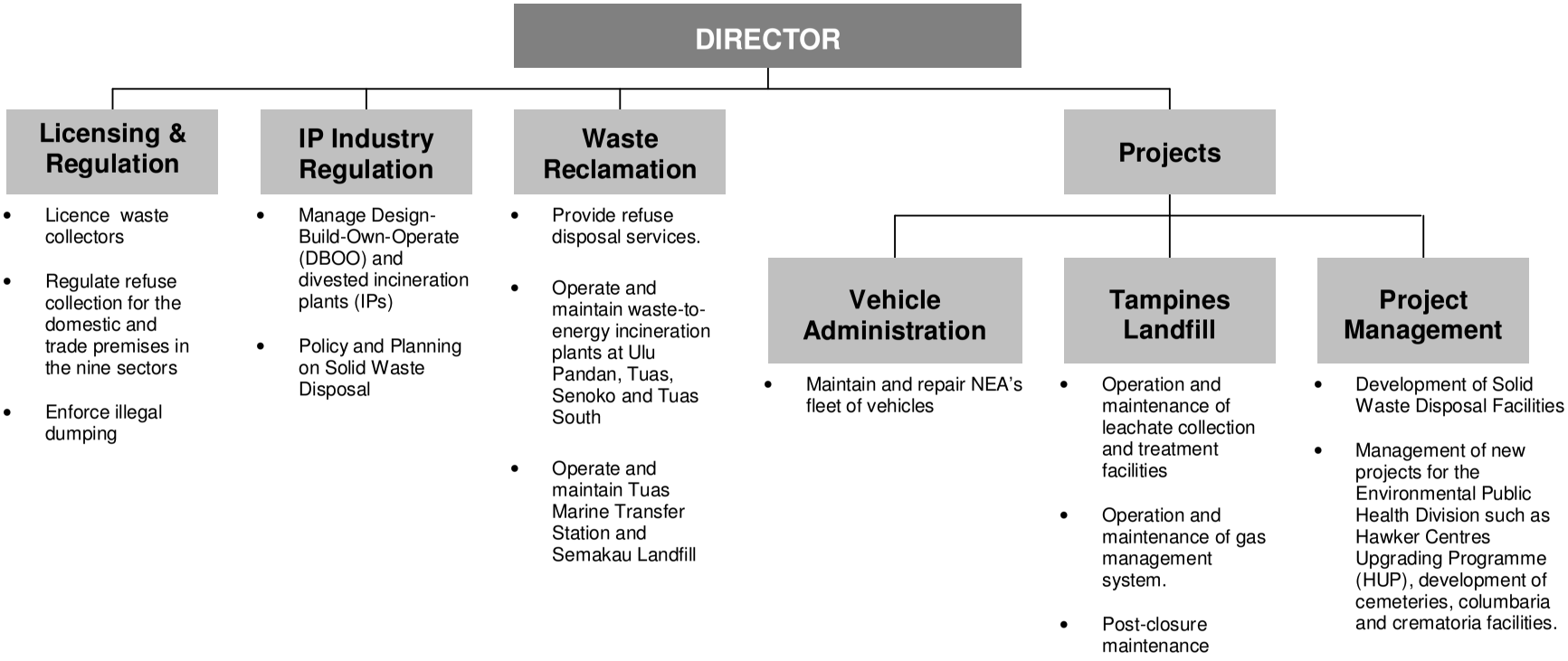


APPENDIX 3

ORGANISATION CHART OF RESOURCE CONSERVATION DEPARTMENT



ORGANISATION CHART OF WASTE MANAGEMENT DEPARTMENT



APPENDIX 5

STANDARDS OF CONCENTRATION OF AIR IMPURITIES

SUBSTANCE	TRADE, INDUSTRY, PROCESS, FUEL BURNING EQUIPMENT OR INDUSTRIAL PLANT	EMISSION LIMITS
(a) Ammonia and ammonium compounds	Any trade, industry or process	76 mg/Nm^3 expressed as ammonia
(b) Antimony and its compounds	Any trade, industry or process	5 mg/Nm^3 expressed as antimony
(c) Arsenic and its compounds	Any trade, industry or process	1 mg/Nm^3 expressed as arsenic
(d) Benzene	Any trade, industry or process	5 mg/Nm^3
(e) Cadmium and its compounds	Any trade, industry or process	3 mg/Nm^3 expressed as cadmium
(f) Carbon monoxide	Any trade, industry, process or fuel burning equipment	625 mg/Nm^3
g) Chlorine	Any trade, industry or process	32 mg/Nm^3
(h) Copper and its compounds	Any trade, industry or process	5 mg/Nm^3 expressed as copper
(i) Dioxins and furans	Any waste incinerator	1.0 ng TEQ/Nm^3 for waste incinerators commissioned before 1st Jan 2001 0.1 ng TEQ/Nm^3 for waste incinerators commissioned on or after 1st Jan 2001
(j) Ethylene oxide	Any trade, industry or process	5 mg/Nm^3
(k) Fluorine, hydrofluoric acid or inorganic fluorine compounds	Any trade, industry or process	50 mg/Nm^3 expressed as hydrofluoric acid
(l) Formaldehyde	Any trade, industry or process	20 mg/Nm^3
(m) Hydrogen chloride	Any trade, industry or process	200 mg/Nm^3
(n) Hydrogen sulphide	Any trade, industry or process	7.6 mg/Nm^3
(o) Lead and its compounds	Any trade, industry or process	5 mg/Nm^3 expressed as lead
(p) Mercury and its compounds	Any trade, industry or process	3 mg/Nm^3 expressed as mercury
(q) Oxides of nitrogen	Any trade, industry, process or fuel burning equipment	700 mg/Nm^3 expressed as nitrogen dioxide

SUBSTANCE	TRADE, INDUSTRY, PROCESS, FUEL BURNING EQUIPMENT OR INDUSTRIAL PLANT	EMISSION LIMITS
(r) Particulate substances including smoke, soot, dust, ash, fly-ash, cinders, cement, lime, alumina, grit and other solid particles of any kind	Any trade, industry, process, fuel burning equipment or industrial plant (except for any cold blast foundry cupolas)	100 mg/Nm^3 ; or where there is more than one flue, duct or chimney in any scheduled premises, the total mass of the particulate emissions from all of such flue, duct or chimney divided by the total volume of such emissions shall not exceed 100mg/Nm^3 and the particulate emissions from each of such flue, duct or chimney shall not exceed 200 mg/Nm^3 at any point in time.
(s) Smoke	All stationary fuel-burning sources	Standard Ringelmann No 1 or equivalent opacity (Not to exceed more than 5 mins in any period of one hour, 3 times a day)
(t) Styrene monomer	Any trade, industry or process	100 mg/Nm^3
(u) Sulphur dioxide (non-combustion sources)	Any trade, industry or process	500 mg/Nm^3
(v) Sulphur trioxide and other acid gases	The manufacture of sulphuric acid	500 mg/Nm^3 expressed as sulphur trioxide. Effluent gases shall be free from persistent mist.
(w) Sulphur trioxide or sulphuric acid mist	Any trade, industry or process, other than any combustion process and any plant involving the manufacture of sulphuric acid	100 mg/Nm^3 expressed as sulphur trioxide
(x) Vinyl chloride monomer	Any trade, industry or process	20 mg/Nm^3

Note: The concentration of any specified substance (1st column) emitted from any specified operation in any trade, industry, process, fuel burning equipment or industrial plant (2nd column) shall not at any point before mixture with air, smoke or other gases, exceed the specified limits (3rd column).

''dioxins and furans''	means polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF), being tricyclic and aromatic compounds formed by 2 benzene rings which are connected by 2 oxygen atoms in PCDD and by one oxygen atom in PCDF and the hydrogen atoms of which may be replaced by up to 8 chlorine atoms;
''mg''	means milligram;
''ng''	means nanogram;
''Nm^3''	means normal cubic metre, being that amount of gas which when dry, occupies a cubic metre at a temperature of 0 degree Centigrade and at an absolute pressure of 760 millimetres of mercury;
''TEF''	means Toxic Equivalency Factor;

APPENDIX 6

LIST OF PREMISES CLASSIFIED AS SCHEDULED PREMISES UNDER THE ENVIRONMENTAL POLLUTION CONTROL ACT

Scheduled Premises are any premises :-

(a) being used for :

(i) cement works, being works for the manufacture or packing of portland cement, similar cement or pozzolanic materials;

(ii) concrete works, being works for the manufacture of concrete and of each batch capacity greater than 0.5 cubic metre;

(iii) asphalt works, being works for the manufacture of asphalt or tarmacadam;

(iv) ceramic works, being works in which any products such as bricks, tiles, pipes, pottery goods, refractories or glass are manufactured in furnaces or kilns fired by any fuel;

(v) chemical works, being works in which acids, alkali, chemical fertilizer, soap, detergent, sodium silicates, lime or other calcium compounds, chlorine, chemicals or chemical products are manufactured;

(vi) coke or charcoal works, being works in which coke and charcoal is produced and quenched, cut, crushed or graded;

(vii) ferrous and non-ferrous metal works, being works in which metal melting process for casting and/or metal coating are carried out;

(viii) gas works, being works in which coal, coke, oil or other mixtures or derivatives are handled or prepared for carbonisation or gasification and in which such materials are subsequently carbonised or gasified;

(ix) crushing, grinding and milling works, being works in which rock, ores, cals or natural grain products are processed by crushing, grinding, milling or separating into different sizes by sieving, air elutriation or in any other manner;

(x) petroleum works, being works in which crude or shale oil or crude petroleum or other mineral oil is refined or reconditioned;

(xi) scrap metal recovery works, being works in which scrap metals are treated in any type of furnace for recovery of metal irrespective of whether this is the primary object of any specific premises or not;

(xii) primary metallurgical works, being works in which ores are smelted or converted to metal of any kind;

(xiii) pulping works, being works in which wood or cellulose material is made into pulp;

(xiv) abrasive blasting works, being works in which equipment or structures are cleaned by abrasive blasting;

(b) on which there is erected any boiler of steam generating capacity of 2300 kilogrammes or more per hour, incinerator or furnace burning 500 kilogrammes or more of solid combustible material per hour or 220 kilogrammes or more of liquid material per hour;

(c) being used or intended to be used for storing:-

(i) more than 100 tonnes of one or more of the following substances:-

chemicals, chemical products, hydrocarbons or hydrocarbon products which are toxic or which produce toxic gases on burning or on contact with water or air; or

(ii) more than 1000 tonnes of one or more of the following substances:-

chemicals, chemical products, hydrocarbons or hydrocarbon products with a flash point lower than 55º C.

APPENDIX 7

ALLOWABLE LIMITS FOR TRADE EFFLUENT DISCHARGED INTO A PUBLIC SEWER/WATERCOURSE/CONTROLLED WATERCOURSE

	Items Of Analysis	Public Sewer	Watercourse	Controlled Watercourse
		Units in milligram per litre or otherwise stated		
1	Temperature of discharge	45ºC	45ºC	45ºC
2	Colour	-	7 Lovibond Units	7 Lovibond Units
3	pH Value	6 - 9	6 - 9	6 - 9
4	BOD (5 days at 20ºC)	400	50	20
5	COD	600	100	60
6	Total Suspended Solids	400	50	30
7	Total Dissolved Solids	3000	-	1000
8	Chloride (as chloride ion)	1000	-	250
9	Sulphate (as SO_4)	1000	-	200
10	Sulphide (as sulphur)	1	0.2	0.2
11	Cyanide (as CN)	2	0.1	0.1
12	Detergents (linear alkylate sulphonate as methylene blue active substances)	30	15	5
13	Grease and Oil (Total) Grease and Oil (Hydrocarbon) Grease and Oil (Non-hydrocarbon)	- 60 100	10 10 -	1 - -
14	Arsenic	5	0.1	0.01
15	Barium	10	2	1
16	Tin	10	-	5
17	Iron (as Fe)	50	10	1
18	Beryllium	5	-	0.5
19	Boron	5	5	0.5
20	Manganese	10	5	0.5
21	Phenolic Compounds (expressed as phenol)	0.5	0.2	NIL
22	*Cadmium	1	0.1	0.003
23	*Chromium (trivalent and hexavalent)	5	1	0.05
24	*Copper	5	0.1	0.1
25	*Lead	5	0.1	0.1
26	*Mercury	0.5	0.05	0.001
27	*Nickel	10	1	0.1
28	*Selenium	10	0.5	0.01
29	*Silver	5	0.1	0.1
30	*Zinc	10	1	0.5
31	*Metals in Total	10	1	0.5
32	Chlorine (Free)	-	1	1
33	Phosphate (as PO_4)	-	5	2
34	Calcium (as Ca)	-	-	150
35	Magnesium (as Mg)	-	-	150
36	Nitrate (NO_3)	-	-	20

NOTE: * The concentration of Toxic Metal shall not exceed the limits as shown, individually or in total.

'Controlled Watercourse' means a watercourse from which potable water supplied by PUB under the Public Utilities Act is obtained but does not include a watercourse from which water is pumped into a main of the PUB.

The trade effluent discharged must not include:-

(1) Calcium carbide.

(2) Petroleum spirit or other inflammable solvents.

(3) Materials that may give rise to fire or explosion hazards.

(4) Materials that may be a hazard to human life, a public nuisance, injurious to health or otherwise objectionable.

(5) Refuse, garbage, sawdust, timber, or any solid matter.

(6) Pesticides, fungicides, insecticides, herbicide, rodenticide or fumigants.

(7) Radioactive material.

The trade effluent discharged into a public sewer must not include rainwater, storm water, ground water or other form of street drainage, subsurface drainage, roof drainage or yard drainage.

The trade effluent shall be analysed in accordance with the latest edition of 'Standard Methods for the Examination of Water and Wastewater' published jointly by the American Water Works Association and the Water Pollution Control Federation of the United States.

APPENDIX 8

TRADE EFFLUENT TARIFF SCHEME

The fees to be levied for discharge of biodegradable trade effluent into the public sewers are as follows:-

Concentration (mg/l)	Fee at $ per cubic metre or part thereof	
	BOD	TSS
401 - 600	0.21	0.15
601 - 800	0.42	0.30
801 – 1000	0.63	0.45
1001 - 1200	0.84	0.60
1201 - 1400	1.05	0.75
1401 - 1600	1.26	0.90
1601 - 1800	1.47	1.05
1801 - 2000	1.68	1.20
2001 - 2200	1.89	1.35
2201 - 2400	2.10	1.50
2401 - 2600	2.31	1.65
2601 - 2800	2.52	1.80
2801 - 3000	2.73	1.95
3001 - 3200	2.94	2.10
3201 - 3400	3.15	2.25
3401 - 3600	3.36	2.40
3601 - 3800	3.57	2.55
3801 - 4000	3.78	2.70

NB: BOD = Biochemical Oxygen Demand (5 days at 20℃)
TSS = Total Suspended Solids

Trade effluent with BOD and TSS each in excess of 4000 mg/l shall be treated to below this standard at the factory prior to discharge into the public sewers.

Prior approval is required to dispose of organic sludge at designated Water Reclamation Plants/Sludge Treatment Works on the payment of a fee at a rate of $7.00 per cubic meter or part thereof.

Organic sludge means the organic matter in trade effluent which has a minimum solid content of 3 per cent by weight or a maximum moisture content of 97 per cent by weight.

APPENDIX 9

HAZARDOUS SUBSTANCES LISTED IN THE 2ND SCHEDULE OF THE ENVIRONMENTAL POLLUTION CONTROL ACT

HAZARDOUS SUBSTANCES	
Substance	**Exclusion**
Acetic acid	Substances containing not more than 80%, weight in weight, of acetic acid; Preparations and solutions for photographic use.
Alkali metal bifluorides; Ammonium bifluoride; Potassium fluoride; Sodium fluoride; Potassium silicofluoride; Sodium silicofluoride; Silicofluoric acid	Preparations containing not more than 0.3%, weight in weight, of potassium fluoride in radiator protectors; Preparations containing not more than 0.96%, weight in weight, of potassium fluoride in photographic chemicals; Substances containing not more than 3%, weight in weight, of sodium fluoride or sodium silicofluoride as a preservative; Substances containing sodium fluoride intended for the treatment of human ailments.
Ammonia	Preparations and solutions of ammonia containing not more than 10%, weight in weight, of ammonia; Refrigeration equipment; Photographic and plan developers; Hair colour dyes; Perm lotions; Smelling bottles.
Ammonium chlorate	
Ammonium nitrate	Aqueous solutions containing less than 60%, weight in weight, of ammonium nitrate.
Ammonium perchlorate	
Anionic surface active agents	Preparations containing less than 5% by weight of anionic surface active agents; Preparations containing anionic surface active agents which are not less than 90% biodegradable under a test carried out in accordance with that part of the OECD method which is referred to as “Confirmatory Test Procedure” in European Communities Council Directive No. 73/405/EEC (C) or other equivalent test methods acceptable to the Director.
Antimony pentachloride	Polishes
Arsenical substances, the following: Arsenic acid Arsenic sulphide Arsenic trichloride Arsine Calcium arsenite Copper arsenate Copper arsenite Lead arsenate Organic compounds of arsenic Oxides of arsenic Potassium arsenite Sodium arsenate	Pyrites ores or sulphuric acid containing arsenical poisons as natural impurities; Animal feeding stuffs containing not more than 0.005%, weight in weight, of 4-hydroxy-3-nitrophenyl-arsonic acid and not containing any other arsenical poison; Animal feeding stuffs containing not more than 0.01%, weight in weight, of arsanilic acid and not containing any other arsenical poison; Animal feeding stuffs containing not more than 0.0375%, weight in weight, of carbarsone and not containing any other arsenical poison.

HAZARDOUS SUBSTANCES	
Substance	**Exclusion**
Sodium arsenite Sodium thioarsenate	
Asbestos in the form of crocidolite, amosite, chrysotile and amphiboles and products containing these forms of asbestos	Asbestos products containing chrysotile other than roofing sheets, refuse chutes, ceiling boards, partition boards, fire barriers, doors, paints, cement, floor tiles and putty; Asbestos in the form of chrysotile in any vehicle brake or clutch lining not installed in any vehicle if the packaging of the vehicle brake or clutch lining is affixed with the appropriate label or in any vehicle brake or clutch lining installed in any vehicle registered before 1st April 1995. The label to be affixed on the packaging of the vehicle brake and clutch lining is in accordance with Part III of the Second Schedule of the EPCA.
Barium nitrate	Preparations and solutions containing less than 10%, weight in weight, of barium nitrate.
Boric acid; Sodium borate	Boric acid or sodium borate in medicinal preparations, cosmetics, toilet preparations and substances being preparations intended for human consumption; Preparations containing boric acid or sodium borate or a combination of both where water or solvent is not the only other part of the composition.
Boron trichloride	
Boron trifluoride	
Bromine; Bromine solutions	
Cadmium-containing silver brazing alloy	
Captafol	
Carbamates	Benomyl; Carbendazim; Chlorpropham; Propham; Thiophanate-methyl; Preparations containing not more than 1%, weight in weight, of propoxur and not containing any other carbamate; Preparations containing not more than 1%, weight in weight, of methomyl and not containing any other carbamate.
Carbon tetrafluoride	
Chlorinated hydrocarbons, the following: Aldrin Benzene hexachloride (BHC) Bromocyclen Camphechlor Chlorbenside Chlorbicyclen Chlordane Chlordecone Chlorfenethol Chlorfenson Chlorfensulphide Chlorobenzilate	Paper impregnated with not more than 0.3%, weight in weight, of benzene hexachloride or gamma - BHC provided it is labelled with directions that no food, wrapped or unwrapped, or food utensils are to be placed on the treated paper, and that it is not to be used where food is prepared or served.

HAZARDOUS SUBSTANCES	
Substance	**Exclusion**
Chloropropylate Dicophane (DDT) pp'-DDT Dicofol Dieldrin Endosulfan Endrin Fenazaflor Fenson Fluorbenzide Gamma benzene hexachloride (Gamma - BHC) HEOD [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a- octahydro-1, 4 (exo): 5,8 (endo)-dimethano naphthalene] HHDN [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4 (exo):5,8 (endo)-dimethano naphthalene] Heptachlor Isobenzan Isodrin Kelevan Methoxychlor [1,1,1-trichloro-2,2-di-(p-methoxyphenyl) ethane] Tetrachlordiphenylethane [TDE; 1,1-dichloro-2,2-bis (p-chlorophenyl) ethane] Tetradifon Tetrasul Toxaphene Allied chlorinated hydrocarbon compounds used as pesticides (insecticides, acaricides, etc.)	
Chlorine	Chlorine used for chlorination of water in swimming pools.
Chlorine trifluoride	
Chlorobenzenes, the following: Monochlorobenzene Meta-dichlorobenzene Ortho-dichlorobenzene Trichlorobenzene Tetrachlorobenzene Pentachlorobenzene Hexachlorobenzene	
Chlorophenols, the following: Monochlorophenol Dichlorophenol Trichlorophenol Tetrachlorophenol Pentachlorophenol and their salts	Substances containing not more than 1%, weight in weight, of chlorophenols.
Chlorophenoxyacids; their salts, esters, amines	
Chloropicrin	
Chlorosilanes, the following: Hexachlorodisilane Phenyltrichlorosilane Tetrachlorosilane	
Chlorosulphonic acid	

HAZARDOUS SUBSTANCES	
Substance	**Exclusion**
Chromic acid	Substances containing not more than 9%, weight in weight, of chromic acid; Photographic solutions containing chromic acid in individual containers containing not more than 15 kilograms each of such solutions and of aggregate weight of not more than 500 kilograms of such solutions.
Cyanides	Ferrocyanides; Ferricyanides; Acetonitrile; Acrylonitrile; Butyronitrile; 2-Dimethylaminoacetonitrile; Isobutyronitrile; Methacrylonitrile; Propionitrile.
Diborane	
Dibromochloropropane	
Diethyl sulphate	
Dinitrocresols (DNOC); their compounds with a metal or a base	
Dinosam; its compounds with a metal or a base	
Dinoseb; its compounds with a metal or a base	
Diquat; its salts	
Drazoxolon; its salts	Dressings on seeds.
Endothal; its salts	
Epichlorohydrin	
Ethyl mercaptan	Substances containing less than 1%, weight in weight, of ethyl mercaptan
Ethylene dibromide	
Ethylene dichloride	
Ethylene imine	
Ethylene oxide	Mixtures of inert gases and ethylene oxide comprising not more than 12%, weight in weight, of ethylene oxide contained in cylinders of water capacity less than 47 litres and for aggregate of not more than 3 numbers of such cylinders.
Ferric chloride	
Fluorine	
Fluoroacetamide	
Formaldehyde	Substances containing not more than 5%, weight in weight, of formaldehyde; Photographic glazing or hardening solutions.
Formic acid	Substances containing not more than 5%, weight in weight, of formic acid.
Germane	
Guanidine nitrate	

HAZARDOUS SUBSTANCES	
Substance	**Exclusion**
Hydrazine anhydrous; Hydrazine aqueous solutions	
Hydrochloric acid	Substances containing not more than 9%, weight in weight, of hydrochloric acid.
Hydrofluoric acid	Preparations or solutions containing not more than 2%, weight in weight, of hydrofluoric acid.
Hydrogen chloride	
Hydrogen cyanide; Hydrocyanic acid	Preparations of wild cherry; In reagent kits supplied for medical or veterinary purposes, substances containing less than the equivalent of 0.1%, weight in weight, of hydrocyanic acid.
Hydrogen fluoride	
Hydrogen peroxide	Preparations and solutions containing not more than 20%, weight in weight, of hydrogen peroxide.
Hydrogen selenide	
Isocyanates	Polyisocyanates containing less than 0.7%, weight in weight, of free monomeric diisocyanates; Pre-polymerised isocyanates in polyurethane paints and lacquers; Hardeners and bonding agents for immediate use in adhesives.
Lead compounds in paint	Lead compounds in paint in which the lead content is not more than 0.06% by weight of the paint; Lead compounds in paint in which the container is affixed with an appropriate label. The labels to be used for paints containing lead compounds are in accordance with Part IV of the Second Schedule of the EPCA
Lead tetra-ethyl and similar lead containing compounds	
Lead tetra-ethyl and similar lead containing compounds in petrol intended for use in Singapore as fuel for motor vehicles	
Mercuric chloride; Mercuric iodide; Organic compounds of mercury	Dressings on seeds or bulbs; Toilet, cosmetic and therapeutic preparations containing not more than 0.01%, weight in weight, of phenyl mercuric salts as a preservative; Antiseptic dressings on toothbrushes; Textiles containing not more than 0.01%, weight in weight, of phenyl mercuric salts as a bacteriostat and fungicide.
Mercury and its compounds in batteries	Batteries other than mercury oxide batteries, zinc carbon batteries containing more than 0.001% by weight of mercury per cell and alkaline batteries, except those in button form, containing more than 0.025% by weight of mercury per cell.
Metanil yellow (sodium salt of metanilylazo-diphenylamine)	Dye-indicators used in laboratories
Methyl chloride	
Methyl mercaptan	Substances containing less than 1%, weight in weight, of methyl mercaptan

HAZARDOUS SUBSTANCES	
Substance	**Exclusion**
Monomethyltetrachloro diphenyl methane	
Monomethyl-dichloro-diphenyl methane	
Monomethyl-dibromodiphenyl methane	
Niclofolan	
Nicotine sulphate	
Nitric acid	Substances containing not more than 9%, weight in weight, of nitric acid.
Nitric oxide	
Nitrobenzene	Substances containing less than 0.1%, weight in weight, of nitrobenzene; Soaps containing less than 1%, weight in weight, of nitrobenzene; Polishes and cleansing agents.
Nitrogen trifluoride	
Ozone depleting substances, namely: (a) Chlorofluorocarbons, the following: Chloroheptafluoropropane Chloropentafluoroethane Chlorotrifluoromethane Dichlorodifluoromethane Dichlorohexafluoropropane Dichlorotetrafluoroethane Heptachlorofluoropropane Hexachlorodifluoropropane Pentachlorofluoroethane Pentachlorotrifluoropropane Tetrachlorodifluoroethane Tetrachlorotetrafluoropropane Trichlorofluoromethane Trichloropentafluoropropane Trichlorotrifluoroethane (b) Halons, the following: Bromochlorodifluoromethane Bromochloromethane Bromotrifluoromethane Dibromotetrafluoroethane (c) Hydrochlorofluorocarbons, the following: 1,1-dichloro-1-fluoro-ethane 1,1-dichloro-2,2,3,3,3-pentafluoropropane 1,3-dichloro-1,2,2,3,3-pentafluoropropane 1-chloro-1,1-difluoro-ethane Chlorodifluoroethane Chlorodifluoromethane Chlorodifluoropropane Chlorofluoroethane Chlorofluoromethane Chlorofluoropropane Chlorohexafluoropropane Chloropentafluoropropane Chlorotetrafluoroethane	Products containing any ozone depleting substance other than the following products: (a) in the case of chlorofluorocarbons - (i) air-conditioners in vehicles registered on or after 1st January 1995 or intended for such vehicles; (ii) equipment for domestic or commercial refrigeration or air-conditioning installed on or after 1st January 1993, or heat pump equipment, which contains any chlorofluorocarbon substance as a refrigerant or in any insulating material of such equipment; (iii) refrigerators that have a compressor rating which exceeds one horsepower; (iv) non-pharmaceutical aerosol products; (v) insulation boards, panels or pipe covers; (vi) polystyrene sheets or finished products; (b) in the case of Halons, portable fire extinguishers; and (c) in the case of bromotrifluoromethane, fire protection systems with building plans approved after 17th June 1991 and installed after 31st December 1991.

HAZARDOUS SUBSTANCES	
Substance	**Exclusion**
Chlorotetrafluoropropane Chlorotrifluoroethane Chlorotrifluoropropane Dichlorodifluoroethane Dichlorodifluoropropane Dichlorofluoroethane Dichlorofluoromethane Dichlorofluoropropane Dichloropentafluoropropane Dichlorotetrafluoropropane Dichlorotrifluoroethane Dichlorotrifluoropropane Hexachlorofluoropropane Pentachlorodifluoropropane Pentachlorofluoropropane Tetrachlorodifluoropropane Tetrachlorofluoroethane Tetrachlorofluoropropane Tetrachlorotrifluoropropane Trichlorodifluoroethane Trichlorodifluoropropane Trichlorofluoroethane Trichlorofluoropropane Trichlorotetrafluoropropane Trichlorotrifluoropropane (d) Hydrobromofluorocarbons, the following: Bromodifluoroethane Bromodifluoromethane Bromodifluoropropane Bromofluoroethane Bromofluoromethane Bromofluoropropane Bromohexafluoropropane Bromopentafluoropropane Bromotetrafluoroethane Bromotetrafluoropropane Bromotrifluoroethane Bromotrifluoropropane Dibromodifluoroethane Dibromodifluoropropane Dibromofluoroethane Dibromofluoromethane Dibromofluoropropane Dibromopentafluoropropane Dibromotetrafluoropropane Dibromotrifluoroethane Dibromotrifluoropropane Hexabromofluoropropane Pentabromodifluoropropane Pentabromofluoropropane Tetrabromodifluoropropane Tetrabromofluoroethane Tetrabromofluoropropane Tetrabromotrifluoropropane Tribromodifluoroethane Tribromodifluoropropane Tribromofluoroethane Tribromofluoropropane Tribromotetrafluoropropane Tribromotrifluoropropane	

HAZARDOUS SUBSTANCES	
Substance	**Exclusion**
(e) Carbon tetrachloride (f) 1,1,1-trichloroethane (methyl chloroform) (g) Methyl bromide	
Oleum	
Orange II [sodium salt of p-(2-hydroxy-1-naphthylazo) benzenesulphonic acid]	Dye-indicators used in laboratories
Organic peroxides	Car puttys; Substances and preparations containing not more than 3%, weight in weight, of organic peroxides; Solutions of not more than 60%, weight in weight, of methyl ethyl ketone peroxides and total aggregate weight of less than 50 kilograms of such solutions.
Organo-tin compounds, the following: Compounds of fentin Cyhexatin	
Paraquat; its salts	Preparation in pellet form containing not more than 5%, weight in weight, of salts of paraquat ion.
Perchloromethyl mercaptan	Substances containing less than 1%, weight in weight, of perchloromethyl mercaptan
Phenols, the following: Catechol Cresol Hydroquinone Octyl phenol Phenol Resorcinol	Preparations containing less than 1%, weight in weight, of phenols; Phenols which are intended for the treatment of human ailments and other medical purposes; Soaps for washing; Tar (coal or wood), crude or refined; Photographic solutions containing hydroquinone in individual containers containing not more than 15 kilograms each of such solutions and of aggregate weight of not more than 500 kilograms of such solutions.
Phosgene	
Phosphides	
Phosphine	
Phosphoric acid	Substances containing not more than 50%, weight in weight, of phosphoric acid.
Phosphorus compounds used as pesticides (insecticides, acaricides, etc.)	Acephate; Bromophos; Iodofenphos; Malathion; Pirimiphos-methyl; Temephos; Tetrachlorvinphos; Trichlorfon;

HAZARDOUS SUBSTANCES	
Substance	**Exclusion**
	Preparations containing not more than 0.5%, weight in weight, of chlorpyrifos and not containing any other phosphorus compound; Preparations containing not more than 0.5%, weight in weight, of dichlorvos and not containing any other phosphorus compound; Materials impregnated with dichlorvos and not containing any other phosphorus compound for slow release; Preparations containing not more than 1%, weight in weight, of azamethiphos and not containing any other phosphorus compound.
Phosphorus oxychloride	
Phosphorus pentachloride	
Phosphorus pentafluoride	
Phosphorus trichloride	
Polybrominated biphenyls	
Polychlorinated biphenyls	
Polychlorinated terphenyls	
Potassium chlorate	
Potassium hydroxide	Substances containing not more than 17%, weight in weight, of potassium hydroxide; Accumulators; Batteries.
Potassium nitrate	Preparations and solutions containing less than 5%, weight in weight, of potassium nitrate or a combination of both potassium nitrate and sodium nitrate.
Potassium nitrite	Aqueous solutions containing less than 5%, weight in weight, of potassium nitrite.
Potassium perchlorate	
Prochloraz	
Sodium chlorate	
Sodium hydroxide	Substances containing not more than 17%, weight in weight, of sodium hydroxide; Made-up formulated preparations either liquid or solid for biochemical tests.
Sodium nitrate	Preparations and solutions containing less than 5%, weight in weight, of sodium nitrate or a combination of both sodium nitrate and potassium nitrate
Sodium nitrite	Aqueous solutions containing less than 5%, weight in weight, of sodium nitrite.
Sodium perchlorate	
Sulphur in diesel intended for use in Singapore as fuel for motor vehicles or industrial plants	Sulphur in diesel in which the sulphur content is 0.05% or less by weight.
Sulphur tetrafluoride	
Sulphur trioxide	

HAZARDOUS SUBSTANCES	
Substance	**Exclusion**
Sulphuric acid	Substances containing not more than 9%, weight in weight, of sulphuric acid; Accumulators; Batteries; Fire extinguishers; Photographic developers containing not more than 20%, weight in weight, of sulphuric acid.
Thallium; its salts	
Titanium tetrachloride	
Tris (2, 3-dibromo-l-propyl) phosphate	

APPENDIX 10

HAZARDOUS SUBSTANCES QUANTITIES EXCEEDING WHICH TRANSPORT APPROVAL IS REQUIRED			
Substance	**Qty (kgs)**	**Substance**	**Qty (kgs)**
Acetic acid	1000	Hydrogen peroxide	1000
Ammonia	500	Hydrogen selenide	0
Antimony pentachloride	50	Isocyanates	500
Arsine	0	Lead tetra-ethyl and similar lead containing compounds	0
Arsenical Substances	50	Metanil yellow (sodium salt of metanilylazo-diphenylamine)	5000
Boric Acid; Sodium borate	5000	Methyl bromide	50
Boron trichloride	50	Methyl chloride	50
Boron trifluoride	50	Methyl mercaptan	50
Bromine, bromine solutions	50	Monomethyltetrachloro diphenyl methane	0
Captafol	0	Monomethyl-dichloro-diphenyl methane	0
Carbamates except bendiocard, BPMC (fenobucarb), mercaptodimethur (methiocarb)	0	Monomethyl-dibromo-diphenyl methane	0
Carbon tetrafluoride	500	Nitric acid (95% or greater)	50
Chlorine	500	Nitric acid (less than 95%)	1000
Chlorine trifluoride	50	Nitric oxide	0
Chlorinated hydrocarbon compounds used as pesticides	0	Nitrogen trifluoride	50
Chlorobenzenes	0	Oleum	50
Chlorophenols	0	Orange II (sodium salt of p-(2-hydroxy-1 naphthylazo) benzenesulphonic acid)	5000
Chlorophenoxyacids	0	Organic compounds of Mercury; Mercuric chloride; Mercuric iodide	0
Chlorosilanes	50	Organic peroxides	500
Chlorosulphonic acid	50	Organo-tin compounds	0
Chromic acid	50	Perchloro methyl mercaptan	50
Cyanides	50	Phenols	500
Diborane	50	Phosgene	0
Dibromochloropropane	50	Phosphides	0
Diethyl sulphate	500	Phosphorous compounds except Dimethoate, diazinon, Fenchlorophos, fenitrothion, Phenthoate, profenophos, Prothiophos, quinalphos	0
Epichlorohydrin	50	Phosphorus oxychloride	50
Ethyl mercaptan	50	Phosphorus pentachloride	50
Ethylene dibromide	0	Phosphorus pentafluoride	50
Ethylene dichloride	0	Phosphorus trichloride	50

HAZARDOUS SUBSTANCES QUANTITIES EXCEEDING WHICH TRANSPORT APPROVAL IS REQUIRED			
Substance	**Qty (kgs)**	**Substance**	**Qty (kgs)**
Ethylene imine	0	Polybrominated biphenyls	0
Ethylene oxide	50	Polychlorinated biphenyls	0
Ferric chloride	1000	Polychlorinated terphenyls	0
Fluorine	0	Potassium hydroxide	1000
Fluoroacetamide	0	Prochloraz	0
Formic acid	1000	Sodium hydroxide	1000
Germane	0	#Sulphur in Diesel	0
Hydrazine anhydrous, hydrazine aqueous solutions	50	Sulphur tetrafluoride	0
Hydrochloric acid	1000	Sulphur trioxide	50
Hydrocyanic acid; Hydrogen cyanide	0	Sulphuric acid	1000
Hydrofluoric acid	500	Titanium tetrachloride	1000
Hydrogen chloride, all forms	500	Tris(2,3-dibromopropyl) phosphate	0

NB: Definition and exemptions of Poisons in Part II List will also be extended to the above list.

APPENDIX 11

TOXIC INDUSTRIAL WASTES CONTROLLED UNDER THE ENVIRONMENTAL PUBLIC HEALTH (TOXIC INDUSTRIAL WASTE) REGULATIONS 1988
List of Toxic Industrial Wastes
Acids 1. Spent inorganic acids e.g. hydrochloric acid, sulphuric acid, nitric acid, phosphoric acid, hydrofluoric acid, boric acid and pickling acid 2. Spent organic acids e.g. acetic acid, formic acid, benzoic acid and sulphonic acid
Alkalis 1. 1.Spent alkaline solutions 2. Spent ammoniacal solutions 3. Metal hydroxide sludges and oxide sludges
Antimony and its Compounds 1. Spent antimony potassium tartrate
Arsenic and its Compounds 1. Timber preservative residues containing arsenic 2. Wastes containing gallium arsenide
Asbestos 1. Asbestos wastes from asbestos/cement manufacturing processes 2. Empty sacks/bags which have contained loose asbestos fibres
Cadmium and its Compounds 1. Plating effluents and residues containing cadmium 2. Wastes containing cadmium from Ni/Cd battery manufacturing
Chromium Compounds 1. Plating effluents and residues containing chromium 2. Timber preservative residues containing chromium 3. Spent and aqueous solutions containing chromium compounds 4. Tannery effluents and residues containing chromium
Copper Compounds 1. Plating effluents and residues containing copper 2. Spent etching solutions containing copper from printed circuit board manufacturing 3. Timber preservative residues containing copper
Cyanides 1. Plating effluents and residues containing cyanides 2. Heat treatment residues containing cyanides 3. Spent quenching oils containing cyanides 4. Spent processing solutions containing cyanides from photographic processing
Fluoride Compounds 1. Timber preservative residues containing fluorides 2. Spent ammonium bi-fluoride
Isocyanates 1. Spent di-isocyanates e.g. toluene di-isocyanate (TDI) and methylene di-isocyanate (MDI) from polyurethane foam-making process

TOXIC INDUSTRIAL WASTES CONTROLLED UNDER THE ENVIRONMENTAL PUBLIC HEALTH (TOXIC INDUSTRIAL WASTE) REGULATIONS 1988

List of Toxic Industrial Wastes

Laboratory Wastes
1. Obsolete laboratory chemicals
2. Toxic chemical wastes from chemical analysis

Lead Compounds
1. Sludges containing lead oxide/sulphate
2. Spent organo-lead compounds
   e.g. tetraethyllead (TEL) and tetramethyllead (TML)
3. Waste lead-acid batteries, whole or crushed

Mercury and its Compounds
1. Effluents, residues or sludges containing mercury from chlor-alkali industry
2. Wastes containing mercury from equipment manufacturing involving the use of metal mercury
3. Spent catalysts from chemical processes containing mercury
4. Spent organo-mercury compounds

Metal Catalysts
1. Spent metal catalysts from chemical processes and petroleum refining
   e.g. catalysts containing chromium and cobalt

Nickel Compounds
1. Plating effluents and residues containing nickel

Organic Compounds containing Halogen
1. Spent halogenated organic solvents
   e.g. trichloroethylene, 111-trichloroethane, perchloro-ethylene, methylene chloride, tetra-chloromethane and 112-trichloro-122-trifluoroethane
2. Residues from recovery of halogenated organic solvents
3. Packaging materials or residues containing chloro- benzenes and/or chlorophenols and their salts

Organic Compounds not containing Halogen
1. Spent non-halogenated organic solvents
   e.g. benzene, toluene, xylene, turpentine, petroleum, thinner, kerosene, methanol, ethanol, isobutanol, iso-propanol, methyl ethyl ketone, methyl isobutyl ketone, isopropyl ether, diethyl ether, hexane, dimethyl sulphide and dimethyl sulphoxide
2. Residues from recovery of non-halogenated organic solvents

Other Wastes
1. Obsolete/abandoned chemicals and pesticides from storage, manufacturing and trading activities
2. Used containers, bags and process equipment contaminated by chemicals and pesticides from storage, manufacturing and trading activities
3. Wastes/residues containing unreacted monomers, eg. vinyl chloride and styrene monomers, from polymer manufacturing processes
4. Tar residues from distilling and tarry materials from refining
5. Wastes from toxic waste treatment processes e.g. wastes and residues from solidification, fixation and incineration processes
6. Wastes from toxic chemical drums and tank cleaning activities
7. Chemical and oil slops from ship tankers
8. Wastes from the production, formulation and use of resins, latex, plasticisers, glues/adhesives containing solvents and other contaminants.
9. Wastes from the production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish containing organic solvents, heavy metals or biocides.

Pathogenic Wastes
1. Pathogenic wastes from hospitals

TOXIC INDUSTRIAL WASTES CONTROLLED UNDER THE ENVIRONMENTAL PUBLIC HEALTH (TOXIC INDUSTRIAL WASTE) REGULATIONS 1988

List of Toxic Industrial Wastes

Phenolic Compounds
1. Sludges/residues from paint stripping using chemicals containing phenols
2. Residues containing unreacted phenol and formaldehyde from adhesive industry

Polychlorinated Bi-phenyl (PCB) including
Poly-chlorinated Ter-phenyl (PCT)
1. Spent transformer oil containing PCB and/or PCT
2. Retrofilled transformer contaminated with PCB and/or PCT
3. Electrical equipment and parts containing or contaminated with PCB and/or PCT
   e.g. Capacitors and transformers
4. Containers and all waste materials contaminated with PCB and/or PCT

Polyvinyl Chloride (PVC)
1. All waste materials containing PVC
   e.g. PVC insulated wires, PVC pipes and trunking, PVC parts, PVC upholstery and PVC resins

Silver Compounds
1. Spent processing solutions containing silver from photographic processing

Used, Contaminated Oil
1. Used mineral, lubricating and hydraulic oil from machine cylinders, turbines, switch gears and transformers
2. Spent motor oils from petrol and diesel engines
3. Spent quenching oil from metal hardening
4. Oil recovered from solvent degreasers
5. Spent oil water emulsions
   e.g. Spent coolants from metal working industries
6. Oil water mixtures (mainly oil)
   e.g. Oily ballast water from ship tankers
7. Oil and sludge from oil interceptors
8. Tankers sludges and oil sludges/residues from storage tanks
9. Oil sludges containing acid from recovery and recycling of used oil

Zinc Compounds
1. Plating effluents and residues containing zinc

APPENDIX 12

BOUNDARY NOISE LIMITS FOR FACTORY PREMISES

The maximum permissible boundary noise levels are as follows:

Type of affected premises	Maximum permissible noise level (reckoned as the equivalent continuous noise level over the specified period) in decibels (dBA)		
	Day 7 am - 7 pm	Evening 7 pm - 11 pm	Night 11 pm -7 am
Noise Sensitive Premises	60	55	50
Residential Premises	65	60	55
Commercial Premises	70	65	60

Type of affected premises	Maximum permissible noise level (reckoned as the equivalent continuous noise level over 5 minutes) in decibels (dBA)		
	Day 7 am - 7 pm	Evening 7 pm - 11 pm	Night 11 pm -7 am
Noise Sensitive Premises	65	60	55
Residential Premises	70	65	60
Commercial Premises	75	70	65
Factory Premises	75	70	65

APPENDIX 13

MAXIMUM PERMISSIBLE NOISE LEVELS FROM CONSTRUCTION SITES

Since 1 Oct 2001, the permissible noise limits for evening (7 pm to 10 pm) and night time (10 pm to 7 am) for construction sites located within 150 m from any residential areas have been tightened. The permissible noise limits are as shown:

Maximum Permissible Noise Limits (Construction sites that commenced work before 1 Oct 2001)		**Maximum Permissible Noise Limits (Construction sites that commenced work on or after 1 Oct 2001)**	
Time	**Noise Limits**	**Time**	**Noise Limits**
7 am to 7 pm	Leq 12 hr – 75 dBA Leq 5 min – 90 dBA	7 am to 7 pm	Leq 12 hr – 75 dBA Leq 5 min – 90 dBA
7 pm to 7 am	Leq 12 hr – 65 dBA Leq 5 min – 70 dBA	7 pm to 10 pm	Leq 1 hr – 65 dBA Leq 5 min – 70 dBA
		10 pm to 7 am	Leq 1 hr – 55 dBA Leq 5 min – 60 dBA

APPENDIX 14

USEPA AMBIENT AIR QUALITY STANDARDS			
USEPA AMBIENT AIR QUALITY STANDARDS			
Pollutants	**Averaging Time**	**USEPA Primary Air Quality Standards**	
		Concentration	**Method**
GASEOUS POLLUTANTS			
Sulphur Dioxide	Annual Mean 24 Hours	80 $\mu g/m^3$ (0.03 ppm) 365 $\mu g/m^3$ (0.14 ppm)	Pulsed Fluorescence
Carbon Monoxide	8 Hours 1 Hour	10 mg/m^3 (9 ppm) 40 mg/m^3 (35 ppm)	Non-dispersive Infrared Spectrometry
Nitrogen Dioxide	Annual Mean	100 $\mu g/m^3$ (0.053 ppm)	Chemiluminescence
Ozone	1 Hour 8 Hours	235 $\mu g/m^3$ (0.12 ppm) 157 $\mu g/m^3$ (0.08 ppm)	Ultraviolet Photometry
PARTICULATE POLLUTANTS			
PM10 (Particles that are 10 micrometers or smaller)	Annual Mean 24 Hours	50 $\mu g/m^3$ 150 $\mu g/m^3$	1) High Volume Sampling 2) Continuous Filter-Based Mass Measurement 3) Beta Attenuation
Lead	3 Months	1.5 $\mu g/m^3$	Atomic Absorption Spectroscopy

THE SCHEDULE OF THE ENVIRONMENTAL POLLUTION CONTROL (OZONE DEPLETING SUBSTANCES) REGULATIONS 2000

ANNEX A

Group I		
$CFCl_3$	CFC-11	Trichlorofluoromethane
CF_2Cl_2	CFC-12	Dichlorodifluoromethane
$C_2F_3Cl_3$	CFC-113	Trichlorotrifluoroethane
$C_2F_4Cl_2$	CFC-114	Dichlorotetrafluoroethane
C_2F_5Cl	CFC-115	Chloropentafluoroethane
Group II		
CF_2BrCl	Halon-1211	Bromochlorodifluoromethane
CF_3Br	Halon-1301	Bromotrifluoromethane
$C_2F_4Br_2$	Halon-2402	Dibromotetrafluoroethane

ANNEX B

Group I		
CF_3Cl	CFC-13	Chlorotrifluoromethane
C_2FCl_5	CFC-111	Pentachlorofluoroethane
$C_2F_2Cl_4$	CFC-112	Tetrachlorodifluoroethane
C_3FCl_7	CFC-211	Heptachlorofluoropropane
$C_3F_2Cl_6$	CFC-212	Hexachlorodifluoropropane
$C_3F_3Cl_5$	CFC-213	Pentachlorotrifluoropropane
$C_3F_4Cl_4$	CFC-214	Tetrachlorotetrafluoropropane
$C_3F_5Cl_3$	CFC-215	Trichloropentafluoropropane
$C_3F_6Cl_2$	CFC-216	Dichlorohexafluoropropane
C_3F_7Cl	CFC-217	Chloroheptafluoropropane
Group II		
CCl_4		Carbon tetrachloride
Group III		
$C_2H_3Cl_3$		1,1,1-trichloroethane (methyl chloroform)

THE SCHEDULE OF THE ENVIRONMENTAL POLLUTION CONTROL (OZONE DEPLETING SUBSTANCES) REGULATIONS 2000

ANNEX C

Group I		
$CHFCl_2$	HCFC-21	Dichlorofluoromethane
CHF_2Cl	HCFC-22	Chlorodifluoromethane
CH_2FCl	HCFC-31	Chlorofluoromethane
C_2HFCl_4	HCFC-121	Tetrachlorofluoroethane
$C_2HF_2Cl_3$	HCFC-122	Trichlorodifluoroethane
$C_2HF_3Cl_2$	HCFC-123	Dichlorotrifluoroethane
C_2HF_4Cl	HCFC-124	Chlorotetrafluoroethane
$C_2H_2FCl_3$	HCFC-131	Trichlorofluoroethane
$C_2H_2F_2Cl_2$	HCFC-132	Dichlorodifluoroethane
$C_2H_2F_3Cl$	HCFC-133	Chlorotrifluoroethane
$C_2H_3FCl_2$	HCFC-141	Dichlorofluoroethane
CH_3CFCl_2	HCFC-141b	1,1-dichloro-1-fluoro-ethane
$C_2H_3\ F_2Cl$	HCFC-142	Chlorodifluoroethane
CH_3CF_2Cl	HCFC-142b	1-chloro-1,1-difluoro-ethane
C_2H_4FCl	HCFC-151	Chlorofluoroethane
C_3HFCl_6	HCFC-221	Hexachlorofluoropropane
$C_3HF_2Cl_5$	HCFC-222	Pentachlorodifluoropropane
$C_3HF_3Cl_4$	HCFC-223	Tetrachlorotrifluoropropane
$C_3HF_4Cl_3$	HCFC-224	Trichlorotetrafluoropropane
$C_3HF_5Cl_2$	HCFC-225	Dichloropentafluoropropane
$CF_3CF_2CHCl_2$	HCFC-225ca	1,1-dichloro-2,2,3,3,3-pentafluoropropane
CF_2ClCF_2CHClF	HCFC-225cb	1,3-dichloro-1,2,2,3,3-pentafluoropropane
C_3HF_6Cl	HCFC-226	Chlorohexafluoropropane
$C_3H_2FCl_5$	HCFC-231	Pentachlorofluoropropane
$C_3H_2F_2Cl_4$	HCFC-232	Tetrachlorodifluoropropane
$C_3H_2F_3Cl_3$	HCFC-233	Trichlorotrifluoropropane
$C_3H_2F_4Cl_2$	HCFC-234	Dichlorotetrafluoropropane
$C_3H_2F_5Cl$	HCFC-235	Chloropentafluoropropane
$C_3H_3FCl_4$	HCFC-241	Tetrachlorofluoropropane
$C_3H_3F_2Cl_3$	HCFC-242	Trichlorodifluoropropane
$C_3H_3F_3Cl_2$	HCFC-243	Dichlorotrifluoropropane
$C_3H_3F_4Cl$	HCFC-244	Chlorotetrafluoropropane
$C_3H_4FCl_3$	HCFC-251	Trichlorofluoropropane
$C_3H_4F_2Cl_2$	HCFC-252	Dichlorodifluoropropane
$C_3H_4F_3Cl$	HCFC-253	Chlorotrifluoropropane
$C_3H_5FCl_2$	HCFC-261	Dichlorofluoropropane
$C_3H_5F_2Cl$	HCFC-262	Chlorodifluoropropane
C_3H_6FCl	HCFC-271	Chlorofluoropropane

THE SCHEDULE OF THE ENVIRONMENTAL POLLUTION CONTROL (OZONE DEPLETING SUBSTANCES) REGULATIONS 2000

ANNEX C

Group II		
$CHFBr_2$		Dibromofluoromethane
CHF_2Br	HBFC-22B1	Bromodifluoromethane
CH_2FBr		Bromofluoromethane
C_2HFBr_4		Tetrabromofluoroethane
$C_2HF_2Br_3$		Tribromodifluoroethane
$C_2HF_3Br_2$		Dibromotrifluoroethane
C_2HF_4Br		Bromotetrafluoroethane
$C_2H_2FBr_3$		Tribromofluoroethane
$C_2H_2F_2Br_2$		Dibromodifluoroethane
$C_2H_2F_3Br$		Bromotrifluoroethane
$C_2H_3FBr_2$		Dibromofluoroethane
$C_2H_3F_2Br$		Bromodifluoroethane
C_2H_4FBr		Bromofluoroethane
C_3HFBr_6		Hexabromofluoropropane
$C_3HF_2Br_5$		Pentabromodifluoropropane
$C_3HF_3Br_4$		Tetrabromotrifluoropropane
$C_3HF_4Br_3$		Tribromotetrafluoropropane
$C_3HF_5Br_2$		Dibromopentafluoropropane
C_3HF_6Br		Bromohexafluoropropane
$C_3H_2FBr_5$		Pentabromofluoropropane
$C_3H_2F_2Br_4$		Tetrabromodifluoropropane
$C_3H_2F_2Br_4$		Tetrabromodifluoropropane
$C_3H_2F_3Br_3$		Tribromotrifluoropropane
$C_3H_2F_4Br_2$		Dibromotetrafluoropropane
$C_3H_2F_5Br$		Bromopentafluoropropane
$C_3H_3FBr_4$		Tetrabromofluoropropane
$C_3H_3F_2Br_3$		Tribromodifluoropropane
$C_3H_3F_3Br_2$		Dibromotrifluoropropane
$C_3H_3F_4Br$		Bromotetrafluoropropane
$C_3H_4FBr_3$		Tribromofluoropropane
$C_3H_4F_2Br_2$		Dibromodifluoropropane
$C_3H_4F_3Br$		Bromotrifluoropropane
$C_3H_5FBr_2$		Dibromofluoropropane
$C_3H_5F_2Br$		Bromodifluoropropane
C_3H_6FBr		Bromofluoropropane
Group III		
$CHClBr$		Bromochloromethane

ANNEX E

Group I	
CH_3Br	Methyl bromide