



Thailand State of Pollution R e p o r t 2 0 1 0



กรมควบคุมมลพิษ
POLLUTION CONTROL DEPARTMENT

Pollution Control Department, Ministry of Natural Resources and Environment

ISBN 978-974-286-920-5



Thailand State of Pollution Report 2010
Pollution Control Department
Ministry of Natural Resources and Environment
Published in Year 2012 Number 2,000 Copies
(Thai version 1,500 Copies and English version 500 Copies)
PCD. No. 06-037 ISBN 978-974-286-920-5
Produced by : Pollution Control Department
92 Soi Phahon Yothin 7 , Phahon Yothin Rd., Sam Sen Nai,
Phayathai, Bangkok 10400 Thailand
Tel. (+66) 2298 2000 Fax. (+66) 2298 2002
E-mail : pr@pcd.go.th URL : <http://www.pcd.go.th>
Printed and Design by : BTS press co.,ltd



Thailand State Of Pollution Report 2010





Preface

Thailand State of Pollution Report 2010 has been made according to the Article 53 (9) of the Enhancement and Conservation of the National Environmental Quality Act B.E. 2535 (1992), which stipulates that the Pollution Control Committee must prepare a report on the state of pollution and propose to the National Environment Board once a year with a view to disseminate information of Thailand's pollution situation.

This report provides data and information on air quality, noise level, water surface, underground water, coastal water, solid waste, hazardous substances, chemical accidents, pollution problem complaints, important pollution events and the overall pollution management during January – December 2010. In conclusion, the overall state of pollution in the year had not changed significantly from previous year. The quality of water in major rivers had deteriorated slightly due to the droughts in early of the year and the floods in late of the year. There was also no investment in the management of municipal wastewater that was the source of water pollution over the past 2 years, which resulted in the deterioration of coastal water quality, especially the river estuaries in the Inner Gulf of Thailand. The overall air quality shown the improving trend except problems related to particulate matters sized smaller than 10 microns (PM_{10}) and problems of Ozone in roadside areas of Bangkok and large cities due to the traffic congestion and vehicles released air pollution exceeding the standard as well as the haze problem in the North. The amount of solid waste had increased slightly from last year but there was insufficient proper management. The department, therefore, had focused on campaigning on the reduction of solid waste, sorting and recycling of the waste while more care should be provided for communities' hazardous waste and infectious waste as well as the reduction of usage of hazardous chemicals in both agricultural and industrial sectors.

The department wishes to express the sincere appreciation to all related parties for their kind cooperation in providing data, opinions and suggestions to complete the report on Thailand State of Pollution 2010. Consequently, the report will be the reference for different government agencies to use in their planning and implementation of the prevention measures and solutions for pollution problems while other stakeholders and the general public will understand and realize the current state of pollution problems, leading to the maximization of resources to ensure the least or zero waste that will create the environmental quality suitable to the living while maintaining the balance of natural ecology.



(Mr. Chote Trachu)

Permanent Secretary of the Ministry of Natural Resources and Environment
Chairman of the Pollution Control Committee

Executive Summary



1. State of pollution and environmental quality in various aspects

1.1 Air quality : The overall air quality in Thailand in 2010 shown an improving trend when compared with previous year. Particulate matters sized smaller than 10 microns (PM_{10}) remained a main problem, followed by Ozone (O_3). The total suspended particulate (TSP) were found to exceed the standard in the temporary air monitoring station areas. Other pollutant substances such as Sulfur dioxide (SO_2), Carbon monoxide (CO) and Lead (Pb) remained within the standard.

Air Quality in Bangkok : Particulate matters remained a main problem in **roadside** areas. 24-hour average value was measured to be in the range of 8.3 – 195.2 micrograms per cubic meter. It exceeded the standard by 4.6% (the standard is not over 120 micrograms per cubic meter), which was a decline from 2009. Areas in which particulate matters exceeded the standard were Rama VI Road, Din Daeng Road, Phahon Yothin Road and Rama IV Road. For Ozone, the value slightly exceeded the standard in nearly all areas. For General areas which are residential areas, problem involved the Ozone which the 1-hour average value exceeded the standard in nearly all areas from time to time. The value was measured to be in the range of 0-172 part per billion (ppb), which was exceeded the standard by 0.2% (the standard is not over 100 ppb) which was a slightly decline from 2009. Particulate matters exceeding the standard were found in areas including Bansomdejchaopraya Rajabhat University and the Government Public Relations Department. Other air pollutants remained within the standard.

Air Quality in Vicinity Areas : The value of particulate matters in vicinity areas was measured to be in the range of 10.3 – 170.2 micrograms per cubic meter. It exceeded the standard in Samut Prakan, Nonthaburi and Pathum Thani. The 24-hour average value in Samut Prakan was measured to be in the range of 12.4 – 170.2 micrograms per cubic meter, exceeding the standard by 1.5%. For Ozone, the value slightly exceeded the standard in nearly all areas, except Pathum Thani. The value exceeding the standard found the most in Samut Prakan or 0.3% exceeding the standard. Other air pollutants remained within the standard.



Air Quality in Provincial Areas : Particulate matters and ozone remained the major pollutants in provincial areas. Area with the most problems of particulate matters was in Tambon Na Phralarn of Chalerm Phrakiat district, Saraburi which the measured value was in the range of 21.2 – 242.5 micrograms per cubic meter, which was exceeding the standard by 20.9%, a decline from 2009. This area was followed by Lamphun, Chiang Rai, Mae Hong Son, Chiang Mai, Nan, Lampang, Phayao, Phra Nakhon Si Ayutthaya, Chon Buri and Rayong respectively. For ozone, the measured value was exceeded the standard in many areas. The area where ozone exceeded the standard the most was Phra Nakhon Si Ayutthaya with measured value in the range of 0 – 149 part per billion, or exceeding the standard by 0.8%. Other air pollutants remained within the standard.

1.2 Volatile Organic Compounds (VOCs) : The monitoring of 44 types of volatile organic compounds in Bangkok and vicinity, Rayong, Chiang Mai, Songkhla and Khon Kaen. **Bangkok :** Found the level of 1,3-Butadiene exceeded the standard at Din Daeng Community Housing on Din Daeng Road while chloroform exceeded the standard at King Chulalongkorn Memorial Hospital on Rama IV Road. The Benzene level exceeded the standard in every sampling station except the Environmental Research and Training Center in Pathum Thani. When comparing average annual values, it was found that the concentration level of 1,3-Butadiene and Benzene declined from the previous year. **Chiang Mai :** Found the level of Benzene exceeded the standard at areas around Yupparaj Wittayalai School and Chiang Mai City Hall. When comparing the average annual values during 2008 – 2010, it was found that concentration level of Benzene had a tendency to increase from the previous year. **Rayong :** The monitoring results of VOCs revealed that 3 types with concentration values exceeding the average annual standards were 1,3-Butadiene which exceeded the standard at Map Ta Phut Public Health Station and Pluak Ket Temple. The Benzene level was found to exceed the standard in every sampling station except Mab Chalude Temple and Nong Chok Public Health Station. The 1,2-Dichloroethane level exceeded the standard at Mab Chalude Temple, Banplong Community, Muang Mai Station and Nopaked Village. When comparing the average annual values during 2008 – 2010, it was found that concentration level of Benzene rose in 2010 except those at Muang Mai Station and Pluak Ket Temple which were found to decrease. Meanwhile, concentration level of Dichloromethane at Nopaked Village declined from the previous year. **Songkhla and Khon Kaen :** Found the level of Benzene exceeded the standard but was found that concentration level of Benzene had declined from the previous year in both provinces.





1.3 Noise Level : The noise levels at roadsides in Bangkok and vicinity shown the declining trend from previous year while the noise levels in general areas slightly increased. The 24-hour average noise levels (L_{eq}) at roadsides in Bangkok were in the range of 61.0 – 85.8 decibels A (dBA) with the average level of 69.3 dBA, a slight drop from the previous year. Areas where noise levels exceeded the standard on a daily basis were Tri Petch Road and Lat Phrao Road (the standard 24-hour average noise level (L_{eq}) is not exceeding 70 dBA). The 24-hour average noise levels (L_{eq}) in general areas in Bangkok and vicinity were in the range of 49.7 – 79.1 dBA with the average level of 59.9 dBA, a slightly increase from the previous year. The 24-average noise levels (L_{eq}) at roadsides in provincial areas were in the range of 50.1 – 80.1 dBA with the average level of 63.1 dBA, close to that of the previous year. The 24-hour average noise levels (L_{eq}) in general areas in provincial areas were in the range of 44.0 – 70.0 dBA which were within the standard. The average level was 57.6 dBA, a slightly increase from the previous year.



1.4 Surface Water : The overall water quality in water sources and major rivers in Thailand in 2010 shown a deteriorated trend from previous year. The water quality in the level of good, fair and deteriorated conditions, represented 22%, 39% and 39% respectively. There was no water source with highly deteriorated conditions. It was found lower numbers of water sources with fair and better quality (Water Source Class 3 : for agriculture usages and Water Source Class 2 : for consumption and animal conservation). The surface water sources with deteriorated condition increased from 33% in 2009 to 39% in 2010. The surface water sources with good condition were Kok, Kwae Noi, Upper Phetchaburi, Un, Moon, Songkram, Nong Han, Weru, Trat, Prasae, Upper Tapee, Lower Tapee, Phumduang and Trang. The surface water sources with deteriorated condition were Yom, Nan, Kuang, Bueng Boraphet, Kwan Phayao, Central Chao Phraya, Lower Chao Phraya, Lower Tha Chin, Central Tha Chin, Kui Buri, Pasak, Sakae Krang, Lower Phetchaburi, Lampao, Upper Lamtakong, Lower Lamtakong, Nakhon Nayok, Lower Rayong, Lower Pattani, Chumphon, Saiburi, Talay Noi, Talay Luang, and Songkhla Lake. Deteriorated water quality was mainly a result of community wastewater and the discharging of water from industrial and agricultural usages into natural water sources without the treatment.



1.5 Groundwater : The groundwater in general was within the consumption standard. Some mineral generally can be found in the groundwater in a relatively, yet naturally, high level such as iron and manganese. Some minerals can be found in areas with specific geological features such as fluoride can often be found in the northern and southern region. Saline groundwater problem can be found in the northeastern region and the coastal areas. High water hardness is often found in groundwater that accumulated in limestone in some areas of Saraburi and Ratchaburi. There was also found chemical contamination from human activities. For instance, the smuggling to dump chemical substances in Tambon Klang Dong, Pak Chong District, Nakhon Ratchasima caused the absorption of chemical underground and water went from surface soil into the groundwater layer which is the hard rock. The monitoring of volatile organic compounds (VOCs) in the illegal dump site of chemical substance, it was found that 4 types of VOCs were found including 1,1 Dichloroethylene, Tetrachloroethylene, Trichloroethylene and 1,1,2-Trichloroethane. For the illegal dump site in Rayong, it was found the contamination of heavy metals and VOCs in samples of soil, underground water and groundwater, exceeding the groundwater standard in areas around industrial estates and inside industrial estates. Contaminated heavy metals included iron, manganese, fluoride, arsenic, mercury, chromium and lead but the amount of iron and manganese was likely to occur naturally due to geological features of laterite and lateritic soil. The volatile organic compounds contaminated in Map Ta Phut Industrial Estate with value exceeding standard include Trichloroethylene, 1-2-Dichloroethylene and Tran-1-2-Dichloroethylene.

1.6 Coastal Water : The overall coastal marine water quality in 2010 comparing with the water quality during the past three years showed the deteriorated trend. The water quality were in the level of excellent, good, fair, deteriorated and highly deteriorated, representing 8%, 47%, 34%, 6% and 5% respectively. Areas with highly deteriorated water quality were the estuaries of major rivers including estuary of Chao Phraya, estuary of Tha Chin, estuary of Mae Klong and estuary of Bang Pakong, estuary of 12 Thanwa Canal, In front of Dye Factory Km. 35, Bang Khun Thien and estuary of Ban Leam Canal because they were the waste acceptance from major rivers which had activities from communities, industry and agriculture.





1.7 Acid Deposition Situation in Thailand : The monitoring of the acidity – alkalinity of rainwater in 10 provinces, which were Bangkok, Pathum Thani, Kanchanaburi, Chiang Mai, Nakhon Ratchasima, Chainat, Nakhon Pathom, Chon Buri, Sonkhla and Rayong, revealed that the average annual acidity – alkalinity (pH) values of rainwater ranged from 4.50 – 6.23. The areas with the average acidity value below the natural rainwater were found in Bangkok, Pathum Thani, Nakhon Ratchasima, Chon Buri and Rayong. The area with the highest average acidity value was found in Chon Buri at the value of 4.50. The monitoring of the rainwater quality during the past 8 years (2003 – 2010) had the average annual acidity – alkalinity value in the range of 4.30 – 7.10.

1.8 Solid Waste : In 2010, there were 15.16 million tons of municipal waste generated throughout the country or 41,532 tons/day, slightly increased from 2009 (around 0.05 tons). Bangkok generated 8,766 tons/day (21%). Municipalities and Pattaya generated about 16,620 tons/day (40%) and Subdistrict Administrative Organizations generated about 16,146 tons/day (39%). The national average waste generated per person was 0.65 kilograms/day. Approximately 15,819 tons of waste per day or 38% of the country's total waster was property managed.





1.9 Waste Utilization : In 2010, approximately 3.9 million tons of waste or 26% of the total waste generated in the country were utilized. Of the total utilized amount, about 3.2 million tons (82%) were sorted. Wastes such as broken glasses, paper, plastic, steel and aluminum had been reused and recycled through activities including the purchases of recyclable waste by waste-purchasing shops, community recycle centers, recycle waste banks and the recalls of packaging by manufacturers. The remaining of 0.59 million tons (15%) of organic waste had been fermented to produce organic fertilizer, bio-fertilizer and biogas. About 0.12 million tons (3%) were used to generate electricity and alternative energy. For the utilization of recycled materials in the industrial sector, there were approximately 12.76 million tons of recyclable industrial waste, of which 8.4 million tons (66%) were recycled. Of that amount, 3.19 million tons (38%) were from the purchases of recyclable waste from communities and the rest of 5.20 million tons (62%) were from the Waste Exchange System by manufacturers, importers or distributors of products. Steel was the materials used the most in waste utilization, followed by glasses and aluminum.



1.10 Hazardous Waste : In 2010, there were approximately 3.16 million tons of hazardous waste throughout the country, increase 2.9% from 2009 with the majority generated from the eastern region and Bangkok and vicinity. Of the total, 77% or 2.44 million tons were generated from the industrial sector and 23% or 0.72 million tons were from the household sector (including waste from electrical and electronic products and infectious waste). There were only Bangkok Metropolitan Administration and 26 Local Administrative Organizations at municipality level that had the collection and property management of hazardous waste from household sector while majority of the hazardous waste were dumped and disposed with general solid waste. Of total industrial waste, 100% or 2.441 million tons were properly managed.

1.11 Hazardous Substances : In 2010, it was expected that there were the usage of 79.96 million tons of chemical in the country, of which 74.30 million tons were produced domestically and 5.66 million tons were imported. These chemicals were harmful to people's health. The information from Department of Disease Control showed that there were 2,306 patients exposed to chemical toxic in 2010 (increasing by 380 cases or 19.73% from 2009). These patients can be divided into 291 patients exposed to industrial hazardous substances and 2,015 patients exposed to toxic from agricultural hazardous substances.

1.12 Environmental Inspection and Enforcement : Law In 2010, the monitoring of pollution sources under the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992) was conducted in 3 river basins which were Chao Phraya River Basin, Tha Chin River Basin and Songkhla Lake Basin. The monitoring was carried out on wastewater drainage in building type A, real estate land plots and swine farming in altogether 922 areas and found 113 of them had value of exceeding the standard. The monitoring of pollution source in category of industrial factories and industrial estates in 13 areas in Rayong found that 4 of them had value exceeding the standard. The monitoring was conducted on 8,443 auto vehicles and detected 1,770 of them had pollution-emitting auto vehicles that exceeded the standard and received temporary banning orders, banning vehicles from being used. There were 1,586 auto vehicles (90% of auto vehicles received temporary banning orders) improved their engines and requested for the revocation of the orders. For the supervision of factories under the Factory Act B.E. 2535 (1992), the monitoring was conducted on 10,081 factories, 98% of them had followed the act.





1.13 Pollution Problem Complaints : During 2008 – 2010, complaints regarding environmental problems were filed continuously with the declining trend in 2010 when there were a total of 7,266 cases. Pollution problems receiving the most complaints were air pollution such as odor smell, smoke and haze pollution and loud noise / annoying noise. Areas receiving the most complaints were Bangkok and the vicinity. From the implementation to solve pollution complaints, most of the cases were settled. When compared to 105,918 complaints reported by the people to Public Service Center, only 843 cases (0.79% of total) were about the pollution, it indicated that the pollution complaints made up only a small proportion.

2. Important Events in the Year

2.1 Emergency Chemical Accidents : In 2010, there were 30 chemical accidents including illegal dumping of chemical waste. Of the total, 4 were caused by chemicals transport, 11 accidents in factories and chemicals warehouses, 12 accidents by illegal dumping of solid waste and 3 accidents by other causes. Areas with emergency chemical accidents found the most in provinces with high concentration of business establishments such as Rayong, Chon Buri, Samut Prakan and Bangkok. Illegal dumping of chemical waste continuously took place in deserted areas or old mud puddles. Important emergency chemical accidents that affected to workers' health, environment and surrounding communities around factories were.



Chemical leak at Aditya Birla Chemicals (Thailand) Company Limited which is situated in Hemaraj Eastern Industrial Estate, Rayong. The tank, after the collapse of its base, fell onto and broke the pipe used for transmitting hydrochloric acid (HCl), causing the leak of HCl which reacted with the NaOCl, creating chlorine gas to spread throughout the area, injured 259 people who were taken to the hospital.

Fire and chemical leak at Marigot Jewellery (Thailand) Company Limited which is situated in Hi-Tech Industrial Estate, Bang Pa-In district, Phra Nakhon Si Ayutthaya. The fire exposed at the metal plating room closed for renovation. The cause of fire might be that a spark from metal cutting activities inside the room came into contact with inflammable gases or vapors of chemical residues inside the plastic pipes used for transmitting chemicals. The accident resulted in about 300 injured people being sent to the hospital.

2.2 Solution to Pollution Problem in Map Ta Phut Area : Government agencies, Local Administrative Organization, private sectors and the communities had jointly worked to find solution to pollution problems in Map Ta Phut areas and surrounding areas in several measures. The Action Plan to reduce and eradicate pollution in Rayong Pollution Control Area during 2010 – 2013 which was endorsed by the National Environment Board at its 3/2553 meeting on 8th July 2010. The Action Plan covered the plan/project focused on solving pollution problems, the development of living quality of people in the areas and the reduction of pollution by business operators situated in and outside industrial estate. Important operations to solve pollution problems were the contamination of volatile organic compounds (VOCs) in the atmosphere such as accelerate the distribution and the usage of benzene or gasohol under EURO 4 standard before 2013, installation of VRT at all oil depots, determining measure to control the releasing of VOCs from activities considered as not normal in business (Shutdown/ Turn Around/ Start Up), rehabilitating the accumulation of contaminated black sediment in Pradu Bay in Chak Mak estuary, the solid waste problem of Map Ta Phut Town Municipality. There was also the capacity enhancement of the volunteer network to monitor



and follow up the environmental qualities. For the management mechanism to solve problems in Map Ta Phut areas, the National Environment Board appointed 2 subcommittees which were the Subcommittee Oversees the Solution to Pollution Problems in Rayong Pollution Control Area and Nearly Areas chaired by Permanent Secretary of the Ministry of Natural Resources and Environment and the Multilateral Subcommittee for Solving Pollution Problems and Developing Quality of Life in Rayong chaired by Governor of Rayong.

2.3 The Solution to Haze Pollution and Forest Fire Problems in the Upper Northern Region : In 2010, the situation of haze pollution in 8 provinces in the upper Northern region (Chiang Mai, Lamphun, Chiang Rai, Mae Hong Son, Lampang, Phayao, Nan and Phrae) indicated that Chiang Rai had the highest number of days with the detection of particulate matters (PM_{10}) at the level exceeding the standard (43 days from 119 days) The evaluation of areas risking to open burning using satellite images revealed all hotspots occurred in the country. Of the total hotspots, 41% situated in reserved forests, 34% in agricultural areas, 25% in conserved forests. Of the total hotspots, 42% were numbers of hotspots in 8 provinces in upper Northern region which the majority of 55% were in reserved forests, 33% in conserved forests and 12% in agricultural areas. This was because there were forest burnings in the upper Northern region for the shifting cultivation. Areas with the highest risk to open burnings based on the highest numbers of detected hotspots were Wieng Sa district in Nan; Khun Krong Yang district and Um Phang district in Tak and Mae Jam district and Om Koi district in Chiang Mai Measures to solve the problems focused on the readiness to handle the forest fires during the drought, monitoring the forest fires, strictly prohibiting the burning of solid waste and roadside burning of farming residues and weeds. This was the Agreement on Cooperation to Prevention and Solving of Open Burning and Haze Pollution in the North among 7 government agencies (Prime Minister Office, Ministry of Defense, Ministry of Agriculture and Cooperatives, Ministry of Transport, Ministry of Interior, Ministry of Public Health and Ministry of Natural Resources and Environment). There was the preparation of the Action Plan on Solving of Haze Pollution and Forest





Fires in 2010 and the initiative to prepare a Haze and Forest Fires Management Plan during 2012 – 2016. The implementation of International Cooperation on Transboundary Haze Pollution included the organization of the Meeting of Technical Working Group on Transboundary Haze Pollution in the Mekong Sub-region, the implementation of the cooperation to monitor air quality in the Mekong Sub-region and the establishment of a committee at environment minister level of 5 countries in the Mekong Sub-region on transboundary haze pollution.

2.4 The Solution to Environmental Problems caused by Flood

Flood that occurred during October – November 2010 can be seen as one of the severe floods in Thailand in many years. The vital environmental damage and impact from flooding in 2010 were the damages of 15 wastewater treatment plants, 1 waste disposal system with a combined value of damage at 69,720,130 baht. Regarding the impact of the flood to water quality, several water sources were found having unusual low level of Dissolved Oxygen (DO) but at the level not harmful to aquatic animals. There were 5 rivers with the DO level in deteriorated level which were required the monitoring of water quality. There were Bang Pakong, Tha Chin, Lower Yom, Chao Phraya and Prachinburi. Related organizations had solved environmental problems in flooding areas especially on problems of wastewater. There were the continuous surveys of flooding areas and monitoring of water quality in surface water resources. There were the allocations of budgets for importing and repairing of damaged wastewater treatment system and waste disposal system of local administrative organizations.





3. Pollution Management

3.1 The Overall Pollution Management : In the fiscal year 2010, there was the allocation of budget totaling 8,116.5364 million baht for the pollution management or 0.48% of the country's total budget (1,700,000 million baht). Of that amount, 4,910.3427 million baht was for strategy for strategy on land, natural resources and environmental management/ the utilization and conservation of natural resources and the pollution control and environmental management plan and 3,206.1937 million baht for strategy on managing governmental administration efficiently and fairly, and promotion of Local Administration and the administration of provinces and provincial clusters.

The overall pollution management focused on operations in both priority areas and policy level areas by integrating collaboration with all sectors to precipitate measures and mechanisms including **Water pollution management**: Organizing a public campaign on reducing wastewater by lowering water usage, treating wastewater at household, constructing and efficiently operating municipal wastewater treatment plants, determining and collecting wastewater treatment service fee, collecting wastewater treatment fee together with tap water, encouraging business operators to manage waste and treat wastewater before discharging to the environment, monitoring and enforcing related laws to sources of pollution to have proper wastewater treatment and sewage system according to the standards, determining regulations and criteria that business operators shall establish wastewater and waste management guidelines in order to request operating permit, campaigning on reducing chemical fertilizer usage and making organic fertilizer and biogas out of waste. **Air and noise pollution management**: Controlling pollution in urban areas by detecting auto vehicles with emission exceeded pollution standards, promoting preventive customization and maintenance system in auto vehicles used for transportation and public transportation, controlling particulate matter from construction activities and cleaning roads in urban areas regularly, resolving pollution problems in areas that pollution sources are from industry and restricted businesses, solving haze and forest fires in the Upper Northern region and the Lower Southern region, controlling noise pollution caused by traffic by detecting auto vehicles with emission exceeded noise standards, encouraging people to maintenance their auto

vehicles and business operators to improve their auto vehicles in accordance with the new standards.

Municipal waste and hazardous substance management: Establishing public participation on reducing, sorting and utilizing municipal waste (Reduce Reuse Recycle: 3Rs), encouraging local administrative organizations to operate municipal waste and hazardous waste management service by increasing local administrative organizations efficiency, determining and collecting waste management service fees in order to maintain the system, encouraging waste-purchasing shops to have the good management system and minimize impact on the environment and people, precipitating laws on used electrical and electronics products disposal, supervising on industrial hazardous waste, hazardous substance and chemical pesticides.



3.2 New and Important Measures and Mechanisms in 2010

Pollution and Environmental Laws : In 2010, there were the enactments of important laws including 6 volumes of law related to water pollution, 10 volumes of law related to air and noise, 2 volumes of law related to waste and hazardous substances, 6 volumes of law related to general environment and 7 volumes of local ordinance related to pollution and environment.

The Solution to Salinity Usage in Freshwater Aquaculture : The National Environment Board at its 3/2553 (2010) meeting on 8th July, 2010 agreed on the solution guidelines on marine aquaculture in freshwater according to the proposal of Ministry of Natural Resources and Environment which amended Prime Minister's statement No. 2/2541 (1998) signed on 22nd July 1998 from **To refrain low salinity tiger prawn culture system in freshwater areas** to **To refrain salinity usage in aquaculture in freshwater areas**. However, after enacted the refrain order, if anyone is in the midst of aquaculture processes, it is allowed to operate each process and catch aquatic animals within 120 days. Moreover, the Board has assigned Department of Fisheries and Land Development Department, Ministry of Agriculture and Cooperatives to conduct a master plan for aquaculture in the country which considers potential of areas and environmental impact including studying impact of salinity usage in aquaculture. The Cabinet at the meeting on 7th September 2010 has agreed on the resolution of the National Environment Board and the Prime Minister issued the Notification No. 6/2553 (2010) on 24th December 2010 to amend Prime Minister's Statement No. 2/2541 (1998) dated 22nd July 1998 on authorization Provincial Governor to be Prime Minister's representative to refrain low salinity tiger prawn culture system in freshwater in provincial areas from "To refrain low salinity tiger prawn culture system in freshwater areas" to "To refrain salinity usage in aquaculture in freshwater areas".



Fiscal Measures for Environment : The draft Fiscal Measures for Environment Act is a master law for other organizations that have environmental mission operation to apply a proper economic tool for environmental management which was defined as a Royal Decree under this draft Fiscal Measures for Environment Act. Means for environmental management were determined in 6 categories which are 1) Environmental Tax, 2) Management Fee, 3) Product Tax and Surcharge, 4) Deposit Insurance for Environmental Risk and Damage, 5) Trading of Natural Resource Usage Rights or Pollution Emission Rights and 6) Subsidies, Support Measures or other privileges. Moreover, the Environmental Tax Fund and environmental surcharge were established in order to use in the related activities. The Cabinet meeting on 12th October 2010 approved in principal the draft as proposed by Ministry of Finance. It also assigned Ministry of Finance, Ministry of Natural Resource and Environment, Ministry of Energy, Ministry of Public Health and Ministry of Industry to take into account the Cabinet's resolution in order to jointly deliberate and submit the result to Office of the Council of State for consideration of the draft Fiscal Measure for Environment Act.

Environmentally Friendly Development: Green Thailand : Thailand has integrated related concepts and theories in sustainable development to determine strategies and apply in several production and service sectors in order to make development to be an environmentally friendly development : Green Thailand.

Agricultural sector : Encourage organic farming development, improve country's agricultural products and food to be acceptable in world safety standard, educate farmers in sustainable farming, production and marketing planning, sustainable farming enhancement, export promotion, quality control and assurance of organic farm products and marketing development especially organic farm product market.

Industrial sector : Encourage sustainable production in every process in order to reduce environmental impact and regard to users of products and services such as Clean Technology, Eco Design, Life Cycle Assessment : LCA, International Organization for Standardization 14000 (ISO 14000), Green Logistic. The country needs to create image of products and services toward environmentally friendly marketing which is increasing in Thailand and foreign countries. Business operators are able to request label certification from several organizations.

Tourism sector : Adjustment of tourism business operation and travel under Seven Green Concept including 1) Green Heart 2) Green Logistics 3) Green Attraction 4) Green Community 5) Green Activity 6) Green Service 7) responsibility for social and environment (Green Plus).

Environmentally Friendly Building (Green Building) : The project was established since 2008 to develop tools for efficient environmental and energy management in buildings starting from building design, construction, management, utilization and maintenance in order to be a green building. At this moment, it was in the preparation process of regulations which are suitable for both old buildings and new construction buildings.

Environmentally Friendly Products and Services The criteria were established for 17 items of environmentally friendly products and services and 157 government agencies in department level have participated in green procurement of environmentally friendly products and services. In 2010, there were 12 items of environmentally friendly products and services under the consideration. Moreover, there was the preparation of the plan for procurement of environmentally friendly products and services during 2012 – 2015. The key strategies of this plan were 1) strategy to drive procurement volume of government agencies 2) strategy to stimulate the production of environmentally friendly products and services 3) strategy to establish sustainable consumption in public and organizations 4) strategy to manage and control promotion plan of procurement of environmentally friendly products and services to expand the operation into all sectors.

Preparation System of Pollutant Release and Transfer Registers (PRTR) : PRTR system is the database system of pollution emitted from several sources into environment, air, water and soil, including treatment and disposal information of wastewater and waste from factories in order to disseminate to the public. Furthermore, it encouraged industrial factories to apply clean technology to reduce waste that needed to be disposed and pollution emission. Additionally, it can be used as information for pollution management plan of government agencies. Department of Industrial Works, Industrial Estate Authority of



Thailand, Pollution Control Department and Japan International Cooperation Agency (JICA) had cooperated in the preparation of “The Development of Basic Schemes for Pollutant Release and Transfer Register (PRTR) System: PRTR in the Kingdom of Thailand”. Rayong was selected to be the pilot study area.

Corporate Social Responsibility in Environmental Protection : Government and private sectors starting to operate businesses to return to the society and apply the Corporate Social Responsibility (CSR) concept in mission and context of organizations/agencies such as the information disclosure in Corporate Social Responsibility Report (CSR Report) or Sustainability Report together with Annual Report of organizations at regular basis. The CSR Report shall be prepared in accordance with GRI (Global Reporting Initiative) regulations which included economic indicators, environmental indicators, human rights indicators, workforce indicators, product responsibility indicators and social indicators. The environment indicators shall consider raw material issues, energy issues, water resources usage issues, biodiversity issues, pollution emission issues, products and services issues, complaints issues and transportation issues. Regarding environmental issues under a draft ISO 26000 (ISO/FDIS 26000), it shall consider pollution protection issues, sustainable use of resources, relief and adapting to climate changes and protection and restoration of natural habitats.





4. The Implementation of International Obligation and Cooperation :

The implementation of international obligation and cooperation in 2010 consisted of the implementation of obligation under 3 conventions including 1) Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade: PIC 2) Stockholm Convention on Persistent Organic Pollutants: POPs 3) Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal. There were also the international cooperation in other 5 issues including 1) The 2nd Ministerial Meeting on Health and Environment in Southeast and East Asian Countries 2) The 11th Meeting of ASEAN Working Group on Coastal and Marine Environment 3) GIZ Trilateral Cooperation Programme which were the cooperation between Germany and Thailand to extend assistance to Lao People's Democratic Republic, the Kingdom of Cambodia and Socialist Republic of Vietnam 4) Clean Air for Smaller Cities in the ASEAN Region (the cooperation between Germany and Thailand through ASEAN Secretariat 5) The 5th Regional Environmentally Sustainable Transport (EST) Forum, 2010.

Table of Contents

Executive Summary

1. Pollution States and Environmental Quality	Page
1.1 Air Quality	1 - 2
1.2 Volatile Organic Compounds (VOCs)	1 - 12
1.3 Noise Level	1 - 20
1.4 Surface Water	1 - 28
1.5 Groundwater	1 - 40
1.6 Coastal Water	1 - 47
1.7 Acidity-Alkalinity of Rainwater	1 - 53
1.8 Solid Waste	1 - 55
1.9 Waste Utilization	1 - 61
1.10 Hazardous Waste	1 - 65
1.11 Hazardous Substances	1 - 69
1.12 Environmental Inspection and Law Enforcement	1 - 80
1.13 Pollution Problem Complaints	1 - 82
2. Important Events in the Year	
2.1 Emergency Chemical Accidents	2 - 2
2.2 Solving Pollution Problems in Map Ta Phut Area	2 - 4
2.3 The Solution to Haze Pollution in the Upper Northern Region	2 - 10
2.4 The Solution to Environmental Problems caused by Flood	2 - 15
3. Pollution Management	
3.1 Overall Pollution Management Operation	3 - 2
3.2 New and Important Measures and Mechanisms in 2010	3 - 4
• Pollution and Environmental Laws	3 - 4
• The Solution to Salinity Usage in Freshwater Aquaculture	3 - 6
• Fiscal Measures for Environment	3 - 7
• Environmentally Friendly Development: Green Thailand	3 - 7
• Preparation System of Pollutant Release and Transfer Registers (PRTR)	3 - 10
• Corporate Social Responsibility in Environmental Protection	3 - 11



Table of Contents

4. The Implementation of International Obligation and Cooperation	Page
4.1 International Obligations	4 - 2
• Rotterdam Convention in the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade: PIC	4 - 2
• Stockholm Convention on Persistent Organic Pollutants: POPs	4 - 4
• Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal	4 - 6
4.2 International Cooperation	4 - 8
• Ministerial Meeting on Health and Environment in Southeast and East Asian Countries	4 - 8
• AESAN Working Group on Coastal and Marine Environment Meeting	4 - 9
• Thai-German Trilateral Cooperation Programme on Supporting Laos PDR, Cambodia and Vietnam (GIZ Trilateral Cooperation Programme)	4 - 9
• Clean Air for Smaller Cities in the ASEAN Region Program	4 - 10
• Regional Environmentally Sustainable Transport Forum	4 - 11
5. Appendix	
5.1 Environmental Laws and Regulations in 2010	A - 2
• Water pollution laws enacted in the Royal Government Gazette B.E. 2553 (2010)	
• Air and noise pollution laws enacted in the Royal Government Gazette B.E. 2553 (2010)	
• Waste and hazardous substances laws enacted in the Royal Government Gazette B.E. 2553 (2010)	
• General environmental laws enacted in the Royal Government Gazette B.E. 2553 (2010)	
• Local pollution ordinances enacted in the Royal Government Gazette B.E. 2553 (2010)	
5.2 Results of Water Quality Analysis in 2010	B - 2
• Surface water quality in Thailand	
• Coastal water quality in Thailand	
5.3 Result of Air Quality Analysis in 2010	C - 2
5.4 Glossary/Abbreviation	D - 2
5.5 Name List of Thailand state of pollution report working group 2010	E - 2

List of Figures

Page

Figure 1 :	Map of Thailand Displaying Provinces with the Automatic Air Quality Monitoring Stations	1 - 3
Figure 2 :	Annual Particulate Matter (PM ₁₀) during 2006 to 2010	1 - 4
Figure 3 :	Average Annual Ozone during 2006 - 2010	1 - 4
Figure 4 :	Automatic Air Quality Monitoring Stations in Bangkok	1 - 6
Figure 5 :	Temporary Air Quality Monitoring Stations in Bangkok's Roadside Areas	1 - 7
Figure 6 :	Particulate Matter in Samut Prakan during 1997 – 2010	1 - 9
Figure 7 :	Percentage of Particulate Matter Exceeding the Air Quality Standard in Samut Prakan during 2004-2010	1 - 9
Figure 8 :	Number of Days that Ozone Exceeded the Air Quality Standard in Vicinity Areas during 2008 -2010	1 - 9
Figure 9 :	Number of Days that Ozone Exceeded the Air Quality Standard in Provincial Areas during 2008 -2010	1 - 9
Figure 10 :	Monitoring Results of Volatile Organic Compounds in the Carbonyl Compound Group in Bangkok and Vicinity Areas during 2008 - 2010	1 - 16
Figure 11 :	Comparison of Monitoring Results of 9 Types of Carbonyl Compounds in Bangkok and Provincial Areas during 2008 – 2010	1 - 18
Figure 12 :	Comparison of Monitoring Results of 9 Types of Carbonyl Compounds in Rayong during 2008 – 2010	1 - 19
Figure 13 :	The 24-Hour Average Noise Levels (L _{eq}) in Bangkok and Vicinity in 2010	1 - 22
Figure 14 :	Average Values of the 24-Hour Average Noise Levels (L _{eq}) in General Areas of Bangkok and Vicinity during 2004 – 2010	1 - 22
Figure 15 :	Average Values of the 24-Hour Average Noise Levels (L _{eq}) in General Areas of Bangkok and Vicinity during 2004 – 2010	1 - 23
Figure 16 :	The 24-Hour Average Noise Levels (L _{eq}) in Provincial Areas in 2010	1 - 24
Figure 17 :	Average Values of the 24-Hour Average Noise Levels (L _{eq}) at Roadsides in Provincial Areas during 2004 – 2010	1 - 25
Figure 18 :	Average Values of the 24-Hour Average Noise Levels (L _{eq}) in Provincial General Areas during 2004 – 2010	1 - 26
Figure 19 :	Average Values of the 24-Hour Average Noise Levels (L _{eq}) during 2001 - 2010	1 - 26
Figure 20 :	Surface Water Quality Monitored in 48 Rivers and 4 Standing Surface Water Resources in 2010	1 - 29
Figure 21 :	Surface Water Quality in 48 Major Rivers and 4 Standing Surface Water Resources during 2008 – 2010	1 - 30
Figure 22 :	Displays Percentage of Major Parameters with Values Below the Surface Water Standard in 2010 in Comparison with Each Region	1 - 31
Figure 23 :	Surface Water Quality during Dry and Rainy Seasons in 2010	1 - 35
Figure 24 :	Map Displaying Thailand's Groundwater Quality	1 - 41
Figure 25 :	Map Displaying Iso-Concentration of Trichloroethylene in June 2009	1 - 42
Figure 26 :	Map Displaying Iso-Concentration of Trichloroethylene in February 2010	1 - 42



List of Figures

Page

Figure 27 : Map Displaying the Locations of Groundwater Wells with VOCs Exceeding the Groundwater Quality Standard in the Industrial Estate	1 - 44
Figure 28 : Proportion of Coastal Water Quality	1 - 47
Figure 29 : Assessment Results of Marine Water Quality Index throughout Thailand in 2010	1 - 48
Figure 30 : Coastal Water Quality Trend during 2008 – 2010	1 - 52
Figure 31 : Acidity-Alkalinity Value (pH) of Rainwater in Various Areas throughout Thailand during 2003 – 2010	1 - 54
Figure 32 : Amount of Solid Waste during 2008 – 2010 by Administrations	1 - 56
Figure 33 : Amount of Solid Waste in 2010 by Administrations	1 - 56
Figure 34 : Amount of Solid Waste in 2010 by Regions	1 - 57
Figure 35 : Amount of Proper Solid Waste Management during 2003 – 2010	1 - 57
Figure 36 : Solid Waste Management in Bangkok in 2010	1 - 59
Figure 37 : Solid Waste Utilization during 2003 – 2010	1 - 61
Figure 38 : Proportions of Solid Waste Utilization in 2010	1 - 61
Figure 39 : Utilization of Industrial Recyclable Waste during 2005 – 2010	1 - 62
Figure 40 : Proportions of Industrial Recyclable Waste Utilization during 2008 – 2010	1 - 63
Figure 41 : Amount of Hazardous Waste in 2010 by Regions	1 - 65
Figure 42 : Type and Amount of Household Hazardous Waste in 2010 by Regions	1 - 67
Figure 43 : Amount of Industrial Hazardous Waste in 2010 by Regions	1 - 67
Figure 44 : Importation and Production of Chemicals in Thailand during 2003 – 2010	1 - 69
Figure 45 : Patients from Industrial Hazardous Chemical Exposure during 2008 - 2010 by Regions	1 - 73
Figure 46 : Patients from Agricultural Hazardous Chemical Exposure during 2008 - 2010 by Regions	1 - 74
Figure 47 : Crematory with 2 cremation rooms using diesel as fuel	1 - 78
Figure 48 : Collection of environmental samples in crematory areas	1 - 79
Figure 49 : Proportions of Pollution Problems in 2010	1 - 83
Figure 50 : Environmental Complaints by Regions	1 - 84
Figure 51 : Statistics of Chemical Accidents during 2003 – 2010	2 - 2
Figure 52 : Proportions of Hotspots in Thailand by Land Utilization	2 - 11
Figure 53 : Proportions of Hotspots in 8 Provinces in Upper North by Land Utilization	2 - 11
Figure 54 : The Signing Ceremony for the Cooperation Agreement on Preventing and Resolving Open Burning Problem and Haze Pollution in the Upper North	2 - 12
Figure 55 : Crop planting, afforesting, chicken farming instead of searching for forest products and capacity building workshops for volunteer network.	2 - 13
Figure 56 : Launching Ceremony of Mobile Air Quality Monitoring Unit from Thailand to Lao People's Democratic Republic and Republic of the Union of Myanmar	2 - 14
Figure 57 : Proportions of Thailand's Environmental Budget in the Fiscal Year 2010	3 - 2

List of Tables

Page

Table 1 :	Roadside Air Quality in Bangkok in 2010	1 - 8
Table 2 :	Air Quality in Bangkok's General Areas in 2010	1 - 8
Table 3 :	Monitoring Results of Carbonyl Compounds in 2010	1 - 15
Table 4 :	Comparison of the 24-Hour Average Annual Values and Average Annual Standard Values of 9 Types of Volatile Organic Compounds in 2010	1 - 17
Table 5 :	The 24-Hour Average Noise Levels (L_{eq}) in 2010	1 - 20
Table 6 :	The 24-Hour Average Noise Levels (L_{eq}) at Roadsides in Bangkok and Vicinity in 2010	1 - 21
Table 7 :	The 24-Hour Average Noise Levels (L_{eq}) at Roadside Temporary Monitoring Stations in Bangkok in 2010	1 - 21
Table 8 :	The 24-Hour Average Noise Levels (L_{eq}) in General Areas of Bangkok and Vicinity in 2010	1 - 23
Table 9 :	The 24-Hour Average Noise Levels (L_{eq}) at Roadsides in Provincial Areas in 2010	1 - 25
Table 10 :	The 24-Hour Average Noise Levels (L_{eq}) in Provincial General Areas in 2010	1 - 25
Table 11 :	Summary of Surface Water Quality in 48 Major Rivers and 4 Standing Surface Water Resources in 2010	1 - 28
Table 12 :	Displays Percentage of Detected Problems from the Total Times of Monitoring and Compares Each Major Parameter in Each Region in 2010	1 - 31
Table 13 :	Displays Parameters and Problem Areas with Deteriorated Water Quality	1 - 32
Table 14 :	Displays Percentage of Problem Parameters in Comparison between Dry and Rainy Seasons in 2010	1 - 35
Table 15 :	Summary of Surface Water Quality Monitored in 48 Major Rivers and 4 Standing Surface Water Resources during Dry and Rainy Seasons in 2010	1 - 36
Table 16 :	State of Coastal Water Quality	1 - 49
Table 17 :	Amount of Solid Waste during 2009 - 2010	1 - 55
Table 18 :	Properly Designed and Constructed Municipal Waste Treatment Plants	1 - 60
Table 19 :	Amount of Industrial Recyclable Waste in 2010	1 - 63
Table 20 :	Amount of Hazardous Waste by Sources and Regions during 2009 - 2010	1 - 65
Table 21 :	Industrial Hazardous Waste Management in 2010	1 - 68
Table 22 :	Number of Factories and Industrial Waste Management Capacity in 2010	1 - 68
Table 23 :	List of Top Ten Imported Organic and Inorganic Chemical Substances in 2010	1 - 70
Table 24 :	List of Top Ten Imported Hazardous Substances under the Hazardous Substances Act B.E. 2553 (2010) in 2010	1 - 71
Table 25 :	List of Imported Agricultural Hazardous Chemicals during 2009 - 2010	1 - 71
Table 26 :	List of Top Ten Imported Agricultural Hazardous Chemicals in 2010	1 - 72
Table 27 :	Number of Patients and Deaths Caused by Hazardous Substance Exposure during 2003 - 2010	1 - 72



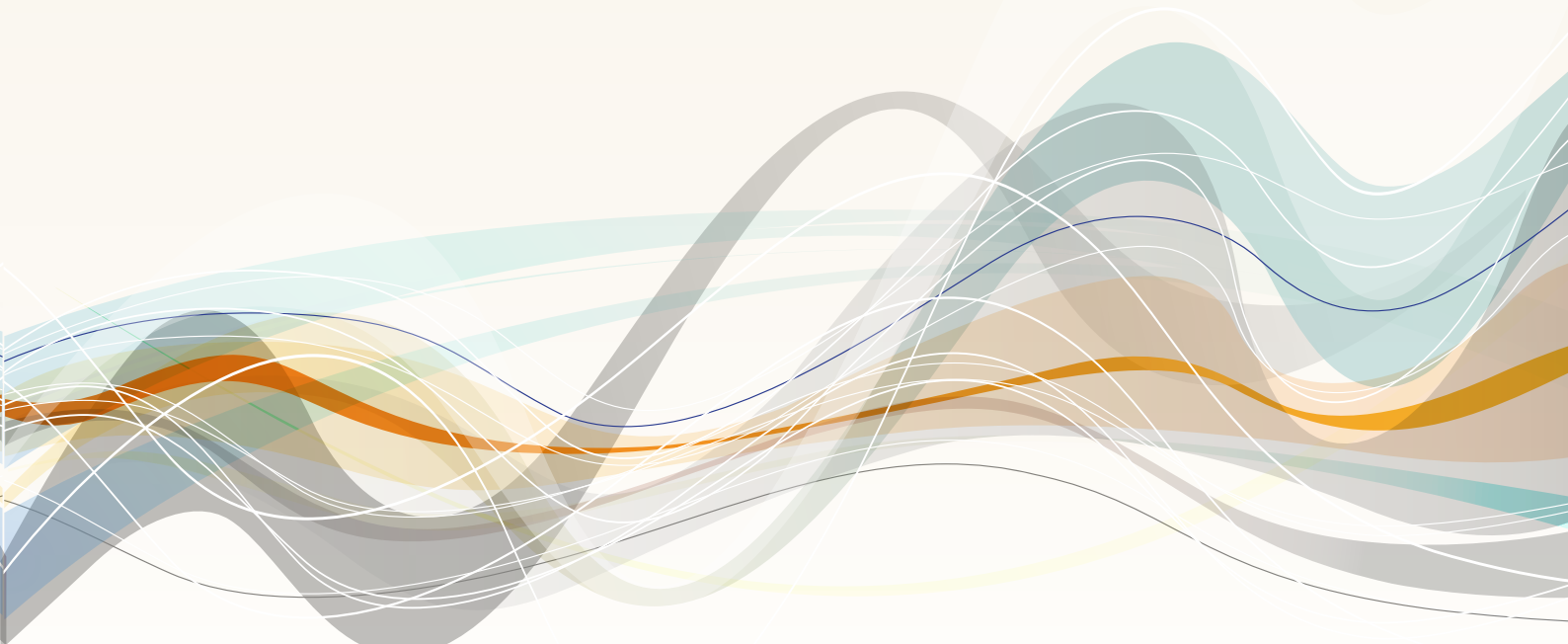
List of Tables

	Page
Table 28 : Dioxin and Furan Emission Levels from Exhaust Vents of Power Plants and Industrial Boilers that Employed Certain Types of Fuels in 2010	1 - 76
Table 29 : Dioxin and Furan Emission from Exhaust Vents of Steel Industry in 2010	1 - 77
Table 30 : Pollution Analysis of Emission from Crematories with 2 Cremation Rooms	1 - 78
Table 31 : Monitoring Results of Dioxin and Furan in Environmental Samples in Crematory Areas	1 - 79
Table 32 : Monitoring Results of Pollution Sources in Chao Phraya River Basin, Tha Chin River Basin and Songkhla Lake Basin	1 - 80
Table 33 : Inspection and Detection Results of Auto Vehicles Exceeding Pollution Emission Standards	1 - 81
Table 34 : Statistics of Environmental Complaints by Government Agencies during 2008 – 2010	1 - 83
Table 35 : Results of Complaint Handling	1 - 84
Table 36 : Monitoring Results of Air Quality (Level of 24-Hour Average Particulate Matter: PM ₁₀ at 09.00 a.m.) in the Upper North during January – April 2010	2 - 10
Table 37 : Summary of Damage Assessment on Municipal Wastewater Treatment Plant and Municipal Waste Disposal System from Flood in 2010	2 - 17





1. Pollution States and Environmental Quality





1.1 Air Quality

Air pollution originates from sources including vehicles, establishments, construction and open burning. The key areas that require continuous control and remedy measures are Bangkok, Samut Prakan, Saraburi, Chiang Mai and Rayong. Pollution problems also include smog and forest fires in the Upper Northern region.

Pollution Control Department under Ministry of Natural Resources and Environment had monitored the air quality in 2010 by using 59 automatic monitoring stations in 27 provinces (Figure 1). Of the total, 7 stations were added from 2009 in Lampang, Phrae, Phayao, Nakhon Ratchasima, Saraburi, Chon Buri and Surat Thani. Additionally, the Pollution Control Department also monitored the air quality through 21 temporary air monitoring stations located on roadsides in heavy traffic congestion areas in Bangkok. According to air quality assessment results, **particulate matters sized smaller than 10 microns (PM_{10})** remained a main problem as in 2009. The 24-hour average value exceeded the standard in many areas which were Saraburi, Lamphun, Chiang Rai, Mae Hong Son, Chiang Mai, Nan, Lampang, Bangkok, Samut Prakan, Phayao, Phra Nakhon Si Ayutthaya, Nonthaburi, Pathum Thani, Chon Buri and Rayong. Sources of particulate matters were mostly vehicles, industry, construction, open burning and pollution from cross-border smog in certain areas.

Particulate matters sized smaller than 100 microns or total suspended particulate (TSP) were found to exceed the standard only in the temporary air monitoring station areas. **Particulate matters sized smaller than 2.5 microns ($PM_{2.5}$)**¹ were found to exceed the standard in Din Daeng Community Housing areas and Chiang Mai.

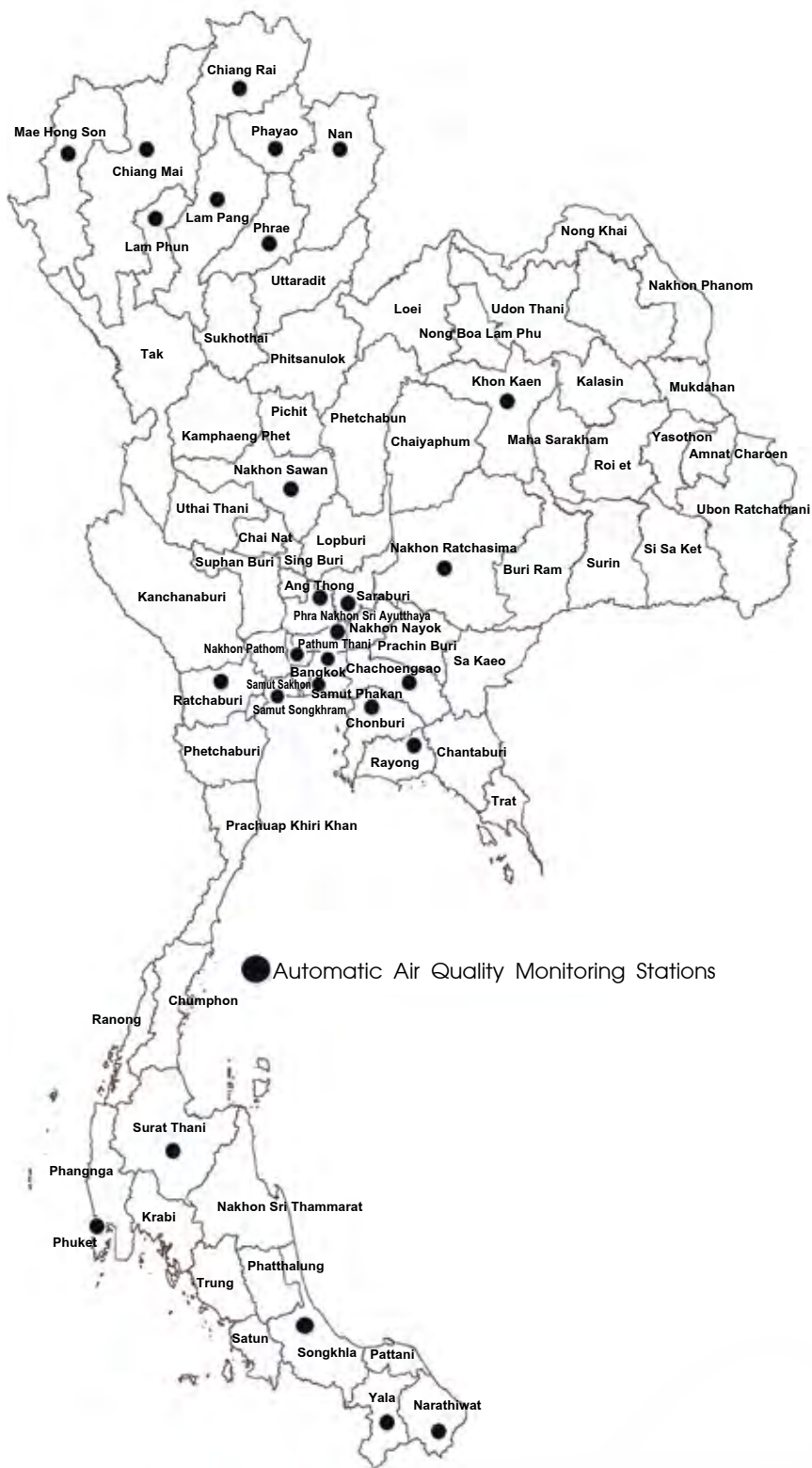
Particulate matter of large size can cause pollution problems or nuisance. The sizes of particulate matter that can enter human respiratory system are smaller than 10 microns. These particulate matters tend to accumulate in various parts of the respiratory system, causing irritation and damage to organ tissues such as lung tissues. Exposure to particulate matter in large amounts or over a long period of time can lead to accumulations of particulate matter in the lung tissues, resulting in fascia or injury and affecting lung function. It can also cause bronchitis, asthma, emphysema and an increased chance to develop respiratory diseases due to infections.

Ozone (O_3) is gas commonly found near the Earth's surface and in upper atmosphere situated over 20 km. altitude above the surface. People often speak of benefits of ozone inhalation by going to mountains or beaches. Inhalation of ozone may provide a great feeling due to its degermination characteristic. However, ozone with concentration levels higher than safety standard can be harmful to human health. Ozone gas naturally occurring in upper atmosphere is produced by dissociation of oxygen as a result of shortwave solar ultraviolet radiation. Therefore, ozone plays a significant role in helping the Earth to filter out dangerous ultraviolet radiation which can harm human and animal's skin cells as well as vegetation. However, ozone gas that occurs near the surface nowadays is produced by a chemical reaction of volatile organic compounds and nitrogen oxide (NO_x) with sunlight as a catalyst. Both compounds are created by the combustion of fuel in engines, machinery, industrial factories and open burning. At present, it is found that the level of ozone near the Earth's surface is increasing to above the safety level and has a tendency to impact human health. Long-term exposure to ozone may be harmful to lungs, particularly during the lung development in children. It can cause damages to reproductive system and genetics and may be harmful to unborn child. It can cause lung diseases such as inated lung lobes and bronchitis. It decreases the immunity in the respiratory system, causes asthma and heart attack, reduces the amount of breath as well as increases the uid in lungs, causing breathing difficulty.

Sulfur dioxide (SO_2) is mainly released by industrial factories that rely on fuels from coal, gas or oil which contain sulfur compounds. Types of factory that may release SO_2 are, for instance, power plant, which causes acid rain. Exposure to SO_2 can also affect human health, especially the respiratory system such as inammation and irritation to nose and throat.

Nitrogen dioxide (NO_2) is partly produced by combustion of fuels such as gas, coal and oil. Major sources include vehicles and industrial plants. NO_2 emitting plants may include those engaged in power producing, smelting, petroleum and food industry. NO_2 also causes acid rain as well as respiratory system diseases if exposed to large amounts.

¹Particulate matter sized smaller than 2.5 microns ($PM_{2.5}$) was monitored in 3 stations which were 1. Bansomdejchao-phraya Rajabhat University 2. Din Daeng Community Housing 3. Yupparaj Wittayalai School, Chiang Mai



Region	Province	Number (Stations)
Central	Bangkok	17 (7 roadside areas and 10 general areas)
	Samut Prakan	5
	Pathum Thani	1
	Samut Sakhon	2
	Nonthaburi	2
	Phra Nakhon Si Ayutthaya	1
	Saraburi	2
	Ratchaburi	1
	Chiang Mai	2
	Lampang	4
North	Nakhon Sawan	1
	Chiang Rai	1
	Mae Hong Son	1
	Nan	1
	Lamphun	1
	Phrae	1
	Phayao	1
Northeast	Khon Kaen	1
	Nakhon Ratchasima	1
East	Rayong	4
	Chon Buri	3
	Chachoengsao	1
South	Surat Thani	1
	Phuket	1
	Songkhla	1
	Narathiwat	1
	Yala	1
Total		59

Figure 1 : Map of Thailand Displaying Provinces with the Automatic Air Quality Monitoring Stations

Ozone (O_3): exceeded the standard in many areas including Phra Nakhon Si Ayutthaya, Saraburi, Chiang Mai, Samut Sakhon, Chachoengsao, Rayong, Ratchaburi, Bangkok, Phrae, Lamphun, Chon Buri, Nonthaburi, Nan, Lampang, Mae Hong Son, Nakhon Sawan and Chiang Rai.

Nitrogen dioxide (NO_2): exceeded the standard only in Khon Kaen. Other pollutants such as Sulfur dioxide (SO_2), Carbon monoxide (CO) and lead (Pb) were still within the standard levels.

For Thailand's overall air quality, it was found that particulate matter's 1-year average value decreased to 41.5 micrograms/ cubic meter ($\mu g/m^3$) in 2010 from 44.2 $\mu g/m^3$ in 2009. Ozone's value remained unchanged at 19 parts per billion (ppb). The decline of particulate matter was due to consistent implementation of measures every year which included monitoring pollution releases from vehicles, mills and stone mines/ information dissemination/ encouraging participation in the management of air and noise quality and setting and improving the air quality standards. The 1-year average values of particulate matter and ozone from 2006 to 2010 is shown in Figure 2 and 3.

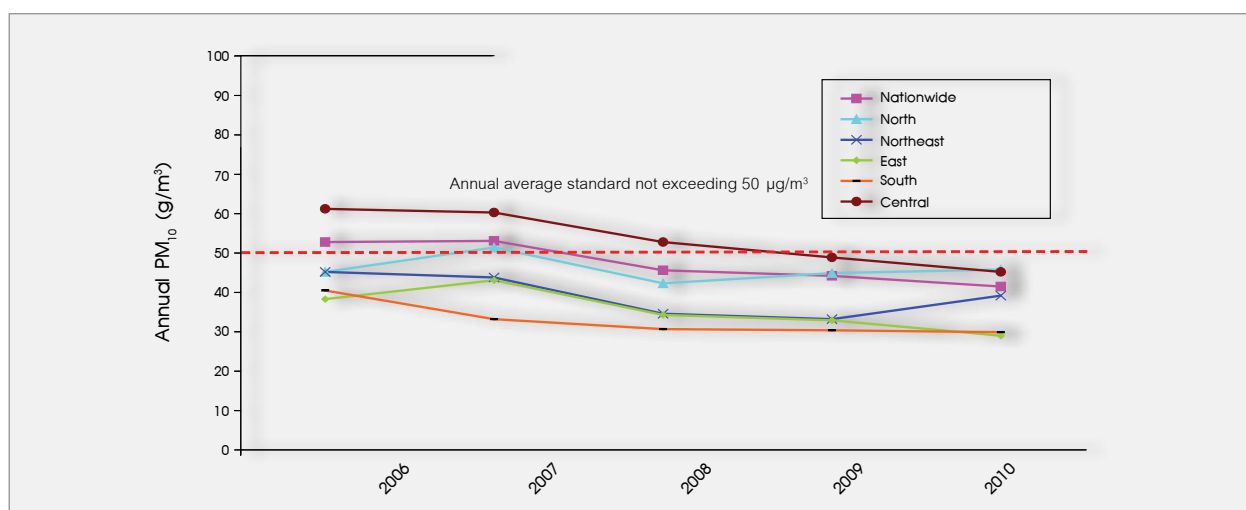


Figure 2 : Annual Particulate Matter (PM_{10}) during 2006 to 2010

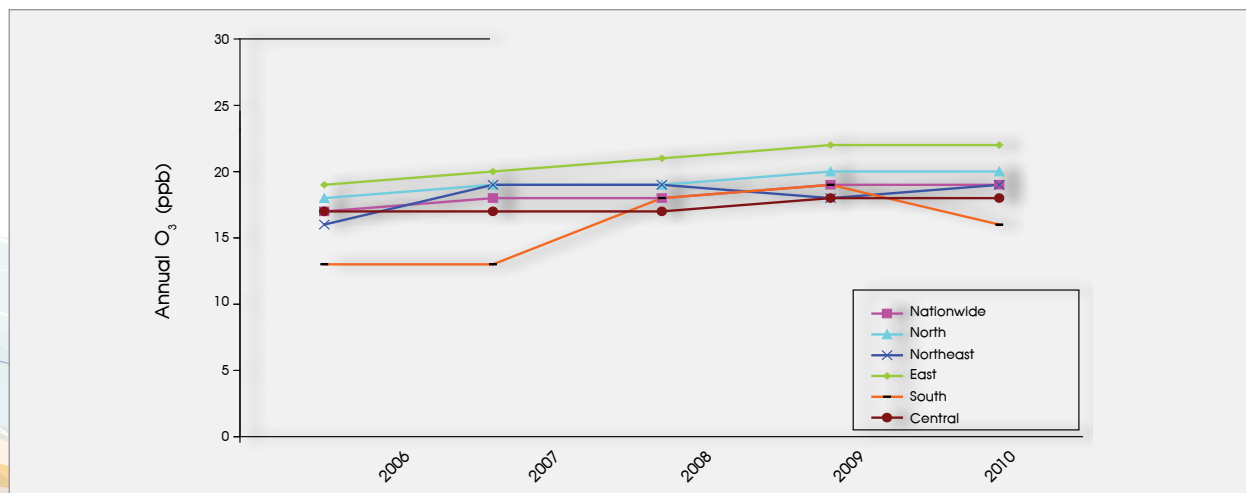


Figure 3 : Average Annual Ozone during 2006 - 2010



Air quality in Bangkok

Particulate matters: remained a major problem in Bangkok as every year, followed by ozone which was found to exceed the standard level in some areas. Total suspended particulate was found to exceed the standard from time to time in some areas and particulate matters sized smaller than 2.5 microns exceeded the standard in roadside areas. Other pollutants remained within the standard levels. Bangkok had been divided into 2 monitoring areas for air quality examination which were roadside areas and general areas (Figure 4). Additionally, there were 21 temporary air quality monitoring stations in traffic-congested roadside areas (Figure 5). Monitoring period was 2 weeks for each station. Bangkok's air quality monitoring results showed that pollutants tended to decrease in roadside and general areas.

● Roadside areas

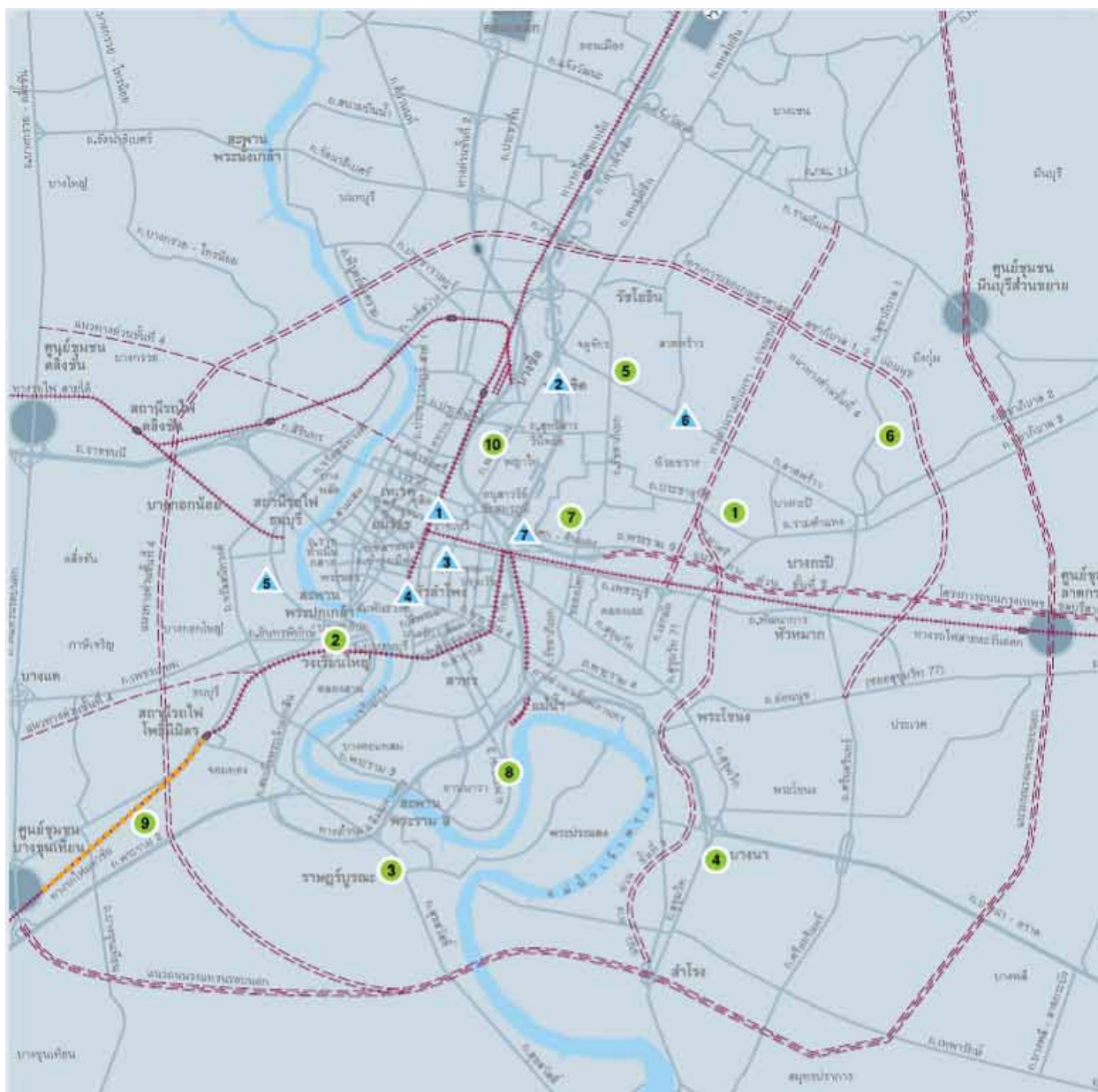
Particulate matters: 24-hour average value was measured to be in the range of 8.3 – 195.2 $\mu\text{g}/\text{m}^3$. It exceeded the standard 85 times out of the total 1,852 times of monitoring, making up 4.6% (the 24-hour average particulate matter standard is not over 120 $\mu\text{g}/\text{m}^3$) which was a decline from 2009 (In 2009, it exceeded the standard 109 times out of 2,043 times of monitoring, making up 5.3%). Areas in which particular matters exceeded the standard were the same areas as in 2009 namely Rama VI Road, Din Daeng Road, Phahon Yothin Road and Rama IV Road while other areas were within the standard.

Particulate matters sized smaller than 2.5 microns: 24-hour average value exceeded the standard from time to time in Din Daeng National Housing Authority areas.

Ozone: 1-hour average value was measured to be in the range of 0 – 109 parts per billion (ppb). The value slightly exceeded the standard 9 times in nearly all areas out of 30,269 times of monitoring, making up 0.03% (The 1-hour average ozone standard is not over 100 ppb). The number of days with value exceeding the standard was 4 days, a slight decrease from 2009. (In 2009, the value exceeded the standard 17 times out of 32,039 times of monitoring, representing 0.05%). Areas where standard-exceeding ozone was found included Intharaphitak Road, Phahon Yothin Road and Din Daeng Road.

Nitrogen dioxide: annual average value slightly exceeded the standard. Meanwhile, other air pollutants were still within the standard.

Additionally, the results from the temporary air quality monitoring stations in traffic-congested roadside areas revealed that there were many roads with a particulate matter problem. These roads were Phitsanulok Road, Sukhumvit Road, Sathupradit Road, Ratchaprarop Road, Rama I Road, Ramkhamhaeng Road, Phahon Yothin Road and Ratchawithi Road. Total suspended particulate was found to exceed the standard only on Sukhumvit Road, Sathupradit Road and Ratchaprarop Road. (Table 1 and details in Appendix C, Table 1– 2). Art Narong Road, Sam Sen Road, Ratchadpisek Road, Sukhapiban I Road, Yaowarat Road, Larn Luang Road, and Total



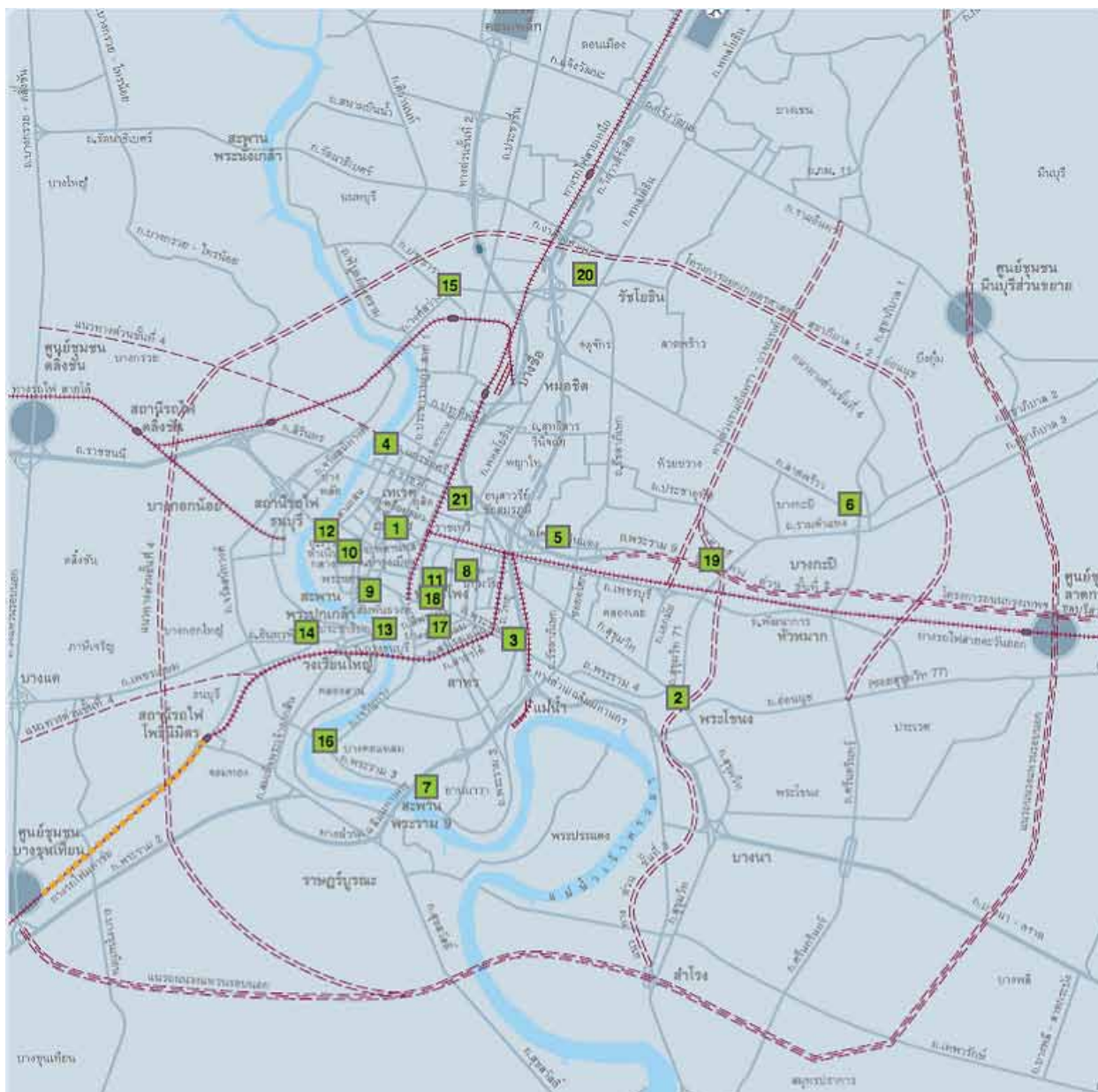
○ Automatic Air Quality Monitoring Stations in General Areas

- | | |
|---|---|
| 1. Bodindecha (Sing Singhaseni) School | 6. Klongjan National Housing Authority |
| 2. Bansomdejchaopraya Rajabhat University | 7. Huay Kwang National Housing Authority Stadium |
| 3. Ratburana Post Office | 8. Nonsi Witthaya School |
| 4. Bangna Meteorological Department | 9. Mathayom Watsing School (Singharat Pitthayakhom) |
| 5. Chandrakasem Rajabhat University | 10. Government Public Relations Department |

▲ Automatic Air Quality Monitoring Stations in Roadside Areas

- | | |
|---|---|
| 1. Ministry of Science and Technology | 5. Thonburi Branch Power Station |
| 2. Department of Land Transport | 6. Chok Chai 4 Police Station |
| 3. Chulalongkorn Hospital | 7. Din Daeng National Housing Authority |
| 4. 22 nd July Traffic Circle | |

Figure 4 : Automatic Air Quality Monitoring Stations in Bangkok



- | | |
|--|---------------------------------|
| 1. Yommarat Intersection | 12. Bang Lampoo |
| 2. On Nut Intersection | 13. Siphaya |
| 3. Klong Toey Intersection | 14. Wong Wien Yai Roundabout |
| 4. Sriyan Intersection | 15. Wong Sawang Intersection |
| 5. Tien Ruammit Intersection | 16. Thanon Tok Intersection |
| 6. Bang Kapi Intersection | 17. Bangkok Christian Hospital |
| 7. Sathupradit Post and Telegraph Office | 18. Ma Boon Krong Intersection |
| 8. Pratunam | 19. Ramkhamhaeng Intersection |
| 9. Ratchawong Intersection | 20. Land Development Department |
| 10. Lam Luang | 21. Victory Monument |
| 11. Mansri | |

Figure 5 : Temporary Air Quality Monitoring Stations in Bangkok's Roadside Areas

Table 1 : Roadside Air Quality in Bangkok in 2010

Air Pollutants	Standard Value	Measured Value	95 th Percentile	Number of Times Exceeding Standard / Number of Times Monitored (%)	1-Year Average Value	1-Year Average Standard
TSP 24-hour average (mg/m ³)	0.33	0.03 – 0.57	0.29	21/615 (3.4)	0.14	0.10
PM ₁₀ 24-hour average (g/m ³)	120	8.3 – 195.2	117.6	85/1,852 (4.6)	55.3	50
PM _{2.5} 24-hour average (g/m ³)	50	16.6 – 77.4	58.5	7/59 (11.9)	31.9	25
Pb 1-month average (g/m ³)	1.5	0.01 – 0.10	0.06	0/94 (0)	0.04	–
CO 1-hour average (ppm)	30	0.0 – 9.8	3.1	0/57,941 (0)	1.3	–
CO 8-hour average (ppm)	9	0.0 – 6.8	2.8	0/58,670 (0)	1.3	–
O ₃ 1-hour average (ppb)	100	0 – 109	39	9/30,269 (0.03)	13	–
O ₃ 8-hour average (ppb)	70	0 – 79	34	23/31,480 (0.07)	13	–
SO ₂ 1-hour average (ppb)	300	0 – 30	9	0/33,010 (0)	4	40
SO ₂ 24-hour average (ppb)	120	0 – 19	7	0/1,437 (0)	4	40
NO ₂ 1-hour average (ppb)	170	0 – 128	66	0/32,857 (0)	31	30

● General Areas

Particulate Matters: 24-hour average value was measured to be in the range of 7.1–179.1 µg/m³. In some areas, it exceeded the standard 13 times out of the total 3,350 times of monitoring, making up 0.4% which was a decline from 2009 (in 2009, particulate matter value exceeded the standard 31 times out of 3,171 times of monitoring, making up 1.0%). Particulate matters exceeding the standard were found in areas including Bansomdejchaopraya Rajabhat University and the Government Public Relations Department.

Ozone: 1-hour average value was measured to be in the range of 0 – 172 ppb. The value exceeded the standard 161 times in nearly all areas out of 77,530 times of monitoring, making up 0.2%. The number of days with value exceeding the standard was 33 days, a slight drop from 2009. (In 2009, the value exceeded the standard 214 times out of 78,020 times, representing 0.3%). Other air pollutants were within the standards. (Table 2 and details in Appendix C Table 3)

Table 2 : Air Quality in Bangkok's General Areas in 2010

Air Pollutants	Standard Value	Measured Value	95 th Percentile	Number of Times Exceeding Standard / Number of Times Monitored (%)	1-Year Average Value	1-Year Average Standard
TSP 24-hour average (mg/m ³)	0.33	0.02 – 0.22	0.13	0/525 (0)	0.07	0.10
PM ₁₀ 24-hour average (g/m ³)	120	7.1 – 179.1	74.2	13/3,350 (0.4)	37.8	50
PM _{2.5} 24-hour average (g/m ³)	50	13.3 – 65.1	44.2	1/18 (5.6)	25.0	25
Pb 1-month average (g/m ³)	1.5	<0.005 – 0.15	0.07	0/114 (0)	0.04	–
CO 1-hour average (ppm)	30	0.0 – 6.1	1.7	0/82,053 (0)	0.7	–
CO 8-hour average (ppm)	9	0.0 – 4.9	1.6	0/84,566 (0)	0.7	–
O ₃ 1-hour average (ppb)	100	0 – 172	50	161/77,530 (0.2)	17	–
O ₃ 8-hour average (ppb)	70	0 – 134	43	482/79,609 (0.6)	17	–
SO ₂ 1-hour average (ppb)	300	0 – 39	8	0/82,872 (0)	3	40
SO ₂ 24-hour average (ppb)	120	0 – 17	7	0/3,554 (0)	3	40
NO ₂ 1-hour average (ppb)	170	0 – 120	47	0/82,534 (0)	20	30

Air quality in Vicinity areas

The air quality monitoring was conducted in Samut Prakan, Pathum Thani, Samut Sakhon and Nonthaburi. The results showed that particulate matter and ozone remained major pollutants that exceeded the standard in the vicinity areas. As well, there was a slight change in concentration levels when compared with the previous year (Details in Appendix C Table 4)

Particulate matters: 24-hour average value was measured to be in the range of 10.3 - 170.2 $\mu\text{g}/\text{m}^3$. It exceeded the standard in Samut Prakan, Nonthaburi and Pathum Thani. The measured value in Samut Prakan was in the range of 12.4 - 170.2 $\mu\text{g}/\text{m}^3$, exceeding the standard 24 times out of the total 1,607 times of monitoring representing 1.5% (Figure 6 and Figure 7). The measured value in Nonthaburi was in the range of 14.3 - 132.0 $\mu\text{g}/\text{m}^3$, exceeding the standard 3 times out of the total 614 times of monitoring, making up 0.5%. The measured value in Pathum Thani was in the range of 10.3 - 123.4 $\mu\text{g}/\text{m}^3$, exceeding the standard one time out of the total 343 times which represents 0.3%.

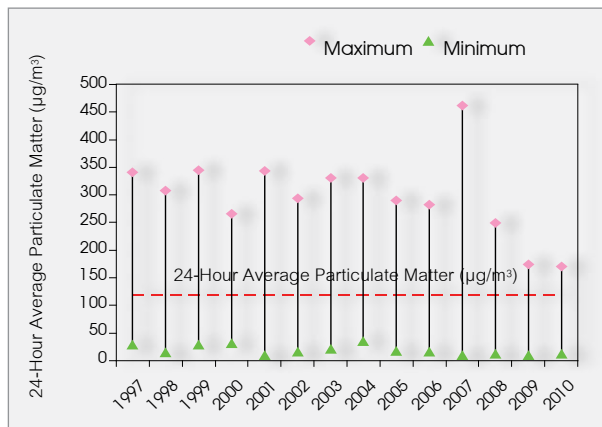


Figure 6 : Particulate Matter in Samut Prakan during 1997 – 2010

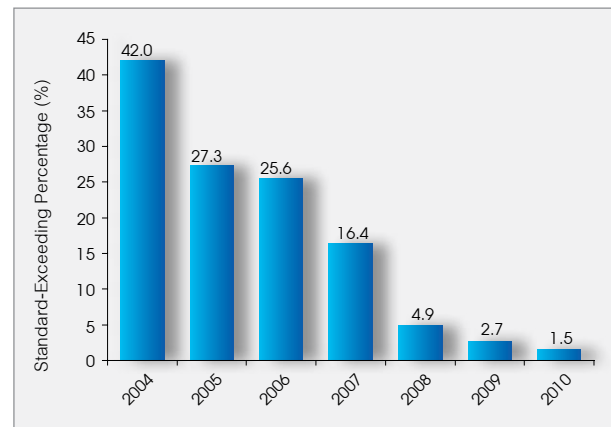


Figure 7 : Percentage of Particulate Matter Exceeding the Air Quality Standard in Samut Prakan during 2004 – 2010

Ozone: 1-hour average value exceeded the standard in nearly all areas except Pathum Thani. The area where ozone was found to exceed the standard the most was Samut Prakan with the measured value in the range of 0 - 168 ppb. This value exceeded the standard 125 times out of the total 37,990 times of monitoring, making up 0.3% or equivalent to 36 days (Figure 8).

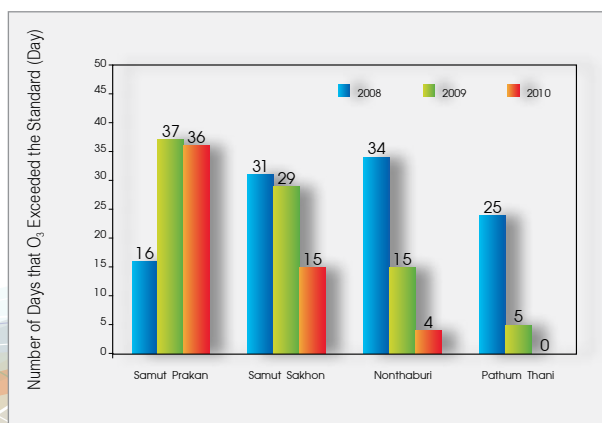


Figure 8 : Number of Days that Ozone Exceeded the Air Quality Standard in Vicinity Areas during 2008 – 2010

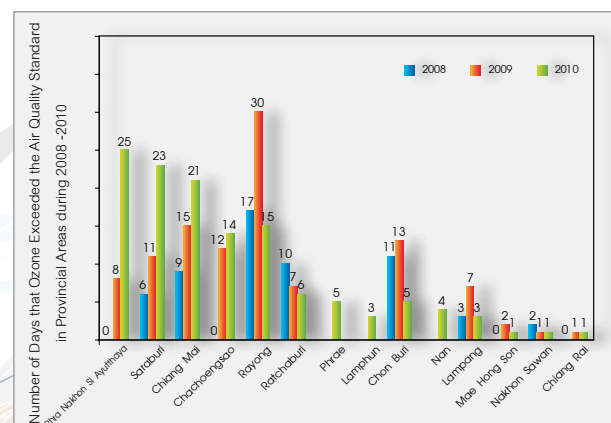


Figure 9 : Number of Days that Ozone Exceeded the Air Quality Standard in Provincial Areas during 2008 – 2010

Air Quality in Provincial Areas

Air quality monitoring was conducted through 32 monitoring stations in 22 provinces namely Chiang Mai, Lampang, Nakhon Sawan, Chiang Rai, Mae Hong Son, Nan, Lamphun, Phrae, Phayao, Khon Kaen, Nakhon Ratchasima, Phra Nakhon Si Ayutthaya, Saraburi, Ratchaburi, Rayong, Chon Buri, Chachoengsao, Surat Thani, Phuket, Songkhla, Narathiwat and Yala. The results showed that particulate matter and ozone remained the major pollutants in provincial areas as every year. Particulate matter sized smaller than 2.5 microns was found to exceed the standard from time to time around Yupparaj Wittayalai School area in Chiang Mai. Nitrogen dioxide slightly exceeded the standard in Khon Kaen. Other pollutants were within the standards. (Figure 9 and details in Appendix C Table 5)

Particulate matters: 24-hour average value was measured to be in the range of 2.1 – 505.5 $\mu\text{g}/\text{m}^3$. It exceeded the standard the most in area around police station in Na Phralarn Subdistrict, Saraburi with monitored value in the range of 21.2 – 242.5 $\mu\text{g}/\text{m}^3$. The standard was exceeded by 75 times out of the total 359 times of monitoring, making up 20.9% which was a decrease from 2009 (in 2009, particulate matter value exceeded the standard 97 times out of 364 times of monitoring, making up 26.6%). This area was followed by Lamphun, Chiang Rai, Mae Hong Son, Chiang Mai, Nan, Lampang, Phayao, Phra Nakhon Si Ayutthaya, Chon Buri and Rayong respectively. Other areas were still within the standard.

Particulate matters sized smaller than 2.5 microns: 24-hour average value around Yupparaj Wittayalai School area in Chiang Mai was measured to be in the range of 5.5 – 133.0 $\mu\text{g}/\text{m}^3$. The value exceeded the standard 17 times out of the total 86 times of monitoring, representing 19.8%.

Ozone: 1-hour average value was measured to be in the range 0 - 177 ppb. The value was found to exceed the standard in many areas. The area where ozone exceeded the standard the most was Phra Nakhon Si Ayutthaya with measured value in the range of 0 – 149 ppb. The value exceeded the standard 65 times out of the total 8,337 times, making up 0.8% or equivalent to 25 days (Figure 9).

Nitrogen dioxide: 1-hour average value slightly exceeded the standard only in Khon Kaen with measured value in the range of 0 – 176 ppb. The value exceeded the standard one time out of the total 8,110 times of monitoring, making up 0.01%





Air Pollution Management

Continues to focus on controlling and reducing air pollution released from sources which include vehicles, establishments, construction and open burning. The areas that require continuous control and remedy measures are Bangkok, Samut Prakan, Saraburi, Chiang Mai and Rayong as well as smog and forest fire problems in the Upper Northern region. Pollution control in metropolitan areas requires measures to monitor and detect vehicles emitting standard-exceeding pollutants. It also needs to support the use of preventive machine customization and maintenance system on vehicles for transportation and public transport such as trucks, buses and taxis. As well, measures to control dust from construction activities and constantly conduct street cleaning in urban areas also need to be implemented. Solving pollution problems in areas where pollution sources such as industries and establishments are situated requires strict control and regulation on discharges of pollution. For instance, control and regulation on industrial factories in Samut Prakan, control and regulation on stone grinding mills around Na Phralan areas in Saraburi as well as industrial pollution control in Rayong. In solving smog and forest fire problems, it is necessary to obtain cooperation from local authorities in controlling, regulating, supervising and managing community solid waste by not allowing burning of waste, grass or weeds on roadsides. It also requires public cooperation not to conduct an open burning and take measures to control agricultural burning as well as develop early warning and monitoring system on air pollution and smog situations.



1.2 Volatile Organic Compounds (VOCs)

Volatile Organic Compounds (VOCs) are organic compounds that can evaporate into the air at room temperature. In daily life, we are exposed to VOCs from various products such as paints, dry cleaning fluid, pesticides, liquid bleach, chemical solutions used for hair dying and perming, solvents in printing inks and paints from auto painting service. VOCs can as well be found in substances created by combustion and smoking. Long-term exposure to VOCs can cause accumulation and can be harmful to human health. It also has an impact on the environment which is the Earth's ozone.

The main component of VOCs is carbon. Other components including hydrogen, oxygen, fluoride, chloride, bromide, sulfur or nitrogen are joined to become Aliphatic or Aromatic compounds. They also include a carbonyl group (Aldehyde, Ketone) and an alcohol group which in general are hydrocarbon compounds consisting of 2 -12 carbon atoms, easily vaporize as vapor or gas at room temperature and are good solvents. VOCs in the atmosphere are considered toxic air; therefore, strict supervision is required in working conditions that are exposed to VOCs. Examples of VOCs solvents are Benzene, Xylene, Toluene, Styrene, Formaldehyde and Perchloroethylene.

Pollution Control Department had continuously monitored VOCs in Bangkok, vicinity and major provinces, namely Rayong, Chiang Mai, Songkhla and Khon Kaen. The monitored VOCs were divided into 2 groups which were.

Carbonyl compounds: Consisting of 5 types which are Formaldehyde, Acetaldehyde, Acrolein, Acetone and Propionaldehyde. The monitored areas were as follows.

- Bangkok and vicinity areas: Areas around 1) Din Daeng National Housing Authority on Din Daeng Road 2) King Chulalongkorn Memorial Hospital on Rama IV 3) Chok Chai 4 Police Station on Lad Phrao Road 4) Bansomdejchaopraya Rajabhat University Thon Buri District and 5) Environmental Research and Training Center in Pathum Thani. The samples were collected every 12 days. Additionally, monthly monitoring was carried out in the following areas.
 - Chiang Mai: Areas around 1) Yupparaj Wittayalai School and 2) Chiang Mai City Hall
 - Khon Kaen: Area around assistance district officer residence, Muang District
 - Songkhla: Area around Songkhla Municipality Station
 - Rayong: Areas around 1) Map Ta Phut Public Health Station 2) Nong Chok Public Health Station

Volatile Organic Compounds according to Notification of National Environment Board No. 30 (B.E. 2550/2007): Consisting of 9 types which are Benzene, Vinyl Chloride, 1,2-Dichloroethane, Trichloroethylene, Dichloromethane, 1,2-Dichloropropane, Tetrachloroethylene, Chloroform and 1,3-Butadiene. Samples were collected once a month. The monitored areas were as follows.

- Bangkok and vicinity areas: Areas around 1) Din Daeng Community Housing on Din Daeng Road 2) King Chulalongkorn Memorial Hospital on Rama IV 3) Chok Chai IV Police Station on Lad Phrao Road 4) Bansomdejchaopraya Rajabhat University, Thon Buri District and 5) Environmental Research and Training Center in Pathum Thani
- Rayong: Areas around 1) Map Ta Phut Public Health Station 2) Mab Chalude Temple 3) Nong Faeb School 4) Mueng Mai Station 5) Banplong Community 6) Takuan Public Health Center 7) Nopaked Village 8) Nong Chok Public Health Station and 9) Pluak Ket Temple
 - Chiang Mai: Areas around 1) Yupparaj Wittayalai School and 2) Chiang Mai City Hall
 - Khon Kaen: Area around assistant district officer residence, Muang District
 - Songkhla: Area around Songkhla Municipality Station



Monitoring Results of Volatile Organic Compounds in 2010

Bangkok and vicinity areas: The monitoring results showed that concentration values of carbonyl compounds in roadside areas were higher than those in general areas (Table 3). When comparing average annual values during 2008 - 2010, it was found that concentration values in 2010 mostly tended to decrease from the previous year, except those of Formaldehyde which were found to be higher than the previous year at King Chulalongkorn Memorial Hospital on Rama IV, Bansomdejchaopraya Rajabhat University and Environmental Research and Training Center in Pathum Thani (Figure 10). Meanwhile, the monitoring results of 9 types of VOCs (Table 4) revealed that the level of 1,3-Butadiene exceeded the standard at Din Daeng Community Housing on Din Daeng Road while Chloroform exceeded the standard at King Chulalongkorn Memorial Hospital on Rama IV. Moreover, the Benzene level also exceeded the standard in every sampling station except the Environmental Research and Training Center in Pathum Thani. When comparing average annual values, it was found that concentration levels of 1,3-Butadiene and Benzene declined from the previous year (Figure 11).

Chiang Mai: The monitoring results showed that concentration values of carbonyl compounds in roadside areas were higher than those in general areas (Table 3). Meanwhile, the monitoring results of 9 types of VOCs (Table 4) revealed that the Benzene level exceeded the standard in the sampling areas around Yupparaj Wittayalai School and Chiang Mai City Hall (Table 4). When comparing the average annual values during 2008 - 2010, it was found that concentration level of Benzene had a tendency to increase from the previous year (Figure 11).



Rayong: The monitoring results of carbonyl compounds showed that the concentration levels were within the surveillance value (Table 3). The monitoring results of 9 types of VOCs (Table 4) revealed that those with concentration values exceeding the average annual standards were 1,3-Butadiene which exceeded the standard at Map Ta Phut Public Health Station and Pluak Ket Temple. The Benzene level was found to exceed the standard in every sampling station except Mab Chalude Temple and Nong Chok Public Health Station. Additionally, the 1,2-Dichloroethane level exceeded the standard at Mab Chalude Temple, Banplong Community, Muang Mai Station and Nopaked Village. When comparing the average annual values during 2008 - 2010, it was found that concentration level of Benzene rose in 2010 except those at Muang Mai Station and Pluak Ket Temple which were found to decrease. Meanwhile, concentration level of Dichloromethane at Nopaked Village declined from the previous year (Figure 12).

Songkhla: The monitoring results of carbonyl compounds showed that the concentration levels were within the surveillance value (Table 3). The monitoring results of 9 types of VOCs revealed that Benzene level exceeded the standard (Table 4) with its concentration level in 2010 declining from the previous year (Figure 11).

Khon Kaen: The monitoring results of carbonyl compounds showed that the concentration levels were within the surveillance value (Table 3). The monitoring results of 9 types of VOCs revealed that Benzene level exceeded the standard (Table 4) with its concentration level in 2010 declining from the previous year (Figure 11).



Table 3 : Monitoring Results of Carbonyl Compounds in 2010

Station	Formaldehyde ($\mu\text{g}/\text{m}^3$)			Acetaldehyde ($\mu\text{g}/\text{m}^3$)			Acrolein ($\mu\text{g}/\text{m}^3$)			Acetone ($\mu\text{g}/\text{m}^3$)			Propionaldehyde ($\mu\text{g}/\text{m}^3$)		
	Range of Measured Values	Average Annual Value	Range of Measured Values	Average Annual Value	Range of Measured Values	Average Annual Value	Range of Measured Values	Average Annual Value	Range of Measured Values	Average Annual Value	Range of Measured Values	Average Annual Value	Range of Measured Values	Average Annual Value	Range of Measured Values
Bangkok and Vicinity Areas															
Roadsides															
- Din Daeng National Housing Authority Din Daeng Rd.	3.1 – 20.5	11.8	1.3 – 11.6	4.8	ND	-	ND	-	-	-	-	-	0.1 – 1.3	0.7	-
- Chok Chai 4 Police Station Lad Phrao Rd.	0.9 – 27.4	11.6	1.2 – 13.1	5.1	ND	-	ND	-	-	-	-	-	0.3 – 1.4	0.8	-
- King Chulalongkorn Memorial Hospital Rama IV Rd.	3.2 – 19.4	12.6	1.6 – 10.2	5.3	ND	-	ND	-	-	-	-	-	0.2 – 1.5	0.8	-
General areas															
- Bansomdejchaopraya Rajabhat University Thon Buri District	1.9 – 15.8	8.1	0.8 – 10.3	4.2	ND	-	ND	-	-	-	-	-	0.1 – 1.7	0.6	-
- Environmental Research and Training Center Pathum Thani Province	2.6 – 10.2	5.5	1.2 – 1.9	4.3	ND	-	ND	-	-	-	-	-	-	-	-
Chiang Mai															
Roadsides															
Yupparaj Wittayalai School	6.1 – 25.1	13.2	1.6 – 5.8	4.3	ND	-	ND	-	-	-	-	-	0.2 – 1.2	0.6	-
General areas															
Chiang Mai City Hall	3.4 – 22.0	9.8	0.9 – 7.7	3.4	ND	-	ND	-	-	-	-	-	0.2 – 1.3	0.6	-
Rayong															
Map Ta Phut Public Health Station	4.1 – 11.6	7.9	4.6 – 8.4	6.2	ND	-	ND	-	-	-	-	-	0.2 – 0.7	0.4	-
Nong Chok Public Health Station	3.2 – 9.0	5.4	0.7 – 3.4	2.2	ND	-	ND	-	-	-	-	-	0.2 – 0.4	0.3	-
Khon Kaen															
Assistant district officer residence	0.1 – 10.4	7.1	0.9 – 7.4	3.3	ND	-	ND	-	-	-	-	-	0.3 – 0.4	0.3	-
Songkhla															
Songkhla Municipality	7.0 – 26.2	14.9	1.7 – 8.9	5.4	ND	-	ND	-	-	-	-	-	0.2 – 0.8	0.6	-
24-Hour Average Surveillance Value	-	-	860	-	0.55	-	-	-	-	-	-	-	-	-	-

Remark: * Monitoring results were not sufficient for average annual value calculation

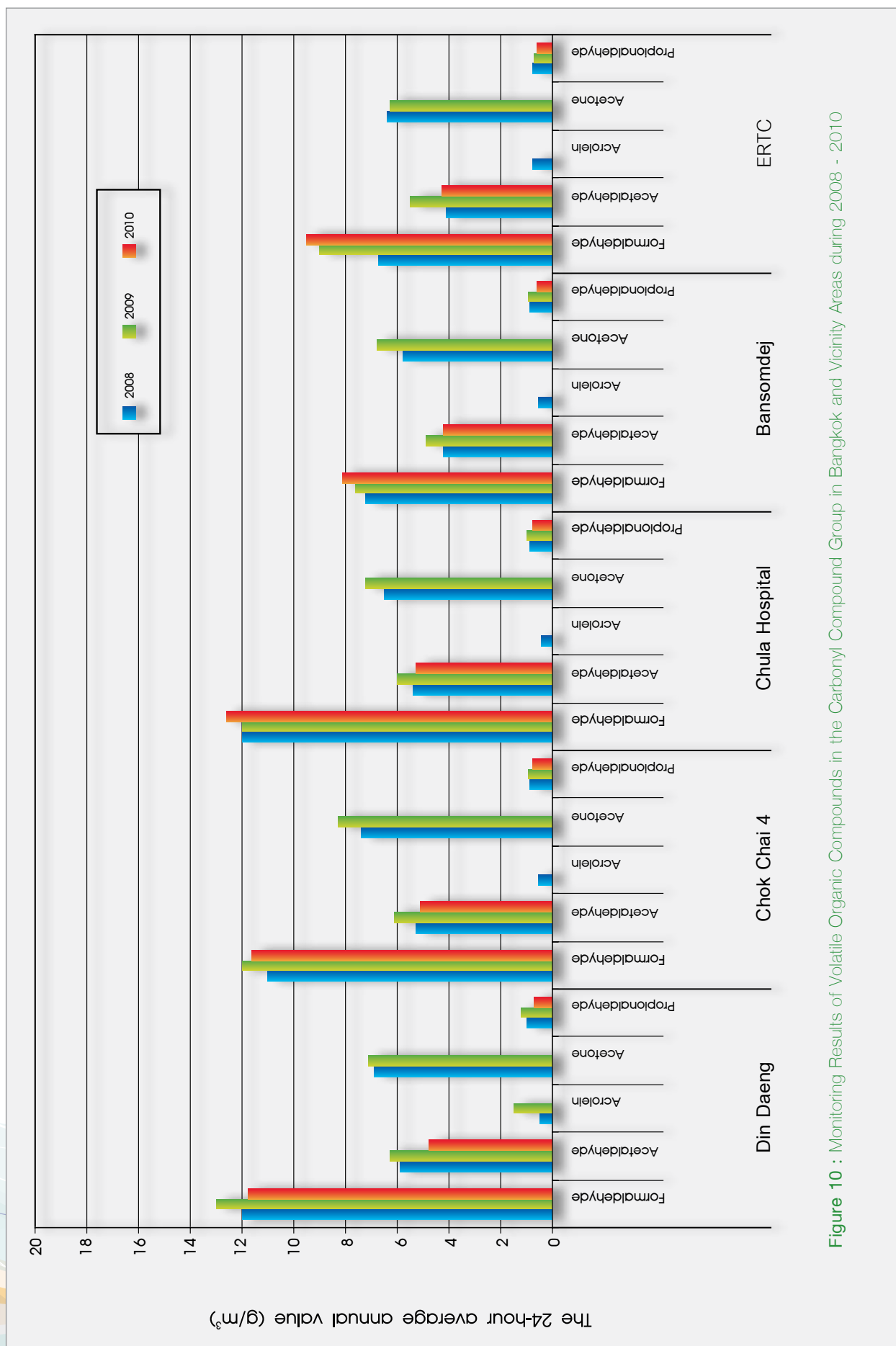


Figure 10 : Monitoring Results of Volatile Organic Compounds in the Carbonyl Compound Group in Bangkok and Vicinity Areas during 2008 - 2010

Table 4 : Comparison of the 24-Hour Average Annual Values and Average Annual Standard Values of 9 Types of Volatile Organic Compounds in 2010

Station	Vinyl chloride	1,3-Butadiene	Dichloro- methane	Chloroform	1,2-Dichloroeth- ane	Benzene	Trichloroeth- ylene	1,2-Dichloropropane	Tetrachloroeth- ylene
Bangkok and Vicinity areas									
Roadsides									
- Din Daeng National Housing Authority Din Daeng Rd.	0.02	0.34	0.82	0.20	0.18	5.2	0.31	0.10	0.23
- Chok Chai 4 Police Station Lad Phrao Rd.	0.01	0.14	0.87	0.19	0.17	3.9	0.86	0.10	0.26
- King Chulalongkorn Memorial Hospital Rama IV Rd.	0.01	0.17	0.84	0.80	0.20	4.5	0.28	0.10	0.36
General areas									
- Bansomdejchaopraya Rajabhat University Thon Buri District	0.02	0.09	1.2	0.21	0.21	2.8	0.28	0.10	0.17
- Environmental Research and Training Center Pathum Thani Province	0.02	0.09	0.52	0.15	0.19	1.4	0.27	0.10	0.13
Chiang Mai									
Roadsides Yuppajai Wittayalai School	0.01	0.19	0.41	0.15	0.14	4.3	0.09	0.13	0.11
General areas Chiang Mai City Hall	0.01	0.16	0.20	0.14	0.14	2.0	0.08	0.13	0.10
Khon Kaen Assistant district officer residence	0.01	0.13	0.35	0.13	0.16	3.5	0.12	0.12	0.13
Songkhla Songkhla Municipality	0.01	0.04	0.29	0.12	0.14	1.8	0.06	0.15	0.06
Rayong									
- Nong Faeb Temple	0.11	0.13	0.52	0.23	0.30	2.0	0.21	0.27	0.22
- Mab Chalude Temple	0.20	0.07	0.62	0.19	0.59	1.7	0.30	0.13	0.21
- Banplong Community	2.7	0.30	0.85	0.18	1.2	4.1	0.23	0.11	0.24
- Muang Mai Station	0.95	0.30	0.60	0.17	0.94	2.5	0.24	0.11	0.22
- Map Ta Phut Public Health Station	0.19	0.43	0.61	0.16	0.30	3.8	0.23	0.11	0.21
- Takuan Public Health Center	0.21	0.33	0.53	0.16	0.35	3.4	0.24	0.11	0.21
- Noppakad Village	0.45	0.26	0.97	0.17	0.42	2.5	0.34	0.11	0.30
- Nong Chok Public Health Station	0.04	0.19	0.34	0.10	0.21	1.7	0.19	0.12	0.22
- Pluak Ket Temple	0.04	0.55	0.34	0.16	0.21	0.33	0.16	0.12	0.22
Average Annual Standard Value ($\mu\text{g}/\text{m}^3$)	10	0.33	22	0.43	0.4	1.7	23	4	200

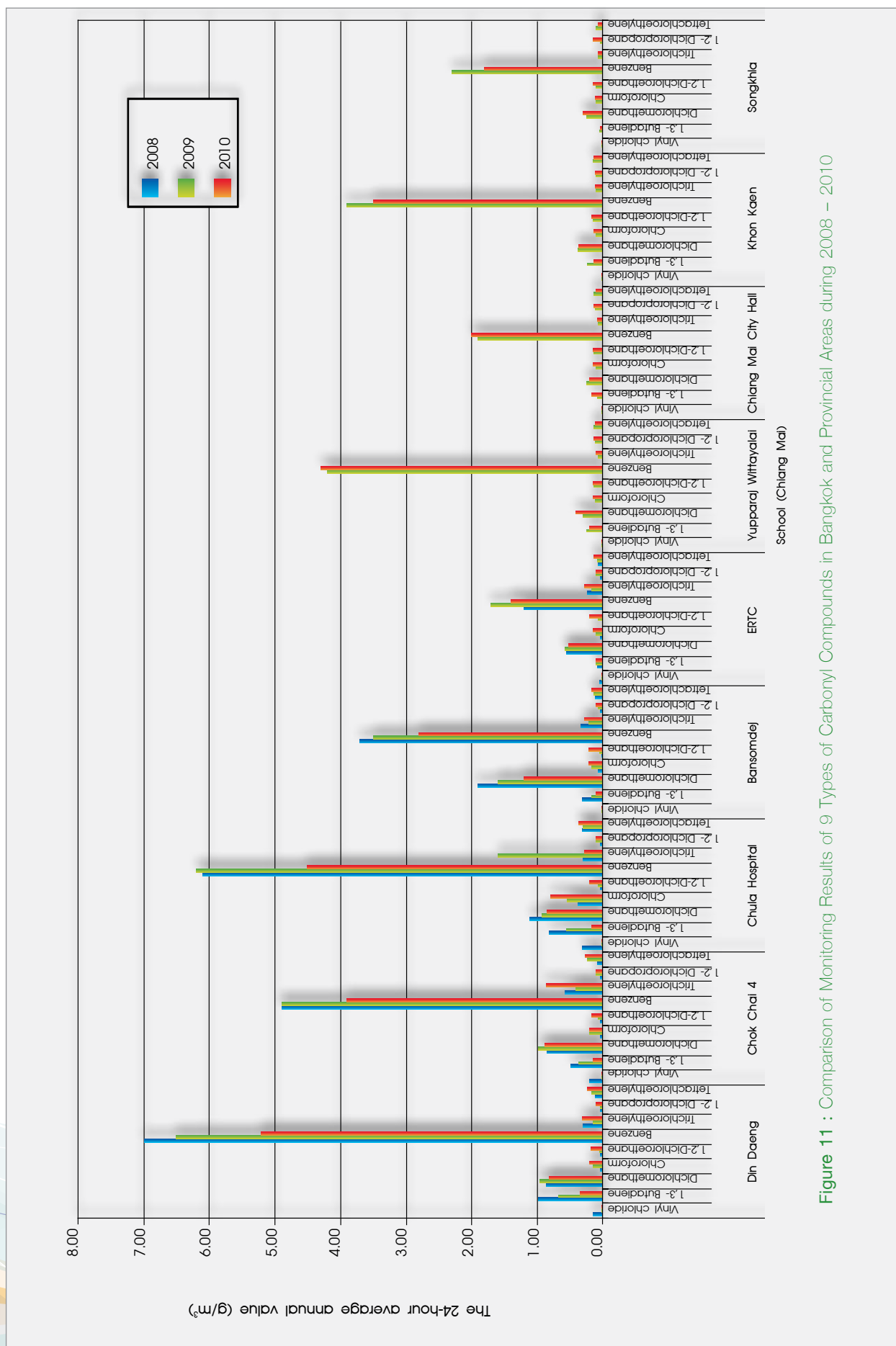
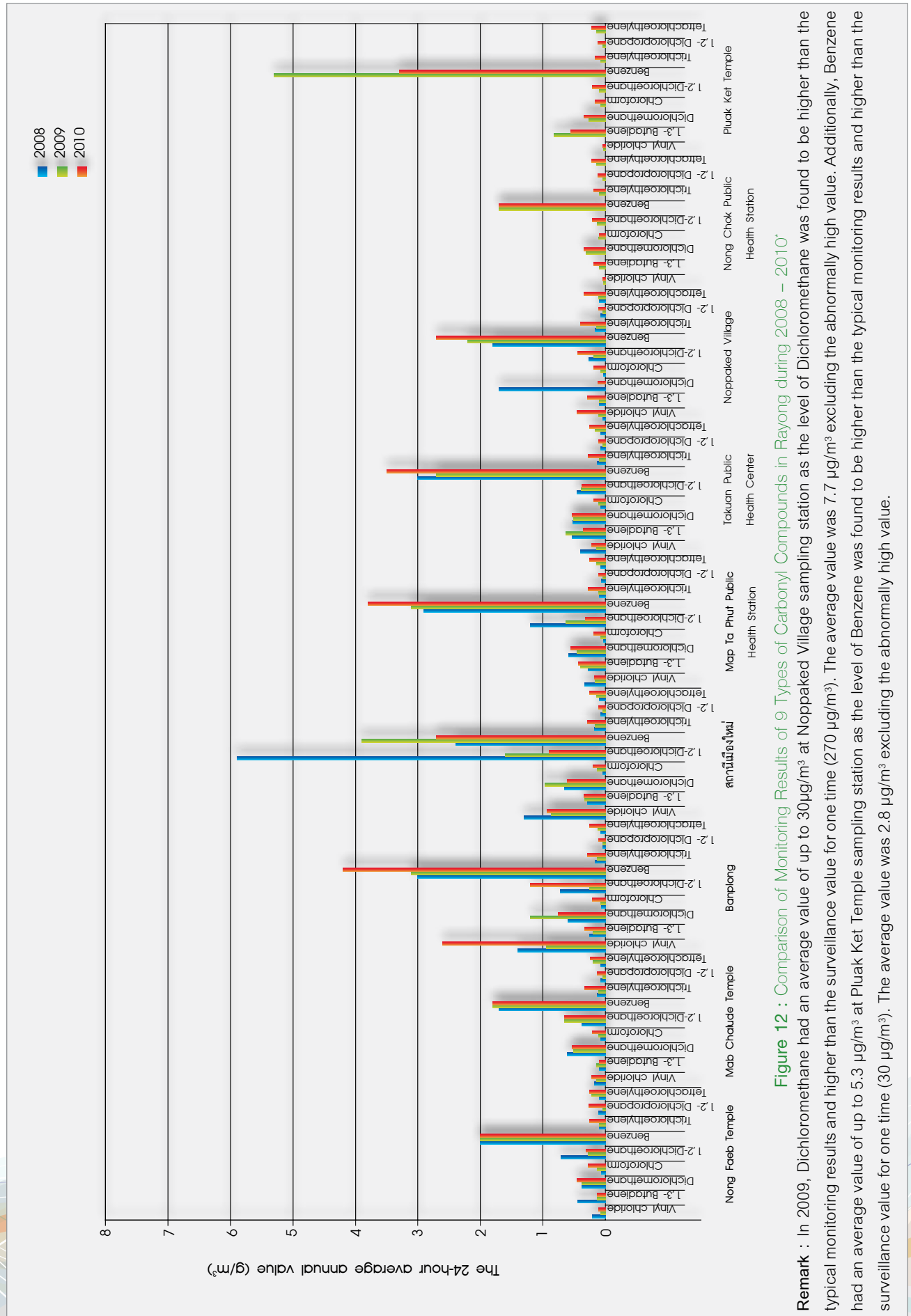


Figure 11 : Comparison of Monitoring Results of 9 Types of Carbonyl Compounds in Bangkok and Provincial Areas during 2008 – 2010



1.3 Noise Level

Noise pollution in big densely populated cities is mainly caused by vehicles. In the age of increasing numbers of vehicles, being exposed to high noise levels has become a major pollution problem to urban dwellers. According to a study by U.S. Environmental Protection Agency, it was found that people who live in an environment where 24-hour average noise levels exceed 70 decibels A for a long period of time can encounter sensorineural hearing loss. In addition, they also have impacts on health as a result of stress such as headaches, strong heartbeat and high blood pressure.

The noise level monitoring was carried out in Bangkok and vicinity areas through 14 monitoring stations and in 9 provinces through 16 monitoring stations. Additionally, temporary monitoring stations were also placed in 22 locations with heavy traffic congestion. The results showed that vehicles were a major source of noise in every area. Most roadside areas had noise levels that exceeded the standard (the 24-hour average noise level standard (L_{eq}) is no more than 70 decibels A). However, noise levels at roadsides in Bangkok and vicinity declined from the previous year while noise levels in general areas increased.

Noise levels at roadsides and general areas in Bangkok and vicinity

Roadsides : The 24-hour average noise levels (L_{eq}) at roadside stations were in the range of 61.0 – 85.8 decibels A (dBA) with the average level of 69.3 dBA, a slight drop from the previous year (In 2009, average level was 69.6 dBA). The number of days with value exceeding the standard was equivalent to 51%. Areas where noise levels exceeded the standard on a daily basis were Tri Petch Road and Lat Phrao Road. The temporary monitoring stations with 3 highest noise levels were Taksin Road, Sukhumvit Road and Rama IX Road (Table 5 – Table 7, Figure 13 and Figure 14)

General areas : Noise levels exceeded the standard in some areas. The 24-hour average noise levels (L_{eq}) were in the range of 49.7 – 79.1 dBA with the average level of 59.9 dBA, an increase from the previous year (In 2009, average level was 59.3 dBA) (Table 5, Table 8, Figure 13 and Figure 15).

Table 5 : The 24-Hour Average Noise Levels (L_{eq}) in 2010

Location		24 -hour average noise level (dBA)			Standard-Exceeding Area
		Min-Max	Average *	Number of Days Exceeding Standard (%)	
Bangkok, Nonthaburi and Samut Sakhon	Roadside	61.0 – 85.8	69.3	51	Major roadsides in Bangkok
	General	49.7 – 79.1	59.9	6	Nonsi Witthaya School
Provincial Areas	Roadside	50.1 – 80.1	63.1	7	Saraburi, Chiang Mai, Nakhon Ratchasima, Phuket, Songkhla
	General	44.0 – 70.0	57.6	0	
Standard		70			

Remark: * The average value of the 24 -hour average noise level (L_{eq}) that was measured within a year

Table 6 : The 24-Hour Average Noise Levels (L_{eq}) at Roadsides in Bangkok and Vicinity in 2010

Monitoring Station	Noise Level (dBA)		Number of Days Exceeding Standard/ Number of Days Monitored (%)
	Min-Max	Average*	
Pahurad, Tri Petch Rd.	74.1 - 85.8	75.6	270/270 (100)
Din Daeng National Housing Authority, Din Daeng Rd.	65.2 - 81.3	72.3	301/324 (93)
Choke Chai Police Station, Lad Phrao Rd.	70.4 - 73.9	71.7	326/326 (100)
22nd July Traffic Circle, Santipab Rd.	61.0 - 81.0	70.2	226/315 (72)
Thonburi Branch Power Station, Intharapithak Rd.	68.2 - 74.9	69.7	89/364 (24)
EGAT, Bangkruey-Sainoi Rd., Nonthaburi	63.4 - 70.0	66.5	0 /344 (0)
Huay Kwang Community Housing Stadium, Prachasongkroh Rd.	61.2 - 69.4	64.1	0 /197 (0)
Samut Sakhon Highway District, Samut Sakhon	62.9 - 66.7	64.0	0 /223 (0)
Standard	70		

Remark: * The average value of the 24 - hour average noise level (L_{eq}) that was measured within a year

Table 7 : The 24-Hour Average Noise Levels (L_{eq}) at Roadside Temporary Monitoring Stations in Bangkok in 2010

Monitoring Station	Monitoring Period	Noise Level (dBA)		Number of Days Exceeding Standard/Number of Days Monitored (%)
		Min-Max	Average**	
1. Ministry of Science and Technology , Rama VI Rd.	7 - 13 Jan	74.6 - 75.2	75.0	7/7 (100)
2. Police booth, Kiak Kai Intersection, Samsen Rd.	29 Jan - 4 Feb	74.5 - 75.2	75.0	7/7 (100)
3. Department of Land Transport, Phahonyothin Rd.	7 - 13 Feb	70.1 - 71.4	70.8	7/7 (100)
4. In front of Horwang School, Phahonyothin Rd.	25 Feb - 3 Mar	75.5 - 76.0	75.8	7/7 (100)
5. Police booth, Mahai Sawan Intersection, Taksin Rd.	1 - 7 Apr	79.6 - 80.3	80.0	7/7 (100)
6. Police booth, Bansomdejchaopraya Rajabhat, Issarapab Road	26 Mar - 1 Apr	76.9 - 77.7	77.4	7/7 (100)
7. Police booth, Suksawad-Prachauthid Rd. Intersection	22 - 28 Apr	74.0 - 77.9	75.8	7/7 (100)
8. Police booth, Kaset Intersection, Phahon Yothin Rd.	29 Apr - 5 May	74.0 - 75.2	74.6	7/7 (100)
9. Police booth, Sathupradit Intersection, Rama III Rd.	14 - 20 May	61.1 - 67.0	64.1	0/7 (0)
10. Police booth, Lam Sali Intersection, Ramkhamhaeng Rd.	8 - 13 Jul	77.9 - 78.4	78.1	6/6 (100)
11. Police booth, Victory Monument, Dokya bookstore	8 - 14 Jul	75.0 - 76.3	75.5	7/7 (100)
12. Police booth, MCOT Intersection, Rama IX Rd.	18 - 24 Jul	78.1 - 79.1	78.5	7/7 (100)
13. Police booth, Wongsawang Intersection, Bangkok-Nonthaburi Rd.	21 - 28 Jul	75.7 - 76.3	76.1	8/8 (100)
14. Phra Khanong Metropolitan Police Station, Sukhumvit Rd., Soi 77	28 Jul - 3 Aug	79.0 - 79.6	79.2	7/7 (100)
15. Police booth, Rama IX Intersection, Rama IX Rd.	28 Jul - 3 Aug	75.6 - 76.3	76.0	7/7 (100)
16. Police booth, Mansri, Bamrungmuang Rd.	16 - 22 Aug	76.9 - 77.8	77.4	7/7 (100)
17. Police booth, Yaowarat, Yaowarat Rd.	20 - 26 Aug	76.9 - 78.0	77.4	7/7 (100)
18. Police booth, Arunamarin-Prannok Rd. Intersection	23 - 29 Aug	77.5 - 78.1	77.9	7/7 (100)
19. Police Booth, Klong Toey Intersection, Art Narong Rd.	6 - 12 Aug	74.9 - 76.9	75.9	7/7 (100)
20. Meteorological Department, Sukhumvit Rd.	31 Aug - 6 Sep	76.3 - 77.0	76.6	7/7 (100)
21. Office of Atoms for Peace, Vibhavadi Rangsit Rd.	15 - 21 Sep	75.2 - 76.0	75.6	7/7 (100)
22. Royal Forest Department, Phahon Yothin Rd., Chatuchak District	15 - 21 Sep	73.1 - 74.6	73.7	7/7 (100)
Standard		70		

Remark: ** The average value of the 24 -hour average noise level (L_{eq}) during the monitoring period

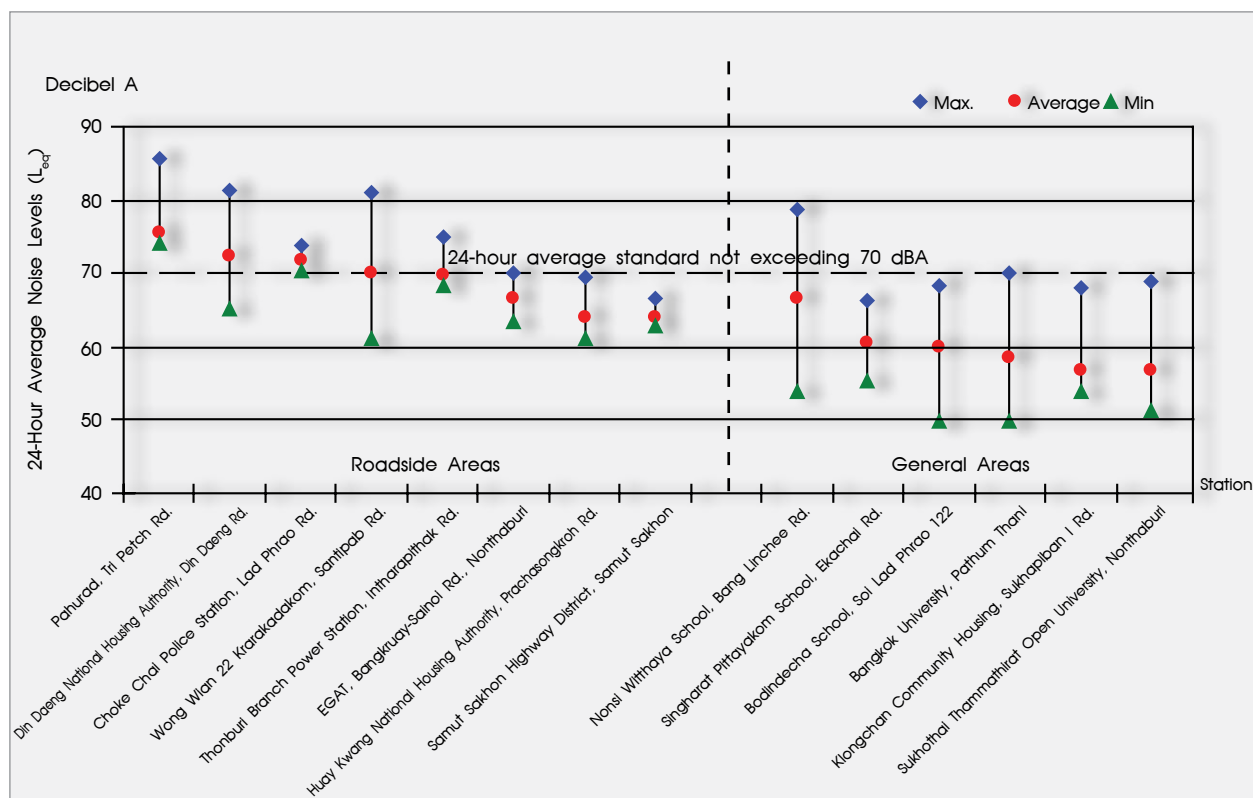


Figure 13 : The 24-Hour Average Noise Levels (L_{eq}) in Bangkok and Vicinity in 2010

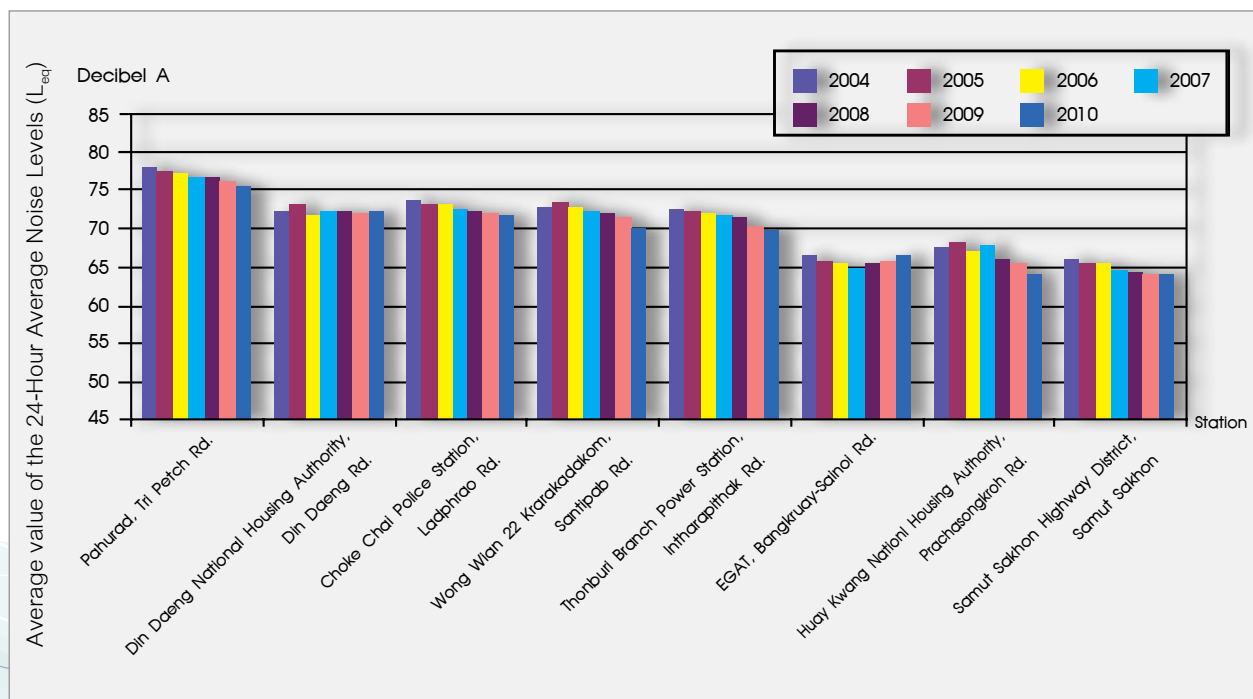


Figure 14 : Average Values of the 24-Hour Average Noise Levels (L_{eq}) in General Areas of Bangkok and Vicinity during 2004 - 2010

Table 8 : The 24-Hour Average Noise Levels (L_{eq}) in General Areas of Bangkok and Vicinity in 2010

Station	Noise Level (dBA)		Number of Days Exceeding Standard/Number of Days Monitored (%)
	Min-Max	Average*	
Nonsi Witthaya School, Nang Linchee Rd.	53.8 - 78.8	66.7	88/226 (39)
Singharat Pittayakom School, Ekachai Rd.	55.2 - 66.3	60.5	0/244 (0)
Bodindecha School, Soi Lad Phrao 122	49.7 - 68.3	60.0	0/254 (0)
Bangkok University, Rangsit Campus, Pathum Thani	49.8 - 70.0	58.5	0/230 (0)
Klongjan Community Housing, Sukhapiban I Rd.	54.0 - 67.9	56.9	0/248 (0)
Sukhothai Thammathirat Open University, Nonthaburi	51.3 - 69.0	56.8	0/258 (0)
Standard	70		

Remark : * The average value of the 24 -hour average noise level (L_{eq}) that was measured within a year

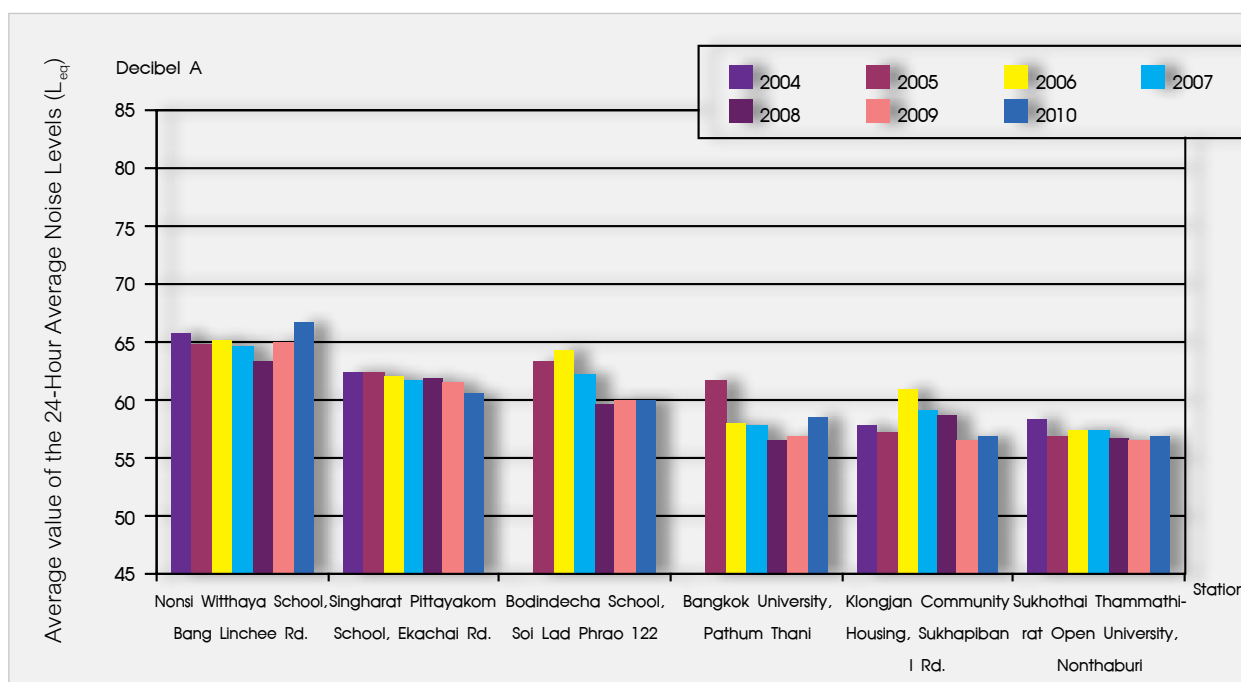


Figure 15 : Average Values of the 24-Hour Average Noise Levels (L_{eq}) in General Areas of Bangkok and Vicinity during 2004 – 2010

Noise levels at roadsides and general areas in provincial areas

Roadsides : The 24-hour average noise levels (L_{eq}) were in the range of 50.1 – 80.1 dBA with the average level of 63.1 dBA, close to that of the previous year (In 2009, average level was 62.9 dBA). The number of days with value exceeding the standard was equivalent to 7%. The problem area was Saraburi with noise levels in the range of 57.8 – 73.0 dBA. It was found that 50% of the total data exceeded the standard (Table 5, Table 9, Figure 16 and Figure 17).

General areas : The 24-hour average noise levels (L_{eq}) were in the range of 44.0 – 70.0 dBA which were within the standard. The average level was 57.6 dBA, an increase from the previous year (In 2009, average level was 57.0 dBA) (Table 5, Table 10, Figure 16 and Figure 18).

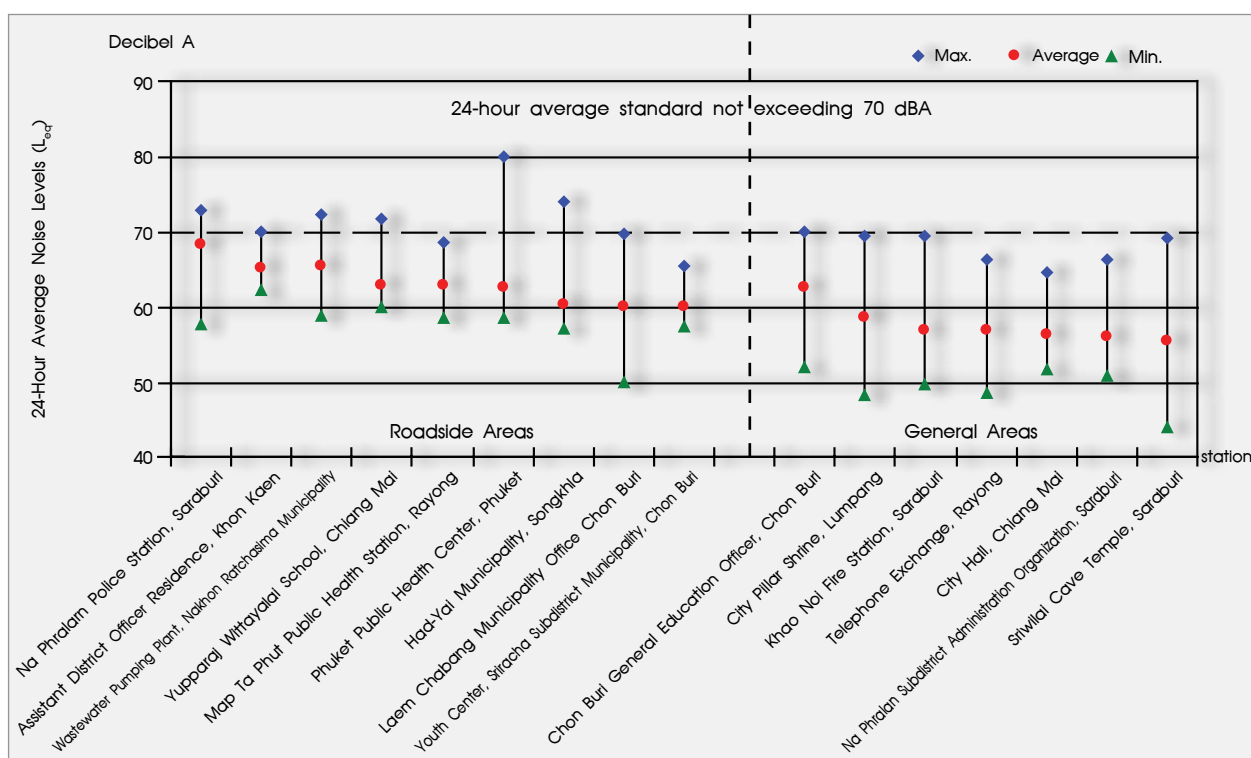


Figure 16 : The 24-Hour Average Noise Levels (L_{eq}) in Provincial Areas in 2010

Table 9 : The 24-Hour Average Noise Levels (L_{eq}) at Roadsides in Provincial Areas in 2010

Province	Station	Noise Level (dBA)		Number of Days Exceeding Standard/Number of Days Monitored (%)
		Min-Max	Average*	
Saraburi	Na Phralam Police Station, Chalem Prakiat Dist.	57.8 - 73.0	68.3	178/354 (50)
Khon Kaen	Assistant District Ofcer Residence, Muang Dist.	62.4 - 70.1	65.2	1/356 (0)
Nakhon Ratchasima	Wastewater Pumping Plant, City Municipality	59.0 - 72.2	65.5	6/328 (2)
Chiang Mai	Yupparaj Wittayalai School, Muang Dist.	60.0 - 71.8	62.9	2/351 (1)
Rayong	Map Ta Phut Public Health Station, Muang Dist.	58.6 - 68.7	62.8	0/352 (0)
Phuket	Phuket Public Health Center, Muang Dist.	58.7 - 80.1	62.5	13/339 (4)
Songkhla	Had-Yai Municipality, Had-Yai Dist.	57.2 - 74.1	60.4	6/340 (2)
Chon Buri	Laem Chabang Municipality Ofce, Sriracha Dist.	50.1 - 69.6	60.1	0/314 (0)
Chon Buri	Youth Center, Sriracha Subdistrict Municipality, Sriracha Dist.	57.3 - 65.3	60.1	0/356 (0)
Standard		70		

Remark : * The average value of the 24 -hour average noise level (L_{eq}) that was measured within a year

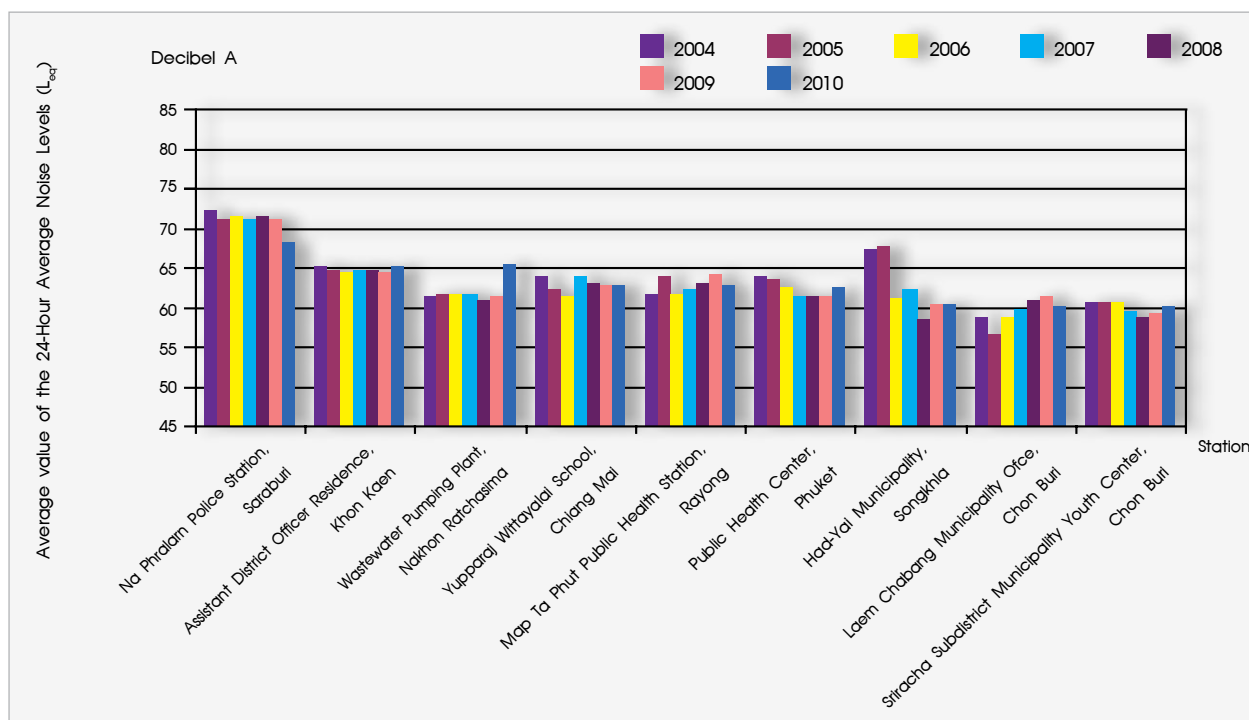


Figure 17 : Average Values of the 24-Hour Average Noise Levels (L_{eq}) at Roadsides in Provincial Areas during 2004 – 2010

Table 10 : The 24-Hour Average Noise Levels (L_{eq}) in Provincial General Areas in 2010

Province	Station	Noise Level (dBA)		Number of Days Exceeding Standard/Number of Days Monitored (%)
		Min-Max	Average*	
Chon Buri	Chon Buri General Education Office, Muang Dist.	51.9-70.0	62.6	0/315 (0)
Lampang	City Pillar Shrine, Muang Dist.	48.2-69.5	58.7	0/363 (0)
Rayong	Rayong Telephone Exchange, Muang Dist.	48.5-66.4	56.9	0/318 (0)
Saraburi	Fire Station (Khao Noi), Muang Dist.	49.6-69.5	56.8	0/351 (0)
Chiang Mai	Chiang Mai City Hall, Muang Dist.	51.6-64.6	56.3	0/352 (0)
Saraburi	Na Phralan Subdistrict Administration Organization, Chalem Prakiat Dist.	50.9-66.4	56.1	0/352 (0)
Saraburi	Sriwilai Cave Temple, Chalem Prakiat Dist.	44.0-69.2	55.5	0/364 (0)
Standard		70		

Remark : * The average value of the 24 -hour average noise level (L_{eq}) that was measured within a year

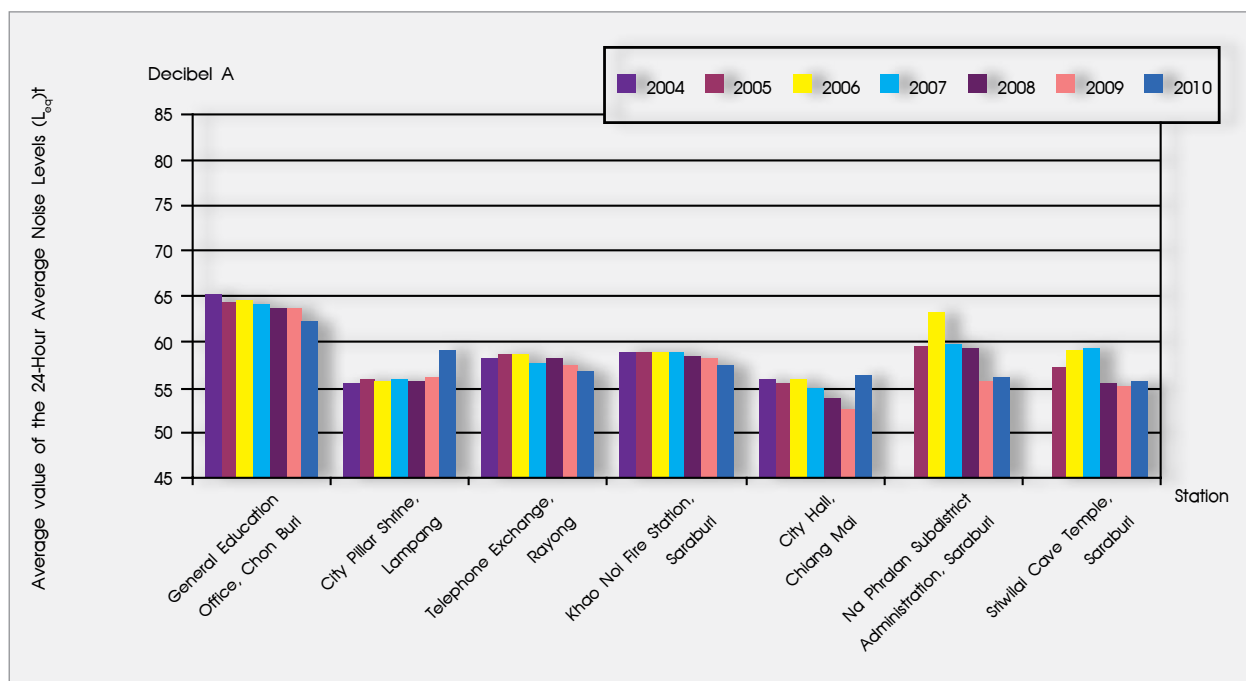


Figure 18 : Average Values of the 24-Hour Average Noise Levels (L_{eq}) in Provincial General Areas during 2004 – 2010

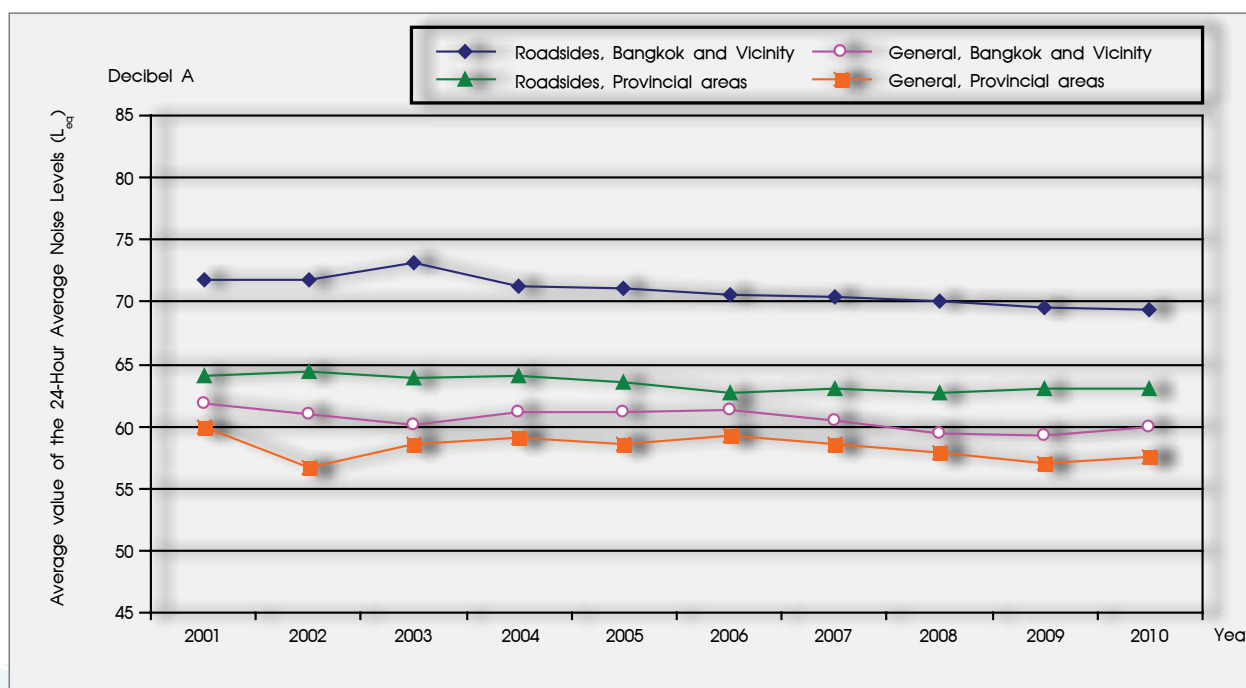
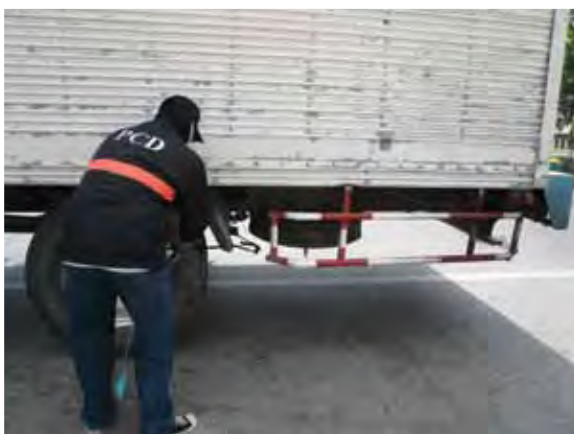


Figure 19 : Average Values of the 24-Hour Average Noise Levels (L_{eq}) during 2001 - 2010



The 24-hour average noise levels in Bangkok and vicinity during the past 10 years (2001 – 2010) (Figure 19) tended to decline as a result of continuous measures being carried out by related agencies, including Bangkok, Department of Land Transport, Metropolitan Police Bureau and Pollution Control Department. Noise pollution management in 2010 still focused on noises caused by traffic through integrated collaboration of agencies mentioned above. Activities were as follows.

1. Stringent inspection of vehicles with noise levels exceeding the standard. According to laws and related laws of Ministry of Natural Resources and Environment which are regulations of Royal Thai Police Department, the maximum noise level for cars is 100 dBA and the maximum noise level for motor tricycles and motorcycles is 95 dBA.
2. Promoting awareness among the public regarding vehicle maintenance by focusing on keeping the noise level within the standard before use as well as encouraging entrepreneurs and drivers of motor tricycles to improve the vehicles in accordance with the laws to be implemented.



1.4 Surface Water

Water pollution is a major pollution problem which has become more severe due to an increase in population and industrial factories in line with the economic growth. There are 3 major sources of water pollution which are domestic wastewater, industrial wastewater and agricultural wastewater. In 2010, the quality of surface water was monitored in 52 water resources which were divided into 48 major rivers and 4 standing surface water sources, namely Kwan Phayao, Bueng Boraphet, Nong Han and Songkhla Lake. There were 366 water monitoring stations. The evaluation of water quality standards for surface water sources² showed that water quality in the level of good, fair and deteriorated conditions were in the proportion of 22%, 39% and 39% respectively (Table 11 and Figure 20).

Table 11 : Summary of Surface Water Quality in 48 Major Rivers and 4 Standing Surface Water Resources in 2010

Water Quality	Surface Water Resources in Thailand					Percentage (%)
	North	Central	Northeast	East	South	
 Good	Kok ⁺⁺	Kwae Noi, Upper Petchaburi ⁺	Un ⁺⁺ , Songkram ⁺⁺ , Moon, Nong Han ⁺	Trat, Weru, Prasae	Upper Tapee, Lower Tapee, Phumduang, Trang	22
 Fair	Ping ⁻ , Wang ⁻ , Mae Jang, Li, Ing	Upper Chao Phraya, Upper Tha Chin ⁺ , Pranburi ⁻ , Noi, Kwae Yai, Mae Klong	Siew ⁻ , Pong, Chi ⁻ , Loei ⁺ , Lamchi ⁻	Bang Pakong, Upper Rayong, Upper Pangrad ⁻ , Lower Pangrad ⁻ , Prachin Buri ⁻ , Chanthaburi ⁻	Pak Panang, Upper Pattani, Langsuan ⁻	39
 Deteriorated	Yom ⁻ , Nan ⁻ , Kuang, Bueng Boraphet, Kwan Phayao	Central Chao Phraya ⁻ , Pasak, Kui Buri ⁻ , Lower Chao Phraya, Lower Tha Chin, Central Tha Chin, Lop Buri, Lower Petchaburi, Sakae Krang	Lampao ⁻ , Upper Lamtakong ⁻ , Lower Lamtakong	Nakhon Nayok, Lower Rayong	Lower Pattani ⁻ , Chumphon ⁻ , Saiburi ⁻ , Talay Noi, Talay Luang, Songkhla Lake ⁻	39
 Highly Deteriorated	—	—	—	—	—	—

Remark:

- (+ +) Indicates water resource where water quality improved by 2 levels compared to 2009
- (+) Indicates water resource where water quality improved by 1 level compared to 2009
- (-) Indicates water resource where water quality deteriorated by 1 level compared to 2009
- (- -) Indicates water resource where water quality deteriorated by 2 levels compared to 2009

² Good Water Quality

Fair Water Quality

Deteriorated Water Quality

Highly Deteriorated Water Quality

Overall monitoring result acquired the Surface Water Quality Standard Class 2

Overall monitoring result acquired the Surface Water Quality Standard Class 3

Overall monitoring result acquired the Surface Water Quality Standard Class 4

Overall Monitoring result did not acquire the Surface Water Quality Standard Class 4

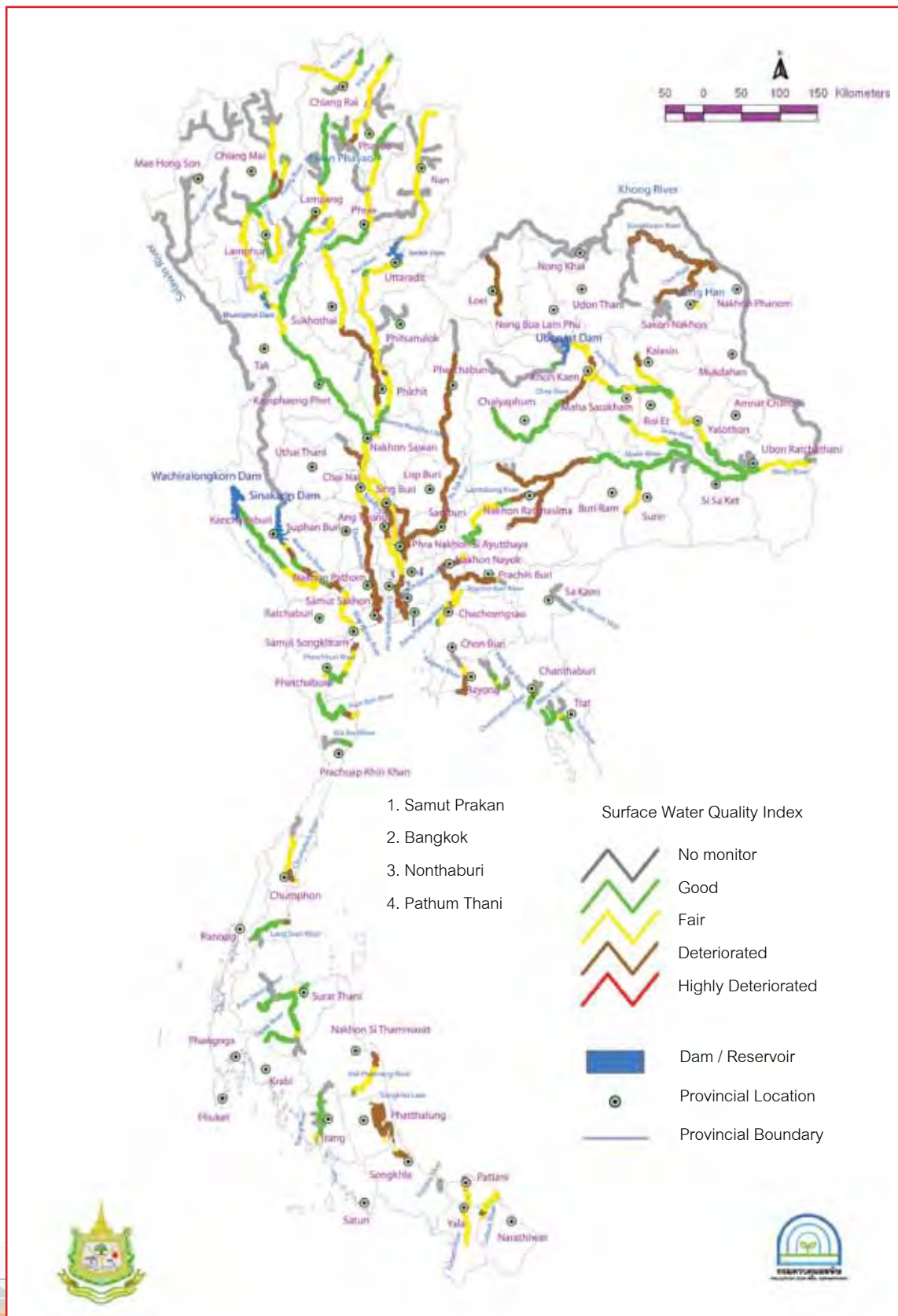


Figure 20 : Surface Water Quality Monitored in 48 Rivers and 4 Standing Surface Water Resources in 2010

Comparison of water quality during the 3 year period from 2008 – 2010 (Figure 21), it was found that the overall water quality had deteriorated, considering a continuous increase of water resources with a deteriorated water condition. When comparing water quality in 2010 and 2009, there were 10 water resources where water quality declined from fair and good conditions in 2009 to a deteriorated condition in 2010. Of the total 10 water resources, the increased dirtiness of 9 water resources was a result of Biochemical Oxygen Demand (BOD) while another water resource, Chumphon River, was found to have higher level of Fecal Coliform Bacteria (FCB), indicating a major contamination from sewage. There were 4 water resources where water quality improved from a deteriorated level in 2009 to a fair level in 2010 due to a decreased level of BOD. Water quality of Loei River improved due to a decline in the contamination of Total Coliform Bacteria (TCB) and Fecal Coliform Bacteria (FCB). Meanwhile, there were 9 water resources where water quality deteriorated from a good level in 2009 to a fair level in 2010 mainly due to an increased level of BOD and FCB.

The overall water quality of water resources in the northern, central and southern regions became more deteriorated from the previous year. During the 3 year period, there was no water resource with highly deteriorated water quality.

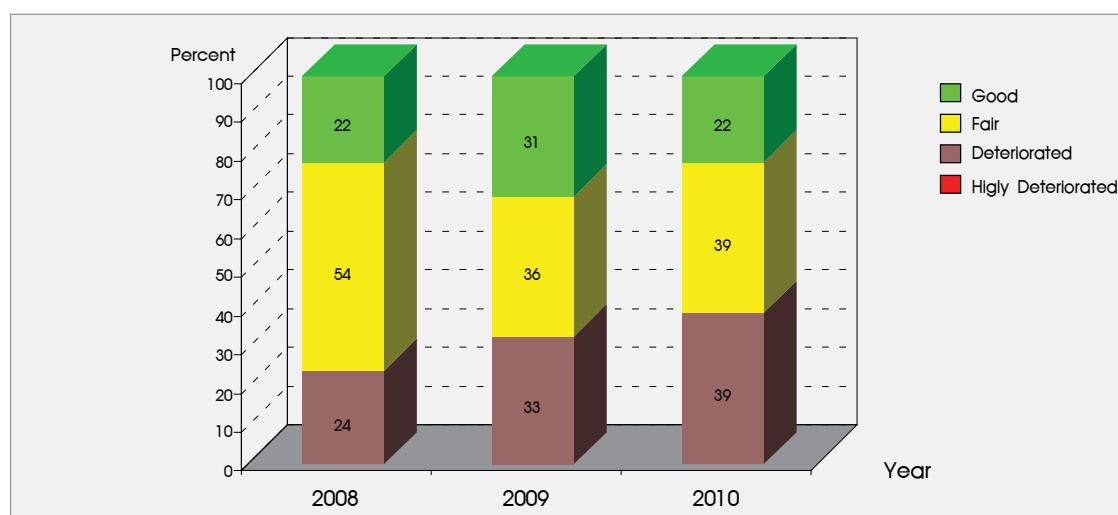


Figure 21 : Surface Water Quality in 48 Major Rivers and 4 Standing Surface Water Resources during 2008 – 2010

Parameters indicating water quality problems (Table 12) are Dissolved Oxygen (DO), BOD, TCB, FCB and Ammonia (NH_3). The monitoring results are as follows.

- DO value of below 2.0 milligrams per liter (mg/l) was detected 63 times out of the total 1,438 times of monitoring, representing 4%.
- BOD value of over 4.0 mg/l was detected 93 times out of the total 1,438 times of monitoring, representing 7%.
- TCB value of over 20,000 most probable number per 100 milliliters (MPN/100 ml) was detected 198 times out of the total 1,439 times of monitoring, representing 14%.
- FCB value of over 4,000 MPN/100 ml was detected 221 times out of the total 1,439 times of monitoring, representing 15%.
- NH_3 value of over 0.5 mg/l was detected 153 times out of the total 1,349 times of monitoring, representing 11%.

Table 12 : Displays Percentage of Detected Problems from the Total Times of Monitoring and Compares Each Major Parameter in Each Region in 2010

Parameter	Region				
	North	Central	Northeast	East	South
DO	2	10	2	5	3
BOD	8	9	5	2	7
TCB	11	26	5	21	6
FCB	20	20	5	15	17
NH ₃	4	16	15	15	6

Remark : Detected problem for DO was the value was below 2.0 mg/l, Detected problem for BOD was the value was over 4.0 mg/l, Detected problem for TCB was the value was over 20,000 MPN/100ml, Detected problem for FCB was the value was over 4,000 MPN/100ml and Detected problem for NH₃ was the value was over 0.5 mg/l

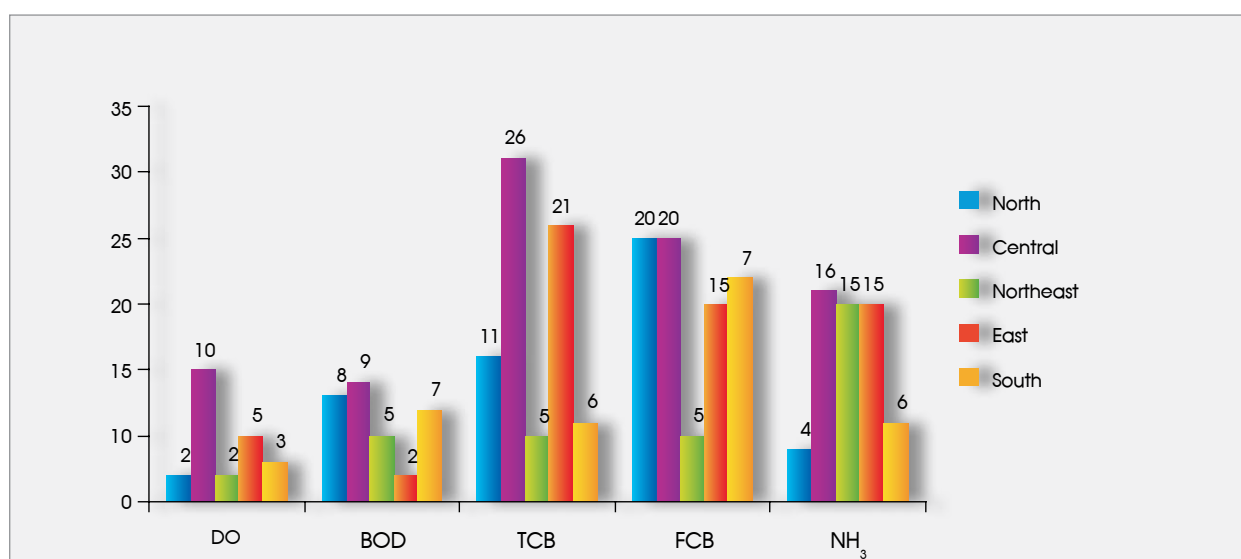


Figure 22 : Displays Percentage of Major Parameters with Values Below the Surface Water Standard in 2010 in Comparison with Each Region

Major parameters with values below the surface water standard in comparison with each region (Table 21 and Figure 22)

DO : The monitored values below 2.0 mg/l were mostly detected in water resources in the central region with a proportion of 10% of the total monitoring, namely Lower Tha Chin River covering Nakhon Pathom to Samut Sakhon and Lower Chao Phraya River covering Nonthaburi, Bangkok and Samut Prakan.

BOD : The monitored values over 4.0 mg/l were mostly detected in water resources in the central, northern and southern regions with proportions of 9%, 8% and 7% of the total monitoring respectively, namely Lower Chao Phraya River, Petchaburi River, areas around estuary of Petchaburi River, Kwan Phayao (During June and December), Yom River in Bang Rakam sanitation district area, Bang Rakam District, Phitsanulok and Songkla Lake in the estuary of Samrong Canel, Muang District, Songkla.

TCB : The monitored values over 20,000 MPN/100ml were mostly detected in water resources in the central and eastern regions with proportions of 26% and 21% of the total monitoring respectively, namely Lower Chao Phraya River, Tha Chin River in Sampran District, Nakhon Pathom, Krathumbaen District, Samut

Sakhon, Muang District, Suphan Buri, Mae Klong River in Thamaka District, Kanchanaburi, Noi River in Pothong District area, Ang Thong, Lop Buri River in Ban Praek District, Ayutthaya, Pasak River in Tha Ruea District, Nakhon Luang District, Ayutthaya, Petchaburi River in Muang District, Ban Laem District, Petchaburi, Chanthaburi River in Muang District, Chanthaburi, Pangrad River in Tambon Nayaiaam Municipality, Chanthaburi and Rayong River in Muang District, Rayong.

FCB : The monitored values over 4,000 MPN/100ml were mostly detected in water resources in the northern and central regions with proportions of 20% of the total monitoring of both regions, namely Nan River in Taphan Hin District, Bang Munnak District, Pichit and Muang District, Phitsanulok, Wang River in Nakhon Lampang Municipality, Lampang, Yom River in Tambon Thani, Muang District, Sukhothai, Kuang River in Muang District, Lamphun and Sansai District, Chiang Mai, Lower Chao Phraya River, Petchaburi River in areas around the estuary of Tha Chin River, areas around the estuary of Ban Thamai, Sampran District, Nakhon Pathom and Muang District, Suphanburi.

NH₃ : The monitored values over 0.5 mg/l were mostly detected in water resources in the central, northeastern and eastern regions with the proportions of 16%, 15% and 15% of the total monitoring respectively, namely Lower Chao Phraya River, Lop Buri River in Thawung District, Muang District, Lop Buri, Pasak River in Lomsak District, Muang District, Nongphai District, Petchabun, Chai Badan District, Lop Buri, Muang District, Saraburi, Lampao River, Muang District, Kamalasai District, Kalasin, Pong River in Nam Pong District, Muang District, Khon Kaen, Prachinburi and Nakhon Nayok (During July and August)

Table 13 : Displays Parameters and Problem Areas with Deteriorated Water Quality

Water Source	Problem Parameter					Tendency of Deterioration
	DO	BOD	TCB	FCB	NH ₃	
Yom		Bang Rakam Dist., Phitsanulok	Muang Dist., Sukhothai	Tambon Thani, Muang Dist., Sukhothai		Increase
Nan				Bang Munnak Dist., Tapan Hin Dist., Pichit, Muang Dist., Phitsanulok		Increase
Kuang			Tambon Muang Nga, Muang Dist., Lamphun	Sansai Dist., Chiang Mai, Muang Dist., Lamphun		Stable
Bueng Boraphet	Water quality deteriorated due to relatively high BOD					Stable
Kwan Phayao	Water quality deteriorated due to relatively high BOD during June and December					Decrease
Lower Chao Phraya	There were problems in every parameter throughout the river from Samut Prakan to Nonthaburi					Stable
Central Chao Phraya	Water quality deteriorated due to relatively high BOD					Stable
Lower Tha Chin	Sampran Dist., Nakhon Pathom		Sampran Dist., Nakhon Pathom, Krathum Baen Dist., Samut Sakhon	Muang Dist., Samut Sakhon, Sampran Dist., Nakhon Pathom		Decrease
Central Tha Chin	During August throughout the river		City end, Suphan Buri	City end, Suphan Buri		Decrease
Pasak			Nakhon Luang Dist., Tha Ruea Dist., Ayutthaya		Lomsak Dist., Muang Dist., Nong Phai Dist., Petchabun Dist., Chai Badan Dist., Lop Buri, Muang Dist., Saraburi	Increase
Kui Buri	Water quality deteriorated due to relatively high BOD					Increase



Table 13 : Displays Parameters and Problem Areas with Deteriorated Water Quality (Continued)

Water Source	Problem Parameter					Tendency of Deterioration
	DO	BOD	TCB	FCB	NH ₃	
Lop Buri			Ban Praek Dist., Ayutthaya		Muang Dist., Thawung Dist., Lop Buri	Stable
Lower Petchaburi		Estuary of Petchaburi River	Muang Dist., Ban Laem Dist., Petchaburi	Estuary of Petchaburi River		Decrease
Sakae Krang	Water quality deteriorated due to relatively high BOD					Decrease
Lampao	Water quality deteriorated due to relatively high BOD, but not exceeding 4.0 mg/l				Kamalasai Dist., Muang Dist., Kalasin	Increase
Upper Lamtakong	Water quality deteriorated due to relatively high BOD					Increase
Lower Lamtakong		Muang Dist., Nakhon Rat- chaisima				Decrease
Nakhon Nayok	Ban Na Dist., Ongkharak Dist., Nakhon Nayok				During August and December	Increase
Lower Rayong			Muang Dist., Rayong		Muang Dist., Rayong	Stable
Chumphon					Estuary, Chumphon	Increase
Lower Pattani	Water quality deteriorated due to relatively high BOD, but not exceeding 4.0 mg/l			Pattani estuary, Muang Dist., Pattani		Decrease
Sai Buri	Water quality deteriorated due to relatively high BOD			Estuary, Sai Buri Dist., Pattani		Stable
Talay Noi	Water quality deteriorated due to relatively high BOD					Decrease
Talay Luang	Water quality deteriorated due to relatively high BOD					Decrease
Songkhla Lake	Water quality deteriorated due to relatively high BOD There were BOD, TCB, FCB and NH ₃ problems in areas around estuary of Samrong Canal, Muang Dist., Songkhla					Decrease

Remark : Tendency of deterioration was considered based on WQI scores (5 parameters) in 3 year period which were 2008, 2009 and 2010

Based on important parameters indicating water quality, the major cause of deteriorated water condition (Table 13) was an increase in the BOD value, mainly due to municipal sewage as well as wastewater from other activities such as industrial and agricultural activities. Wastewater from these activities were released into water resources without treatment, particularly in Upper Lamtakong, Central Chao Phraya and Ping Rivers. Deteriorated water quality was mainly a result of population and economic growth and an increase in land use including development of hotels, resorts and restaurants. As well, development of lands adjacent to the waterways for agricultural purpose without wastewater treatment before discharging it into water resources also led to a deterioration in water quality. Wastewater management activities that had been carried out included supporting the establishment of central municipal sewage treatment system, strengthening the capacity of local administrations by creating understanding in wastewater management, encouraging entrepreneurs to conduct their own wastewater treatments, supporting basic domestic wastewater treatments by using readymade treatment tanks and installing grease traps and encouraging public participation in monitoring water quality and preserving water resources as well as efficient enforcement of laws.

When comparing the water quality from the monitoring during dry season (January – June) and rainy season (July – December), parameters indicating water quality problems in each period were as follows (Table 14 and Figure 23).

Dry season

- DO value of below 2.0 mg/l was detected 29 times out of the total 710 times of monitoring, representing 4.1%.
- BOD value of over 4.0 mg/l was detected 59 times out of the total 710 times of monitoring, representing 8.3%.
- TCB value of over 20,000 MPN/100ml was detected 82 times out of the total 709 times of monitoring, representing 11.6%.
- FCB value of over 4,000 MPN/100ml was detected 86 times out of the total 709 times of monitoring, representing 12.1%.
- NH_3 value of over 0.5 mg/l was detected 65 times out of the total 644 times of monitoring, representing 10.1%

● Rainy season

- DO value of below 2.0 mg/l was detected 34 times out of 723 times of monitoring, representing 4.7%.
- BOD value of over 4.0 mg/l was detected 34 times out of the total 723 times of monitoring, representing 4.7%.
- TCB value of over 20,000 MPN/100ml was detected 116 times out of the total 725 times of monitoring, representing 16.0%.
- FCB value of over 4,000 MPN/100ml was detected 135 times out of the total 725 times of monitoring, representing 18.6%.
- NH_3 value of over 0.5 mg/l was detected 86 times out of the total 700 times of monitoring, representing 12.3%.





Table 14 : Displays Percentage of Problem Parameters in Comparison between Dry and Rainy Seasons in 2010

Parameter	DO	BOD	TCB	FCB	NH ₃
Dry Season	4.1	8.3	11.6	12.1	10.1
Rainy Season	4.7	4.7	16.0	18.6	12.3

The analysis of the parameters during dry and rainy seasons revealed that during the rainy season, the water quality of overall water resources deteriorated when compared to the dry season. The significant problem of water quality was the wastewater from communities (as determined from FCB which originated from sewage of warm blooded animals which was primarily human). During the rainy season, problems related to FCB, TCB and NH₃ increased mainly as a result of the leaching of community sewage, organic and inorganic fertilizers from soil caused by rain.

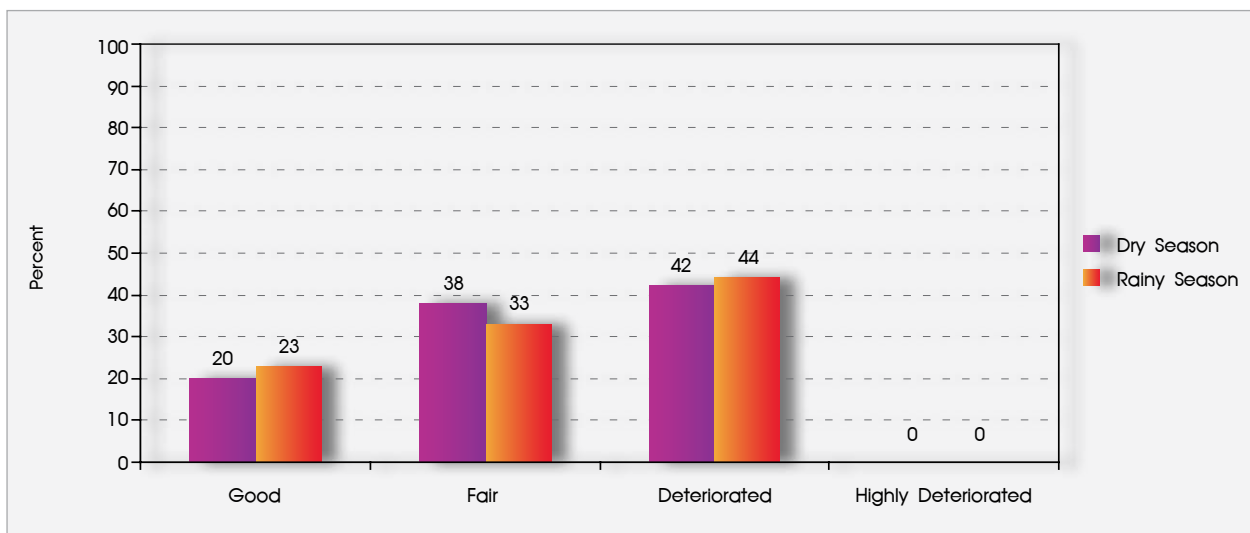


Figure 23 : Surface Water Quality during Dry and Rainy Seasons in 2010



Table 15 : Summary of Surface Water Quality Monitored in 48 Major Rivers and 4 Standing Surface Water Resources during Dry and Rainy Seasons in 2010

Water Quality	Surface Water Resources in Thailand										Percentage of Total Water Resources (%)	
	North		Central		Northeast		East		South		Dry Season	Rainy Season
	Dry Season	Rainy Season	Dry Season	Rainy Season	Dry Season	Rainy Season	Dry Season	Rainy Season	Dry Season	Rainy Season		
 Good	Ping, Kok	-	-	Kwae Noi*, Central Chao Phraya, Upper Tha Chin, Lop Buri, Pranburi, Mae Klong, Kui Buri, Kwae Yai, Upper Petchaburi	Nong Han, Un, Songkram	Nong Han, Moon**, Songkram, Pong*, Siew*, Lampao**	Bang Pakong, Weru, Prasae, Trat	Upper Pangrad*, Lower Pangrad, Chanthaburi, Trat*, Prasae*, Bang Pakong*, Upper Rayong*	Upper Tapee, Lower Tapee, Trang, Phumduang	Upper Tapee, Lower Tapee, Phumduang, Trang, Langsuan*	20	23
	Wang, Li, Ing, Mae Chang, Bueng Boraphet	Ping*, Mae Chang, Kok*, Wang, Li			Pong, Chi, Lamchi, Loei, Siew	Un*, Chi, Lamchi	Chanthaburi, Lower Pangrad		Langsuan, Talay Noi, Upper Pattani	Talay Luang*, Pak Panang*, Upper Pattani	38	33
 Fair	Yom, Nan, Kuang, Kwan Phayao	Nan, Ing*, Yom, Kuang, Bueng Boraphet*, Kwan Phayao	Upper-Lower Chao Phraya, Central-Lower Tha Chin, Pa Sak, Noi, Sakae Krang, Lower Petchaburi	Central Chao Phraya*, Lower Chao Phraya, Upper Tha Chin*, Central-Lower Tha Chin, Lop Buri*, Lower Petchaburi, Pa Sak, Noi, Kui Buri*, Sakae Krang	Upper Lamta-kong, Lower Lamplakong, Moon, Lampao	Loei*, Upper Lamta-kong, Lower Lamtamkong	Prachinburi, Nakhon Nayok, Upper Rayong, Lower Rayong, Upper Pangrad		Lowre Pattani, Pak Panang, Chumphon, Sai Buri, Talay Luang, Songkhla Lake	Saiburi, Lower Pattani, Talay Noi*, Chumphon, Songkla Lake	42	44
											-	-
 Deteriorated												
 Highly Deteriorated												

Remark:

- + Indicates water resource where water quality improved by 1 level compared to dry season
- + Indicates water resource where water quality improved by 2 levels compared to dry season
- Indicates water resource where water quality deteriorated by 1 level compared to dry season
- Indicates water resource where water quality deteriorated by 2 levels compared to dry season



Surface water qualities in each region are described as follows (Table 15)

Northern Region

The monitoring was conducted on 9 rivers which were Ping, Wang, Yom, Nan, Kuang, Kok, Li, Ing, Mae Chang and 2 standing surface water resources which were Kwan Phayao and Bueng Boraphet. Based on the results from 81 water quality monitoring stations, it was found that most water resources were in fair and deteriorated conditions. When compared to the water quality in 2009, the water quality of Yom River and Nan River declined to a deteriorated condition from a fair condition due to higher BOD value (Yom, Nan). The water quality of all water resources are as follows:

- Water resource in good condition was Kok River
- Water resources in fair condition were Ping, Wang, Mae Chang Lee and Ing Rivers
- Water resources in deteriorated condition were Yom, Nan and Kuang Rivers, Bueng Boraphet and Kwan Phayao

Important parameters indicating water quality problems for the whole year were FCB and TCB. Major parameters indicating water quality problems during the dry season was FCB and during the rainy season were FCB and TCB. The overall water quality in the rainy season had deteriorated. Analysis was conducted on the content of 9 heavy metal parameters which were Cadmium (Cd), Chromium (Cr), Manganese (Mn), Nickel (Ni), Lead (Pb), Zinc (Zn), Copper (Cu), Mercury (Hg) and Arsenic (As). The results showed that most parameters did not exceed the surface water quality standards. Heavy metals that exceeded the standard were Cd, Pb, Mn, Cr and Zn, representing 4.5%, 2.7%, 2.3%, 0.9% and 0.8% respectively. Details regarding water resources with water quality problems in the northern water resources are shown in Appendix B, Table 1 and 2.

Central Region

The monitoring was conducted on 12 rivers which were Chao Phraya, Tha Chin, Mae Klong, Kwae Yai, Kwae Noi, Pa Sak, Lop Buri, Noi, Sakae Krang, Phetchaburi, Pranburi and Kuiburi. Samples were taken from 89 water quality monitoring stations. The results revealed that most rivers were in a deteriorated condition. In comparison to 2009, the water quality of Central Chao Phraya River dropped to a deteriorated level from a fair level due to higher BOD value. The water quality of Kui Buri River dropped to a deteriorated level from a good level due to higher BOD value. The water quality of all water resources are as follows.

- Water resources in good condition were Kwae Noi and Upper Petchaburi Rivers
- Water resources in fair condition were Upper Chao Phraya, Upper Tha Chin, Kwae Yai, Noi, Pranburi and Mae Klong Rivers
- Water resources in deteriorated condition were Lower Chao Phraya, Central Chao Phraya, Lower Tha Chin, Central Tha Chin, Kui Buri, Pa Sak, Lop Buri, Sakae Krang and Lower Petchaburi Rivers

Major parameters indicating the water quality problems for the whole year were TCB, FCB and NH_3 . Parameters indicating the water quality problems in the dry season were TCB, FCB and BOD and in the rainy season were TCB, FCB and NH_3 . The overall water quality in the rainy season had deteriorated. Additionally, an analysis was conducted on the content of 7 heavy metal parameters which were Cd, Cr, Mn, Ni, Pb, Zn and Cu. The results showed that most parameters did not exceed the standard values. Heavy metal that exceeded the standard was Mn, making up 0.7% of the total monitoring. Details regarding water resources with water quality problems in the central region are shown in Appendix B, Table 3 and 4.

Northeast Region

The monitoring was conducted on 10 rivers which were Pong, Chi, Moon, Lampao, Siew, Songkram, Loei, Un, Lamchi, Lamtakong and 1 standing surface water resource which was Nong Han. Samples were taken from 86 water quality monitoring stations. It was found that most rivers were in a fair condition. In comparison to 2009, the water quality of Lampao River declined to a deteriorated level from a fair level due to high BOD value. Upper Lamtakong River also dropped to a deteriorated level from a good level due to high BOD value. The water quality of all water resources are as follows.

- Water resources in good condition were Un, Moon, Songkram Rivers and Nong Han
- Water resources in fair condition were Pong, Loei, Siew, Chi and Lamchi Rivers
- Water resources in deteriorated condition were Lampao, Upper Lamtakong and Lower Lamtakong Rivers

Major parameter indicating the water quality problems for the whole year was NH_3 both during the dry and rainy seasons. The over water quality during the rainy season had improved. An analysis was conducted on the content of 9 heavy metal parameters which were Cd, Cr, Mn, Ni, Pb, Zn, Cu, Hg and As. The results showed that most parameters did not exceed the standard values. Heavy metals that exceeded the standard were Cd and Hg, making up 3.2% and 4.5% of the total monitoring respectively. Details regarding water resources with water quality problems in the northeastern region are shown in Appendix B, Table 5 and 6.

Easter Region

The monitoring was conducted on 9 rivers which were Bang Pakong, Prachinburi, Nakhon Nayok, Rayong, Prasae, Pangrad, Chanthaburi, Weru and Trat. Samples were taken from 57 water quality monitoring stations. It was found that most water resources were in a fair condition. In comparison to 2009, the water quality of Lower Pangrad and Chanthaburi Rivers declined to a fair level from a good level due to higher FCB and TCB values respectively. The water quality of all water resources are as follows.

- Water resources in good condition were Weru, Trat and Prasae Rivers
- Water resources in fair condition were Bang Pakong, Upper Rayong, Upper Pangrad, Lower Pangrad, Prachinburi and Chanthaburi Rivers
- Water resources in deteriorated condition were Nakhon Nayok and Lower Rayong Rivers

Major parameters indicating the water quality problems for the whole year were TCB, FCB and NH_3 . Parameters indicating the water quality problems in the dry season were TCB, FCB and NH_3 and in the rainy season were TCB, FCB and NH_3 . The over water quality during the rainy season had improved. An analysis was conducted on the content of 9 heavy metal parameters which were Cd, Cr, Mn, Ni, Pb, Zn, Cu, Hg and As. The results showed that most parameters did not exceed the standard values. Heavy metals that exceeded the standard were Cr and As, representing 3.5% and 5.6% of the total monitoring respectively. Details regarding water resources with water quality problems in the eastern region are shown in Appendix B, Table 7 and 8.



Souther Region

The monitoring was conducted on 8 rivers which were Saiburi, Pattani, Pak Panang, Tapee, Phumduang, Chumphon, Langsuan, Trang and 1 standing surface water resource which was Songkhla Lake (including Talay Noi and Talay Luang). Samples were taken from 53 water quality monitoring stations. It was found that most water resources were in a deteriorated condition. In comparison to 2009, the water quality of Lower Pattani, Chumphon, Saiburi Rivers and Songkhla Lake dropped to a deteriorated condition from a fair condition due to higher BOD, FCB and TCB values respectively. The water quality of all water resources are as follows.

- Water resources in good condition were Upper Tapee, Lower Tapee, Phumduang and Trang Rivers
- Water resources in fair condition were Upper Pattani, Langsuan and Pak Panang Rivers
- Water resources in deteriorated condition were Lower Pattani, Chumphon, Saiburi, Talay Noi, Talay Luang and Songkhla Lake

Major parameter indicating the water quality problems for the whole year was FCB. Parameters for the dry season were FCB and BOD and in the rainy season were FCB and TCB. The over water quality during the rainy season had improved. In addition, an analysis was conducted on the content of 9 heavy metal parameters which were Cd, Cr, Mn, Ni, Pb, Zn, Cu, Hg and As. The results showed that most parameters did not exceed the standard values. Major heavy metals that exceeded the standard were Pb, Ni and Cr, representing 12.8%, 3.3% and 2.6% of the total monitoring respectively. Details regarding water resources with water quality problems in the southern region are shown in Appendix B, Table 9 and 10.



1.5 Groundwater

The groundwater quality in general was within the consumption standard under the Groundwater Act B.E.2520 (1977). Groundwater by nature is located in the pore spaces and fractures in rock and sediment. Therefore, some minerals can be found dissolved in the groundwater in a relatively high level such as iron and manganese. In addition, certain areas have specific geological features. For instance, hot spring areas may contain special minerals such as fluoride which can often be found in the northern and southern regions. Saline groundwater problem also can be found in the northeastern region, which is rich in rock salt sources, and coastal areas resulting from the sea encroachment. High water hardness is often found in groundwater that accumulates in limestone in, for instance, some areas in Saraburi and Ratchaburi (Figure 24).

There are other causes for the deterioration problem of groundwater that tend to become more severe and frequent at present. These causes include, for example, improper burying of waste, illegal dumping, mining and agriculture. Department of Groundwater Resources has acknowledged the problem and conducted studies in many areas. In 2010, Department of Groundwater Resources had conducted survey, inspection and monitoring activities on the situation of groundwater pollution. Areas that were vulnerable to toxin contamination from nature or human activities included an illegal chemical waste disposal area, Klang Dong Subdistrict, Pak Chong District, Nakhon Ratchasima, groundwater quality monitoring area, Rayong, areas surrounding Phu Thap Fa gold mine, Wang Saphung District, Loei, areas surrounding Khao Phanompha, Pichit and areas surrounding industrial waste landfills, Kaeng Koi District, Saraburi. The situation of groundwater can be concluded as follows.

Illegal disposal area for chemical waste, Klang Dong Subdistrict, Pak Chong, Nakhon Ratchasima

From 2006 to 2007, volatile organic compounds (VOCs) were detected in the illegal chemical waste disposal area and surrounding areas from the sampling of groundwater for contaminants which had been conducted twice in February and June 2007. Therefore, Department of Groundwater Resources had continuously monitored the chemical contamination of groundwater by monitoring VOCs in the groundwater surrounding the illegal disposal area for chemicals in Klang Dong Subdistrict, Pak Chong District, Nakhon Ratchasima. A project consultant had been hired to conduct an assessment on the risk of chemical contamination of groundwater in Klang Dong Subdistrict, Pak Chong District, Nakhon Ratchasima for 10 months. Department of Groundwater Resources had also coordinated with Sima Mongkhon Municipality, Klang Dong Subdistrict, Pak Chong District, Nakhon Ratchasima to examine the chemical contamination of groundwater from Department of Groundwater Resources' monitoring wells and community wells located nearby the illegal disposal area. In June 2009, 43 water samples were collected from 40 groundwater wells. The results showed that there were 3 types of VOCs exceeding the groundwater standard in the illegal disposal area for chemical waste, namely Trichloroethylene (Figure 25), Tetrachloroethylene and 1,1,1-Trichloroethane.

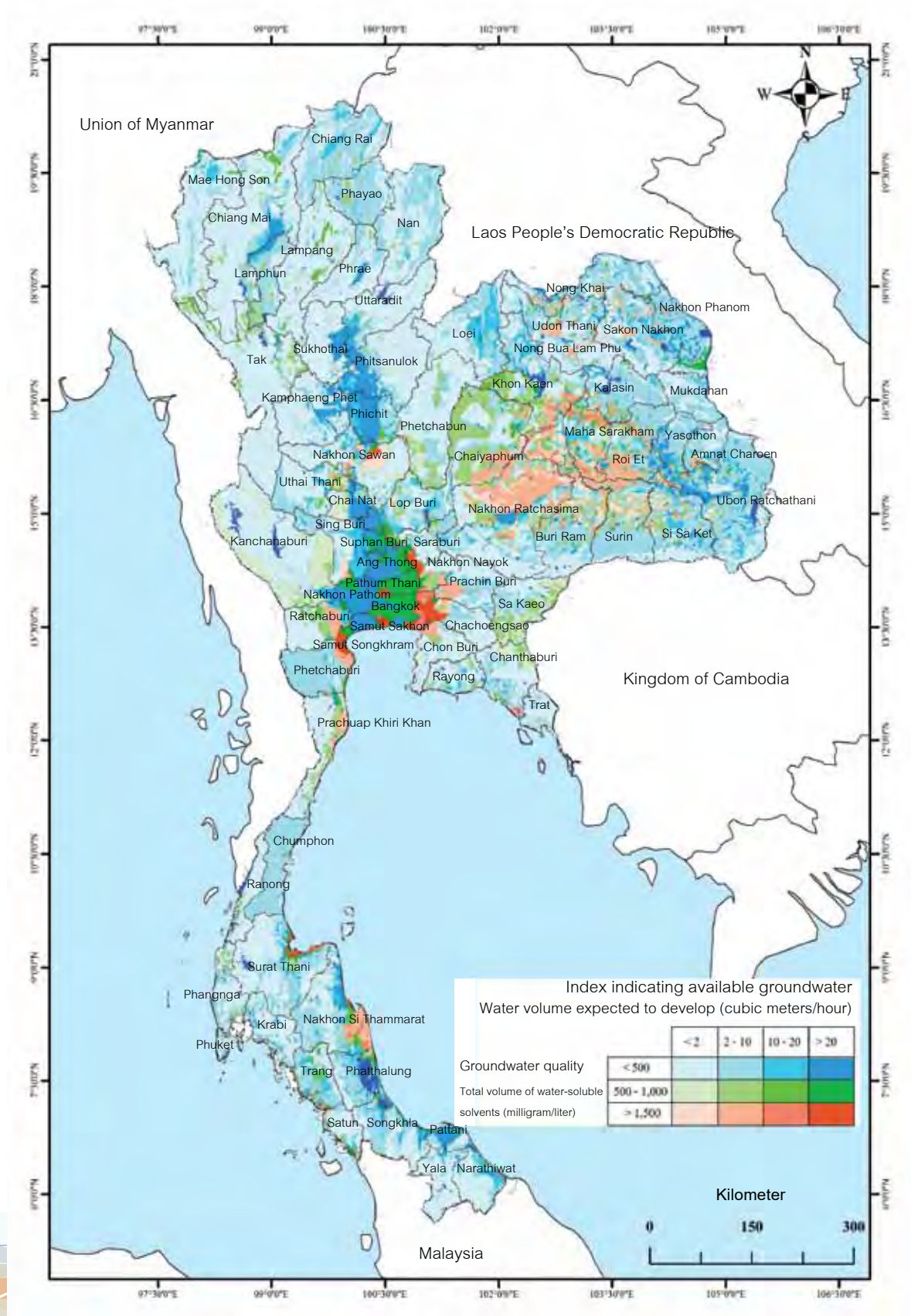


Figure 24 : Map Displaying Thailand's Groundwater Quality

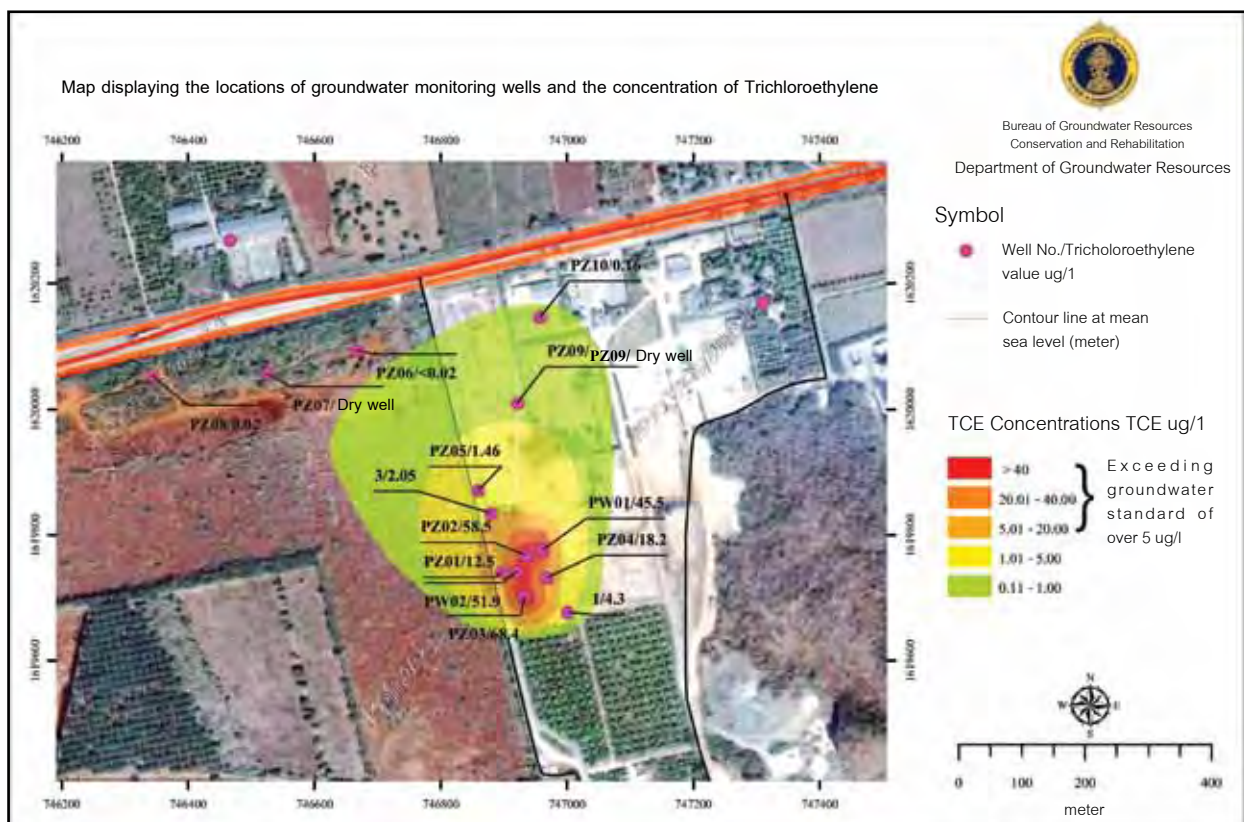


Figure 25 : Map Displaying Iso-Concentration of Trichloroethylene in June 2009

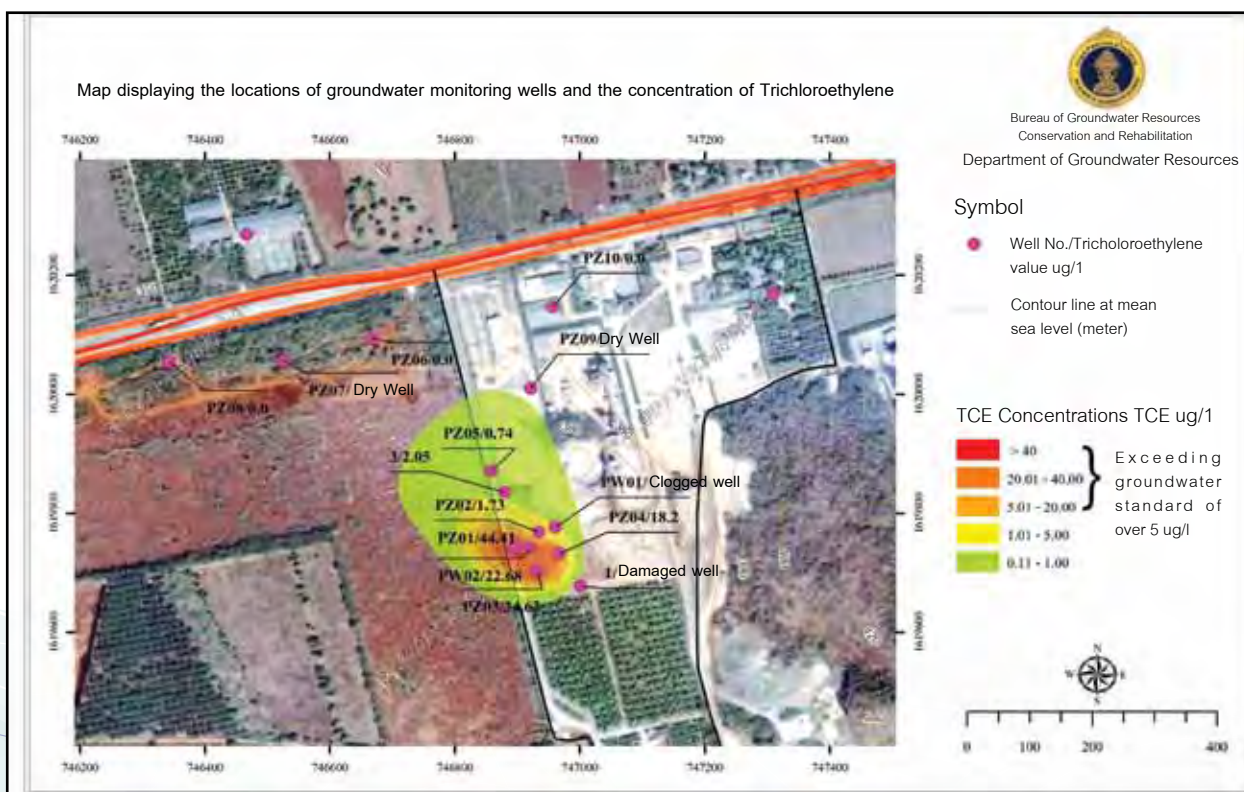


Figure 26 : Map Displaying Iso-Concentration of Trichloroethylene in February 2010



In February 2010, Department of Groundwater Resources had collected 26 water samples from 12 groundwater wells. The analysis revealed that there were 4 types of VOCs exceeding the standard, namely 1,1 – Dichloroethylene, Tetrachloroethylene, Trichloroethylene (Figure 26) and 1,1,2-Trichloroethane. It was found that the concentrations of Trichloroethylene dispersion had decreased possibly because Trichloroethylene, having high density and being heavier than water, tended to penetrate into the ground vertically rather than horizontally. Additionally, the area's geological and hydrogeological characteristics were limestone with fractures, chasm and holes allowed the substance to move through those fractures of limestone and water area at the groundwater level, making it difficult to determine the flow direction of contaminants. Geophysical studies of the soil surface are limited to the soil surface, covering only the upper structure of soil level. The studies on the concentration level and movement direction of contaminants cannot be conducted at a deeper level where the groundwater is situated. There needs to be a survey and drilling of monitoring wells at a deeper level in order to learn about the concentrations and movement of contaminants whether they move vertically or horizontally. Creating a mathematical model is a prediction based on a calculation of available information. However, keeping track on the flow direction of chemical substances in the groundwater level situated in areas with limestone hydrogeological conditions requires further detailed studies to serve as future case studies.

Groundwater quality monitoring area, Rayong

The groundwater quality monitoring was conducted in Map Ta Phut Industrial Estate, Rayong, in 2010. Contaminations of heavy metals and VOCs in soil, subsurface water and groundwater samples were found to exceed the groundwater standard in the Industrial Estate and surrounding areas. The monitoring, in cooperation with other related agencies, found a contamination of heavy metals including iron, manganese, fluoride, arsenic, mercury, chromium and lead. However, the detected amount of iron and manganese was likely to be created by natural geological features such as laterite and lateritic soil which were composed of iron and manganese ores. A VOCs contamination was found in soil and groundwater.

Measures to solve the chemical contamination of soil and groundwater which would affect the groundwater quality in the Industrial Estate areas have been taken since 2005 through the project aimed at solving the water shortage crisis in the Eastern region (Rayong – Chon Buri). The solving measures included withdrawing water pumps, cleaning groundwater wells, closing the well lids and permanently closing some unused groundwater wells. Department of Mineral Resources had examined 33 groundwater wells in the areas, permanently closed 6 wells, withdrew water pumps from 23 wells, cleaned 4 wells and closed the lids of 26 wells. There were 4 wells requested for further use by companies in the Industrial Estate.

In 2010, Pollution Control Department, Department of Groundwater Resources, Department of Environmental Quality Promotion, Office of Natural Resources and Environmental Policy and Planning and Map Ta Phut Industrial Estate Office had collaborated to examine and collect subsurface water and groundwater samples. Department of Groundwater Resources had examined the Industrial Estate areas and nearby areas. The results of heavy metal contamination analysis based on 171 samples showed that there were contaminations of iron, manganese, fluoride, arsenic and lead exceeding the subsurface water and groundwater quality standards for consumption. The acid-base value was found to be below 6.5 in 43 samples, iron volume exceeded the standard in 56 samples, manganese volume exceeded the standard in 28 samples, fluoride volume exceeded the standard in 17 samples, arsenic volume exceeded the standard in 22 samples, mercury volume exceeded the standard in 1 sample, chromium volume exceeded the standard in 1 sample and lead volume exceeded the standard in 3 samples. In addition, the analysis of VOCs was conducted in 68 samples. Four samples from 3 wells in the Map Ta Phut Industrial Estate were found to exceed the standard. VOCs that exceeded the standard were Tri-chloroethylene, 1-2 Dichloroethane and trans-1-2-Dichloroethylene (Figure 27).

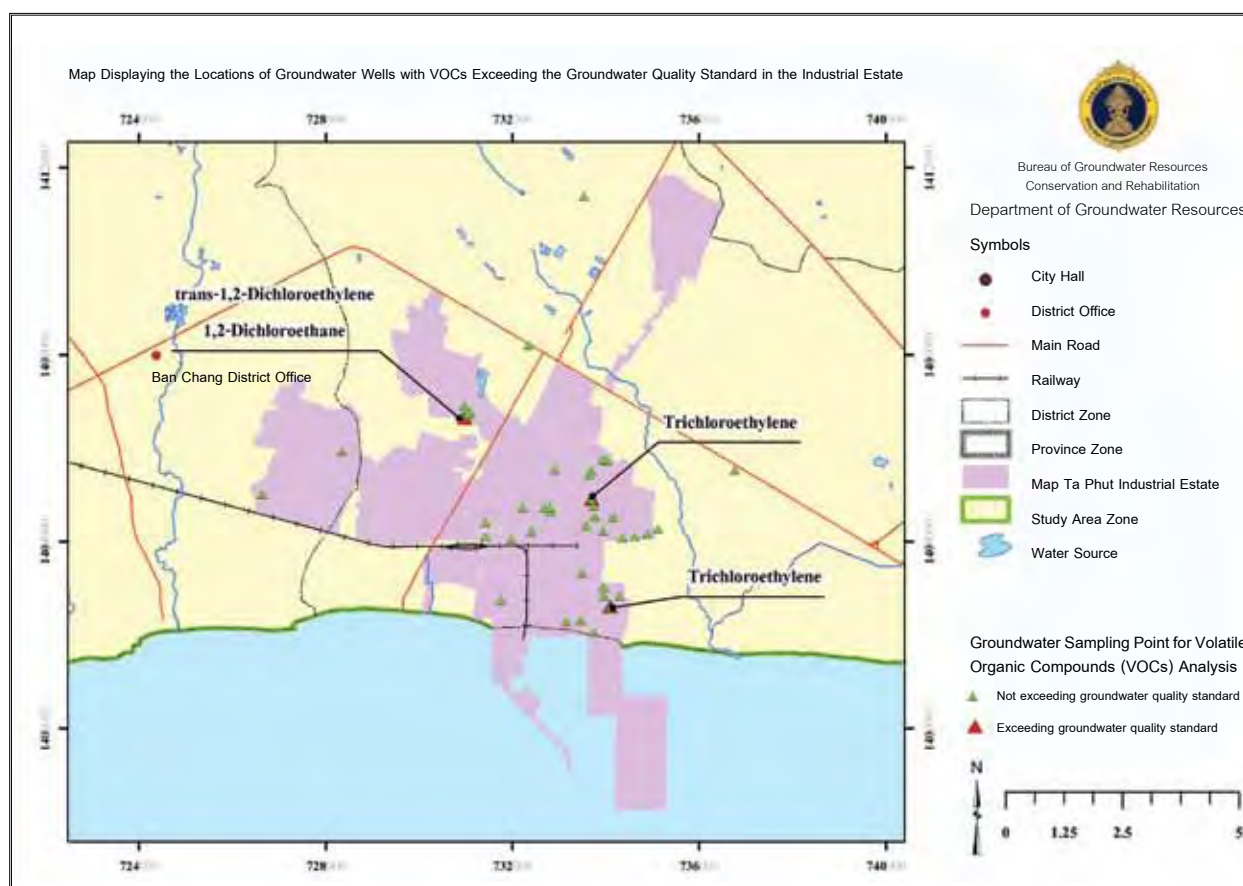


Figure 27 : Map Displaying the Locations of Groundwater Wells with VOCs Exceeding the Groundwater Quality Standard in the Industrial Estate

Areas surrounding Phu Thap Fa gold mine, Wang Saphung District, Loei

The Phu Thap Fa gold mining started operation since 11 September 2006 by Tungkum Limited with a permit to open a mine and operate gold mining in the Phu Thap Fa gold mining concession area in Wang Saphung District, Loei. The gold mine covers 6 plots with approximate land size of 1,290 rais. The gold mining had caused impacts on an environment surrounding the gold mine due to cyanide contamination of natural water resources (Nam Huai Creek) with value exceeding the standard by over 10 times (the standard value of cyanide does not exceed 200 micrograms per liter). The impacts included twisted leaves of rubber trees, low productivity as well as people living nearby encountering rash on their bodies and not being able to use rainwater for consumption. Moreover, there were other toxic substance contaminations that exceeded the standard such as arsenic and cadmium (Public Health, Loei, 2008).

Due to the problems mentioned above, in 2010, Department of Groundwater Resources had examined the situation and the quality of groundwater in the areas around the mine. The monitoring results, based on 18 collected water samples, revealed that water samples in the mine area contained heavy metals that exceeded the standards. That is, lead in 1 sample, chromium in 1 sample and cyanide in 1 sample. Other water samples collected from areas around the mine did not show unusually high amounts of heavy metals.



Areas surrounding Khao Phanompha gold mine, Pichit

In 1999, gold vein was discovered at Khao Phanompha, Nong Phra Subdistrict, Wang Sai Phun District, Pichit, leading to an intrusion by a large number of people into Khoa Phanompha area in search for gold. This had caused a destruction of natural resources and environment. Despite the notification prohibiting the intrusion of the area, the illegal intrusion to search for gold still continues. Pichit Provincial Administration received the gold mining concession in Khao Phanompha areas in order to allow the public to share mining benefits which could solve problems to a certain extent. People were allowed to excavated soils and rocks in the private land areas in front of the mine, and then wash them to clean out the dirt in the rivers, natural canals or pools and ponds dug by local people for private use. Mercury, a toxic heavy metal, was employed in the gold extracting process, resulting in a toxin contamination of groundwater and affecting the groundwater quality in the areas.

In 2010, Department of Groundwater Resources had conducted a survey to examine and monitor the contamination of groundwater due to gold mining activities in the areas. The survey covered the 10 kilometer radius of the Khao Phanompha gold mine areas. In April 2010, forty-nine groundwater samples were collected. The analysis of physical and chemical features found that the samples were contaminated with values exceeding the groundwater quality standard and the maximum acceptable concentration according to the groundwater quality standard for consumption. Contaminants found to exceed the standards were iron in 16 samples, manganese in 6 samples, sulfate in 4 samples, hardness in 2 samples, permanent hardness in 2 samples and total soluble substances in 39 samples. Most samples containing high concentration of iron were probably created by nature with geological features being lateritic soil or laterite whose major chemical component was iron oxide or aluminium oxide. The sample analysis of 7 toxic chemical parameters, namely arsenic, lead, cadmium, chromium, mercury, selenium and nickel, found samples with values exceeding the groundwater quality standard and the maximum acceptable concentration according to the groundwater quality standard for consumption. Mercury was found to exceed the standard in 6 water samples. Other parameters were detected, but values were within the standards. These parameters were arsenic in 3 samples, selenium in 8 samples, and nickel in 8 samples. One in 6 samples of mercury whose concentrations exceeded the standard contained value up to 100 times higher than the standard (the groundwater standard for mercury does not exceed 0.001 milligrams per liter) and was 4 kilometers away from the mining area to the southeast. Therefore, there was a high risk of contamination from the use of mercury in the gold extracting process by the villagers or from other causes. Department of Groundwater Resources will conduct a further detailed study.



Areas surrounding industrial waste landfills, Kaeng Khoi District, Saraburi

There had been a public complaint regarding pollution problems caused by waste disposal operation of Better World Green Public Company Limited (PCL) in Moo 8, Huai Haeng Subdistrict, Kaeng Khoi District, Saraburi since 2000. In solving the problems, related public agencies including Pollution Control Department, Department of Industrial Works, Office of Natural Resources and Environmental Policy and Planning, Saraburi Province and Department of Groundwater Resources had verified the facts and solved the problems. Department of Industrial Works in collaboration with Saraburi had ordered Better World Green Public Company Limited (PCL) to solve the problems. The company, as a result, had complied with the order and solved the problems as recommended by public agencies. Nevertheless, related agencies still received periodic complaints from local people, stating that foul odor still lingered and there were contaminations of surface water and groundwater.

In 2003, there had been an examination of soil and rock layers and groundwater level through a geophysical survey. As well, an examination of composition of the soil and rock layers had also been conducted in order to study the heavy metal and toxic substance contaminations of groundwater in the areas. The survey on the groundwater conditions had as well been carried out to learn about the characteristics of the groundwater level and the flow direction as well as to examine the groundwater quality. Monitoring wells had been established to detect contamination of groundwater. In 2010, the groundwater monitoring was conducted on 78 wells in Huai Haeng Subdistrict, Nong Plalai Subdistrict, Kaeng Khoi District, Pak Khaosan Subdistrict, Kud Nok Plao Subdistrict, Muang District, Saraburi. The evaluation of groundwater quality showed that there were 44 wells whose groundwater quality was within the groundwater quality standard and 34 wells with values exceeding the standard. Of the total wells whose groundwater value exceeding the standard, 21 wells could be improved and allowed to be used for consumption if the amounts of iron and manganese were reduced. Samples of groundwater with selenium exceeding the standard were found in 2 wells, with nitrate in 1 well and with fluoride in 11 wells. The Reverse Osmosis (RO) was required to improve the water quality before consumption. Since the geological conditions of the surveyed areas were volcanic rocks consisting of rhyolite, andesite, tuff, pebble and volcanic breccia, the groundwater in these areas typically contained naturally high amounts of iron, manganese and fluoride.

At present, Department of Groundwater Resources has continuously monitored the areas vulnerable to contamination, so that it can provide a prompt reaction to solve the contamination of groundwater and prevent an impact on health of people living around the areas. Department of Groundwater Resources will notify the public to discontinue using groundwater contaminated with toxic substances exceeding the groundwater quality standard and the maximum acceptable concentration according to the groundwater quality standard for consumption.

1.6 Coastal Water

Coastal water quality problems are caused by wastewater released from various origins and human activities including houses, communities, Industries, agriculture and animal husbandry. The wastewater being discharged to water resources will affect the quality of coastal water. For instance, this can be seen from high nutrients and low dissolved oxygen found in the marine water at the estuaries of rivers and canals which receive water released from rivers and canals. As well, the impact can also be seen from extremely high values of Total Coliform Bacteria found at the estuaries of rivers and canals as well as certain tourist beaches where communities are densely located.

In 2010, Pollution Control Department examined the coastal water quality across the country twice. The first time was carried out during April – June and the second time during August – October with a total sampling stations of 198 and 240 respectively. Assessed by the Marine Water Quality Index³, the coastal water qualities were in excellent, good, fair, deteriorated and highly deteriorated conditions, representing 8%, 47%, 34%, 6% and 5% respectively (Figure 28).

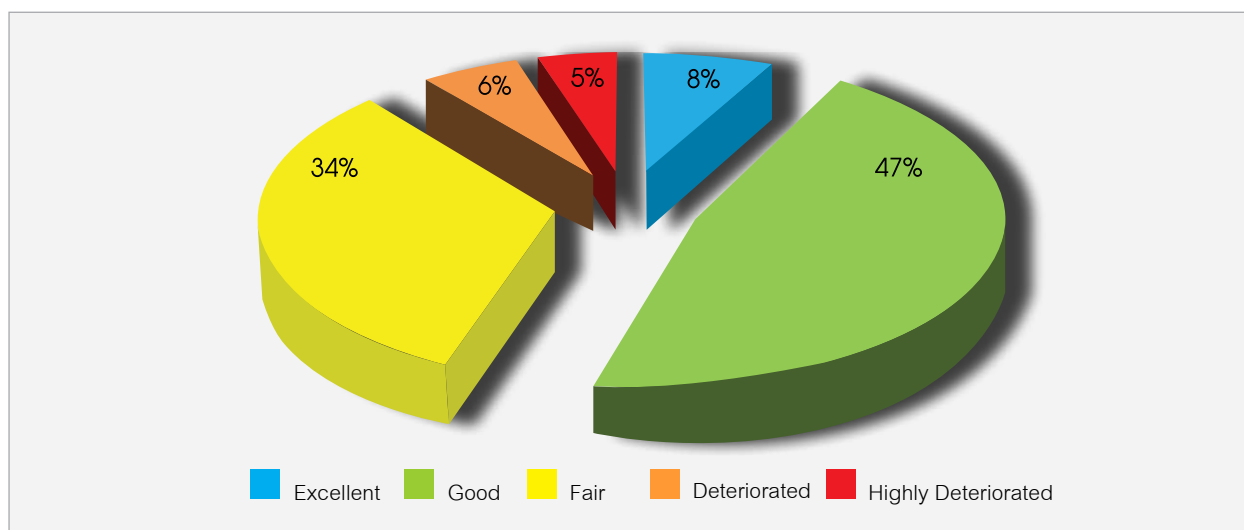


Figure 28 : Proportion of Coastal Water Quality

Highly deteriorated water quality was found in the inner Gulf of Thailand at the estuaries of 4 major rivers (Chao Phraya, Tha Chin, Mae Klong and Bang Pakong) and nearby areas including Chon Buri Bay, Chon Buri, estuary of Ban Laem Canal, Petchaburi (Figure 29 and Table 16). Detected water quality problems were low Dissolved Oxygen in marine water, extremely high values of nutrients (Ammonia, Nitrate and Phosphate) and Total Coliform Bacteria. Areas with deteriorated water quality were estuaries of other rivers, estuaries of canals and certain tourist beaches. Major detected problem was high Total Coliform Bacteria value.

³ Marine Water Quality Index (MWQI) is a tool developed by Pollution Control Department for assessing the total marine water quality. The MWQI values range between 0-100. Assessment is based on information of 8 marine quality parameters which are Dissolved Oxygen (DO), Total Coliform Bacteria (TCB), Phosphate-Phosphorus ($\text{PO}_4\text{-P}$), Nitrate-Nitrogen ($\text{NO}_3\text{-N}$), Temperature (Temp.), Suspension (SS), Acidity-Alkalinity (pH), Ammonia-Nitrogen ($\text{NH}_3\text{-N}$). However, for pesticide and toxic elements such as Mercury (Hg), Cadmium (Cd), Total Chromium (Total Cr), Hexavalent Chromium (Cr^{6+}), Lead (Pb), Copper (Cu), Cyanide (CN) and PCBs, if concentration values exceed the marine water quality standard, the MWQI will promptly become "0".

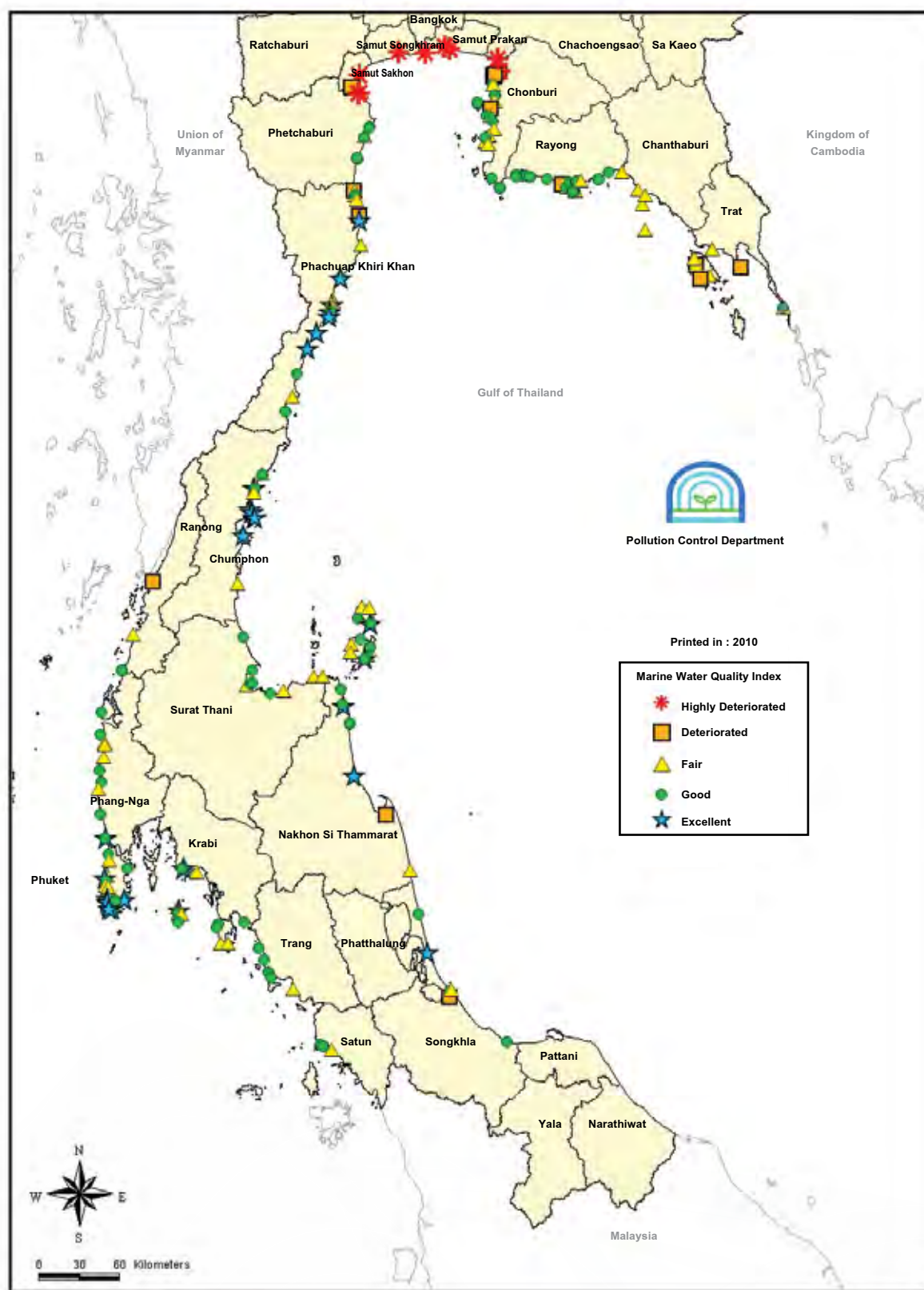


Figure 29 : Assessment Results of Marine Water Quality Index throughout Thailand in 2010

Table 16: State of Coastal Water Quality

Marine Water Quality Index	Inner Gulf of Thailand	Eastern Coast of Gulf of Thailand	Western Coast of Gulf of Thailand	Andaman Coast
 Excellent (>90-100)	None	None	Prachuab Khiri Khan estuary of Pranburi River (in front of Evason Resort) (10)⁺, estuary of Bang Nangrom Canal (Prachuab Bay) (10)⁺, Manao Bay, Kong Bin 53 (10)⁺, Wanakorn Beach, Thab Sakae District (10)⁺ Chumphon Ban Saplee, Saplee Bay (10)⁺, estuary of Chumphon River, Pak Had Bay (500)⁺⁺⁺, Paradornpap Beach (500)⁺, Middle Sai Ri Beach (500)⁺ Surat Thani Ban Hua Thanon (Bang Nam Jeud Bay), Samui Island (10)⁺⁺, Had Rin Bay, Pa Ngan Island (10)⁺⁺ Nakhon Si Thammarat Nai Plao Beach Sichon District (10)⁺⁺	Phang Nga Ban Khao Pilai (10)⁺ Phuket Karon Beach (in front of Phuket Arcadia) (10), Kata Noi Beach (in front of Kata Thani) (10), Naihan Beach (central) (10)⁺, estuary of Tha Chin Canal, Ban Koh Sireh (500)⁺ Krabi Loh Bakao Bay, Phi Phi (east) (10), Yao Beach, Phi Phi Island (South) (10), Maya Bay (100)
 Good (>80-90)	None	Trat Laem Ngob (500) Rayong Ban Nong Phaeb (100⁺, 500⁺), Fertilizer company (Map Ta Phut Port) (100), Sai Thong Beach (100, 500), Mae Rampeung Beach (central) (500), Rukkachat Park (10, 500), Samed Island (Sai Kaew Beach (500), Na Dan pier (10)⁺, Phai Bay (10, 100), Tabtim Bay (10, 100, Laem Mapim (10), Payoon Beach (500) Chon Buri Bangsaen (Ocean World) (10), Sichang (research station) (100), Thevawong pier (100), Phanurangsri pier (100), Hua Laem Chabang (100), Laem Chabang port (central) (100), Laem Chabang port (500), sailing club in Pattaya (500), Lan Island (Ta Waen Beach) (10, 500), Sattaheap port (100), Chong Samaesam (500), Chom Tien Beach (central) (500)	Phetchaburi Chao Samran Beach (10, 500), Peak Tien (500), Middle Cha-am Beach (Tourist Information Center) (500), Northern Cha-am Beach (in front of Long Beach Resort) (100) Prachuab Kiri Khan Hua Hin jetty (100), Beach around Sailom Hotel Hua Hin (500)⁺, Ban Bo Nok (100, 500), Central Prachuab Bay (100, 500), Manao Bay, Kong Bin 53 (500), estuary of Wan Canal (500), Ban Thung Pradoo (500), Ban Hinkrud (10), estuary of Bang Saphan (500)⁺ Chumphon Ban Na Thab, Bangson Bay (10, 500), Ban Saplee, Saplee Bay (500)⁺, Paradornphab Beach (10)⁺, Thung Wua Laen Beach (10), central Sai Ree Beach (10), Ban Bo Kha (Kho Bay), Sawee District, estuary of Sawee Canal (10)⁺, Ban Bo Kha	Ranong Prapas Beach (10, 100) Pang Nga Tai Mueng (10), Pakbang Canal (Khao Lak) (10), Ban Bangnieng (10), Ban Khao Pilai (500), Phra Thong Island (100)⁺, Ban Keuk Kak (10) Phuket Mai Khao Beach (10), Surin Beach (10), Kamala Beach (10), Patong (in front of Daimond Cliff) (10), Kata Yai Beach (South) (10), Rawai Beach (fisherman village) (100), Makhamb Bay (in front of Phuket Marine Fishing Station) (500), Bang Rong Bay (500), Krabi Nopparat Thara Beach (500)⁺, Lanta Island [Laem Tanoad (10), Ban Saladan (10)⁺, Loh Dalam Beach, Phi Phi Island (west) (10), Loh Dalam Beach, Phi Phi Island (500), Loh Dalam Beach (Phi Phi

Remark: (++) Indicates water resource where water quality improved by 1 level compared with 2009 (++) Indicates water resource where water quality improved by 2 levels compared with 2009

(-) Indicates water resource where water quality deteriorated by 1 level compared with 2009 (-) Indicates water resource where water quality deteriorated by 1 levels compared with 2009

10, 100 and 500 indicate the distance between the sampling station and the coast, measured in meter



Marine Water Quality Index	Inner Gulf of Thailand	Eastern Coast of Gulf of Thailand	Western Coast of Gulf of Thailand	Andaman Coast
 Fair (>50-80)	None		(Kho Bay) Sawee District (500) Surat Thani Samret Beach, Tha Chana District (10) ⁺ , estuary of Phum Riang Canal, Chaiya District (500), estuary of Tha Keoi Canal (oyster farm) (100, 500), River Market, Ban Mae Nam (10) ⁺ , Samul Island [(pier in front of District Hall (100) ⁺ , Chaweng noi Bay (10), Central Chaweng Bay (10, 500), Lamai Beach (500), Ban Hua Thanon (Bang Nam Jued Bay) (500), ferry pier (100)), Pa Ngan Island [(ferry pier (100), Had Rin Bay (500))] Nakhon Si Thammarat Kanom power plant in Kanom District (100) ⁺ , Sichon District, Nai Piao Beach (500), Hin Ngam Beach (10, 500), estuary of Tha Sung Canal, Tha Sala District (500) ⁺⁺ , Maharat Beach, Sathing Phra District (10), Thepa Beach (10) ⁺ , Samila Beach (10)	Cabana), Phi Phi Island under (PP2 Station) (10), Tonsai Beach [Tonsai Village, Phi Phi Island (south) (10) ⁻ , in front of Tonsai Village (500)], Yao Beach, Phi Phi Island (north) (10), Riley Bay (10), southern Klong Kwang Beach (Lanta Island) (10) Trang Ban Bor Muang (100), Pakmeng Beach (500), Chao Mai Beach (central) (10) ⁻ , Yao Beach (south) (10) ⁺ Satun Ban Pak Bara Beach (500), Pak Bara Port (100), Ban Thungnin (100) ⁺
		Trat Chang island [(Kai Bae Beach) (10) ⁻ , Klong Prao Beach (500) ⁻ , Sai Khao Beach (10) ⁻ , Salak Petch Bay (100) ⁻], Laem Ngob (10), Laem Ngob Port (100) ⁻ , estuary of Trat -Laem Sok River (Banpu) (500) ⁻ , estuary of Yai Canal (100 ⁻ , 500 ⁻) Chanthaburi Estuary of Prasae River (500), Kung Kraben Bay (500) ⁻ , estuary of Chanthaburi River (500) ⁻ , estuary of Weru River (500) ⁻ , Khung Kraben Beach (10) ⁻ , Rayong , estuary of Rayong River (500) ⁻ , Mae Rampeung Beach (10) ⁻ , fishery pier (Ban Pae Market) (100) ⁺ , Samed Island [Sai Kaew Beach (10) ⁻ , estuary of Klaeng Canal (500) ⁻ , Laem Mae Pim (500) ⁻ , Payoon Beach (10) ⁺	Pheichaburi Estuary of Ban Bangtapoon Canal (central) (500) ⁺ , estuary of Ban Laem Canal (north), oyster farm (500) ⁻ , Peak Tian Beach (10) ⁻ , central Cha-am Beach (Tourist Information Center) (10) ⁻ Prachuab Kiri Khan Beach around Klai Kangwon Palace, Sofitel Hotel (10), Sailom Hotel Beach, Hua Hin (10) ⁻⁻⁻ , Khao Takiab (10) ⁻⁻⁻ , estuary of Pranburi River (500) ⁻ , Sam Phraya Beach, Samroy Yod National Park (10) ⁻ , Northern Prachuab Bay in front of Khao Tamonglai (10), Southern Prachuab Bay (10) ⁻ , central Somboon Beach, Bang Saphan District (10) Chumphon estuary of Langsuan River (500) Surat Thani estuary of Tha Keoi, Tha Chang	Ranong Bangben Beach (100) ⁻ Pang Nga Bangsak Beach (10) ⁻ , Ban Thablamu, estuary of Thablamu Canal (100), Ban Koh Ko Khao (10) ⁻ , Ban Nam Khem (10) Phuket Naiyang Beach (10) ⁻ , Bang Thao Beach (10) ⁻ , Patong Beach [in front of Patong Merlin (10), in front of Patong Beach Hotel (10), in front of Patong Bay Hotel (10 ⁻ , 500 ⁻), Karon Beach (in front of Phuket Golden Sand Inn) (10) ⁻ , Rawai Beach (central) (10) ⁻ , Chalong Bay (central) (10) ⁻ Krabi Nopparat Thara Beach (10), Nopparat Thara Beach (estuary of Haeng Canal) (100) ⁻ , Laem Tong, Phi Phi Island (10) ⁻ ,





Marine Water Quality Index	Inner Gulf of Thailand	Eastern Coast of Gulf of Thailand	Western Coast of Gulf of Thailand	Andaman Coast
 Deteriorated (>25-50)		Chon Buri Ang Sila (oyster farm) (500) --, Bangsaen (Ocean World) (100) --, Bang Phra (100, 500), Sriracha (Loi Island), Udon Bay (Saphan Pla) (100, 500), Na Klua Market (100) **, sailing club in Pattaya (10), North Pattaya (Grand Palace Hotel) (10), South Pattaya (Pakklong) (10), Jomtien Beach (central) (10) --	District (500), estuary of Tapee River, Ban Don Bay (central) (500), Kanchanadit District [(Northern Kradae Canal (500) --, Central Kradae Canal (500), Southern Kradae Canal (500) --], estuary of Don Sak Canal (500) --, ferry pier (Don Sak-Mai) (10), Lamai Beach, Samui Island (10) --, Saphan Pla, Pa Ngan Island (10) --, Thong Tapan Bay (10) Nakhon Si Thammarat estuary of Pak Panang River (500) *, Ban Pakklong, Huasai District (100) ++ Songkla estuary of Songkla Lake (500), Samila (500) --	Ban Klongnin (Lanta Island) (10) --, Ban Sri Raya Community Beach (100) -- Trang Samran Beach (central) (10) Satun Ban Pakbang (10)
	None	Trat Chang Island [Klong Prao Beach (10) --, Bang Bao Bay (100) --], Laem Sok (10) -- Chanthaburi estuary of Pangrad (500) --, Chon Buri Chon Buri Bay (500) *, Chon Buri Bay (oyster farm) (100) --, Ang Sila (500) --, Ang Sila [Port (100) --, oyster farm (100), --], Sriracha (Loi Island) (100) --, Laem Chabang port (end) (100)	Petchaburi Estuary of Ban Bangtaboon Canal [(north (500), south (500)), estuary of Pranburi River (Khao Kalok area) (10) --	Ranong Chandamri Beach, estuary of Ranong (100)
 Highly Deteriorated (0-25)	Chachoengsao Estuary of Bang Pakong River (500) Samut Prakan Estuary of 12 Thanwa Canal (100), in front of dyeing factory, km.35 (100), estuary of Chao Phraya River (500) Bangkok Bang Khun Thien (100) Samut Sakhon Estuary of Tha Chin River (500) Samut Songkram Estuary of Mae Klong River (500)	Chon Buri Chon Buri Bay (100), Chon Buri (oyster farm) (500) --	Petchaburi estuary of Ban Laem Canal [(central (500) --, south (500) --]	None

The state of coastal water quality in the past 3 years :

During 2008 – 2010, the coastal water quality tended to deteriorate from 2008 (Figure 30). The proportions of excellent water quality and good water quality dropped from 16% and 48% in 2008 to 8% and 47% respectively. Meanwhile, the proportions of fair water quality increased from 29% in 2008 to 34% in 2010.

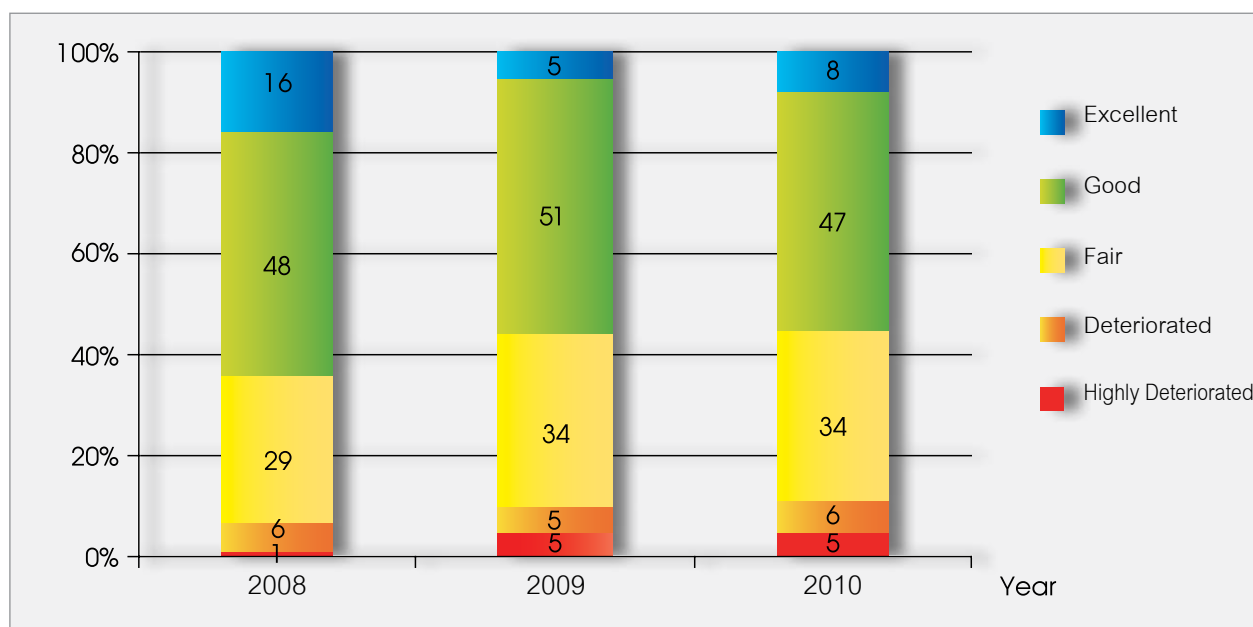


Figure 30 : Coastal Water Quality Trend during 2008 – 2010

According to the state of coastal marine quality data assessed by the Marine Water Quality Index, it can be concluded that the releases of wastewater from various activities and origins (houses, communities, industries, agriculture and animal husbandry) into water resources also had impacts on the coastal water quality. This can be seen from the detection of high nutrients and low dissolved oxygen in the marine water at the estuaries of rivers and canals which receive water released from rivers and canals. As well, the impact can also be seen from extremely high values of Total Coliform Bacteria found at the estuaries of rivers and canals where communities are densely located as well as certain tourist beaches. Most problems were found in the inner Gulf of Thailand at the estuaries of 4 major rivers and nearby areas which received influence from these major rivers. Other areas with less severe problems were other river and canal estuaries as well as certain crowded tourist beaches. When considering the coastal water quality change trend, it was found that the water quality tended to deteriorate with a decline in the proportions of excellent and good water levels. Meanwhile, the proportions of deteriorated water quality distinctly increased partly as a result of nutrients, sediments, polluted floodwaters being discharged into the sea during October to December 2010. Therefore, related agencies must take immediate actions to reduce the impacts from the wastewater quality problems released from various sources such as residences, communities, industries and human activities including agriculture and animal husbandry which affect the coastal water quality. These agencies need to together set up policies and plans to solve the problems.



1.7 Acidity-Alkalinity of Rainwater

The acidity of the rainwater is caused by the air pollutions such as sulfur dioxide or nitrogen oxide which acidify the rain (the pH of natural rainwater is 5.6). These pollutions may occur in the area or be carried from sources outside the area.

The monitoring of rain quality in Thailand was conducted under the Acid Deposition Monitoring Network in Thailand in collaboration with various agencies including Pollution Control Department, Department of Environmental Quality Promotion, Meteorological Department, Electricity Generating Authority of Thailand and universities in each region in 10 provinces, namely Bangkok (Pollution Control Department and Meteorological Department areas⁴), Pathum Thani⁵, Kanchanaburi⁶, Chiang Mai, Nakhon Ratchasima, Chainat, Nakhon Pathom, Chon Buri, Songkla⁷ and Rayong.

The monitoring results showed that the average annual acidity-alkalinity (pH) values of the rainwater⁸ were in the range of 4.50 – 6.23. Areas in which the average annual pH value was lower than that of natural rainwater⁹ were Bangkok, Pathum Thani, Nakhon Ratchasima, Chon Buri and Rayong. The highest average acidity value was found in Chon Buri at 4.50. The rain quality in the last eight years (2003 – 2010) had the average annual pH values in the range of 4.30 – 7.10 (Figure 31).

⁴Monitoring data obtained from Thai Meteorological Department area, conducted by Thai Meteorological Department

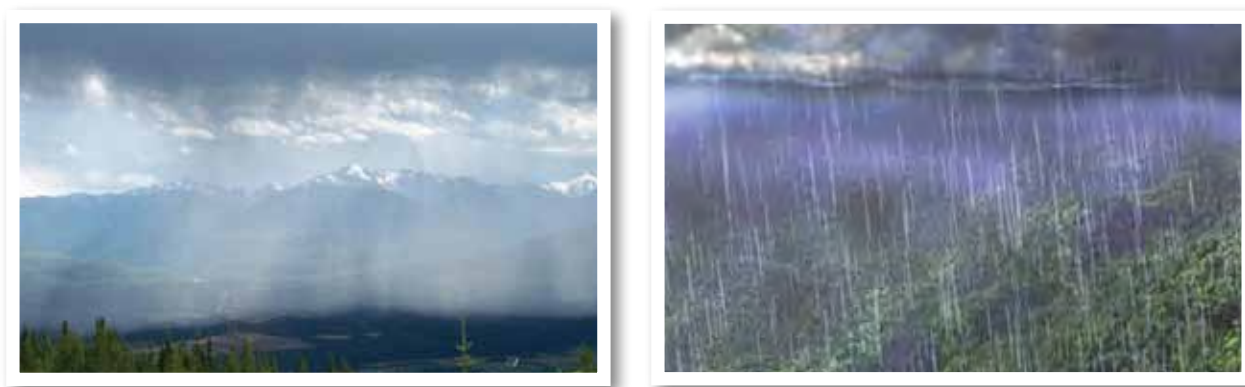
⁵Monitoring data obtained in Pathum Thani, conducted by the Environmental Research and Training Center, Department of Environmental Quality Promotion

⁶Rain quality monitoring in Kanchanaburi as a reference area due to its cleanliness and far location from major pollution sources

⁷Monitoring data obtained in Chiang Mai, Nakhon Ratchasima, Chainat, Nakhon Pathom, Chon Buri and Songkhla, conducted by universities hired from the Acid Deposition Monitoring in Thailand Project. Data from Nakhon Ratchasima, Chon Buri and Songkla were collected during January – September while data from Chainat and Nakhon Pathom were collected during January – October and data from Rayon were collected during June – October.

⁸Average annual pH value obtained by measuring hydrogen ion concentrations in accumulated annual rainfall using annual rainfall

⁹pH value of natural rainwater is 5.6 as carbonic acid forms when carbon dioxide dissolves in rainwater



The acid deposition problem is a boundless pollution problem. Sulfur oxide and nitrogen oxide that are released to the atmosphere from one country may cause acid substance in the atmosphere of another country or many other countries situated thousands of kilometers away. Therefore, measures to prevent and control acid deposition must not only be carried out in each country, but also as network cooperation among countries in the region in order to achieve successful results. Pollution Control Department, as the Focal Point agency of Thailand, has subsequently coordinated an international cooperation in conducting the Acid Deposition Monitoring Network in East Asia (EANET). EANET is comprised of 13 member countries which are China, South Korea, Mongolia, Russia, Vietnam, Malaysia, Indonesia, Philippines, Thailand, Cambodia, Laos and Burma. The network is aimed at monitoring the state of acid deposition in order to create a sustainable solution to the acid deposition problem.

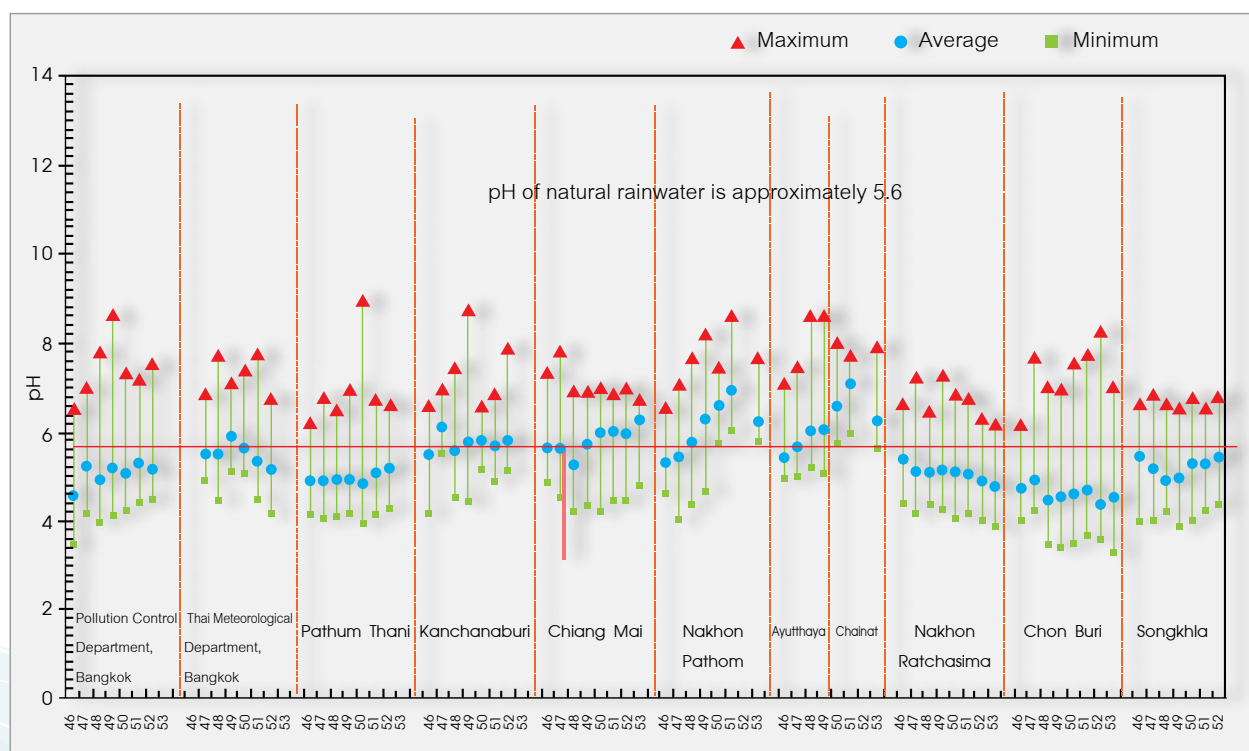


Figure 31 : Acidity-Alkalinity Value (pH) of Rainwater in Various Areas throughout Thailand during 2003-2010



1.8 Solid Waste¹⁰

Solid waste that remains in the environment or piles up without being properly disposed of will have an impact on the environment and public health. That is, the solid waste piles will become breeding sites for animals that are disease carriers (Leptospirosis, digestive system diseases) such as rats, cockroaches and flies. Moisture and organic substance in food scraps can as well cause the bacteria to spread, resulting in foul odor and nuisance to the public. Additionally, solid waste is a major cause of water and air pollutions. Particulate matter from the collection, transportation and open burning of waste can affect the air quality. Dirtiness, germs and toxic substances from the solid waste that has not been properly collected or disposed of can be carried into water sources by rainwater.

In 2010, Thailand generated 15.16 million tons of solid waste or 41,532 tons/day. Bangkok Metropolitan Administration (BMA) generated about 8,766 tons/day, representing 21% of the total waste. Municipalities and Pattaya generated about 16,620 tons/day, representing 40% of the total waste. Subdistrict Administrative Organizations generated about 16,146 tons/day, making up 39% of the total waste. When compared with the previous year, the amount of waste increased from 2009 by only 0.3% (approximately 0.05 million tons). The amount of waste in municipal areas rose by 1.54%. Meanwhile, there was a drop of waste amount in Bangkok and the Subdistrict Administrative Organizations by 0.77% and 0.38% respectively. As many local administrations' status had been raised to municipalities, the amount of solid waste in the Subdistrict Administrative Organizations declined while the amount of waste in municipalities increased (Table 17, Figure 32 and Figure 33). Each person produced an average of 0.65 kilograms of waste per day.

Table 17 : Amount of Solid Waste during 2009 - 2010

Area	Amount of Waste				Increase/ Decrease (%)
	2009		2010		
	Tons/Day	%	Tons/Day	%	
Bangkok ⁽¹⁾	8,834	21	8,766	21	-0.77
Municipalities and Pattaya ⁽²⁾ (2,009 locations)	16,368	40	16,620	40	+1.54
Subdistrict Administrative Organizations ⁽²⁾ (5,767 locations)	16,208	39	16,146	39	-0.38
Total	41,410 Tons/Day		41,532 Tons/Day		+0.29

Remark : Numbers in brackets indicate the number of municipalities and Subdistrict Administrative Organizations as of 30 September, 2010

Source : (1) Bangkok's waste collection data collected from Department of Environment, BMA, February 2011

(2) Waste amount data of municipalities, Pattaya and Subdistrict Administrative Organizations. Estimated waste collection data by Pollution Control Department, February 2011

¹⁰ Waste or solid waste means wastepaper, clout, food scraps, waste products, waste materials, plastic bags, food containers, ashes, dung, carcasses or other things that are collected from streets, markets, animal farms or elsewhere. The definition also includes hazardous waste from communities or households, except unused materials of factories whose characteristics are determined by factory law.

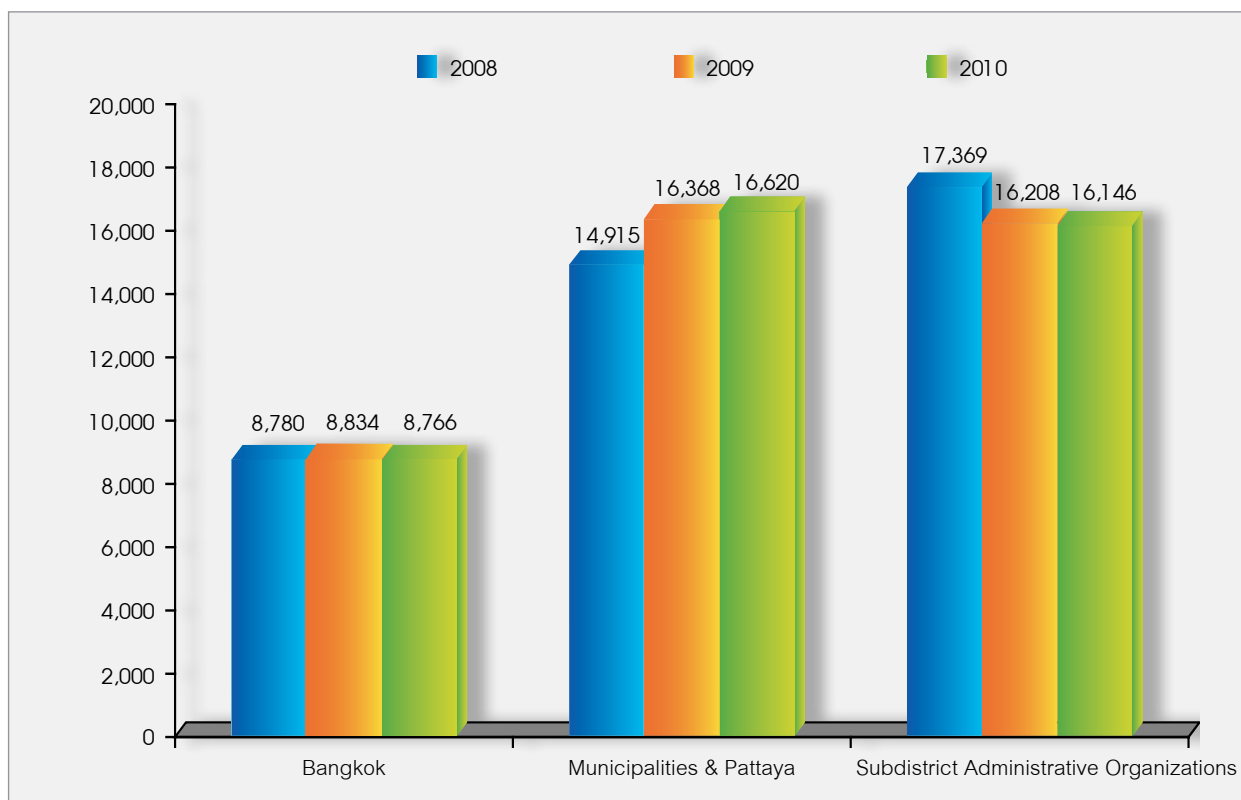


Figure 32 : Amount of Solid Waste during 2008 – 2010 by Administrations

Source : (1) Bangkok's waste collection data collected from Department of Environment, BMA, February 2011

(2) Waste amount data of municipalities, Pattaya and Subdistrict Administrative Organizations. Estimated waste collection data by Pollution Control Department, February 2011

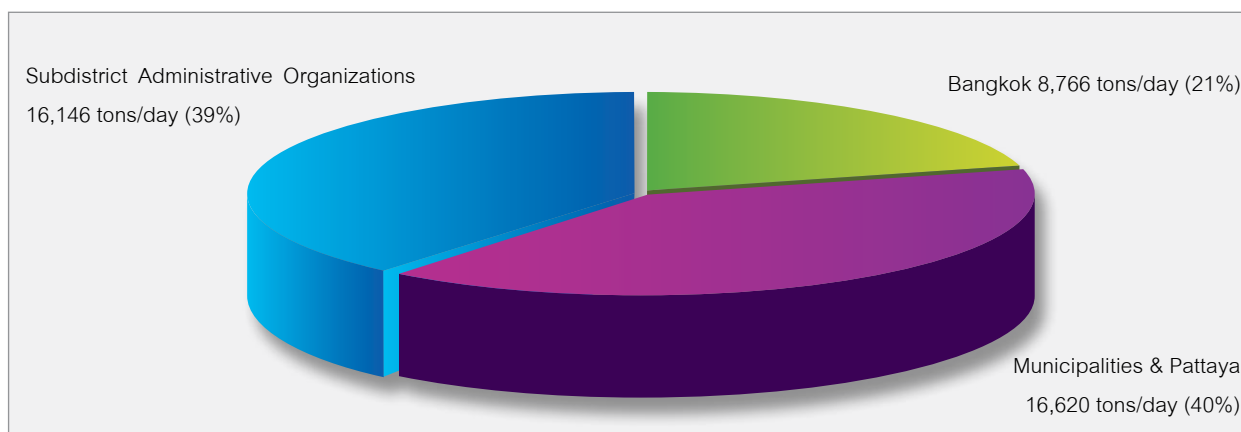


Figure 33 : Amount of Solid Waste in 2010 by Administrations

Source : (1) Bangkok's waste collection data collected from Department of Environment, BMA, February 2011

(2) Waste amount data of municipalities, Pattaya and Subdistrict Administrative Organizations. Estimated waste collection data by Pollution Control Department, February 2011

Northeast and Bangkok still produced the highest amount of waste at 11,430 and 8,766 tons/day, representing 28% and 21% of the total waste generated throughout the country. These were followed by North generating 6,524 tons/day, Central generating 5,312 tons/day, South generating 5,133 tons/day, East generating 2,623 tons/day and West generating 1,744 tons/day, representing 16%, 13%, 12%, 6% and 4% respectively (Figure 34).

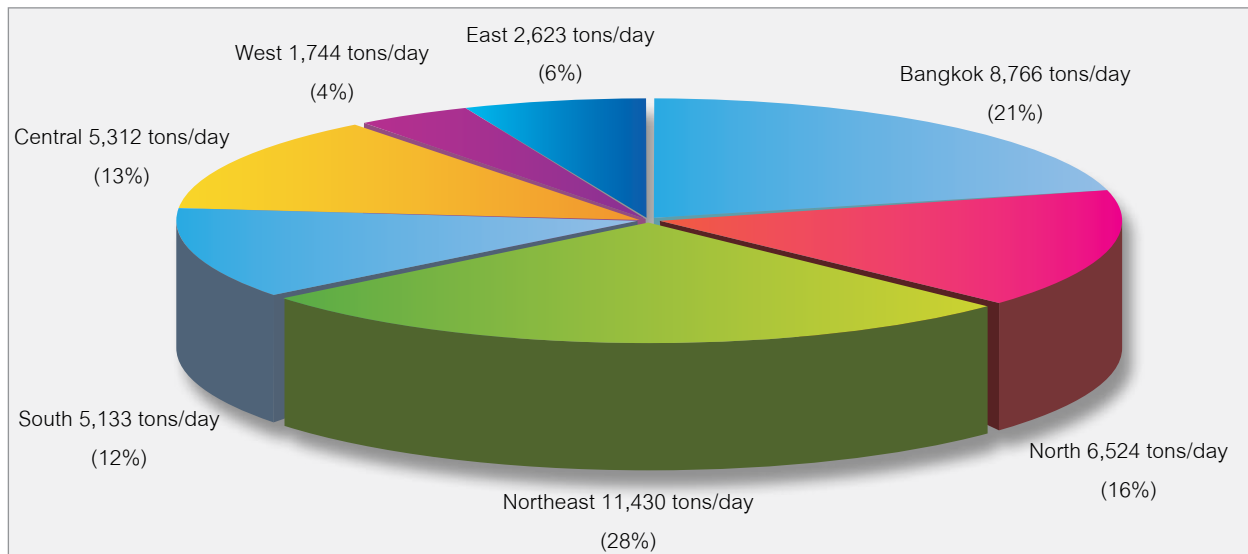


Figure 34 : Amount of Solid Waste in 2010 by Regions

Source : (1) Bangkok's waste collection data collected from Department of Environment, BMA, February 2011

(2) Waste amount data of municipalities, Pattaya and Subdistrict Administrative Organizations. Estimated waste collection data by Pollution Control Department, February 2011

Solid wastes of 5.77 million tons or 15,819 tons/day were properly managed, representing 38% of the total waste (Figure 35). BMA collected its own solid waste and granted a contract to the private sector to manage the disposal. In municipalities and Pattaya, about 5,643 tons/day of waste were managed, representing 34% of the total amount of waste in municipal areas. The Subdistrict Administrative Organizations properly managed only 1,410 tons/day, representing 9% of the total waste in the Subdistrict Administrative Organizations.

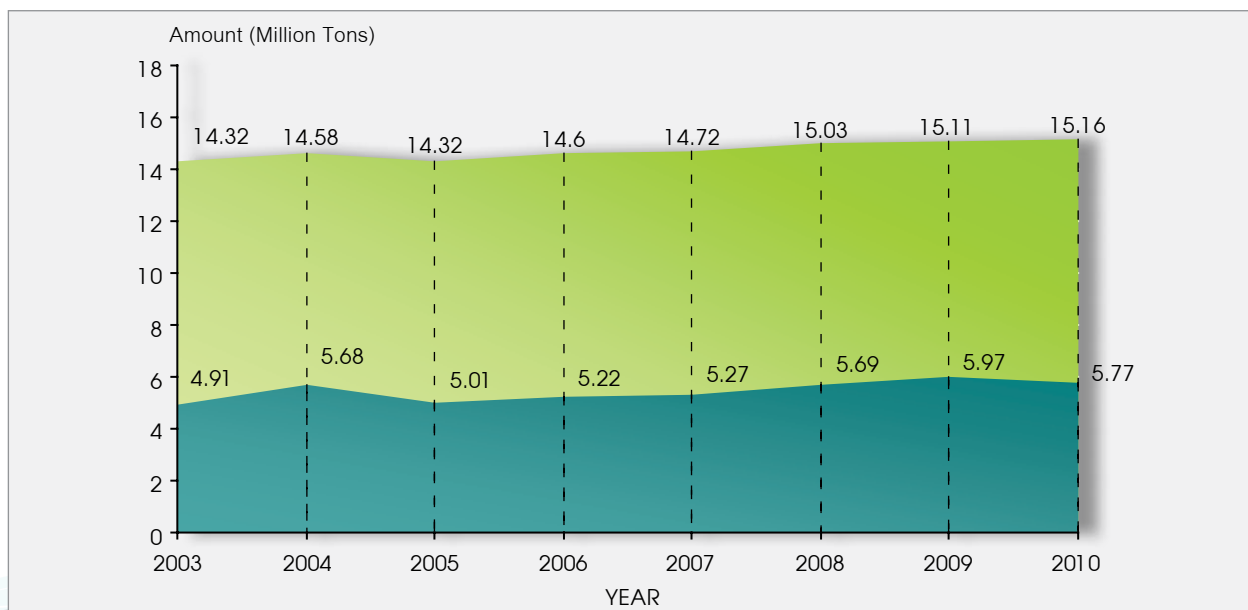


Figure 35 : Amount of Proper Solid Waste Management during 2003 – 2010

Source : (1) Bangkok's waste collection data collected from Department of Environment, BMA, February 2011

(2) Waste amount data of municipalities, Pattaya and Subdistrict Administrative Organizations. Estimated waste collection data by Pollution Control Department, February 2011

With an aim to promote proper waste management without affecting the environment and public health, Pollution Control Department, Environmental Regional Office and Provincial Office of Natural Resources and Environment, under Ministry of Natural Resources and Environment, have continuously supported the Local Administrative Organizations in solving the waste problems efficiently. In 2010, the operation to strengthen the management capacity of waste and hazardous substances was conducted in 94 communities in local administrative organizations at the municipality level nationwide. The operation received well collaboration from participating city municipalities. As a result, there were 90 municipalities that had developed efficient capacity in waste management in accordance with 4 standard criteria out of the total 6 criteria. Of these municipalities, there were 14 municipalities whose waste management capacity had met all 6 criteria. However, there were some complications in solving solid waste problem of local administrative organizations which required over one year of operation, particularly in rehabilitating the efficiency of management system. Therefore, continuous operations regarding this issue as well as the expansion of operations to other municipalities are required.

Assessment criteria for solid waste management capacity of local administrative organizations

- 1) Having action plans for solid waste management in place
- 2) Having activities to reduce, separate and utilize solid waste
- 3) Providing solid waste collection service covering all service areas
- 4) Operating a solid waste management in an integrated manner or sharing waste disposal facilities with nearby local administrative organizations
- 5) Having increased the capacity of solid waste management
- 6) Revenue from waste management increased

List of 14 municipalities participating in the solid waste management capacity building program and having waste managements that meet all the assessment criteria in 2010

1. Lampang City Municipality, Lampang
2. Khelang Nakhon Town Municipality, Lampang
3. Sukhothai Thani Town Municipality, Sukhothai
4. Phitsanulok City Municipality, Phitsanulok
5. Nan Town Municipality, Nan
6. Suphanburi Town Municipality, Suphanburi
7. Nong Khai Town Municipality, Nong Khai
8. Udon Thani City Municipality, Udon Thani
9. Warin Chamrap Town Municipality, Ubon Ratchathani
10. Khlung Town Municipality, Chanthaburi
11. Trat City Municipality, Trat
12. Songkhla City Municipality, Songkhla
13. Hatyai City Municipality, Songkhla
14. Kho Hong Town Municipality, Songkhla

Solid Waste in Bangkok Metropolitan Administration Area

Bangkok Metropolitan Administration was able to collect all 8,766 tons of waste/day generated within its area of responsibility and granted a contract to the private sector to manage the disposal. 63% of collected waste was sent to Nong Khaem and Sai Mai Transferring Stations and was disposed of at landfills in Kampaeng Saen District in Nakhon Pathom. The remaining 37% was sent to On-Nut Transferring Station where 5% was used to produce fertilizers and the other 32% was sent for disposal at landfills in Phanom Sarakham in Chachoengsao (Figure 36).

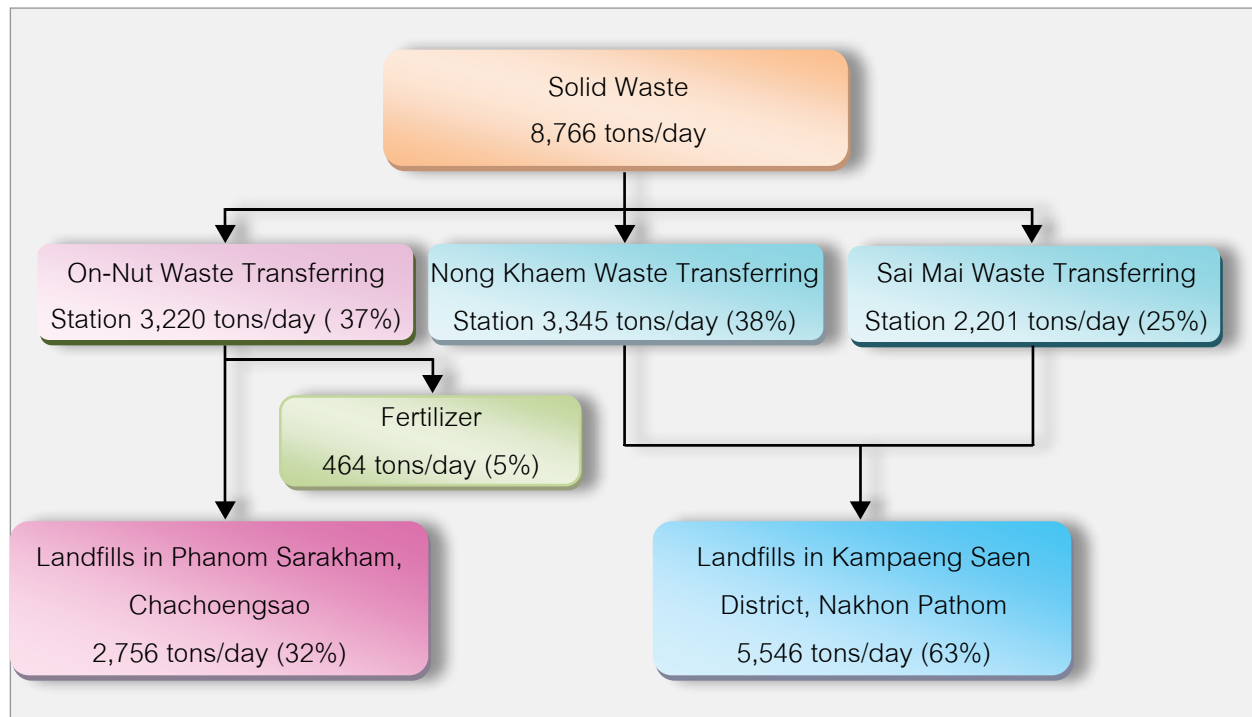


Figure 36 : Solid Waste Management in Bangkok in 2010

Source: Waste collection data, collected from Office of Environment, Bangkok Metropolitan Administration, February 2011.

Solid Waste in Municipalities and Pattaya areas

Municipalities and Pattaya sent approximately 16,620 tons of waste per day to be disposed of through the municipalities' waste disposal system that was designed and constructed according to academic principles. There were 99 systems in operation throughout the country out of the total constructed 117 systems (Table 2). Municipalities transferred 5,643 tons of waste per day to the disposal systems, representing 34% of the total amount of waste generated in municipal areas. In 2010, the number of proper waste management facilities in operation increased from 2009 by only 1 location. However, the proportion of properly managed waste decreased from the previous year by 4% as a result of an increased number of proper landfills halting operations from 5 locations in 2009 to 9 locations in 2010. As well, local administrative organizations in certain areas were not able to bear the costs of waste shipping and disposal which must be delivered to the proper waste disposal facilities. The operational status of waste disposal sites in 2010 (Table 18) can be concluded as follows.

- There were 110 sanitary landfill sites where constructions were completed and 94 of them were in operation. Most of them encountered problems with system operations and improper maintenance due to the lack of system expertise as well as the lack of maintenance and operation budgets. This resulted in the landfill system lacking of efficiency in waste disposal. There were another 10 landfill sites that were not able to operate the system as the waste reached the sites' full capacity or due to complaints. Another 6 landfill sites completed construction, but were not able to operate the system due to the unreadiness of local administrative organizations or public protest.
- There were 3 mixed systems in operation out of 4 locations, namely the system of Wiengphang Subdistrict Municipality in Chiang Mai, the system of Rayong City Municipality in Rayong and the system of Mae Sai Subdistrict Municipality in Chiang Rai. Meanwhile, the system of Chonburi Provincial Administrative Organization remained un-operated due to public protest.
- The incineration systems were in operation in 2 locations out of 3 locations, namely the incinerators of Phuket City Municipality in Phuket and Tao Island Subdistrict Administrative Organization in Surat Thani. Meanwhile, the incinerator of Samui Island Town Municipality in Surat Thani temporarily stopped operations for maintenance. The total number of incineration systems decreased because the incineration system of Lamphun Town Municipality in Lamphun was cancelled.

Table 18 : Properly Designed and Constructed Municipal Waste Treatment Plants

Type of Waste Disposal Type	Operation Status of Disposal Site that completed construction (Location)			
	In Operation	Operation Halted	Never in Operation	Total
Sanitary Landfill Sites	94	10	6	110
Mixed System	3 (Wiengphang Subdistrict Municipality, Chiang Mai, Rayong City Municipality, Mae Sai Municipality, Chiang Rai)	1 (Chon Buri Provincial Administrative Organization)	-	4
Incineration	2 (Phuket City Municipality, Tao Island Subdistrict Administrative Organization, Surat Thani)	1 (Samui Island Town Municipality, Surat Thani)	-	3
Total	99	12	6	117

Remark : Excluding 3 waste disposal sites in Bangkok, Lampang Municipality's disposal site which was operated by private sector and Incinerator on Phi Phi Island, Ao-Nang Subdistrict, Muang District, Krabi, because all systems were damaged by tsunami

Source : Collected by Pollution Control Department, November 2010

Solid Waste in Subdistrict Administrative Organizations

Subdistrict Administrative Organizations generated 16,146 tons of waste per day. Provincial and Subdistrict Administrative Organizations were responsible for waste collection and disposal, most of which had yet to develop proper waste collection systems and waste disposal sites in accordance with academic standards. Therefore, their methods of waste management were open burning or disposing in old ponds or other available sites. Only about 1,410 tons of wastes per day (9% of the total amount of waste generated in Subdistrict Administrative Organizations areas) were properly managed in collaboration with municipalities with proper disposal facilities.

1.9 Waste Utilization

Waste utilization

Of the country's total solid waste of 15.16 million tons, approximately 3.90 million tons of waste or 26% were utilized (Figure 37). Of the total utilized amount, about 3.198 million tons (82%) were recyclable waste, e.g. broken glasses, paper, plastic, steel and aluminum and had been reused and recycled through various activities. These activities included junk shops, community recycle center, recycle bank and the package recalling of entrepreneurs. The remaining 0.59 million tons (15%) of organic waste had been fermented to produce organic fertilizer, bio-fertilizer and biogas. About 0.117 million tons (3%) were used to generate electricity and alternative energy (Figure 38).

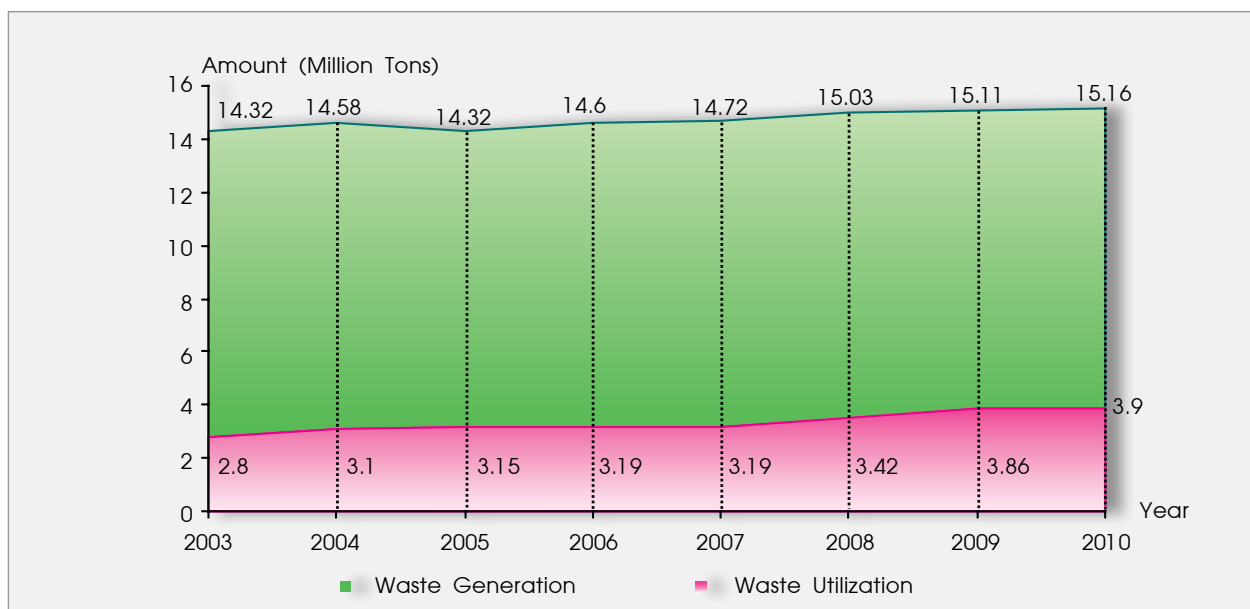


Figure 37 : Solid Waste Utilization during 2003 – 2010

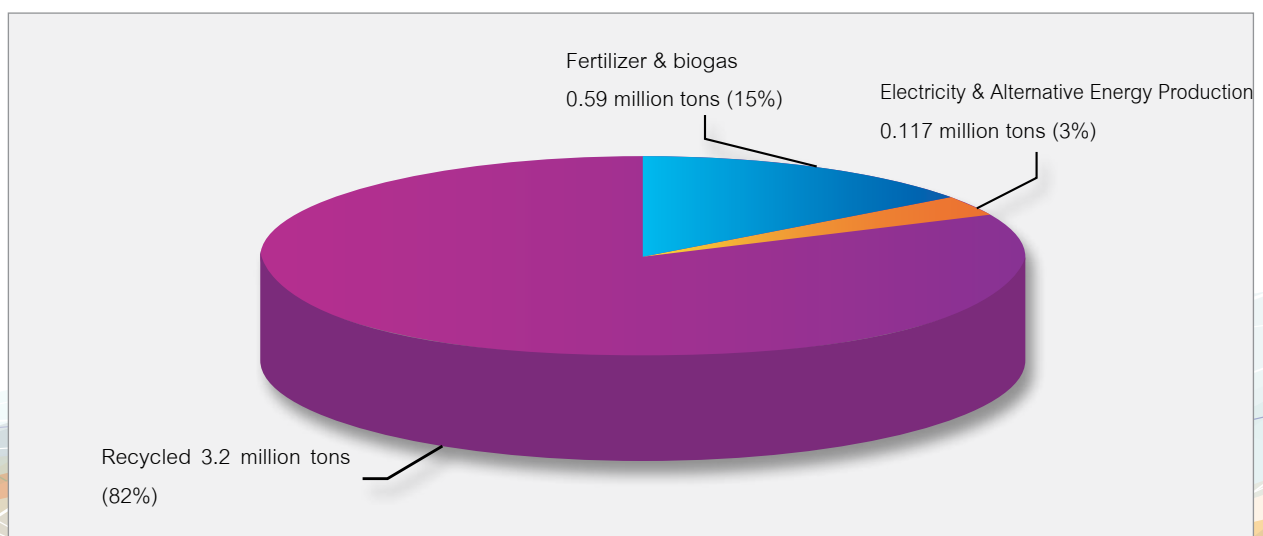


Figure 38 : Proportions of Solid Waste Utilization in 2010

Utilization of recyclable materials in the industrial sector

In 2010, there were approximately 12.76 million tons of recyclable industrial waste consisting of glass, paper, plastic, steel, aluminum and rubber. Of that, about 8.40 million tons or 66% were utilized through re-processing/reusing and used as fuel (Figure 39). When compared to 2009, the proportion of the utilization of recyclable industrial waste decreased by 1%.

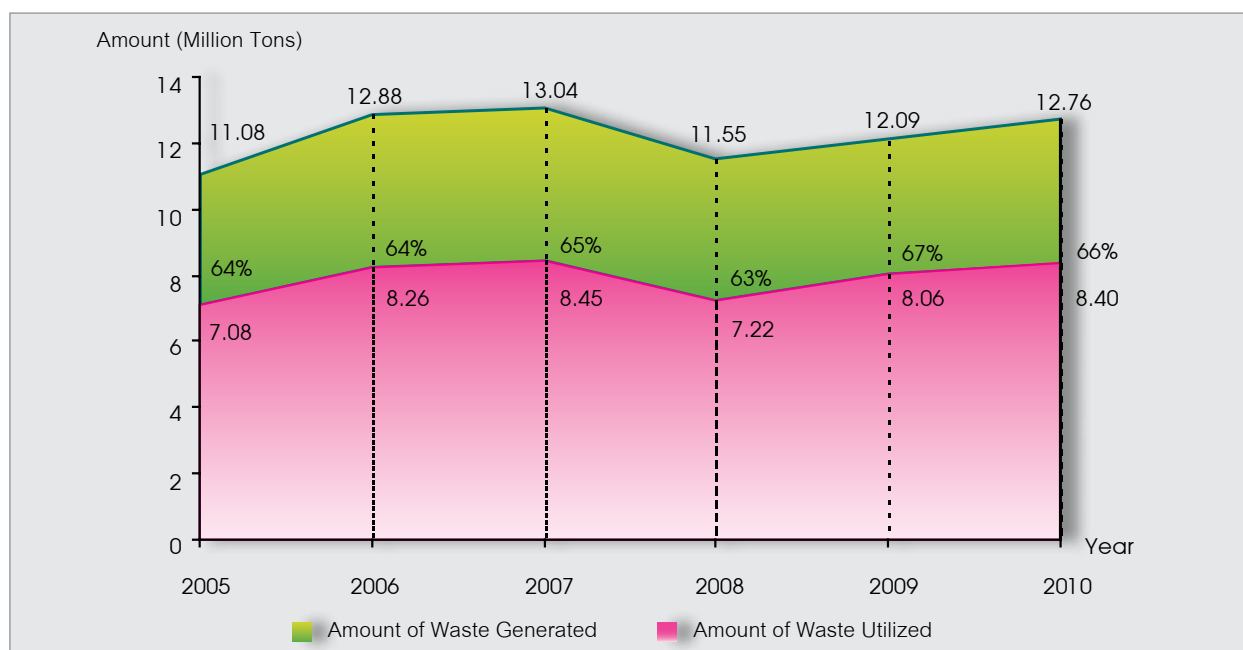


Figure 39 : Utilization of Recyclable Industrial Waste during 2005 – 2010

Source : Data from Glass and Glazing Federation, Thai Pulp and Paper Industries, Federation of Thai Industries, Thai Customs Department (www.customs.go.th), Office of Industrial Economics (www.oie.go.th), Siam Cement (Public Company Limited), Siam City Cement (Public Company Limited), February 2011

Of the total 8.40-million-ton utilized recyclable industrial waste, recyclable waste purchasing in community made up 38% or 3.198 million tons. The other 62% or 5.20 million tons were waste exchange system by the groups of manufacturers, importers or distributors, the package or product recall through the deposit-refund system. The proportion of the utilization of recyclable waste in each industry in the last 3 years showed that the steel industry had utilized 90% of the total steel waste through recycling, remaining the industry with the highest utilization of recyclable waste. This was followed by glass and aluminum industries, with utilization proportion of 76% and 71% respectively. The plastic and rubber industries had the lowest utilization of 28% and 36% of the total waste generated in each industry respectively. Among the utilized waste, about 18,500 tons or 3% of the total tire waste were burnt in cement incinerators to produce fuel. The only industry with an increase in recyclable waste utilization was the glass industry. Meanwhile, the proportions of waste utilization in other industries tended to remain stable or slightly decline from the previous year (Table 19 and Figure 40).

Table 19 : Amount of Recyclable Industrial Waste in 2010

Type	Amount of Waste Generated (Tons)	Amount of Waste Utilization				Approach
		Sell-Purchase in Community (Tons)	Sell-Purchase/ Exchange between Industries (Tons)	Total		
				Tons	%	
Glass	1,707,150	831,480	189,000	1,020,480	60	Recycle
			273,000	273,000	16	Reuse
Paper	3,834,350	991,380	1,176,000	2,167,380	57	Recycle
Plastic	1,831,750	351,780	155,000	506,780	28	Recycle
Steel	4,315,580	927,420	2,945,000	3,872,420	90	Recycle
Aluminum	469,300	95,940	239,000	334,940	71	Recycle
Rubber	601,800	-	121,000	121,000	20	Recycle
			81,000	81,000	13	Reuse
			18,500	18,500	3	Fuel
Total	12,759,930	3,198,000	5,197,500	8,395,500	66	

Source : Data from Thai Pulp and Paper Industries, Federation of Thai Industries, Thai Customs Department (www.customs.go.th), Office of Industrial Economics (www.oie.go.th), Siam Cement (Public Company Limited), Siam City Cement (Public Company Limited), February 2011

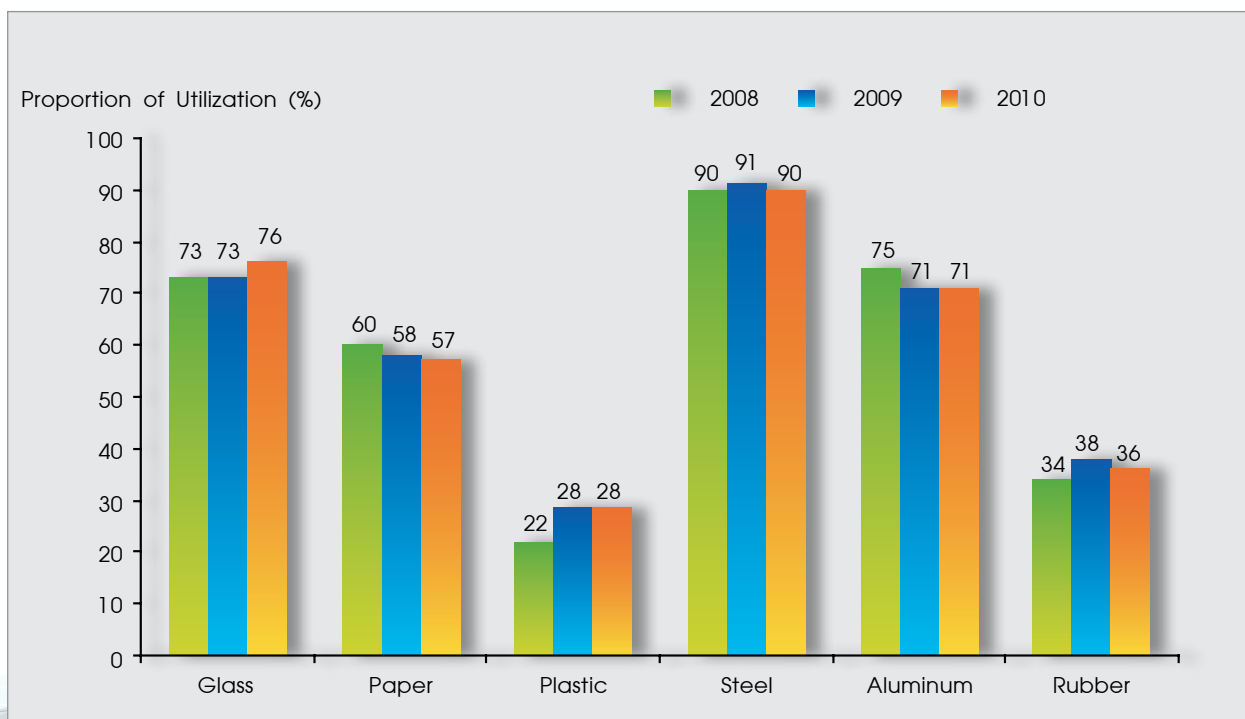


Figure 40 : Proportions of Recyclable Industrial Waste Utilization during 2008 – 2010

Source : Data from Thai Pulp and Paper Industries, Federation of Thai Industries, Thai Customs Department (www.customs.go.th), Office of Industrial Economics (www.oie.go.th), Siam Cement (Public Company Limited), Siam City Cement (Public Company Limited), February 2011

3Rs and cooperation from various sectors

3Rs (Reduce Reuse Recycle): Reducing, reusing, separating and recycling waste are the utilization of waste which helps to reduce the amount of waste. In the public-private partnership which included entrepreneurs, consumers, central public sector and local administrative organizations, the waste reduction, categorization and utilization projects carried out in 2010 were successful through collaboration from many sectors. Examples of activities are as follows.

Green Junk Shop Project: Pollution Control Department promoted and supported the junk shops to develop a good management system that does not cause any impacts on the environment and people living nearby. The Department also praised the junk shops that had set up a good management system for the public which was “a new generation of junk shop that is clean, safe and eco-friendly.” There were 4 assessment criteria as follows: 1) Location, surroundings, building and sanitation 2) Occupational health and safety 3) Operation and 4) Environment. There were 381 junk shops participating in the project nationwide. Of the total, 129 junk shops or 34% met the assessment criteria.

Reduce Reuse Recycle (3Rs) Project: Pollution Control Department in collaboration with Department of Environmental Quality Promotion, local administrative organizations and citizens residing in Songkhla Lake basin areas (Nakhon Si Thammarat, Songkhla and Phatthalung) conducted activities aimed at reducing, categorizing and utilizing solid waste. These activities included making biologically fermented products, using organic waste as animal feed and categorizing waste from junk shops. The project was able to categorize and utilize 31.53% of the total recyclable waste.

Recycling for Earth Project: Thai Beverage Carton Group conducted a campaign to collect used beverage cartons through various networks including educational institutions, public agencies, temples, communities and houses. The project was able to collect and recycle 103,548 kilograms of used beverage cartons, helping to reduce the size of landfills by 414 square meters as well as reduce 93,193 kilograms of carbon dioxide.

Recycled Materials Management Project: Thailand Institute of Packaging and Recycling Management for Sustainable Environment carried out the project at universities, municipalities, communities, recycled materials center for garbage collectors, categorization of recycled materials in housing projects. The project was able to collect 2,134,127 kilograms of recycled materials.

Green Roof Project for Princess Pa Foundation: Tetra Pak (Thailand) Limited in collaboration with Big C Supercenter Public Company Limited with support from Beverage Recycling Center by Fiber Pattana Company Limited and Department of Environmental Quality Promotion collected used beverage cartons to be turned into rooftops with an aim to help support flood victims and those lacking opportunities. The project's goal is to amass 40 tons or 4 million beverage cartons to produce approximately 2,000 green rooftops.

Used Packages Recall Project: Oishi Group Public Company Limited was able to recall 35 tons of used packages through consumer campaigns. These packages, divided into 21 tons of UHT cartons and 14 tons of plastic caps, were then sold to Wongpanit Company Limited. The money from selling used packages was donated to charities.

1.10 Hazardous Waste

Disposal of hazardous waste, such as dead batteries, cell phone batteries, fluorescent lamps, aerosol spray cans as well as infectious wastes that are mixed with general wastes, may cause toxic contaminations of the environment, affecting the qualities of soil, groundwater and various ecological systems. As a result, Pollution Control Department has conducted a project supporting local administrative organizations in preparing a management system for household hazardous waste and in preparing a strategy to manage waste from electrical and electronic equipment. It also supports the establishment of mechanism in recalling waste from electrical and electronic equipment so that the waste can be managed properly.

Thailand generated approximately 3.16 million tons of hazardous waste in 2010, increasing by only 2.9% from 2009. About 77% of hazardous wastes or 2.44 million tons were generated by the industrial sector and 23% or 0.72 million tons originated from households (including waste from electrical and electronic equipment and infectious waste). Eastern region, Bangkok and its vicinity remained the areas that generated hazardous waste the most, representing 72% of the total hazardous waste throughout the country (Table 20 and Figure 41).

Table 20 : Amount of Hazardous Waste by Sources and Regions during 2009 - 2010

Region	2009 (Million Tons)			2010 (Million Tons)			
	Industry	Household	Total	Industry	Household	Total	%
Bangkok and vicinity	0.4682	0.2666	0.7348	0.5684	0.2726	0.8410	26.6
Central	0.4546	0.0901	0.5447	0.4266	0.0934	0.5200	16.5
Eastern	1.3668	0.0590	1.4258	1.3628	0.0610	1.4238	45.1
Northeastern	0.0254	0.1250	0.1504	0.0327	0.1286	0.1613	5.1
Northern	0.0421	0.0648	0.1069	0.0372	0.0659	0.1031	3.3
Southern	0.0127	0.0930	0.1057	0.0130	0.0962	0.1092	3.4
Total	2.3698	0.6985	3.0683	2.4408	0.7177	3.1585	100

Source : 1. Estimated from the data on the quantity of hazardous waste generated by industries with permits to remove waste from factory premises. Proportions were calculated by region from the data on requests for permission to remove waste and used materials from factory premises (Sor Kor.2), assessed in 2007, Department of Industrial Works, 2010.

2. Data of household hazardous waste, estimated by Pollution Control Department, 2010

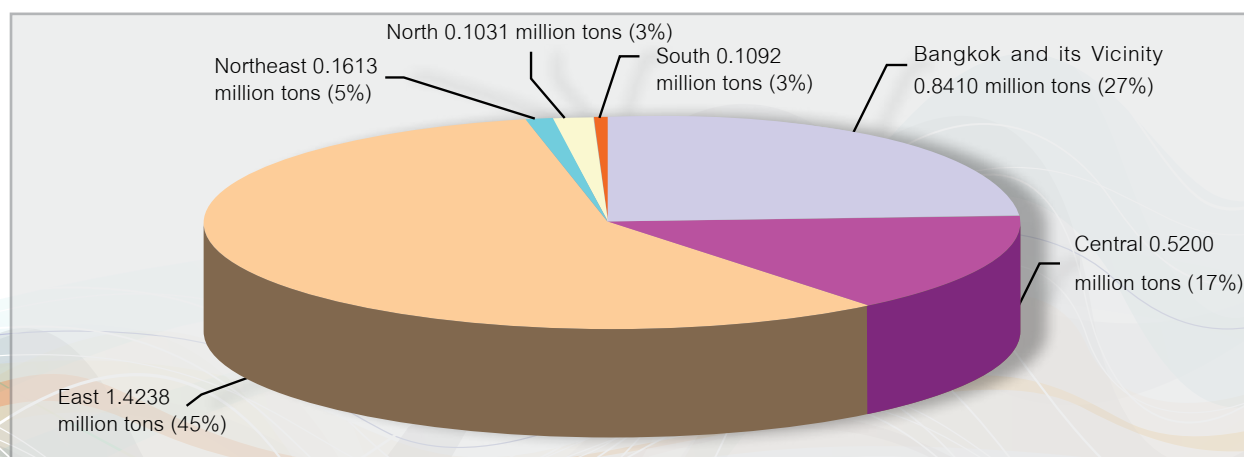


Figure 41 : Amount of Hazardous Waste in 2010 by Regions

Household hazardous waste

There were approximately 717,577 tons of household hazardous waste, increasing from 2009 (698,506 tons) by 2.7% or 19,071 tons. Of the total, a majority or about 341,989 tons (47.66%) were the Waste from Electrical and Electronic Equipment (WEEE), 40,785 tons (5.68%) were infectious waste and 334,803 tons (46.66%) were other household hazardous waste. Bangkok and vicinity generated the highest amount of household hazardous waste at 38% (Figure 42).

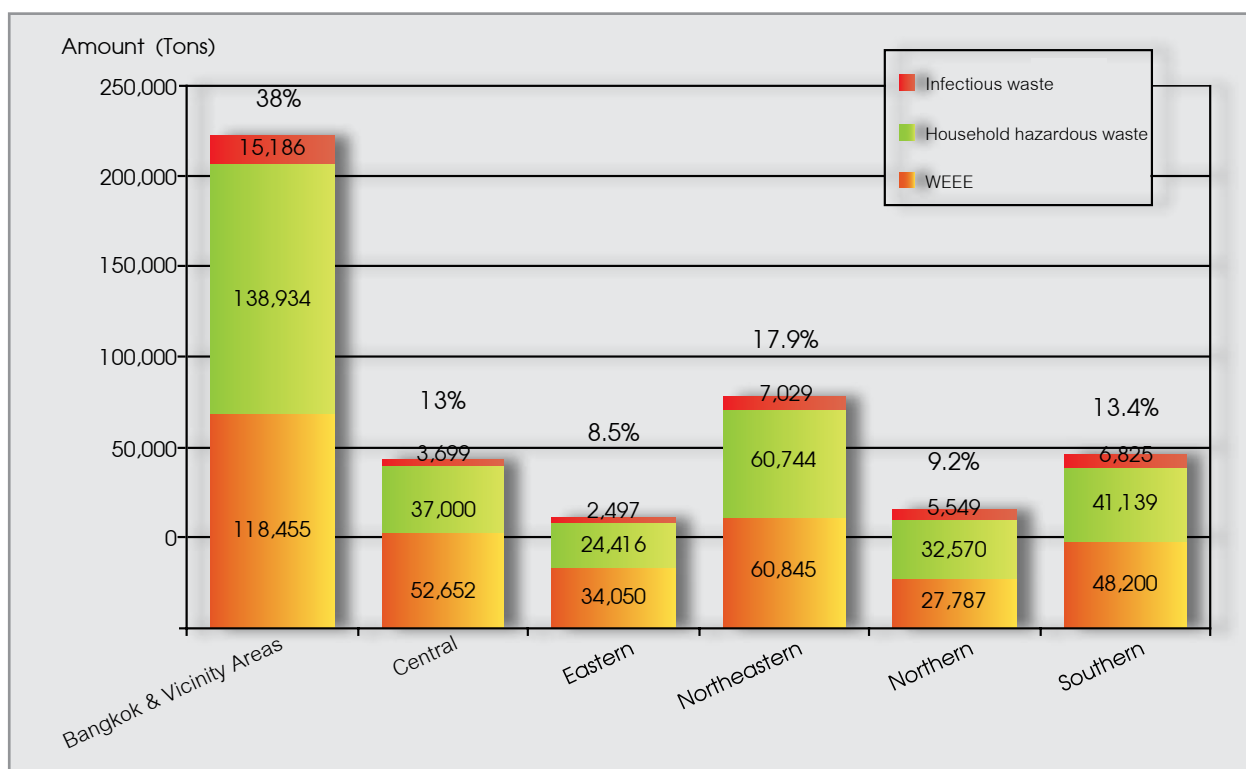


Figure 42 : Type and Amount of Household Hazardous Waste in 2010 by Regions

The management of household hazardous waste was a primary responsibility of Local Administrative Organization in accordance with the Public Health Act B.E. 2535 (1992) and B.E. 2550 (2007) (No. 2) which authorized Local Administrative Organizations to manage solid waste in the communities as well as household hazardous waste. However, at present, there were only Bangkok and 26 Local Administrative Organizations at municipality level (17 City Municipalities and 9 Town Municipalities) having the household hazardous waste collection system in place and transferring waste to be disposed of at legal industrial hazardous waste disposal facilities. Meanwhile, over 7,700 Local Administrative Organizations had not had proper household hazardous waste management system. Household hazardous waste was still disposed of along with general solid waste in waste disposal sites of Local Administrative Organizations. These sites were not designed to prevent the contamination of hazardous substances in the hazardous waste from endangering the environment.

In regard to the management of Waste Electrical and Electronic Equipment, which is a type of household hazardous waste, Pollution Control Department is in the study process of drafting subordinate legislation under Ministry of Finance's Proposed Act of Economic Instruments for Environmental Management B.E., which later was changed to the Proposed Act of Fiscal Measures for Environment B.E. Measures, conditions and fees as well as criteria, measures and conditions for the management of used equipment collection or acceptance system under Royal Decree. Equipment types are determined under Notification of Ministry. Major principles of the Proposed Act include collection of fees from manufacturers and importers

of equipment for the fund with objective to redeem waste equipment as well as the storage, transportation, treatment and disposal of waste equipment which have been collected for proper management.

Local Administrative Organizations or hospitals generating infectious waste were obliged to manage their own waste in accordance with the ministerial regulation on the infectious waste disposal B.E.2545 (2002). Most infectious waste was disposed by incineration through 470 hospitals' waste incinerators, 12 infectious waste incinerators owned by Local Administrative Organizations throughout the country and 4 private incinerators.

Industrial hazardous waste²

Approximately 2.4408 million tons of industrial hazardous waste were generated in 2010. Eastern region remained the area that generated the highest amount of industrial hazardous waste of 1.3628 million tons (55.8%), followed by Bangkok and its vicinity and the central region which generated 0.5684 million tons (23.3%) and 0.4266 million tons (17.5%) of industrial hazardous waste respectively (Figure 43).

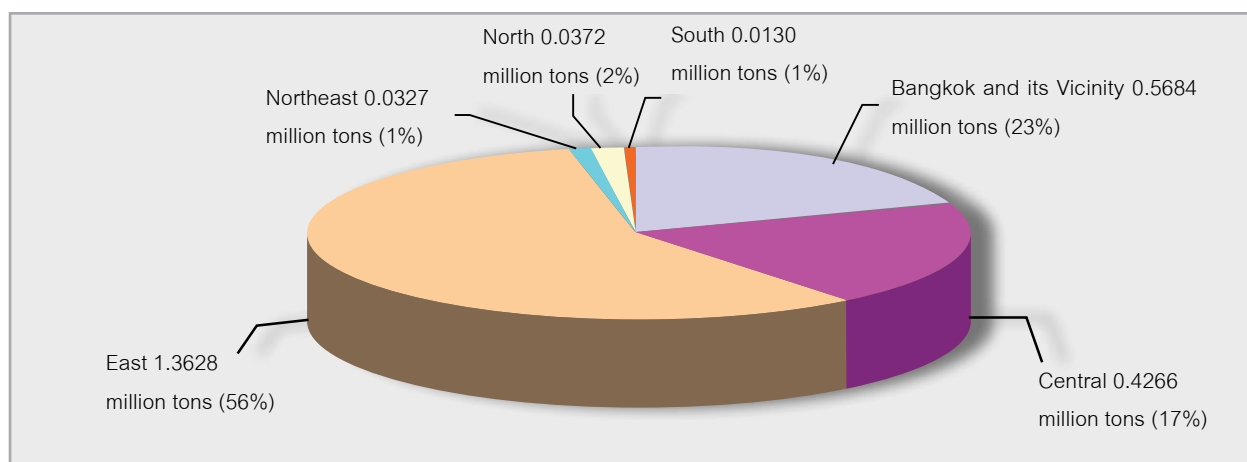


Figure 43 : Amount of Industrial Hazardous Waste in 2010 by Regions

Source : Pollution Control Department, data evaluated from Department of Industrial Work

Department of Industrial Works, Industrial Estate Authority of Thailand and Provincial Industry Offices under Ministry of Industry are government agencies overseeing the management of waste resulting from industrial operations across the country. After collecting data and making inquiries on the amount of industrial hazardous waste from regulatory agencies and private companies that manage industrial waste, it was found that in 2010, approximately 2.44 million tons of hazardous waste with permits to remove waste or used materials from factory premises had been properly managed (Table 21).

Table 21 : Industrial Hazardous Waste Management in 2010

Hazardous Waste Management Approach	Amount	
	Tons	%
Processing to be used as raw materials	378,140.74	15.5
Processing to be used as alternative energy	913,527.94	37.4
Going through process for reuse	582,707.08	23.9
Treatment	63,910.89	2.6
Disposal	434,147.93	17.8
Export for recycle/disposal overseas	68,316.70	2.8
Total	2,440,751.28	100

Source : Data on requests for permission to remove waste or used materials from factory premises (Sor Kor.2), Department of Industrial Works, 2010

According to Department of Industrial Works, there were 313 factories providing disposal service for hazardous waste and used materials in 2010 (excluding factories that could not be found at the reported addresses and those that ceased operations as well as factories whose operations only focused on industrial waste separation). These factories had the capacity to support hazardous waste of 7.77 million tons/year (Table 22).

Table 22 : Number of Factories and Industrial Waste Management Capacity in 2010 *

Type of Disposal Facilities	Number of Factories Capacity (location)	Capacity	
		Million Tons/ Year	%
Secured landfills	3	0.58	7
Cement Kilns and Incinerators	11	6.52	84
Recycle	299	0.67	9
Total	313	7.77	100

Source : Department of Industrial Works, May 2010

1.11 Hazardous Substances

Hazardous substance or hazardous chemical means an element or compound that is toxic or harmful to humans, animals and plants as well as deteriorates properties and environment. There are 9 classifications of hazardous materials based on international principles which are Class 1: Explosive substances and articles, Class 2: Gases, Class 3: Flammable liquids, Class 4: Flammable solids, Class 5: Oxidizing substances and Organic peroxides, Class 6: Toxic substances and Infectious substances, Class 7: Radioactive materials, Class 8: Corrosive substances and Class 9: Miscellaneous dangerous substances and articles.

In 2010, the total volumes of chemical imports to Thailand combined with domestic production were about 79.96 million tons. Domestic production accounted for 92.92% or 74.30 million tons which were produced by factories number 42 (1) whose operations related to chemicals, chemical substances or hazardous articles. Another 7.08% or 5.66 million tons were made up by imported organic chemicals of 2.19 million tons and imported inorganic chemicals of 3.47 million tons. The top ten highest import volumes of the two groups were 2.78 million tons (Figure 44 and Table 23). Thailand's import volume of chemicals decreased by nearly three times or by 9.88 million tons from 2009. Of the total decreased volume, organic chemicals contributed 8.48 million tons and inorganic chemicals made up 1.40 million tons.

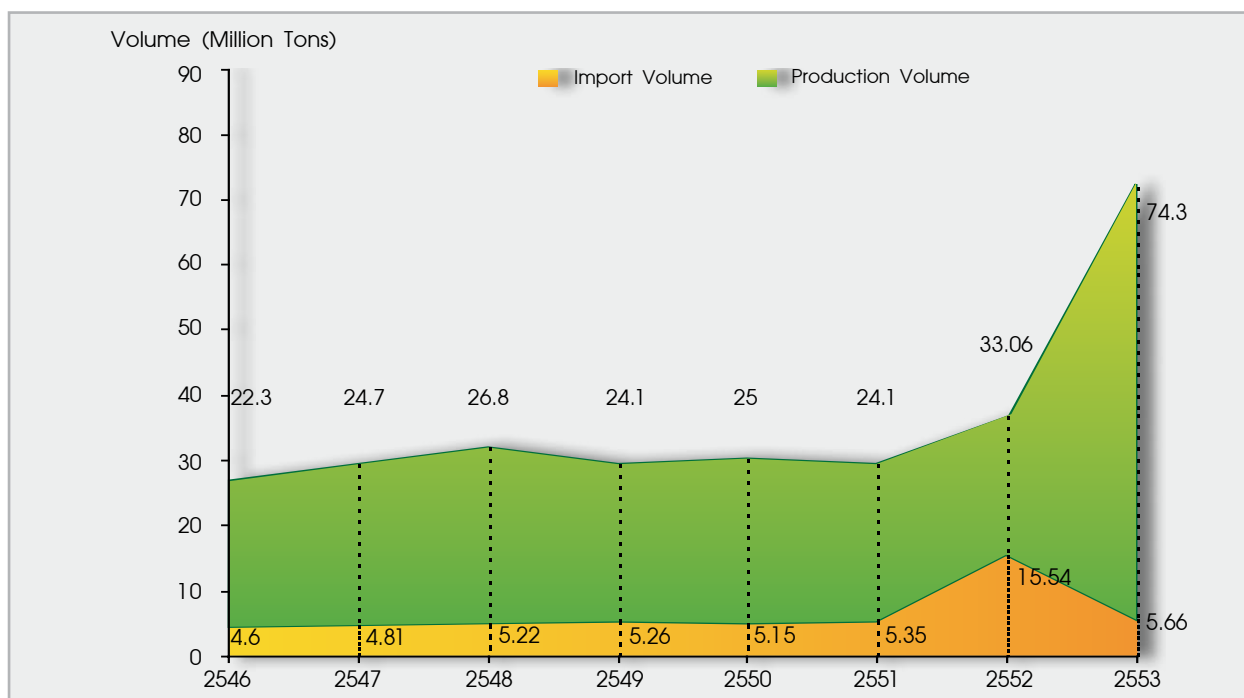


Figure 44 : Importation and Production of Chemicals in Thailand during 2003 – 2010

Source : 1. Chemicals imports data, evaluated from organic chemicals imports (Section 29) and inorganic chemicals (Section 28), the Thai Customs Department www.customs.go.th.

2. Production volume means chemicals production volume of factories number 42(1) reporting to Department of Industrial Works and Industrial Estate Authority of Thailand.

The top-ten imports by volume of organic and inorganic chemicals in 2010 totaled 2,781,825.13 tons (Table 23).

Table 23 : List of Top Ten Imported Organic and Inorganic Chemical Substances in 2010

No.	List of Chemicals	Volume (Ton)	Responsible Agencies
1	Methanol : Methyl Alcohol	556,018.88	Department of Industrial Works Food and Drug Administration
2	Disodium Carbonate	487,045.90	-
3	Ethylene Dichloride	292,115.71	Department of Industrial Works
4	Anhydrous Ammonia	255,286.98	Department of Industrial Works
5	P-Xylene	241,962.93	-
6	Sulphuric acid more than 50%w/w	241,907.90	Department of Industrial Works
7	Ethylene Glycol	224,978.51	Department of Industrial Works
8	Phenol : Hydroxyl Benzene	178,036.36	Department of Industrial Works
9	4,4'-Isopropylidenediphenol and Salts	163,412.43	-
10	Acrylonitrile	141,059.53	-

Source : Evaluated from statistics on chemicals imports, Thai Customs Department, www.customs.go.th

Remark : Responsible agencies as stated in Hazardous Substances Act B.E. 2535 (1992)

— Symbol means substance not controlled under the Hazardous Substances Act B.E. 2535 (1992)

Importation of Hazardous Chemicals

“Hazardous Substances” as stated in the Hazardous Substances Act B.E. 2535 (1992) means explosives, flammable substances, oxidizing agents and peroxides, toxic substances, infectious substances, radioactive substances, mutant causing substances, corrosive substances, irritating substances and other substances either chemicals or otherwise which may cause injury to humans, plants, properties, or the environment.

In 2010, Thailand imported 194 items of **hazardous substances according to the Hazardous Substances Act B.E. 2535 (1992) under the regulation of Department of Industrial Works¹²** out of 525 items. The total import volume was 2,859,002.92 tons, an increase from 2,601,335.33 in 2009, representing 9.9%. The top-ten imports by volume of hazardous chemicals totaled 2,135,137.64 tons (Table 24).



Table 24 : List of Top Ten Imported Hazardous Substances under the Hazardous Substances Act B.E. 2535 (1992) in 2010

No.	List of Chemicals	Volume (Ton)
1	Methyl Alcohol	574,723.86
2	Ethylene Dichloride	298,775.11
3	Anhydrous Ammonia	282,266.36
4	Sulphuric acid more than 50 % w/w	243,325.29
5	Phenol : Hydroxyl Benzene	189,735.58
6	Acrylonitrile	146,927.40
7	Acetic acid more than 80% w/w	144,457.89
8	Styrene Monomer	90,613.22
9	Sodium Hydroxide more than 20% w/w	88,761.49
10	Asbestos – Chrysotile	75,551.44

Source : Evaluated from hazardous substance logistics data in the first 9 months of 2010, Department of Industrial Works, www.diw.go.th, 7 June 2011.

In 2010, Thailand imported 265 items of agricultural hazardous substances according to the Hazardous Substances Act B.E. 2535 (1992) under the regulation of Department of Agriculture, totaling 117,698 tons (Table 25). The top-ten imports by volume of agricultural hazardous chemicals totaled 72,467.65 tons (Table 26).

Table 25 : List of Imported Agricultural Hazardous Chemicals during 2009 -2010

No.	Type of Hazardous Chemicals	Volume (Ton)	
		2009	2010
1	Herbicide	97,957	80,278
2	Insecticide	24,680	23,417
3	Fungicide	10,367	9,671
4	Plant Growth Regulator (PRG)	2,107	2,293
5	Funigants	943	850
6	Rodenticide	223	437
7	Acaricide	622	403
8	Molluscicide	695	349
9	Nematocide	-	-
Total		137,594	117,698

Source : Evaluated from report on an import of agricultural hazardous substances, 2010, Office of Agricultural Regulation, Department of Agriculture, www.doa.go.th. March 2011.

Table 26 : List of Top Ten Imported Agricultural Hazardous Chemicals in 2010

No.	List of Chemicals	Volume (Ton)
1	Glyphosate Isopropyl Ammonium	26,022.20
2	Paraquat Dichloride	21,028.04
3	Ametryn	5,147.63
4	Atrazine	4,301.07
5	2,4-D Sodium Salt	4,132.90
6	2,4-D Dimethyl Ammonium	3,929.33
7	Diuron	2,187.70
8	Butachlor	2,182.17
9	Chlorpyrifos	1,896.62
10	Glyphosate Acid	1,640.00

Source : Evaluated from report on an import of agricultural hazardous substances, 2010, Office of Agricultural Regulation, Department of Agriculture, www.doa.go.th. March 2011.

Impacts of Hazardous chemicals on Health

According to the 506 Disease Surveillance of Epidemiology Bureau of Disease Control Department, there were 2,306 patients receiving chemical toxic in 2010, increasing by 380 cases or 19.73% from the previous year. These patients can be divided into 291 patients exposed to industrial hazardous substances and 2,015 patients exposed to toxic from agricultural hazardous substances (Table 27). The areas with the highest numbers of patients affected by hazardous substance exposure were the North with 1,056 cases, followed by the Central with 572 cases, the Northeast with 530 cases and the South with 148 cases respectively.

Table 27 : Number of Patients and Deaths Caused by Hazardous Substance Exposure during 2003 - 2010

Unit : Persons

Hazardous Substances	Year	2003	2004	2005	2006	2007	2008	2009	2010
Agricultural Hazardous Substances	Patients	2,342	1,864	1,321	1,251	1,286	1,642	1,649	2,015
	Death	9	9	-	-	-	-	-	-
Industrial Hazardous Substance	Patients	157	853	319	201	300	226	277	291
	Death	-	1	-	-	1	-	-	-
Total	Patients	2,499	2,717	1,640	1,452	1,586	1,868	1,926	2,306
	Death	9	10	-	-	1	-	-	-
Increase/Decrease Percentage	Patients	-9.16	+8.72	-39.63	-11.46	+9.23	+17.7	+3.10	+19.73
	Death	-18.18	+11.11	-	-	-	-	-	-

Source : Data from disease surveillance, the Epidemiology Bureau, Disease Control Department, Ministry of Public Health, www.boe.moph.go.th, February 2011

Impacts of Industrial Hazardous Substances on Health

The Epidemiology Bureau of Disease Control Department reported that, in 2010, there were 291 patients affected by industrial hazardous substance exposure, increasing by 14 persons or 5%. Patients exposed to toxic can be divided as follows: 187 patients were exposed to petroleum toxics (benzene, toluene and xylene), 40 patients were exposed to gas and vapor (carbon dioxide, carbon monoxide, methane, sulfur dioxide, chlorine, ammonia and acetylene) and 64 patients were exposed to heavy metal toxics (manganese, mercury, arsenic and lead).

Areas with the highest numbers of patients affected by industrial hazardous substance exposure were the Northeast with 92 patients, followed by the Central with 83 patients, the North with 81 patients and the South with 35 patients respectively (Figure 45). Top-five provinces with the highest numbers of patients were Chachoengsao, Prachinburi, Chiang Rai, Chiang Mai and Udon Thani respectively.

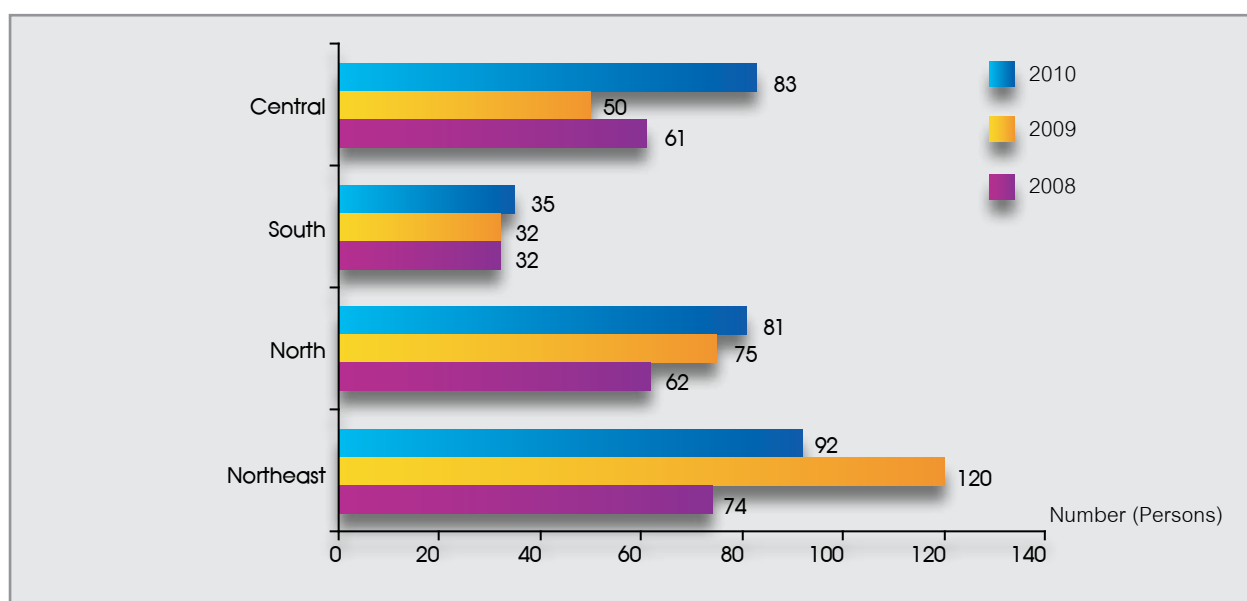


Figure 45: Patients from Industrial Hazardous Chemical Exposure during 2008 - 2010 by Regions

Source : Evaluated from illness by region data from the Epidemiology Bureau, Ministry of Public Health, 2008 - 2010

Impacts of Agricultural Hazardous Substances on Health

There were 2,015 patients affected by agricultural hazardous substance exposure in 2010, increasing by 366 persons or 22% from the previous year. Areas with the highest numbers of patients were the North with 975 patients, followed by the Central with 489 patients, the Northeast with 438 patients and the South with 113 patients respectively (Figure 46). The top - five provinces with the highest numbers of patients were Chiang Rai, Kamphaeng Phet, Nakhon Sawan, Chiang Mai and Suphanburi.

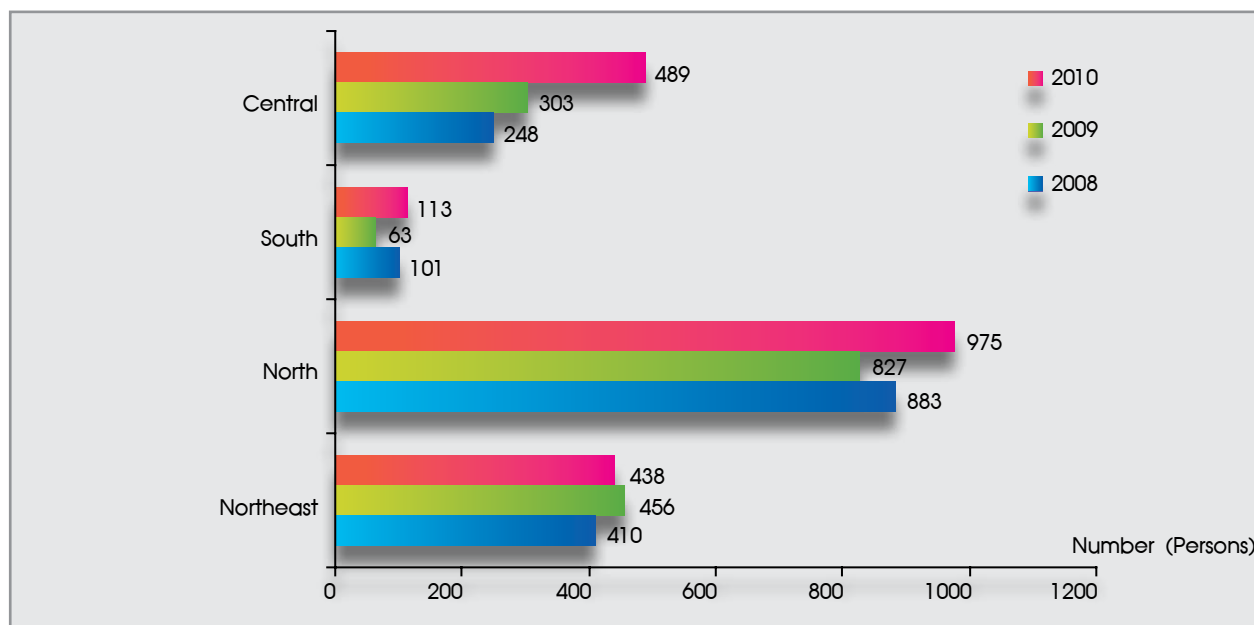


Figure 46 : Patients from Agricultural Hazardous Chemical Exposure during 2008 - 2010 by Regions

Source : Evaluated from illness by region data from the Epidemiology Bureau, Ministry of Public Health, 2008 - 2010

The State of Heavy Metal Contamination in Old Mining Areas

Mining activities cause environmental impacts, particularly the spread of heavy metals. For instance, the arsenic contamination in Ron Phibun District, Nakhon Si Thammarat and the lead contamination in Klity Creek, Kanchanaburi. Pollution Control Department had continuously evaluated and prioritized the severity of the old mines that may affect the environment since 2007 through examining and collecting samples from 23 old mines that ceased operations for at least 10 years. These mines include 6 old mines in the Northern areas, 4 mines in the South, 8 mines in the West, 3 mines in the East and 2 mines in the Northeast. The survey results showed that the tin mines were contaminated with arsenic (As) in surface water, groundwater, soil and sediments in a relatively higher level than other heavy metals as follows.

- **Surface water** : The arsenic contamination in the range of 0.0057 – 31.4 milligrams/liter was found in 95 samples, representing 58.64% of the total samples. The highest contamination level was found in Kanchanaburi, 3,140 times above the surface water quality standards under the Notification of National Environment Board.
- **Groundwater** : The arsenic contamination in the range of 0.005 - 0.146 milligrams/liter was found in 18 samples, representing 27.69% of the total samples. The highest contamination level was found in Kanchanaburi, 14 times above the groundwater quality standards under the Notification of National Environment Board.
- **Soil** : The arsenic contamination in the range 1.6 – 1,860 milligrams/kilogram was found in 261 samples, representing 96.67% of the total samples. The highest contamination level was found in Kanchanaburi, 477 times above the soil quality standards for residential land and agriculture under the Notification of National Environment Board.
- **Sediment** : The arsenic contamination in the range 1.1 – 6,625 milligrams/kilogram was found in 156 samples, representing 91.76% of the total samples. The highest contamination level was found in Chumphon, 677 times above the sediment quality standards of the Environmental Management Office of Florida.



The prioritization of heavy metal contamination severity in the old mining areas was carried out by employing US. EPA's Hazard Ranking System Quickscore (HRS Quickscore) whose assessment is based on 4 migration and exposure pathways of hazardous substances as follows: 1) Surface water 2) Groundwater 3) Soil exposure and 4) Air. Most old mining areas were in the National Priorities List (NPL) Sites which required a feasibility study for rehabilitation of the areas in a long term. For areas with contaminated groundwater used for consumption, Pollution Control Department had initially notified local agencies in order to alert the public to avoid consuming such water. If water consumption cannot be avoided, water is required to be treated before consuming.

Persistent Organic Pollutants (POPs)

Dioxin/Furan is an organic compound produced by incomplete combustion from various activities such as crematories, waste incinerators and industrial incinerators, power and heat production and uncontrollable combustion. Dioxin/Furan persist in the environment, are capable of long-range transport and bioaccumulate in the tissues of living organisms. Dioxin/Furan is carcinogen and can cause damages to nervous system and immune systems. Pollution Control Department, as a coordination center of the Stockholm Convention on Persistent Organic Pollutants, had monitored the emission of Dioxin/Furan under the Best Available Techniques and Best Environmental Practices Program (BAT/BEP) in order to apply best available techniques and practices to reduce or stop the release of Dioxin/Furan. The monitoring results of the Dioxin/Furan emissions from various sources were as follows.

Persistent Organic Pollutants (POPs) are highly toxic chemical substances, persist in the environment, bioaccumulate in tissues of living organisms and are capable of long-range transport. Under the Stockholm Convention on Persistent Organic Pollutants, there are 12 POPs categorized into 3 groups as follows

- 1) 9 pesticides which are Aldrin, Chlordane, DDT, Dieldrin, Endrin, Heptachlor, Mirex, Hexachlorobenzene and Toxaphene
- 2) 1 industrial chemicals which is Polychlorinated Biphenyls (PCBs) and
- 3) 2 chemicals are produced from unintentional production process which are Dioxin or Polychlorinated Dibenzo-*para*-Dioxins (PCDDs) and Furan or Polychlorinated Dibenzo Furans (PCDFs)

Power plants and industrial boilers

The Dioxin/Furan concentrations were analyzed based on 5 air samples from exhaust vents of power plants and industrial factories that used boilers in the production process, classified by the fuel types. Two samples were taken from bagasse and coal each and one sample was taken from bunker oil grade C¹¹. It was found that industrial factories employing bagasse as biomass fuels tended to emit higher level of Dioxin/Furan than those using fossil fuels (coal and bunker oil). These factories' emissions of Dioxin/Furan also exceeded the standards of Federal Republic of Germany for industrial factories using solid fuels with the regulatory limit of 0.1 ng I-TEQ/Nm³ (nanogram I-TEQ per cubic meter)¹² (Table 28). The combustion condition that can reduce the formation of Dioxin/Furan is the condition in which the temperature of the combustion is more than 850 °C for over 2 seconds and oxygen level is sufficient at 6% for solid fuels and 3% for liquid fuels. Bag Filter is an efficient air treatment system suitable for Dioxin/Furan (UNEP, 2005)¹³.

Table 28 : Dioxin and Furan Emission Levels from Exhaust Vents of Power Plants and Industrial Boilers that Employed Certain Types of Fuels in 2010

Fuel Type	Dioxin/Furan Level (ng I-TEQ/Nm ³)	Standard Level* (ng I-TEQ/Nm ³)
Bagasse, Sample 1	0.016	0.1
Bagasse, Sample 2	1.984**	0.1
Coal, Sample 1	0.0083	0.1
Coal, Sample 2	0.0343	0.1
Bunker Oil Grade C	0.0034	0.1

Remark :

* Standard level of Federal Republic of Germany for industrial factories using solid and liquid fuels (The Thirteenth Ordinance on the Implementation of the Federal Emission Control Act, Ordinance on Large Combustion Plants and Gas Turbine Plants – 13. BImSchV, Dated on July 20, 2004)

** Value exceeding standard value of Dioxin/Furan used as a reference

¹¹Bunker oil grade C is medium-viscosity fuel oil of below 180 centistokes with temperature at 50 °C and contains sulfur level not exceeding 2% by weight.

¹²ng.I-TEQ/m³ (nanogram I-TEQ / cubic meter of air) is a concentration unit for Dioxin/Furan, International Toxic Equivalent (I-TEQ) per 1 cubic meter, with TEQ = Sum of (Toxicity value or International Toxicity Equivalent Factor (I-TEF) x detected dioxin/dioxin-like compound levels)

¹³UNEP (United Nations Environment Programme). 2005. Guidelines on best available techniques and provisional guidance on best environmental practices relevant to Article 5 and Annex C for Fossil fuel-fired utility and industrial boilers. UNEP, Geneva. http://chm.pops.int/Portals/o/Repository/batbep_guideline08/UNEP-POPs-BATBEP-GUIDE-08-9.English.Doc.



Steel manufacturing industry

The Dioxin/Furan concentrations were analyzed based on 4 air samples from exhaust vents of steel manufacturing industry, both new and existing steel mills¹⁴, classified by the types of furnace. Two samples were taken from electric arc furnace, one sample from induction furnace and one sample from reheating furnace (Table 29). It was found that steel mills employing induction furnace tended to emit higher levels of Dioxin/Furan than other types of furnace. Steel mills employing electric arc furnace had Dioxin/Furan emission levels of 0.040 and 0.047 ng I-TEQ/Nm³ respectively. Mills using induction furnace had emission level of 0.059 ng I-TEQ/Nm³ and reheating furnace emitting 0.031 ng I-TEQ/Nm³. However, such emission levels of Dioxin/Furan were within the standards of the European Union with the regulatory limit of 0.1 ng I-TEQ/Nm³.

Table 29 : Dioxin and Furan Emission from Exhaust Vents of Steel Industry in 2010

Type of Furnace	Level of Dioxin/Furan (ng I-TEQ/m ³)	Standard Level (ng I-TEQ/m ³)
1. Electric arc furnace, Example 1, New Source	0.040 ^{1/}	0.1 ^{3/}
2. Electric arc furnace, Example 2, Existing Source	0.047 ^{1/}	0.1 ^{3/}
3. Induction furnace, New Source	0.059 ^{1/}	0.1 ^{3/}
4. Reheating furnace, New Source	0.031 ^{2/}	0.2 ^{4/}

Remark :

^{1/} Calculated at pressure 1 atmosphere or 760 millimeters of the mercury column, temperature of 25 degrees Celsius, dry basis with polluted air volume of %O₂ at actual measurement condition (Notification of Ministry of Natural Resources and Environment on air pollution emission standards for industrial factories, dated on 5 April, 2006)

^{2/} Calculated at pressure 1 atmosphere or 760 millimeters of the mercury column, temperature of 25 degree Celsius, dry basis with polluted air volume of %O₂ at 7% (Notification of Ministry of Natural Resources and Environment on air pollution emission standards for industrial factories, dated on 5 April, 2006, where bunker oil is used as fuel for closed combustion system)

^{3/} Standards of the Canadian Council of Ministers of the Environment (CCME), Canada (Steel Manufacturing Electric Arc Furnace Pollution Prevention Strategy, March 24, 2004.)

^{4/} Standards of Environmental Protection Act, Canada (Guideline for the Implementation of Canada-wide Standards for Emissions of Mercury and of Dioxins and Furans for Emissions of Mercury and of Dioxins and Furans and Monitoring and Reporting Requirements for Municipal Waste Incinerators, Biomedical Waste Incinerators, Sewage Sludge Incinerators, Hazardous Waste Incinerators, Steel Manufacturing Electric Arc Furnaces and Iron Sintering Plants, June 10, 2003.)

¹⁴Notification of Ministry of Science, Technology and Environment on air pollution emission standards for steel mills, dated on 9 March, 2001, published in Government Gazette, Volume 118, Section 37d, dated on 8 May, 2001.

- Existing Source means steel mill that has obtained a manufacturing license or factory expansion permit before the date of publication in Government Gazette.
- New Source means steel mill that has obtained a manufacturing license or factory expansion permit after the date of publication in Government Gazette.

The United Nations Environment Programme (UNEP) has provided instructions regarding the reduction of Dioxin/Furan emission from the steel industry. For instance, separating contaminants containing chlorine from scrap iron prior to smelting, maintaining the combustion temperatures more than 850 °C, quickly reducing temperatures after combustion to below 200 °C and installing the bag filter air treatment system which is highly efficient in treating Dioxin/Furan or using the system together with the injection of adsorbent to absorb pollutants produced by furnaces.

Crematories

Crematories are a major source of pollution, releasing various pollutants to the environment including foul odor, particulate matter, smoke, carbon monoxide, nitrogen oxide, sulfur dioxide and heavy metals such as cadmium, mercury, lead as well as dioxin and furan.

There were 35,238 temples in Thailand, 80% of which had crematories. Approximately 312,000 cremations took place each year. Pollution problems caused by the crematories had impacts on public health both in urban and suburban areas. The monitoring of Dioxin/Furan concentrations emitted from crematories was conducted on 3 locations in Bangkok, Samut Prakan and Chiang Mai in 2010. It was found that the air released from the exhaust vents of crematories with 2 cremation rooms that used diesel, charcoal and firewood as fuels contained carbon monoxide (CO) levels of 73.8 – 661 mg/m³ and 664 mg/m³ respectively, which mostly exceeded the standards^{1/}. Meanwhile, concentration levels of Dioxin/Furan from crematories using diesel, charcoal and firewood as fuels were 0.52 – 8.51 nanogram I-TEQ/m³ and 8.84 nanogram I-TEQ/m³ respectively, which exceeded the standards^{2/} (Table 30).



Figure 47 : Crematory with 2 cremation rooms using diesel as fuel

Table 30 : Pollution Analysis of Emission from Crematories with 2 Cremation Rooms

Monitoring Parameters	Type of Fuel		Standards
	Diesel	Charcoal and Firewood	
Carbon Monoxide; CO (mg/m ³)	73.8 – 661	664	100 ^{1/}
Dioxin/Furan (Nanogram TEQ / m ³) ^{3/}	0.52 – 8.51	8.84	0.5 ^{2/}

Remark :

^{1/} Bangkok's standards for pollutants emitted from pollutant-free crematories, calculated at 25 degrees Celsius, 1 atmosphere, dry basis and at 11%O₂

^{2/} Air pollution emission standards for infectious-waste incinerators, calculated at 25 degrees Celsius, 1 atmosphere, dry basis, and at 7% O₂ in accordance with the Notification of Ministry of Natural Resources and Environment on air pollution emission standards for infectious-waste incinerators, dated on 15 December, 2003.

^{3/} I-TEQ means calculation in concentration unit equivalent to toxicity towards human (International Toxic Equivalent)

Source : Analysis report on Dioxin and Furan from Crematories Risk Assessment Project, Pollution Control Department, 2010.



Figure 48 : Collection of environmental samples in crematory areas

Table 31 : Monitoring Results of Dioxin and Furan in Environmental Samples in Crematory Areas

Environmental Samples	Dioxin/Furan Level	Standards
Air in atmosphere (Nanogram I-TEQ/m ³)	< 0.00008 – 0.00013	0.005 ^{1/}
Soil (Picogram I-TEQ/m ³)	0.10 – 7.65	1,000 ^{1/}
Sediment (Picogram I-TEQ/m ³)	0.17 – 17.75	11 ^{2/}
Aquatic animal (Catfish) (Picogram I-TEQ/m ³)	0.24 – 2.08	25 ^{3/}

Remark : ^{1/} Standard of Ministry of Environmental and Energy. Canada, July 1997

^{2/} Standard of U.S. Environmental Protection Agency (U.S. EPA) Region 5

^{3/} Standard of U.S. Food and Drug Administration (FDA)

Source : Analysis report on Dioxin and Furan from Crematories Risk Assessment Project, Pollution Control Department, 2010.

Combustion condition that can reduce the formation of Dioxin/Furan according to the instructions of the United Nations Environment Programme (UNEP) is at 850 °C. The combustion time is of no less than 2 seconds and sufficient level of oxygen at 6% for the second cremation room or smoke cremation room. As well, there should be a dry absorbent treatment system using lime powder and activated carbon together with the fabric filter which is a highly efficient air treatment system for Dioxin/Furan.

In addition, Pollution Control Department had set up plans to further conduct research on basic information, monitor and collect samples of pollutants released from temples' crematories and crematoriums. The objective is to create measures and guidelines in reducing and eliminating pollution caused by crematories, develop the standards for pollutant emission from crematories as well as promote coordination to set up a pilot crematorium center in Thailand.

1.12 Environmental Inspection and Law Enforcement

The inspection of pollution sources and law enforcement are pollution control measures focused on sources including communities, industrial factories, agriculture and motor vehicles. The measures are carried out by government agencies with authority to regulate sources of pollution in order to prevent pollution problems that will affect the environmental quality or create conditions that are harmful to the public health. Such conditions have increased and become more severe, particularly the high risk areas and areas that require special surveillance.

Operations under the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992)

- **Inspection of pollution sources in critical river basins**

Pollution Control Department in collaboration with the Provincial Office of Natural Resources and Environment had monitored pollution sources in 3 river basins which were Chao Phraya, Bang Pakong, Tha Chin and Songkhla Lake. The main pollution sources that had impacts on the three river basins were communities and agriculture consisting of type-A buildings, allocated lands and swine farms. According to the monitoring results on 3 types of pollution sources, totaling 922 locations, the level of water drainage in 113 pollution sources was found to exceed the standard.

Table 32 : Monitoring Results of Pollution Sources in Chao Phraya River Basin, Tha Chin River Basin and Songkhla Lake Basin

Area	Type of Pollution Source	Operational Result (Location)		Remark
		Monitored	Wastewater Drainage Exceeding Standard	
Chao Phraya River Basin	Type-A building	370	58	Currently in the administrative process for pollution sources with analysis results of wastewater drainage exceeding the standard.
	Allocated land	304	9	
	Swine farm	1	-	
Tha Chin River Basin	Swine farm	115	22	
Songkhla Lake Basin	Swine farm	132	24	
Total		922	113	

- **Inspection of pollution sources in industrial factories and the industrial estate in Rayong**

The inspection was conducted in 13 locations. It was found the level of wastewater drainage exceeded the standard in 4 locations. Industrial Estate Authority of Thailand, Department of Industrial Works and Rayong had taken actions under authority to resolve the problems. According to the monitoring results of wastewater after the improvement of wastewater treatment system of the industrial estates with standard-exceeding water drainage, 2 locations were able to improve the wastewater treatment to be within the regulatory standard and another 2 industrial estates would be inspected again in 2011.

• Inspection and detection of auto vehicles exceeding pollution emission standards

Pollution Control Department in collaboration with Royal Thai Police, Bangkok, Nonthaburi, Samut Prakan and Songkhla had inspected 8,443 auto vehicles. It was found that 1,770 auto vehicles, representing 21%, with a standard-exceeding level of black smoke and received a temporary banning order, banning vehicles from being used. After that, there were 1,586 temporarily banned auto vehicles that had been improved to meet the standard and requesting a lift of banning order, representing 90% of the total temporarily banned vehicles (Table 33). If auto vehicles under “temporary ban” were detected to be used on the streets without being improved and requesting for the lift of order within 30 days since the day the order had been issued, the vehicle owners would be prosecuted for violating the sign prohibiting the use of vehicles and would be given a “permanent ban”, meaning absolute prohibition from the use of such vehicle. Exception is granted for vehicles with official permission to be used in the purpose of improvement and officer’s inspection.

Table 33 : Inspection and Detection Results of Auto Vehicles Exceeding Pollution Emission Standards

Area	Inspected	Order Issued	Order Lifted	
			Number	%
Bangkok	6,047	1,284	1,147	89
Nonthaburi	511	103	94	91
Samut Prakan	317	78	72	90
Songkhla	1,568	305	273	89
Total	8,443	1,770	1,586	90

Operations under the Factory Act B.E. 2535 (1992)

Department of Industrial Works had monitored factories that received manufacturing licenses in order to regulate the factories to be in accordance with the environmental and safety laws. In 2010, the monitoring was conducted on 10,081¹⁵ factories. It was found that 98% of the factories had complied with the laws while 213 factories or 2% of the total monitored factories did not. As a result, an order requesting for improvement was issued or an order to cease operation was issued if the factories did not or were not able to perform improvement to meet regulatory standards. Ultimately, an order to close the factories was issued if the factories did not conduct improvement according to the order.



¹⁵ Department of Industrial Works, 2010.

1.13 Pollution Problem Complaints

The rapid growth of urban population and the migration to large cities are mainly contributed to the fast expansion of urban areas. According to National Statistical Office¹⁶, the population density of Bangkok and vicinity is 1,309 persons per square kilometer, which is 10 times higher than the average population density of the whole country of 124 persons per square kilometer. It is also found that the urbanization of Thailand tends to increase every year. Concentration of population in urban areas is due to economic development, the rapid growth of infrastructure and social service system of the city, particularly the industrial and service sectors. The development without a good plan has allowed the household industry, small industries and service facilities lacking of proper pollution management system to intermingle with the communities, causing pollution problems that inevitably affect surrounding communities.

Filing pollution complaints to government agencies is a solution that first comes to the public's mind. This is because people have received more information, allowing them to be aware of their own rights. Meanwhile, people became more aware of means for complaints, leading to continuous complaints with the government agencies. Information on complaints regarding pollution problems were collected from 6 government agencies which were Bangkok Metropolitan Administration, Public Service Center under the Prime Minister's Office, Department of Industrial Works, Pollution Control Department, Service Link Center under Ministry of Natural Resources and Environment and Damrong Dharma Center of Ministry of Interior. In 2010, there were 7,266 complaints. During the 3-year period of 2008 – 2010 (Table 34), government agencies continued to receive pollution complaints despite a tendency to decline. The complaints regarded air pollution such as foul odor, dust and smoke and noise/unwanted sound (Figure 49), which had impacts on the public well-being and health. Bangkok and vicinity was the area with the most complaints (Figure 50). Out of the total 105,918 public complaints filed to Public Service Center, 843 complaints were about pollution problems, representing 0.79% of the total complaints. It can be said that the pollution problem made up only a small proportion.



¹⁶National Statistical Office, Ministry of Information and Communication Technology, Thailand Annual Statistics Report 2009.



Table 34 : Statistics of Environmental Complaints by Government Agencies during 2008 – 2010

Agencies	Number of Complaint		
	2008	2009	2010
Bangkok Metropolitan Administration ¹	6,616	6,583	5,121
Public Service Center ²	1,389	1,190	843
Department of Industrial Works ³	450	488	541
Pollution Control Department ⁴	512	394	424
Service Link Center ⁵	216	98	302
Damrong Dharma Center ⁶	21	31	35
Total	9,204	8,784	7,266

Source : 1) Health Department, Bangkok

2) Public Service Center, Prime Minister's Office

3) Department of Industrial Works

4) Pollution Control Department

5) Service Link Center, Ministry of Natural Resources and Environment

6) Damrong Dharma Center, Ministry of Interior

Remark : Complaint data from Damrong Dharma Center was collected from Damrong Dharma Center in Bangkok only

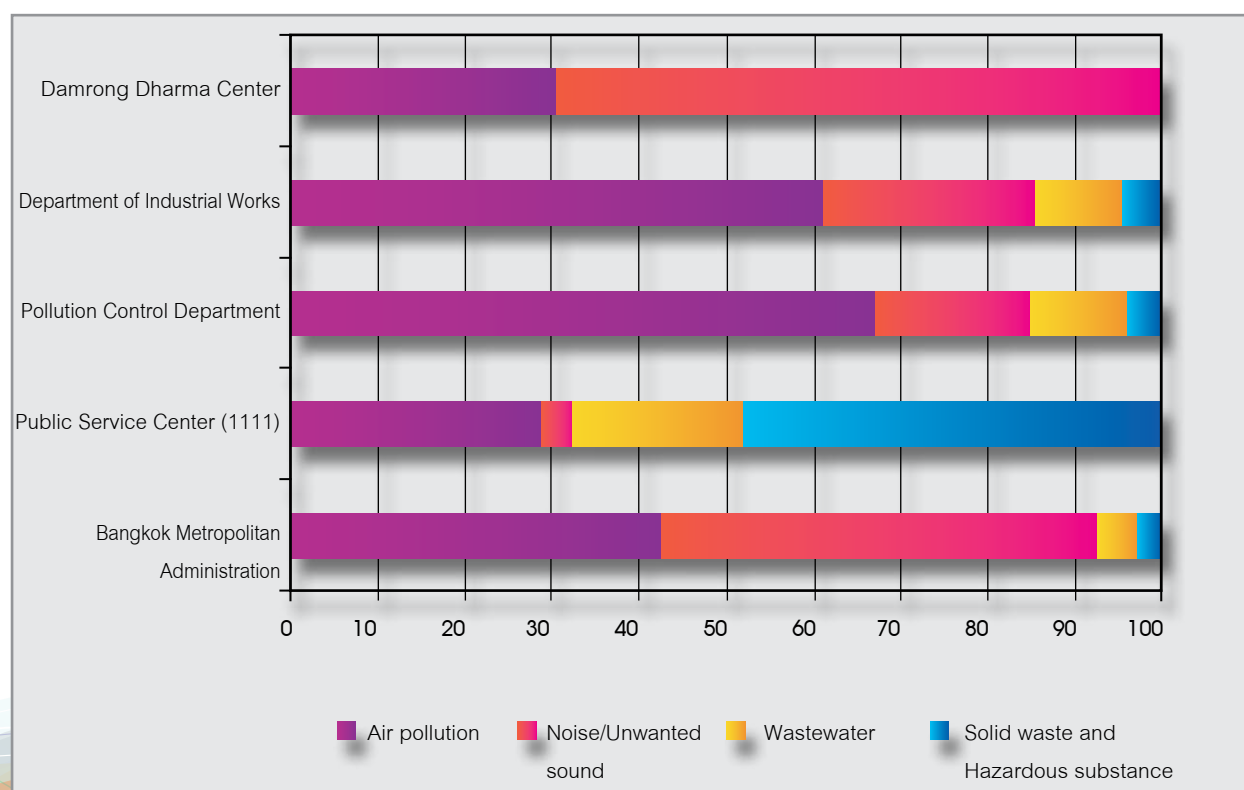


Figure 49 : Proportions of Pollution Problems in 2010

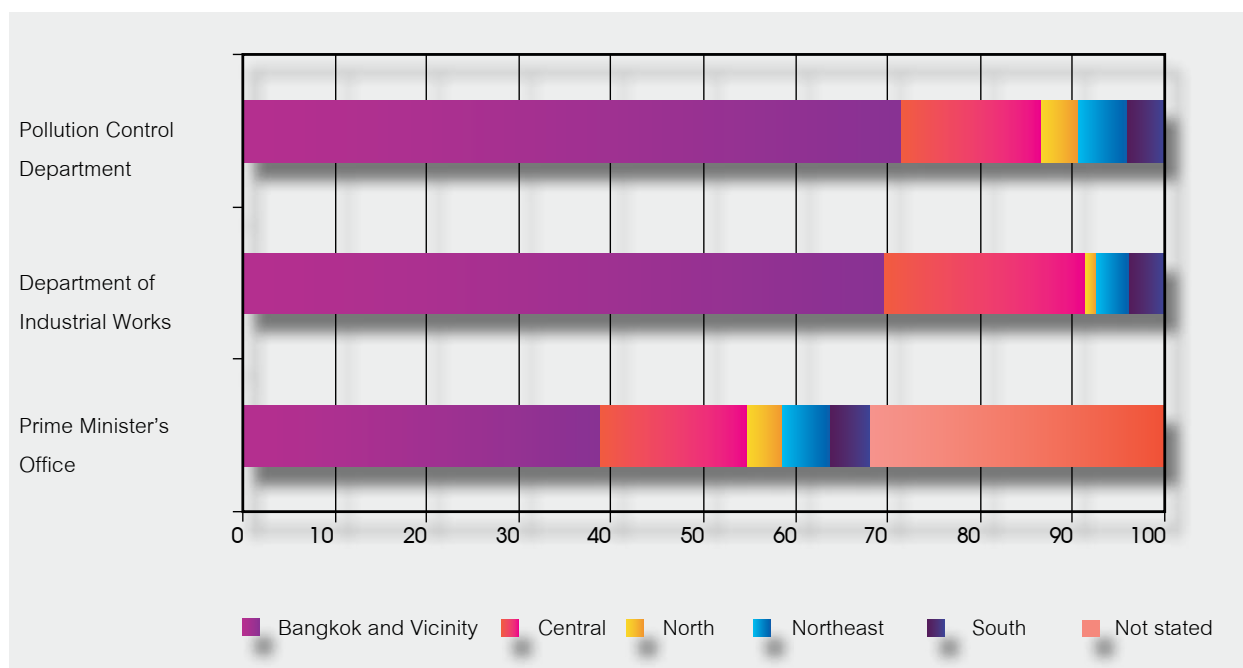


Figure 50 : Environmental Complaints by Regions

In resolving environmental complaints, related agencies would issues orders to adjust and improve, suspend operations, close or prosecute factories. Most cases were solved (Table 35).

Table 35 : Results of Complaint Handling

Government Agencies	Operation Results	
	Solved	In Process
1. Public Service Center	723	120
2. Department of Industrial Works	336	178
3. Pollution Control Department	271	153
4. Damrong Dharma Center	24	11

Satisfaction on handling of pollution complaints

There were 3 government agencies having conducted a satisfaction survey, namely Pollution Control Department, Prime Minister's Office and Office of the Permanent Secretary for Interior. The results can be concluded as follows.

Pollution Control Department had conducted a satisfaction survey on complaint handling by distributing postal surveys. The results showed that most complainers or 78% were satisfied with the service in general. The service that received the highest satisfaction was politeness and friendliness of officials with satisfaction level of 85%. The service that received the lowest satisfaction was providing suggestions and relevant information as well as credibility and trustworthy of officials with satisfaction level of 74%.



Prime Minister's Office had assigned National Statistical Office in cooperation with Office of the Public Sector Development Commission to conduct a satisfaction survey on the quality of service regarding the public complaints filed in person and through Public Service Center's 1111 hot line. Most respondents or 82% were satisfied with the service.

Office of the Permanent Secretary for Interior had conducted a satisfaction survey to assess confidence in the quality of 4 service issues regarding the handling of complaints which were satisfaction on the process/procedure of service providing, satisfaction on officials or personnel providing service, satisfaction on facilities and satisfaction on the quality of services. The results showed that respondents were satisfied with services in general with the score of 79%. Satisfaction was found in 3 issues which were satisfaction on officials or personnel providing service, satisfaction on facilities and satisfaction on the quality of services with equal scores of 80%. Meanwhile, satisfaction on the process/procedure of service providing had a score of 76%.

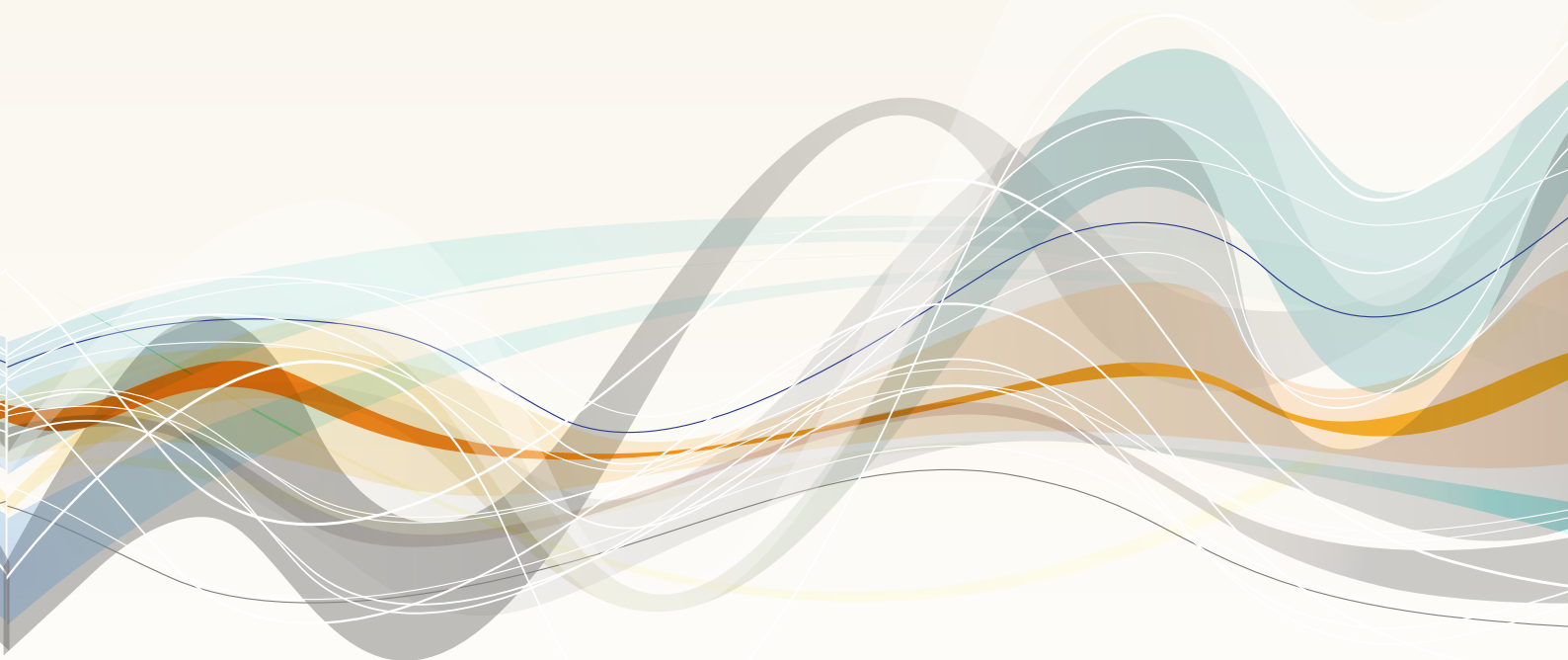
The government agencies will employ these satisfaction surveys as guidelines to improve and develop officials' operations.







2. Important Events in the Year



2.1 Emergency Chemical Accidents

According to the accident data reported to Pollution Control Department in 2010, there were 30 chemical accidents including illegal dumping of chemical waste. Of the total, 4 accidents were caused by chemicals transport, 11 accidents in industrial factories and chemicals warehouses, 12 accidents by illegal dumping of chemicals and solid waste and 3 accidents by other causes such as in chemicals in households (Figure 51). The highest number of the injured admitted to hospitals or 300 cases were caused by fire accident and chemical leak at a factory of Marigot Jewellery (Thailand) Company Limited located in the Hi-Tech Industrial Estate in Phra Nakhon Sri Ayutthaya. This was followed 259 cases caused by chemical leak at a factory of Aditya Birla Chemicals (Thailand) Company Limited located inside the Hemaraj Eastern Industrial Estate in Rayong.

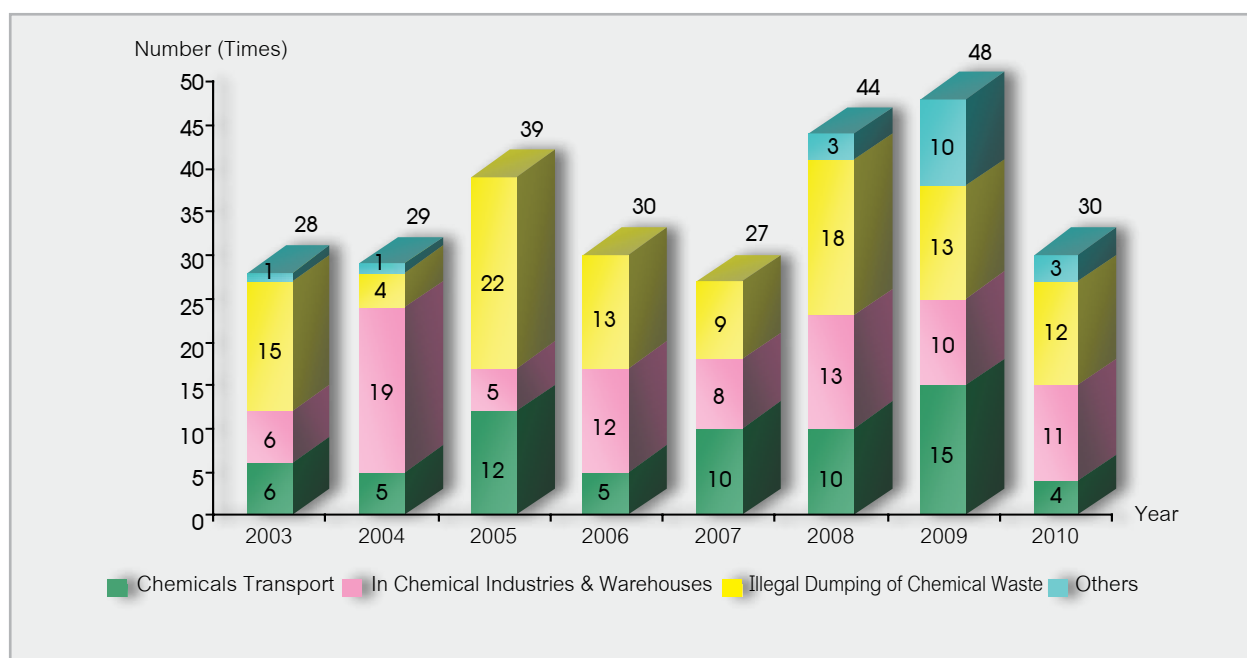


Figure 51 : Statistics of Chemical Accidents during 2003 – 2010

Most accidents occurred in the chemical industries and warehouses. Illegal dumping of chemical waste continuously takes place in deserted areas or old mud puddles in order to avoid disposal expenses. Chemical waste has become a public burden that requires taxes to spend on waste disposal and the rehabilitation of the contaminated areas instead of entrepreneurs. Areas in which chemical accidents mostly occurred were the provincial areas that had a large number of establishments such as Rayong, Chon Buri, Samut Prakan and Bangkok. The best approach is to prevent from the beginning by prohibiting such activities with collaboration from all sectors and strict law enforcement. There also needs to be a preparation for prevention and remedy in case of serious chemical accidents for industrial transports and warehouses. As well, the establishment of network among local administrative organizations, communities, people and volunteers should be promoted in order for the network to conduct monitoring and inspection activities to prevent occurrence of hazardous chemical pollutions.



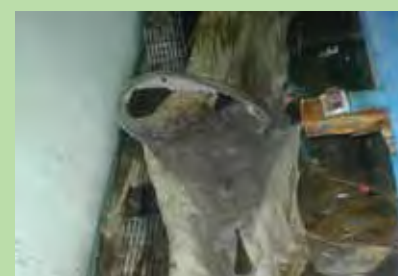
Chemical leak accident at a factory of Aditya Birla Chemicals (Thailand) Company Limited, Hemaraj Eastern Industrial Estate, Rayong

The chemical leak accident took place on 7th June 2010, at around 13.00 p.m. at a factory of Aditya Birla Chemicals (Thailand) Company Limited, located in the Hemaraj Eastern Industrial Estate, Huai Pong Subdistrict, Muang District, Rayong. The factory manufactured various chemicals including Epichlorohydrin, Chlorine, Sodium Hydroxide and Hydrochloric Acid. The accident occurred while employees were pouring sodium Hypochlorite (NaOCl) into a 100-cubic-meter tank. The base under the container suddenly collapsed, causing NaOCl to leak. The tank, after the collapse of its base, fell onto and broke the pipe used for transmitting Hydrochloric Acid (HCl), causing the leak of HCl which reacted with the NaOCl, creating Chlorine gas to spread throughout the area. Employees working at the scene and nearby areas were affected after inhaling chlorine vapors. They experienced constriction, headache, burning eyes and respiratory tract irritation. The 259 people were injured and hospitalized. After treatment, 189 patients with minor injury were allowed to return home while the remaining 70 patients remained hospitalized. No casualty was reported in the incident.



Fire and chemical leak accident at a factory of Marigot Jewellery (Thailand) Company Limited

The fire and chemical accident took place on 15th July 2010, at around 14.00 p.m. at a factory of Marigot Jewellery (Thailand) Company Limited, which manufactured, imported and exported artificial jewelry. The factory was located in the Hi-Tech Industrial Estate, Ban Len Subdistrict, Bang Pa-In District, Phra Nakhon Sri Ayutthaya. Due to the incident, 300 workers were injured and hospitalized after inhaling vapors and gases. Having examined the scene, the area in which the fire broke out was the company's metal plating room which was closed for renovation. The cause of fire might be that a spark from metal cutting activities inside the room came into contact with inflammable gases or vapors of chemical residues inside the plastic pipes used for transmitting chemicals. As the metal plating room contained various toxic chemicals such as Copper Cyanide, Silver Potassium Cyanide and corrosive chemicals (acid/alkaline), the chemical concentrations of volatile organic compounds (VOCs), Hydrogen Chloride Gas and Hydrogen Cyanide Gas inside the room were measured. Only a relatively low level of VOCs (2ppm) was detected while hydrogen chloride and hydrogen cyanide gases were not found. This was a condition that did not affect the health of inhalers. However, the examination of the concentrations of chemical residues inside chemical transmitting pipes detected the level of Hydrogen Chloride Gas to be higher than 500 ppm and the level of Hydrogen Cyanide Gas to be in the range 20 – 30 ppm. Therefore, these toxic gases and vapors were required to be absorbed and treated in accordance with academic principles prior to resuming operations.



2.2 Solving Pollution Problems in Map Ta Phut Area

Map Ta Phut area was declared a pollution control area by the National Environment Board on 30th April 2009, covering Rayong administrative areas which were Map Ta Phut Subdistrict, Huay Pong Subdistrict, Noen Phra Subdistrict and Thab Ma Subdistrict of Rayong's Muang District, Mab Kha Subdistrict, Nikhom Phattana District and Ban Chang Subdistrict of Ban Chang District, Rayong Province as well as the sea area within the boundary line.

Establishment of Action Plan to Reduce and Eliminate Pollution in the Pollution Control Area

Governmental agencies, local administrative organizations, private and public sectors had together established an action plan to reduce and eliminate the pollution in Rayong pollution control area, B.E. 2553 – 2556 (2010 – 2013). The plan was approved by National Environment Board in its No. 3/2553 (2010) meeting on 8th July, 2010. There were 7 frameworks, 71 programs with a total budget of 2,182.88 million baht focusing on solving pollution problems in the area and developing the quality of life of the public. The projects also included 16 urgent projects approved by National Environment Board in its No. 1/2553 (2010) meeting on 22nd January 2010. These programs can be divided as follows.

- | | |
|---|---------------------------------|
| • 26 treatment and rehabilitation programs | Budget of 1,260.74 million baht |
| • 16 monitoring and prevention programs | Budget of 447.89 million baht |
| • 2 awareness promotion programs | Budget of 161.40 million baht |
| • 8 workshop programs | Budget of 129.55 million baht |
| • 7 law enforcement programs | Budget of 11.60 million baht |
| • 8 emergency response and toxic chemicals warning programs | Budget of 155.80 million baht |
| • 4 evaluation programs | Budget of 15.90 million baht |

In addition, entrepreneurs inside and outside the industrial estate in the pollution control area had also established the pollution reduction plan for their plants together with the action plan as to provide an overview of the pollution management in the pollution control area. There were 96 plants, out of 132 plants, in the industrial estate and 6 plants located outside the industrial estate submitting the pollution reduction plans with a total budget of 28,619.33 million baht.





State of Environment in Map Ta Phut and Nearby Areas in 2010

● Water quality

1. Surface water

The water quality monitoring was conducted 3 times/year on 16 public canals through 38 monitoring stations. These canals included Chak Mak Canal, Nam Hoo Canal, Huai Yai Canal, Ta Kuan Canal, Lod Canal, Bang Boed Canal, Bang Kaprun Canal, Namtok Canal, Konpuk Canal, Ka Canal, Phayun Canal, Namdam Canal, Thapma Canal, Nongkhla Canal, Nong Paknam Canal and Krached Canal. The monitoring results showed that the water quality remained in the deteriorated level. Parameters exceeding the surface water quality standards were Dissolved Oxygen (DO), Nitrate-Nitrogen ($\text{NO}_3\text{-N}$), Ammonia-Nitrogen ($\text{NH}_3\text{-N}$), Total Coliform Bacteria (TCB) and Fecal Coliform Bacteria (FCB). The canal with the most problems was Nam Hoo Canal. Currently, public canals in Map Ta Phut area supports the wastewater discharged from households and housing estates which are quickly expanding. Most wastewater did not go through the wastewater treatment system of Map Ta Phut Municipality, resulting in a deteriorated water condition of the public canals.

2. Quality of marine water, sediments and aquatic animals

There were 22 marine water monitoring stations and 10 surface sediments monitoring stations. There was also a random collection of aquatic animal samples having habitat in the area of floating baskets for shells and representing aquatic animals that covered the food chain such as mussels, horse crabs and mullets. The monitoring stations covered the areas including the estuary of Bang Kaprun Canal, the estuary of Bang Boed Canal, water drainage point of Glow Power Plant in the wharf area, water pumping point of BLCP Power Plant's cooling system, the estuary of Chak Mak Canal, Sai Thong Beach around the shell floating basket area and the estuary of Ta Kuan Canal.

The 2010 monitoring results showed that the **water quality** was mostly in the highly deteriorated condition due to water from public canals being discharged into the sea. Parameters exceeding the marine water quality standards were Dissolved Oxygen (DO), Total Coliform Bacteria (TCB), Fecal Coliform Bacteria (FCB), Zinc (Zn), Manganese (Mn), Mercury (Hg), Arsenic (As) and Petroleum Hydrocarbon. For the **quality of surface sediments**, problems were detected at the estuary of Chak Mak Canal with black sediments containing high level of Organic Carbon and the smell of Hydrogen Sulfide (H_2S), the same problems as detected since 2007. In 2010, the levels of all heavy metal parameters in sediments were within the draft coastal sediment quality guidelines at the level of Effects Range Median (ERM). The **quality of aquatic animal tissues** was found to be within the contaminated food standards under the Notification of Ministry of Public Health.

3. Groundwater

The groundwater monitoring was conducted on 33 community areas surrounding Map Ta Phut Industrial Estate and other areas in Rayong pollution control area. The monitoring was carried out 3 times/year in 2010 through 94 wells, divided into 29 groundwater wells, 18 monitoring wells and 47 shallow wells. The results showed that parameters exceeding the groundwater quality standards under the Notification of National Environmental Board, No. 20 (B.E. 2543/2000) and groundwater quality standards for consumption were Arsenic (As), Iron (Fe) and Manganese (Mn). A contamination of Volatile Organic Compounds (VOCs) was still limited in some areas, mostly in the industrial plant areas. Major contaminants that were in the group of Chlorinated Hydrocarbon were Tetrachloroethylene and Trichloroethylene.

● Air quality

1. Basic air pollutants in atmosphere: During 2007 – 2010, the monitoring results of the average and highest values of Sulfur Dioxide (SO₂), Nitrogen Dioxide (NO₂) and Carbon Monoxide (CO) were within the standards, unchanged when compared to 2007. Meanwhile, the values of Ozone (O₃) and Particulate Matter (PM) sized no larger than 10 microns were mostly within the standards. The values were found to occasionally exceed the standards in some areas.

2. Volatile Organic Compounds (VOCs) in atmosphere: The monitoring had continuously been conducted since 2006 with 7 monitoring stations in Map Ta Phut and nearby areas which were Map Chalude Temple, Ban Nong Feab School, Map Ta Phut Public Health Station, Ban Ta Kuan Public Health Service Center, Bang Plong Community, Muang Mai Map Ta Phut and Noppaket Village. As well, there were 2 monitoring stations in the IRPC industrial estate which were Ban Nong Chok Public Health Station and Pluak Ket Temple, bringing the total stations to 9 stations. Samples were collected at least 1 time a month for a continuous period of 24 hours. The monitoring results in 2010 can be concluded as follows.

2.1 Map Ta Phut and nearby areas

- **Comparing 24-hour monitoring values:** It was found that Benzene value exceeded the monitoring value in July at 1 station which was Ban Plong area.
- **Comparing annual standard values:** VOCs were mostly within the standards. However, 3 substances were found to exceed the standards namely Benzene, 1,3-Butadiene and 1,2 – Dichloroethane as follows.
 - Benzene exceeded the standard in 6 stations which were Map Ta Phut Public Health Station, Muang Mai Map Ta Phut, Ban Plong, Nongfab, Ta Kuan and Noppaket. The overall value tended to increase from 2009 in almost every station, except Muang Mai Map Ta Phut where the value decreased. Ban Plong had the highest increased value.
 - 1,3-Butadiene exceeded the standard in 1 station which was Map Ta Phut Public Health Station. The overall value tended to slightly decline from 2009, except Noppaket Village and Ban Plong where the value increased, but remained within the standard.
 - 1,2 – Dichloroethane exceeded the standard in 4 stations which were Muang Mai Map Ta Phut, Ban Plong, Map Chalude Temple and Noppaket. The overall value tended to slightly increase from 2009. Values at Noppaket Village and Ban Plong increased to exceed the standard.

2.2 IRPC Industrial Estate's nearby areas

- **Comparing 24-hour monitoring values:** VOCs did not exceed the monitoring value
- **Comparing annual standard values:** VOCs were mostly within the standard. However, 2 substances were found to exceed the standard in certain areas namely Benzene and 1,3-Butadiene whose values were higher than the standard in 1 station at Pluak Ket Temple.



Operations to Solve Pollution Problems

1. Solving the contamination of certain Volatile Organic Compounds (VOCs) in the atmosphere

1.1 Accelerate the distribution and use of benzene or EURO 4 gasohol (containing Benzene of 1%; originally not over 3.5% by volume) in Rayong prior to the national enforcement in 2012 (1st January 2012).

1.2 Accelerate the enforcement of the use of Vapor Recovery Unit (VRU) together with the Bottom Loading System by oil service entrepreneurs everywhere in Rayong. Installation was completed since November 2010. The monitoring on vapors discharged from before and after fuel transferring activity found that the installation of VRU was able to reduce the releases of VOCs at a fuel transfer point by up to 90%.

1.3 Establish a standard to control the release of VOCs from major sources such as guidelines for activities outside usual operations (Shutdown/ Turn Around/ Start Up) namely suspending operations for annual maintenance, starting operations after maintenance, suspending production process for system improvement/ maintenance/ replacement of raw materials or products that may be a significant cause of VOCs releases, evaluating and determining the reporting system as well as regulating the implementation of such measures.

2. Rehabilitation of the accumulation of contaminated black sediments in Pradu Bay at the estuary of Chak Mak Canal

2.1 **Short term:** Industrial Estate Authority of Thailand will conducted studied to set up guidelines and detailed process to rehabilitate the accumulation of contaminated black sediments in Pradu Bay at the estuary of Chak Mak Canal. The studies also included the risk assessment and rehabilitation operation with academic support from Pollution Control Department, Marine Department, Map Ta Phut Municipality and Rayong Administrative Organization as well supported the area rehabilitation.

2.2 **Long term:** Industrial Estate Authority of Thailand will seek management measures for wastewater discharged into Pradu Bay which were constructing a weir in Chak Mak Canal and reusing water in Chak Mak Canal and wastewater that has been treated, seeking measure to establish a Marine Outfall under the conditions stated in the Environmental Impact Assessment report.

2.3 Investigating the source of petroleum hydrocarbon contamination in order to prevent the accumulation of sediments in Pradu Bay in the future.

3. Solving contaminated soil and groundwater problems

3.1 Entrepreneurs were required to monitor the quality of soil and groundwater to be in accordance with the standards under the Notification of National Environmental Board by examining the quality of soil and groundwater prior to business operations in order to have baseline data in place. Groundwater monitoring wells were also required to be established in all areas for monitoring the quality of soil and groundwater.

3.2 Determining the type of business operations which should be businesses possessing hazardous materials that contained components as stated in the soil and groundwater quality standards, businesses with waste and material piles or underground storage tanks and type 101, 105 and 106 factories.

3.3 Determining the criteria and guidelines for rehabilitation through health and environmental risk assessment. As well, determining rehabilitation measures and operations that were suitable for the problems in the area.

4. Solving solid waste problem in Map Ta Phut Municipality

The subcommittee in charge of following up on the operations to solve problems in Map Ta Phut and nearby areas in Rayong, with the Secretary-General to the Prime Minister acting as the chairman, had approved to close the landfill site of Map Ta Phut Municipality as well as to control the leakage of water

from solid waste into groundwater and conduct water treatment by using budget of 85 million baht. A budget of 185 million baht was allocated to establish buildings for categorizing solid waste and establish landfills. The budget was as well for the installation of waste categorizing equipment at the waste disposal center of Rayong Administrative Organization in order to support solid waste newly generated in Map Ta Phut Municipality. A budget of 60 million baht was also allocated for Map Ta Phut Municipality to build a waste transfer station in order to collect municipal waste before disposing of at the waste disposal center of Rayong Administrative

5. Strengthening the public network in surveillance and monitoring the environmental quality

Establishing an environmental conservation volunteer network of Rayong with an aim to raise awareness and promote participatory environmental conservation. The network was also aimed at enhancing environmental knowledge for the public in surveillance and monitoring the quality of environment in communities as well as cooperating and strengthening mutual understanding between the people and the government in conducting operation in Rayong. Currently, the “Environmental Conservation” volunteer network consisted of 767 members who represented the communities to monitor and keep watch on the environmental quality in the areas.

Management Mechanism for Operation on Solving Problems in Map Ta Phut

Establishing a mechanism in the form of committee to coordinate, regulate and follow up on the operation results under the action plans aimed at reducing and eliminating pollutions in Rayong pollution control area as well as solving pollution problems in Map Ta Phut and nearby areas as follows.

1. Subcommittee follows up and reports on the results of operations to solve problems in Map Ta Phut and nearby areas in Rayong with Secretary-General to the Prime Minister acting as the chairman. Subcommittee is responsible for cooperating, accelerating and following up on the operation progress regarding solving problems in Map Ta Phut area. Their duty as well includes proposing ideas and guidelines to resolve operation problems and obstacles to the cooperation committee and driving operations in accordance with the resolution of the cabinet and the Prime Minister.





2. National Environmental Board appointed 2 subcommittees

2.1 Subcommittee Oversees the Solution to Pollution Problems in Rayong Pollution Control Area and Nearby Areas with the Permanent Secretary of Ministry of Natural Resources and Environment acting as the chairman. The subcommittee is responsible for regulating, driving and following up on the operations under the action plan aimed at reducing and eliminating pollutions in Rayong pollution control area as well as solving pollution problems in nearby areas. The subcommittee also conducts studies, regulates and provides academic advice relating to solving pollution problems, restoring the environmental quality and the health impacts of people in Rayong pollution control area and nearby areas.

2.2 Multilateral Subcommittee for Resolving Pollution Problems and Developing the Quality of Life in Rayong with the Governor of Rayong acting as the chairman. The multilateral subcommittee is responsible for cooperating in following up, evaluating and monitoring the operations under the action plan aimed at reducing and eliminating pollutions in Rayong pollution control area. Their duty is also to regulate environmental operations of industrial factories in the area and to continuously promote participation from all sectors, distribute information and build awareness with the people.



2.3 The Solution to Haze Pollution Problems in the Upper Northern Region

The haze problem in the upper northern region of Thailand usually occurs during the dry weather condition in the beginning of the year and continues to take place for many years. The major cause is the open burning such as the burning of agricultural waste, the burning of solid waste and forest fires. As well, during such period, the cold air mass has started to cover the upper northern region. The dry and stagnant weather condition allows particulate matters to linger on in the air for a long period of time without spreading and falling to the ground. This condition leads to a dim weather covered by haze, affecting the visibility in air and road traffics as well as the environmental quality and the health of people in the areas.

Situations of open burning and haze pollution

The monitoring of the air quality in the Upper North had continuously been carried out since 1996 until present through air monitoring stations in 8 provinces in the Upper North in order to monitor the level of Particulate Matter (PM₁₀). It was found that Chiang Rai had the highest numbers of days that PM₁₀ exceeded the standard which was 43 days out of the total 119 monitoring days (Table 36).

Table 36 : Monitoring Results of Air Quality (Level of 24-Hour Average Particulate Matter: PM₁₀ at 09.00 a.m.) in the Upper North during January – April 2010

Province	No. of day that PM ₁₀ exceeded standard				Total no. of day		Range of Data (ug/m ³)	Date that PM ₁₀ was highest
	Jan	Feb	Mar	Apr	Monitored	Exceeding standard/ (%)		
Chiang Mai	0	1	10	11	120	22 days / (18)	12.3 – 279.9	17– Mar – 53
Lamphun	0	8	19	13	120	40 days / (33)	23.8 – 350.3	17– Mar – 53
Chiang Rai	0	6	24	13	119	43 days / (36)	28.4 – 291.9	26 – Mar – 53
Mae Hong Son	0	2	25	10	118	37 days / (31)	25.9 – 518.5	18 – Mar – 53
Lampang	0	11	16	3	120	30 days / (25)	18.2 – 200.4	17 – Mar – 53
Phayao	0	5	22	6	102	33 days / (32)	29.1 – 271.0	17 – Mar – 53
Nan	0	0	19	5	120	24 days / (20)	14.3 – 181.3	9 – Mar – 53
Phrae	0	0	0	0	120	0 day	27.8 – 105.4	26 – Mar – 53

Remark : 24-hour average PM₁₀ standard must not exceed 120 micrograms/cubic meter

According to the assessment of the fire risk areas in the country through the satellite images, the total numbers of hotspots could be divided into 25% found in the conserved forest areas, 41% in the reserved forest areas and 34% in the agricultural areas (Figure 52). The hotspots occurring in 8 upper

Northern provinces represented 42% of the total hotspots in 2010. When dividing into proportions by land utilization, 33% was in the conserved forest areas, 55% was in the reserved forest areas and 12% was in the agricultural areas (Figure 53). Mobile plantations remained high in the forest areas in the Upper North which was one cause of forest fires. The fire risk areas with 5 highest numbers of hotspots were Wiang Sa District (581 hotspots) of Nan, Tha Song Yang District (465 hotspots) and Umphang District (449 hotspots) of Tak, Mae Jam District (446 hotspots) and Om Koi District (429 hotspots) of Chiang Mai.

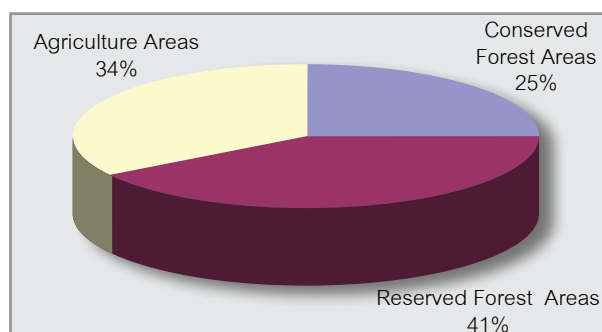


Figure 52 : Proportions of Hotspots in Thailand by Land Utilization

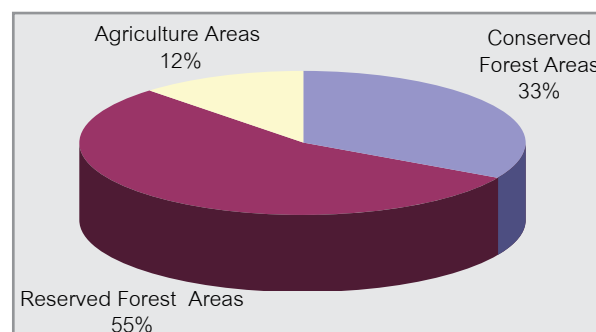


Figure 53 : Proportions of Hotspots in 8 Provinces in Upper North by Land Utilization

Measures to solve haze problem

With an aim to create an integrated implementation of measures in solving the haze problem in the Upper North and efficient solution, various agencies had collaborated in executing measures as follows.

1. The cooperation between provinces and related agencies

- Cooperating with provinces where a high number of hotspots were detected or the level of PM_{10} exceeded the standard in order to notify local agencies, local administrative organizations, subdistrict headman and village headman to monitor forest fires. Prohibiting the burning of solid waste and agricultural materials and spraying water on the roads to reduce the spread of particulate matters.

- Coordinating with related agencies including Department of Highways, Department of Rural Roads and Agricultural Land Reform Office in order to ensure strict control on open burning and burning on roadsides in the fire risk areas.

2. The preparation for forest fires

In order to cope with forest fires that may occur during the dry weather condition, various agencies had prepared to deal with the forest fire situations by cooperating with provinces to establish a provincial cooperation center for forest fire management. The agencies also prepared an action plan to control forest fires in the conserved forest and the national reserved forest areas. There was also a preparation of teams to help extinguish forest fires in their responsible areas. The agencies tightened up the measures on individuals who entered the forest areas and adjacent areas to conduct activities as well as promoted careful use of fire in activities if unavoidable and careful handling of fuel into the areas. Fire breaks were set up in the areas connecting between villages or agricultural areas and forest areas. In addition, the trainings for volunteer forest fire fighters were provided. The subdistrict rescue teams were also tasked to extinguish forest fires.

3. The preparation of agencies in 8 Upper Northern provinces

Ministry of Interior had declared the haze problem as an urgent agenda of the provinces that required participation from the general public and various sectors to solve the problem. The provinces established provincial administration and cooperation centers to tackle haze and forest fire problems. Provincial announcements were issued to set measures on controlling and preventing haze and forest fires. Villages' forest fire control areas were as well announced. Memorandums of understanding were signed with Local Administration Organizations on the surveillance system. There were organizations of campaigns on preventing and eradicating the haze and drought problems. Knowledge regarding participatory management of haze and forest fires was disseminated. They also cleaned roads, sprayed water to increase the moisture in the air for reducing dust in the urban area and sought public cooperation on suspension of garbage burning and open burning of agricultural waste through public relations. Weed burning on the roadsides was strictly prohibited. The explanation to the public regarding the situation and correct self-protection method was conducted in order to promote public sanitation.

4. The control of burning on public roadsides

Ministry of Transport had issued measures strictly prohibiting the burning of roadside weeds as well as established measures to prevent fires and to extinguish fires at public roadsides.

5. The cooperation agreement on preventing and resolving open burning problem and haze pollution in the Upper North

On 25th January 2010, Pollution Control Department had organized a signing ceremony for cooperation in preventing and resolving open burning problem and haze pollution in the Upper North among 7 agencies which were Office of the Prime Minister, Ministry of Defense, Ministry of Agriculture and Cooperatives, Ministry of Transport, Ministry of Interior, Ministry of Public Health and Ministry of Natural Resources and Environment (Figure 54). The purpose of the event was to announce the intention to cooperate in the conservation of natural resources and environment, the rehabilitation of the air quality in communities and the implementation of measures to prevent and solve haze pollution caused by forest fires and open burning. Areas of cooperation included 1) the preparation of Local Administrative Organizations and related agencies 2) the regulation and enforcement of the laws 3) the monitoring, surveillance, prevention and extinguishment of forest fires 4) the distribution of information and knowledge and 5) the integration of plans and related information.



Figure 54 : The Signing Ceremony for the Cooperation Agreement on Preventing and Resolving Open Burning Problem and Haze Pollution in the Upper North



6. The action plan on tackling haze and forest fire problems in 2010 and the management plan for haze and forest fire problems 2012 - 2016

The National Forest Fire and Haze Management Committee, in its No. 1/2553(2010) meeting on 21st January 2010, had approved the action plan on solving haze and forest fire problems in 2010 and assigned related agencies to execute the plan. The Upper North forest fire and haze management subcommittee was also appointed. In addition, Pollution Control Department was in the drafting process of the haze and forest fire management plan for 2012 – 2016 through organizing meetings to obtain ideas from related agencies. The haze and forest fire management plan for 8 provinces in the Upper North was also established to be in line with the problems. The practical solution plan was as well in place.

7. Management of pollutions from haze and forest fires at the area level

The pilot centers for management of pollution from haze and forest fires were operated in 5 areas which were 1) Ban Pan Pongchai, Chae Hom District, Lampang 2) Ban Nabon, Soem Ngam District, Lampang 3) Ban Pachan, Wiang Pa Pao District, Chiang Rai 4) Ban Pi Nua, Ban Luang District, Nan and 5) Ban Rongpo, Phu Kamyao District, Phayao. The centers provided training for staff and volunteers in the area in order to prepare for operation in monitoring and keeping watch on the haze and forest fires. The centers also prepared guideline manual for the management of haze and forest fire problems in the area as well as best practices to reduce the open burning based on successful cases for distribution and practical use. The centers were aimed to enhance the capacity and strength of community such as career development and creating alternative income from forest invasion. Other objectives were to build awareness on forest conservation and burning reduction which included afforestation, the building of check dams, forest expansion and creating village regulations (Figure 55). The action plan to eradicate the haze and forest fire problems at the area level was conducted in order to cope with haze and forest fire situations in 2011.



Figure 55 : Crop planting, afforestation, chicken farming instead of searching for forest products and capacity building workshops for volunteer network.

8. The international cooperation on transboundary haze pollution control

Pollution Control Department served as a focal point of international cooperation on the transboundary haze pollution as follows.

- **The 5th Meeting of the Technical Working Group on Transboundary Haze Pollution in the Mekong Sub-Region (TWG-Mekong)** was held in Vientiane, Lao People's Democratic Republic, during 25th – 26th February, 2010. Member countries at the meeting agreed on increasing the stringency in monitoring the fire and haze situations in their own countries. The meeting also approved Thailand's proposal to gather the needs of member countries regarding the development of capacity in bringing solution to the transboundary haze problem and prepare a project proposal in order to obtain financial support from international organizations and other financial sources under the ASEAN framework.

- **Implementation of Collaboration Project on the Air Quality Monitoring in the Mekong Sub-Region** in which Thailand had provided help for Lao People's Democratic Republic and Union of Myanmar in sending the mobile air quality monitoring unit to examine the air quality in Laos and Myanmar during the dry season in 2010 in order to monitor the air conditions in the case of forest fire (Figure 56).

- **The Sub-Regional Ministerial Steering Committee (MSC) on Transboundary Haze Pollution in the Mekong Sub-Region** was established to oversee the implementation of measures to control and solve the open burning problems as well as the transboundary haze pollution in the Mekong Sub-Region. Thailand was set to host the 1st Meeting of the Sub-Regional Ministerial Steering Committee (MSC) on Transboundary Haze Pollution in 2011.



Figure 56 : Launching Ceremony of Mobile Air Quality Monitoring Unit from Thailand to Lao People's Democratic Republic and Union of Myanmar

Operations to solve smog problem in the northern region had been carried out by allowing participation from all sectors, particularly the people sector, in bringing the solution and seeking integrated preventive measures. Eight provinces in the Upper North had placed importance on the issue and given serious and continuous participation. As a result, the problems were immediately solved. In 2010, there was no haze in the southern region of Thailand.



2.4 The Solution to Environmental Problems caused by Flood

Flood that occurred during October – November 2010 can be seen as one of the severe floods in Thailand in many decades. One of the main causes of this flood was heavy rain in several areas which was influenced by low air pressure in Central, Eastern and Upper Southern regions of Thailand. Moreover, Southwest monsoon was also another cause of sudden flooding and cataract rushed into houses, properties and agricultural areas which were damaged. The flood affected people's lives and created environmental problems.



Flood is a natural disaster caused by high amount of rainfall that has continually fallen in watershed areas for a long period until water flows into channels, streams and rivers more than usual. If amount of additional water is higher than river's capacity, river will overflow its banks or rush into lowlands. If there is no proper drainage system in lowland and community areas, the area will be flooded once heavy rain has been pouring constantly. This will destroy residential areas, communities and agricultural areas. **Diseases caused by flood** such as skin disease, respiratory disease and Leptospirosis are the problems occurred after flooding. These diseases are generated by germs that spread out through the water as well as contaminated food. Another problems caused by flood were **residual waste and decay** resulting from





accumulation and residue of municipal waste or toilet blockage. Flood can also **damage infrastructure systems and structures**. For example, water supply system was unable to distribute tap water to the consumers, waste disposal site was unusable and drainage system, sewage system and wastewater treatment plant were malfunctioned. Moreover, after floodwater reduced, there was a **particulate matter problem** which affects respiratory system and well-being of people in roadside areas. **The deterioration of water quality in water sources** was also one of the problems that have an impact on people in downstream areas, source of water supply and the consumers. The vital environmental damage and impact from flooding in 2010 can be found as follows:



● Wastewater treatment plant and municipal waste disposal system

There were total 15 wastewater treatment plants that were affected from flood. The main damage was the wastewater collection system or wastewater pumping stations which were flooded that destroyed electrical equipment in the pumping stations. For instance, wastewater pump or control system was destroyed and unable to deliver wastewater into the treatment plant. Budget for improving and repairing all of the wastewater treatment plants was 34,582,700 baht. Regarding the waste disposal system, there was 1 system damaged as entrance road and waste disposal pit were flooded. Total restoration budget for both wastewater treatment plant and waste disposal system was 35,137,430 baht (Table 37).





Table 37 : Summary of Damage Assessment on Municipal Wastewater Treatment Plant and Municipal Waste Disposal System from Flood in 2010

No.	List	Cost (baht)
Municipal Wastewater Treatment Plant		
1	Tha Tago Subdistrict Municipality, Nakhon Sawan	379,200
2	Nakhon Ratchasima City Municipality	1,878,900
3	Pak Chong Town Municipality, Nakhon Ratchasima	4,606,400
4	Bua Yai Town Municipality, Nakhon Ratchasima	456,700
5	Kham Thale So Subdistrict Municipality, Nakhon Ratchasima	200,600
6	Singburi Town Municipality	763,800
7	Ang Thong Town Municipality	386,700
8	Suphanburi Town Municipality	1,440,700
9	Koh Samui Town Municipality (Chaweng Community), Surat Thani	4,651,600
10	Koh Samui Town Municipality (Nathon Community), Surat Thani	2,065,700
11	Koh Samui Town Municipality (Lamai Community), Surat Thani	620,100
12	Hat Yai City Municipality, Songkhla	11,821,200
13	Songkhla City Municipality	5,010,600
14	Klong Ri Subdistrict Administrative Organization, Songkhla	212,300
15	Ao Nang Subdistrict Administrative Organization, Krabi	88,200
	Total	34,582,700
Municipal Waste Disposal System		
1	Songpeenong Town Municipality, Suphanburi	554,730
	Total Damage	35,137,430

• Water quality

During the flood, water level of many rivers was high and several areas were flooded, numerous water sources were affected. Dissolved Oxygen (DO) of these resources was lower than the normal level but still not harmful to aquatic animals (not below 2 mg/l). The reason of the low DO was from washing off dirt, nutrients and organic matters into water sources. However, there were deteriorated water sources (DO was in the range of 2 - 4 mg/l) which were required the monitoring of water quality. These water sources were as follows:



Bang Pakong River	DO	was in the range of	2.5 – 3	mg/l
Tha Chin River	DO	was in the range of	2 – 3	mg/l
Lower Yom River	DO	was in the range of	3 – 4	mg/l
Chao Phraya River	DO	was in the range of	3 – 4	mg/l
Prachinburi River	DO	was in the range of	3 – 4	mg/l





The related organizations had solved environmental problems in flooding areas especially wastewater and municipal waste management as follows:

1. Distributing handbook of water pollution management in flooding situation and protection and pollution reduction plans in flooding situation to Provincial Office of Natural Resources and Environment in flooding areas in order to use as a guidelines.

2. Continually surveying flooding areas and monitoring water quality in both floodwater in flooding areas and surface water resources.

3. Evaluating damage of wastewater treatment plant and municipal waste disposal system and improving and repairing budget and proposing to the cabinet for financial support. Ministry of Interior was responsible for coordinating with the related Local Administrative Organizations to verify information and precipitate operations by using Local Administrative Organizations' budget, if there was a need of additional fund, Ministry of Interior will manage budget allocation from Flood Damage Restoration Project of the Department of Local Administrative.

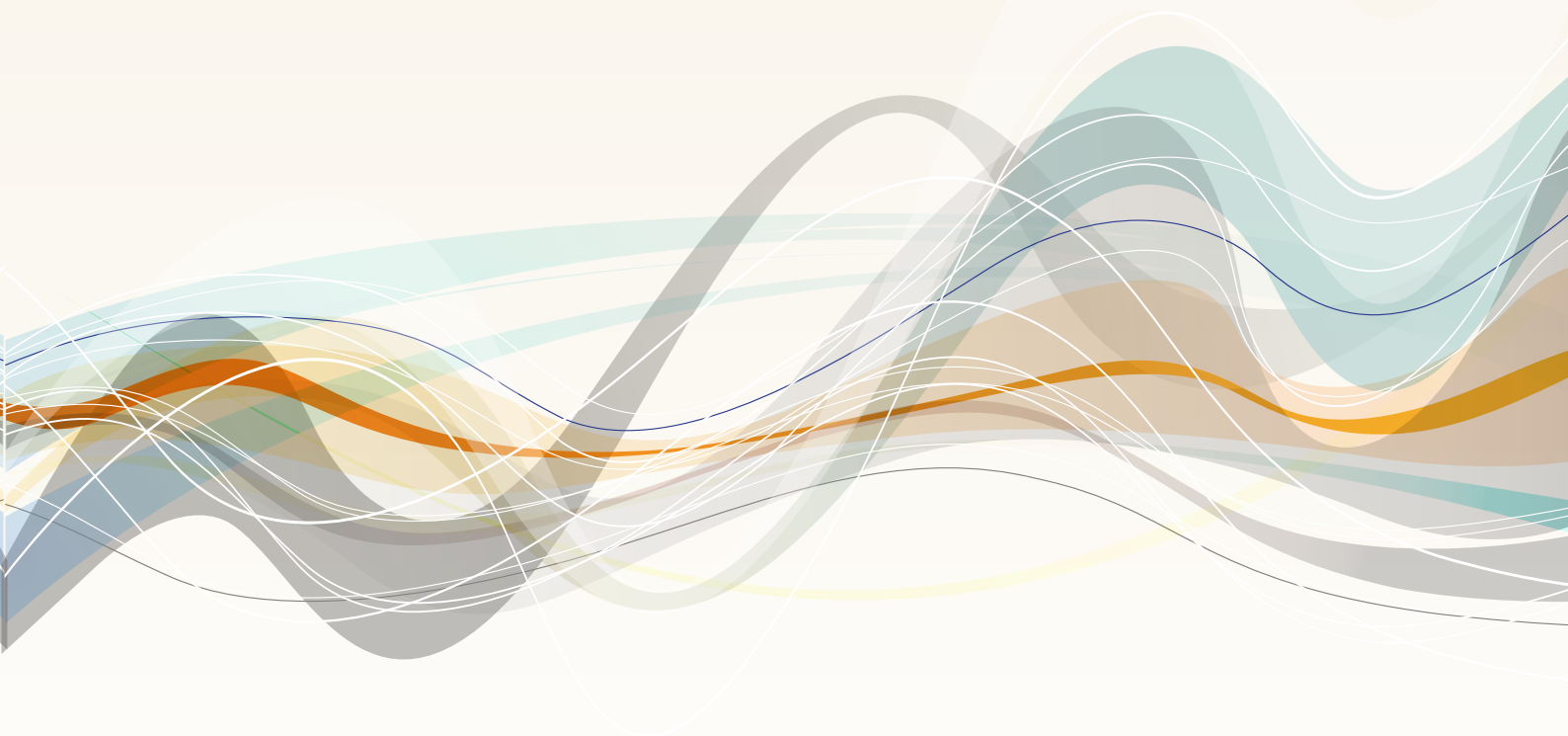
4. Supporting local administrative offices in floodwater treatment in areas that unable to drain floodwater by providing bio-extract to Subdistrict Administrative Organizations that experienced problems including publicize the name of organizations that produce biological extracts for wastewater and odor treatment in several websites such as Pollution Control Department's website (www.pcd.go.th), and Mekhala Center's website, Department of Water Resources (<http://mekhala.dwr.go.th/main>).







3. Pollution Management



3.1 Overall Pollution Management Operation

1. In Fiscal year 2010, budget of 8,116.5364 million baht which was 0.48% of national budget (1,700,000 million baht) was allocated to various agencies for pollution management. The pollution management budget was divided into 2 parts. The first part of the budget, 4,910.3427 million baht, was for land, natural resources and environmental management strategy/ natural resources conservation and management plan and environmental quality management plan. Another 3,206.1937 million baht was assigned to strategy on managing governmental administration efficiently and fairly, and promotion Local Administration (Figure 57).

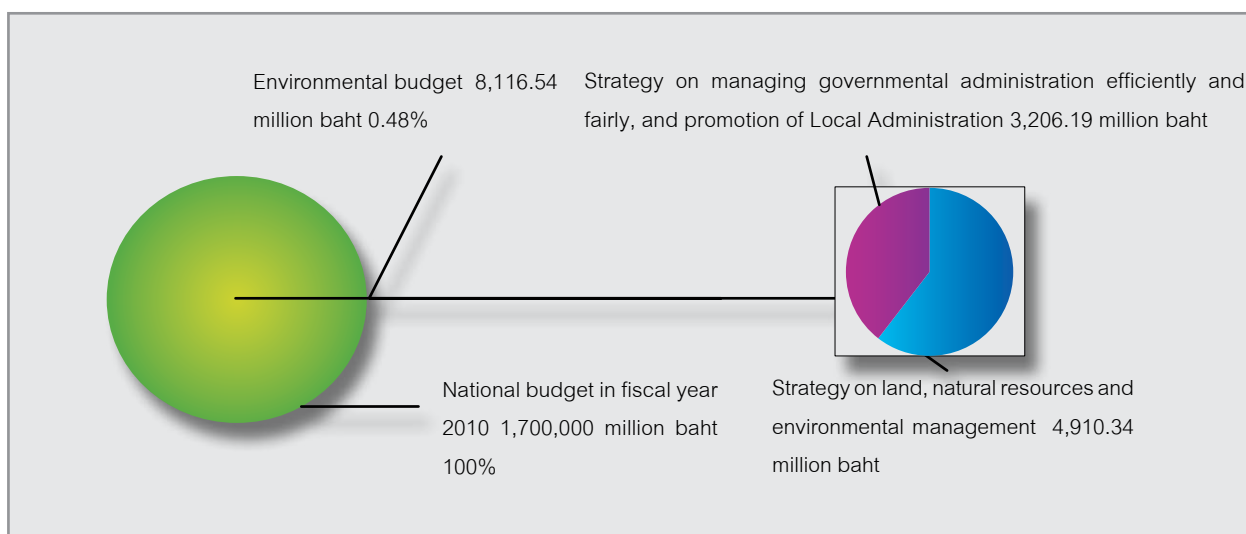


Figure 57 : Proportions of Thailand's Environmental Budget in the Fiscal Year 2010

2. Pollution management in 2010 focused on operations in both priority areas and policy level areas by integrating collaboration with all sectors to precipitate measures and mechanisms such as laws, standards, pollution management master plans, economic, finance and treasury and social measures



Water pollution management : Organizing a public campaign on reducing wastewater by lowering water usage, managing wastewater at origin by treating wastewater at home, constructing and efficiently operating municipal wastewater treatment plants by Local Administrative Organizations, determining and collecting wastewater treatment service fee in order to maintain the plants, gathering information for consideration on collecting wastewater treatment fee together with water supply charge, encouraging business operators to manage waste and treat wastewater before discharging to the environment, monitoring and enforcing related laws to sources of pollution to have proper wastewater treatment and sewage system according to the standards, determining regulations and criteria that business operators shall establish wastewater and waste management guidelines in order to request operating permit, campaigning on reducing chemical fertilizer usage and making organic fertilizer and biogas out of waste.

Air and noise pollution management : Controlling pollution in urban areas by detecting auto vehicles with emission exceeded pollution standards, promoting preventive customization and maintenance system in vehicles used for transportation and public transportation, controlling particulate matter from construction activities and cleaning roads in urban areas regularly, resolving pollution problems in areas that pollution sources are from industry and restricted businesses such as areas in Rayong and Samut Prakan, controlling and supervising stone crushing and grinding quarry in Saraburi, resolving haze pollution and forest fires problems in the Upper Northern and Lower Southern regions by prohibiting open burning (waste, grass and weed burning at roadside), controlling burning in agricultural sector, developing monitoring and warning system for air and fog and smoke pollution, controlling noise pollution caused by traffic by detecting auto vehicles that exceeded noise standards, encouraging people to maintenance their vehicles and business operators to improve their auto vehicles in accordance with the new standards which are going to be declared effective.

Solid waste and hazardous substance management : Public participation on reducing, sorting and utilizing solid waste (Reduce Reuse Recycle: 3Rs), encouraging Local Administrative Organizations to operate solid waste and municipal hazardous waste management service by increasing Local Administrative Organizations efficiency, determining and collecting waste management service fees in order to maintain the system, encouraging waste-purchasing shops to have the good management system and minimize impact on the environment and people, precipitating laws on used electrical and electronics products disposal, supervising on industrial hazardous waste, hazardous substance and chemical pesticides.





3.2 New and Important Measures and Mechanisms in 2010

1. Pollution and Environmental Laws

1.1 Water Pollution Laws which were

- Wastewater treatment service fee in Mae Sod Town Municipality, Tak; Hua Kwang Subdistrict Municipality, Maha Sarakham; Mukdahan Town Municipality, Mukdahan; Hua Hin Town Municipality, Prachuab Khiri Khan and Patong Town Municipality, Phuket.
- Standards for effluents discharged from pollution sources in category of swine farms, municipal wastewater treatment system and design criteria of municipality's wastewater collection and treatment system.
- Determining category of water resources in Kwaë River, Weru River and Pangrad River.
- Determining classification and list of hazardous substance and standards for discharging hazardous into the sea.
- Regulations on permission to transfer items that could be harmful.
- Determining industrial standard of faucet for sanitary wares.

1.2 Air and Noise Pollution Laws which were

- Standards and measurements of Particulate Matter less than 2.5 micron in atmosphere, vibration standards, odor standards of air pollutants emitted from pollution sources, noise standards of auto rickshaws and boats, air emission standards for new power plants, natural gas separation plants, industrial chemical factories and municipal waste incinerators, emission control standards of gasoline vapors from fuel depots, standards for black smoke emitted from vehicles that have compression-ignition engine.
- Determining category of factories in the industrial estate that have to install special tools or equipment in order to monitor emission air quality automatically.
- Determining fuel discharge and supply system above gasoline vapors controlling tank B.E. 2553 (2010) and determining areas that have to install gasoline vapors controlling system.
- Determining characteristics and quality of gasoline, diesel fuel, gasoline base and gasohol including regulations on receiving approval for adding fuel additives and characteristics and quality of fuel for the part that not comply with Department of Energy Business Regulations B.E. 2553 (2010).
- Determining product standards of large automotive industry that used spark-ignition engine and natural gas or liquefied petroleum gas as a fuel and determining product standards of ethanol industry which used as a fuel and industrial uses.



1.3 Waste and Hazardous Substance which were

- Municipal waste disposal service fee in Trat Town Municipality, Trat; Sadao Town Municipality, Songkhla; Klaeng Town Municipality, Rayong; Chiang Yuen Subdistrict Municipality, Maha Sarakham, Ta Klee Town Municipality, Nakhon Sawan and Maha Sarakham Town Municipality, Maha Sarakham.
- List of data, documents and evidence of hazardous substance registration B.E. 2553 (2010), examining documents for hazardous substance registration under Department of Agriculture B.E. 2553 (2010) including giving notice, issuing receipt of notice, application extension and extension of receipt of notice on type 2 hazardous substance operation in accordance with Department of Agriculture B.E. 2553 (2010).

1.4 Others which were

- Determining category, size and operation procedures of projects or businesses that may severely affect community on environmental quality, natural resources and health. These projects or businesses of governmental agencies, state enterprises and private sectors were required to produce the environmental impact assessment report B.E. 2553 (2010).
- Determining areas and environmental protection measures in Krabi, Ban Leam District, Muang District, Phetchaburi, Tha Yang District, Cha-am District, Phetchaburi, Hua Hin District and Pranburi District, Prachuab Khiri Khan, Bang Lamung District and Sattahip District, Chon Buri and Phuket B.E. 2553 (2010).
- Notification on training course for controlling, transporting and gas filling workers, determining category or type of factory that was required to produce report of the types and quantities of pollutants emitted from the factory and waiving annual fee for factories that utilized waste disposal and materials from operation.
- Determining regulations of land allocation in the industrial estate areas.
- Determining name or category of public places that protect non-smokers' health and determining part or the whole public places to be smoking area or non-smoking area.
- Determining energy efficiency ratio, energy efficiency standards testing agency and energy efficiency ratio testing methods of high-efficiency air conditioners and high-efficiency refrigerators.

1.5 Pollution and Environmental Local Ordinances which were local ordinances related to food shops and food accumulated sites, local ordinances related to the disposal of municipal waste and sewage, local ordinances related to product distribution in public areas or on the public ways, local ordinances related to installation of grease trap in the building, local ordinances related to the control of fires and particulate matters from open burning, local ordinances related to businesses that were harmful to health, local ordinances related to the control of animal farming or grazing, common house mosquito breeding sources and causes of nuisance.

2 The Solution to Salinity Usage in Freshwater Aquaculture

2.1 The National Environment Board at its 3/2553 (2010) meeting on 8th July, 2010 has agreed on the solution guidelines on marine aquaculture in freshwater according to the proposal of Ministry of Natural Resources and Environment which amended Prime Minister's statement No. 2/2541 (1998) signed on 22nd July 1998 from **To refrain low salinity tiger prawn culture system in freshwater areas to To refrain salinity usage in aquaculture in freshwater areas**. However, after enacted the refrain order, if anyone is in the midst of aquaculture processes, it is allowed to operate each process and catch aquatic animals within 120 days. Moreover, the Board has assigned Department of Fisheries and Land Development Department, Ministry of Agriculture and Cooperatives to conduct a master plan for aquaculture in the country which considers potential of areas and environmental impact including studying impact of salinity usage in aquaculture and assigned Office of Natural Resources and Environmental Policy and Planning, Ministry of Natural Resources and Environment to prepare a draft of Prime Minister's statement in accordance with the meeting resolution and propose to the cabinet afterward.

2.2 The Cabinet at the meeting on 7th September 2010 has agreed on the solution guidelines on marine aquaculture in freshwater in accordance with agreement of National Environment Board No. 3/2553 (2010) dated 8th July 2010. Nevertheless, it shall be an exception for aquaculture in government's aquaculture hatchery facilities and the existing aquariums under the conditions that area extension was prohibited and water treatment and control system shall be installed including the efficient management in order to minimize impact on environment and nearby areas. Furthermore, the cabinet has agreed on Prime Minister's statement which has authorized Bangkok Governor and all Provincial Governors to refrain salinity usage in aquaculture in freshwater areas according to the proposal of Office of Natural Resources and Environmental Policy and Planning, Ministry of Natural Resources and Environment. In addition, the cabinet has also assigned Department of Fisheries and Land Development Department, Ministry of Agriculture and Cooperatives to urgently conduct a master plan for aquaculture in the country which considers potential of areas and environmental impact including studying impact of salinity usage in aquaculture and prepare impact reduction measures and relief measures for people affected by the solution guidelines on marine aquaculture in freshwater proposed by Ministry of Agriculture and Cooperatives.

2.3 Prime Minister issued a statement No. 6/2553 (2010) on 24th December 2010 to amend Prime Minister's Statement No. 2/2541 (1998) dated 22nd July 1998 on authorization Provincial Governor to be Prime Minister's representative to refrain low salinity tiger prawn culture system in freshwater in provincial areas from "To refrain low salinity tiger prawn culture system in freshwater areas" to "To refrain salinity usage in aquaculture in freshwater areas"



3 Fiscal Measures for Environment

Ministry of Finance has prepared the draft “Fiscal Measures for Environment Act” in order to become a master law for other organizations that set environmental mission operation to apply a proper economic tool for environmental management which was defined as a Royal Decree under this draft Fiscal Measures for Environment Act.

Means for environmental management were determined in 6 categories which were 1) Environmental Tax, 2) Management Fee, 3) Product Tax and Surcharge, 4) Deposit Insurance for Environmental Risk and Damage, 5) Trading of Natural Resource Usage Rights or Pollution Emission Rights and 6) Subsidies, Support Measures or other privileges. Moreover, the Environmental Tax Fund and environmental surcharge were established in order to use in the related activities such as subsidies or loans to government agencies and private sectors or expenses and subsidies for environmental management or recycling as well as enhancement and conservation activities.

There were 2 resolutions in the Cabinet meeting on 12th October 2010 which were 1) Approved in principal the draft Fiscal Measures for Environment Act B.E...that was proposed by Ministry of Finance and assigned Office of the Council of State to deliberate the draft and also received the cabinet's resolution for consideration with; then, passed the draft to Coordinating Committee of the House of Representatives to review before propose to the House of Representatives afterwards. 2) Assigned Ministry of Finance, Ministry of Natural Resource and Environment, Ministry of Energy, Ministry of Public Health and Ministry of Industry to take into account the Cabinet's resolution in order to jointly deliberate and submit the result to Office of the Council of State for consideration of the draft Fiscal Measure for Environment Act.

4 Environmentally Friendly Development: Green Thailand

Economic and Industrial development in many years has deteriorated natural resources and environment. The main reasons were ineffective production and superfluous consumption of international community. Therefore, many countries have started adjusting paradigm of production and consumption to be a sustainable way. In Thailand, the related concepts and theories in sustainable development have been used to determine strategies and applied in several production and service sectors in order to make development to be an environmentally friendly development: Green Thailand.

Agricultural sector encouraging organic farming development, improving country's agricultural products and food to be acceptable in world safety standard, educating farmers in sustainable farming, production and marketing planning, sustainable farming enhancement, export promotion, quality control and assurance of organic farm products and marketing development especially organic farm product market.

Industrial sector encouraging sustainable production in every process to reduce environmental impact and regard to users of products and services. For examples, Clean Technology that decrease production costs, reducing resources usage and increasing production efficiency. Eco Design which integrate economic and environment concepts into product design processes. Life Cycle Assessment (LCA) which used data from Thai National Life Cycle Inventory Database (LCI Database) to adjust products. Applying International Organization for Standardization 14000 (ISO 14000) as an assessment tool in order to reduce costs in the long term and increase quality of products and services. Business operators utilized garbage or waste from the production process. Cargo transportation processes which regarded the environment (Green Logistic) in order to reduce garbage, waste and pollution during the transportation. The reasons for this were to create image of products and services toward environmentally friendly marketing which was increasing in Thailand and foreign countries. Business operators were able to request label certification from several organizations such as Green Label from Thailand Environment Institute, Carbon Label, Carbon footprint, promoting the development of clothing to reducing global warming (CoolMode) from Thailand Greenhouse Gas Management Organization (Public Organization). Thus, manufacturers and distributors were able to demonstrate responsibility for social and environment.



Tourism sector developing tourism business operations pattern and traveling methods to be suitable for changes in climate and global warming crisis, energy efficiency, maintaining ecosystem and biodiversity including diversification of products and services, promoting demand and supply in every season, selecting transportation method that produced carbon monoxide the least and selecting environmentally friendly activities.



7 Green

Tourism Authority of Thailand determined 7 concepts to use as practice framework which was called Seven Green Concept according to various elements of each tourism sector. The Seven Green Concept were 1) Green Heart 2) Green Logistics 3) Green Attraction 4) Green Community 5) Green Activity 6) Green Service 7) responsibility for social and environment (Green Plus). Examples of programs that promoted sustainable tourism and protected environment were green national park program, environmental protection declaration program or Low Emission: Tourism Thai, traveling and tree planting to reduce global warming



program, using energy-efficient vehicle in local tourism and cycling travel program. Promoting the services of accommodations and hotels that achieved Green Leaf Standard from Green Leaf Foundation under concept “economic and environmental conservation”. There were 150 green hotels in Thailand.



Environmentally Friendly Building or Green Building established in 2008 to develop tools for efficient environmental and energy management in buildings; starting from building design, construction, management, utilization and maintenance; in order to be a green building. At this moment, it was in the preparation process of regulations which were suitable for both old buildings and new construction buildings.



Environmentally Friendly Products and Services

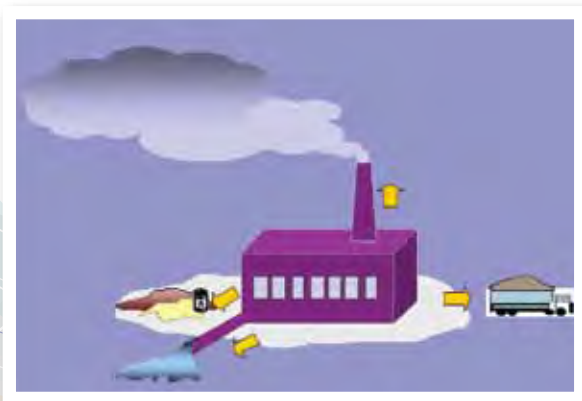
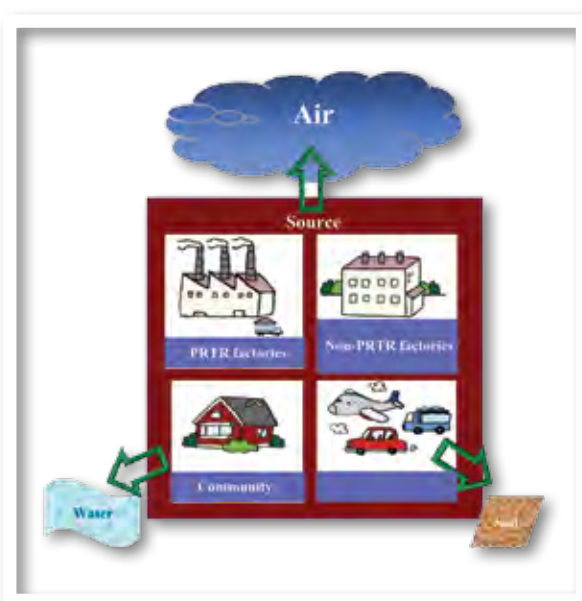
The criteria were established for 17 items of environmentally friendly products and services and 157 government agencies in department level have participated in green procurement of environmentally friendly products and services. In 2010, there were 12 items of environmentally friendly products and services under the consideration of Green Procurement Promotion Committee which was appointed by Pollution Control Committee. These 12 items were vehicles, air conditioners, computers, facsimile machines, lubricant oil, fuel, wooden furniture, plastic waste bins, booklets, gasoline stations, car-care service centers and printing services. To continue the operation and make it more concrete, the promotion plan of procurement for environmentally friendly products and services during 2012 – 2015 was prepared. The key strategies of this plan were 1) strategy to drive procurement volume of government agencies 2) strategy to stimulate the production of environmentally friendly products and services 3) strategy to establish sustainable consumption in public and organizations 4) strategy to manage and control promotion plan of procurement of environmentally friendly products and services to expand the operation into all sectors.



5 Preparation System of Pollutant Release and Transfer Registers (PRTR)

Preparation System of Pollutant Release and Transfer Registers or PRTR system was the database system of pollution emitted from several sources into environment, air, water and soil, including treatment and disposal information of wastewater and waste from factories in order to disseminate to the public. Furthermore, it encouraged industrial factories to apply clean technology to reduce waste that needed to be disposed and pollution emission. Additionally, it can be used as information for pollution management plan of governmental agencies.

Department of Industrial Works, Industrial Estate Authority of Thailand, Pollution Control Department and Japan International Cooperation Agency (JICA) had cooperated in the preparation of “The Development of Basic Schemes for Pollutant Release and Transfer Register (PRTR) System: PRTR in the Kingdom of Thailand”. Rayong was selected to be the pilot study area. The program will operate for 4 years from March 2011 – February 2015. The pilot study in Rayong will start around 2013 – 2014 which will include sources from industrial sector, vehicles, business sector and agricultural sector.





6 Corporate Social Responsibility in Environmental Protection

Nowadays, Thai society has increasingly focused on social responsibility and good governance system. This caused government and private sectors starting to operate businesses to return to the society and apply the Corporate Social Responsibility (CSR) concept in mission and context of organizations/agencies. For instance, “SR Mark (Social Responsibility Mark)’ of Department of Export Promotion, Ministry of Commerce” was the sign that showed the pre-purchase agreement (Contract Farming) more than 50 percent of raw material in order to help farmers to have secure and fair incomes. “Business Compass of the Stock Exchange of Thailand” was the basic principles and concepts of social responsibility of companies registered in the Stock of Exchange of Thailand. “CSR-DIW handbook of Department of Industrial Works” was the guidelines for business operators in the industrial sector towards ISO 26000 standards.

Adopting CSR in business operation of private sectors leaded to disclose information regarding environmental and social operations to the public in Corporate Social Responsibility Report (CSR Report) or Sustainability Report together with Annual Report of organizations at regular basis. The CSR Report shall be prepared in accordance with GRI (Global Reporting Initiative) regulations which included economic indicators, environmental indicators, human rights indicators, workforce indicators, product responsibility indicators and social indicators. The environment indicators shall consider raw material issues, energy issues, water resources usage issues, biodiversity issues, pollution emission issues (water, air and waste), products and services issues, complaints issues and transportation issues. Regarding environmental issues under a draft ISO 26000 (ISO/DIS 26000), it shall consider pollution protection issues, sustainable use of resources, relief and adapting to climate changes and protection and restoration of natural habitats.

The CSR concept played the vital part in driving business operators or volunteers to conduct public activities/programs together in order to improve community, local and environment towards being a hospitable society, maintaining a balance between economic, social and environmental development, reduce disparity between economic classes and improve overall environment.





4. Implementation of International Obligation and Cooperation



4. Implementation of International Obligation and Cooperation

The implementation of international obligation and cooperation on pollution management was one of the important mechanisms that drove towards the integration of environmental management between several agencies and organizations in both country and international levels in order to have overall consistency, knowledge sharing development including development of technology transfer capability and exchange of good pollution management practices for all sectors. In 2010, Thailand has implemented various international obligations and cooperation on pollution management.

4.1 International Obligations

Rotterdam Convention in the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade: PIC

Thailand has acceded to the Rotterdam Convention on 19th February 2002 which enacted on 24th February 2004. The objectives of the Rotterdam Convention were to promote cooperation and share responsibility between member parties of international trade in hazardous chemicals, to protect human health and environment from hazards of chemicals and to promote the use of chemicals in environmentally safe way by notifying or exchanging information regarding the chemical characteristics and establishing decision making process in import and export of prohibited hazardous chemicals or strictly limiting the use of chemicals and notifying formulas of highly hazardous chemicals and pesticides including informing decision to the member parties to control import and export of chemicals in accordance with the decision.

Participation as a member party in Rotterdam Convention helped Thailand enhance the hazardous chemical control operation in accordance with the Hazardous Substance Act B.E. 2535 (1992) in receiving information regarding the prohibited and strictly limited the use of chemicals in foreign countries in order to review the need of use in consideration of hazardous chemical control for safety in the country. The related agencies were able to use chemical information on notifying exportation of member party to evaluate the risk of the use of some chemicals in order to control chemical usage in the country. Moreover, Thailand was able to propose the list of highly hazardous chemicals and pesticides and create health and environmental problems including receiving technical supports from member countries.



Thailand has involved in the process of negotiation and development of Rotterdam Convention since the beginning and also cooperated and coordinated with the Secretariat Office of the international organizations and member countries to continuously implement the Rotterdam Convention. Pollution Control Department, as a Designated National Authority (DNA) and National Focal Point under the Rotterdam Convention, has closely coordinated with the other 2 governmental agencies which were Department of Agriculture and Department of Industrial Works including other agencies that related to the control of import and export of hazardous chemicals in accordance with the Hazardous Substance Act B.E. 2535 (1992) and other related regulations in prior informed consent procedure (PIC), notifying import and export information of hazardous chemicals prior to the import and export under the Rotterdam Convention in order to protect illegal import and export hazardous chemicals and illegal hazardous chemicals dumping in the country.

In 2010, the summary report on the situation of notification of hazardous chemical exports was conducted under the Rotterdam Convention to use for monitoring the export situation of prohibited or limited the use of hazardous chemicals in foreign countries, reviewing information of tributyltin compounds which was additionally listed in appendix III of Rotterdam Convention and hexachlorobutadiene that was strictly limited the use in foreign countries to be controlled as hazardous substance under the Hazardous Substance Act B.E. 2535 (1992). Furthermore, this was to determine customs statistic code for hazardous chemicals under the Rotterdam Convention which were not controlled under the Hazardous Substance Act B.E. 2535 (1992) in order to monitor import – export statistics of those chemicals. In addition, Pollution Control Department has prepared the Capacity Building and Awareness Raising Programmes on the Implementation of the Rotterdam Convention in Thailand which was the cooperation program under the Strategic Approach to International Chemicals Management Quick Start Programme: SAICM QSP



Stockholm Convention on Persistent Organic Pollutants: POPs



Thailand has acceded to the Stockholm Convention on 22nd May 2002 and ratified the Stockholm Convention on 31st January 2005. The purposes of the Stockholm Convention were to protect human health and environment by reducing and terminating manufacturing, the usage and emitting Persistent Organic Pollutants: POPs which were the group of organic compounds that were difficult to degrade, toxic, persistent, accumulated in living organisms and able to move long distance in the environment.

In the first stage, the Stockholm Convention had determined 12 items of primary POPs which were 9 pesticides; aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex and toxaphene; 1 industrial chemical; Polychlorinated Biphenyls (PCBs); and 2 unintentionally produced POPs; Polychlorinated Dibenzo-p-Dioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs). Additionally, at the 4th Meeting of the Conference of the Parties to the Stockholm Convention in May 2009 has agreed to add another 9 POPs which were 4 pesticides; alpha-hexachlorocyclohexane, beta-hexachlorocyclohexane, chlordecone and lindane; 4 industrial chemicals; hexabromobiphenyl, commercial pentabromodiphenyl ether, commercial octabromodiphenyl ether and perfluorooctane sulfonate; and 1 unintentionally produced POPs; pentachlorobenzene, under the Stockholm Convention. In 2010, there were 21 items of POPs under the Stockholm Convention.

Pollution Control Department, as a National Focal Point of the implementation of the Stockholm Convention, has continuously coordinated with domestic and international agencies in the implementation of the Stockholm Convention. Many agencies have conducted activities and programs in accordance with the national management plan for the implementation on the Stockholm Convention on Persistent Organic Pollutants: POPs in order to reduce and/or terminate the usage, manufacturing and emission of POPs, for example, conducting the meeting to build awareness of the implementation of the national management plan, Best Available Techniques and Best Environmental Practices (BAT/BEP) Program to reduce or stop emission of dioxin and furan from electricity and heat production sources and iron and steel industrial sources, the risk assessment of dioxin and furan from crematoriums, the preparation of information of new 9 POPs in order to prepare for determination of legal measures to control the new POPs, the improvement of national management plan which was the implementation under the agreement in the 4th Meeting of the Conference of the Parties to the Stockholm Convention which agreed to list additional 9 POPs under the Stockholm Convention.



Furthermore, Thailand has assigned Thai representatives/ Thai delegation to attend international meeting to demonstrate roles of Thailand in the implementation of the Stockholm Convention. The vital point was the attending the 3rd East and South East Asia BAT/BEP Forum Annual Board Meeting in Siem Reap, Kingdom Of Cambodia which was the regional cooperation in the development and technology and BAT/BEP knowledge transfer in order to reduce the emission of unintentionally produced POPs from the sources that were the urgent issues of the region. The meeting also was a forum in consideration of environmental problem management policy and development under the Stockholm Convention. In the meeting, Thailand, as a president of the regional cooperation, has reported on the progress of the implementation of regional management plan for BAT/BEP. The regional cooperation has already prepared programs which were requested the support from Global Environment Facility (GEF) 3 programs in total. These programs were 1) the implementation of the overall management plan for BAT/BEF, 2) sources from electricity and heat production and 3) sources from steel production. At this moment, budget of the 2nd program was approved from GEF in the amount of USD 4,000,000. 6 member countries which were 1) Kingdom of Cambodia, 2) Republic of Indonesia, 3) The Lao People's Democratic Republic, 4) Mongolia, 5) Republic of the Philippines and 6) Thailand have been under the development of another 2 programs which were the implementation of sources from incinerator and open burning, and chemical management activities with the government of Sweden to build capability for improving legal measures to enforce BAT/BEF in order to reduce emission of unintentionally produced POPs and other related pollutants.



Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal

Thailand has ratified the Basel Convention on 24th November 1997 and enacted on 22nd February 1998. The Basel Convention was intended to protect human health and environment from hazardous wastes by minimizing transboundary movement of hazardous wastes, disposal hazardous wastes at the sources as much as possible and reducing the production of hazardous wastes in both quantity and hazard level.



In 1999, the subcommittee on the Basel Convention was established under the Pollution Control Committee. Later in 2007, the subcommittee was promoted to be the subcommittee under the National Environment Board to implement the Basel Convention and the cabinet assigned the Pollution Control Department to be the National Focal Point and Department of Industrial Works to be Competent Authority. The Pollution control Department which was the focal point and the secretariat of the Basel Convention subcommittee, has conducted subcommittee meeting 32 meetings in total. In 2010, the subcommittee had important agreement on approval the list of 5 hazardous wastes that shall be prohibited to import into Thailand which were 1) wastes or any materials or items containing or contaminating with Polychlorinated Biphenyls compounds (PCBs) and/or derivatives regardless the concentration level, 2) wastes or anything from Cathode-ray glass tube, 3) used lead-acid battery in both intact and fragmented, 4) waste asbestos, and 5) wastes or anything containing or contaminating with dioxin – furan.



In addition, Thailand has assigned Thai representatives/ Thai delegation to attend international meeting to demonstrate roles of Thailand in the implementation of the Basel Convention. In 2010, Thai representatives attended the 7th meeting of the Open-ended Working Group of the Basel Convention (OEWG) in Geneva, the Swiss Confederation to make opinions on annual strategies for 2012 – 2021. The representatives also attended the workshop to exchange knowledge of the control of waste movements and management in the region such as the Workshop of Asian Network for Prevention of Illegal Transboundary Movement of Hazardous Wastes in Yokohama, Japan; the Regional Workshop on WEEE/ E-Waste Management in Osaka, Japan; the Regional Technical Training Workshop for Environmentally Sound Collection, Separation and Management of E-Wastes in Jakarta, Indonesia and the 4th Steering Committee Meeting in Jakarta, Indonesia.



4.2 International Cooperation

Ministerial Meeting on Health and Environment in Southeast and East Asian Countries

Thailand with the United Nations Environment Programme and World Health Organization co-hosted the 1st Ministerial Meeting on Health and Environment of countries in Southeast and East Asia during 8th – 9th August 2007 in Bangkok. The Meeting endorsed the Charter and obligations that all parties shall cooperate in promoting the better health and environment and use the Charter as a tool for collaboration and also apply Bangkok Declaration on Environment and Health and the implementation plan for environment and health of each country as the operational framework for the consistency of implementation. The 2nd Ministerial Meeting on health and Environment was determined to be held in Republic of Korea in 2010.

The 2nd Ministerial Meeting on Environment and Health in Southeast and East Asian Countries was held on 15th July 2010 in Jeju Island, Republic of Korea. The Meeting agreed on implementation plan for 2010 – 2013 of the Regional Technical Working Group in 6 areas which were 1) Air Quality, 2) Clean Water, Hygiene and Sanitation, 3) Solid and Hazardous Wastes, 4) Toxic Chemicals and Hazardous Substances, 5) Climate and Ecosystem Change, and 6) Environmental Health Emergencies and the new committee and the 7th area, Health Impact Assessment. Furthermore, the Meeting has signed on the Jeju Declaration on Environment and Health. The essence of the Declaration were 1) the focus on environmental issues and people's good health including children's good health, 2) the amendment to the name of Regional Technical Working Group from Clean Water, Hygiene and Sanitation to be Water, Sanitation and Hygiene, 3) proposing the forum meeting on health and environment in Southeast and East Asian countries to be the main forum meeting that shall facilitate the cooperation in environmental and health operation for all areas, 4) establishing Task Force to report to Advisory Board to consider reviewing the improvement of implementation and working as associated member countries which effect forum meeting on health and environment and complete the operation by proposing recommendations to the Advisory Committee, and 5) assigning the members of the forum meeting on health and environment to establish sustainable and effective mechanisms for the operations of the forum meeting on health and environment that shall be received the budget.



For the 3rd Ministerial Meeting on Health and Environment in Southeast and East Asian Countries in 2013, Malaysia will host the meeting.



AESAN Working Group on Coastal and Marine Environment Meeting

In 2010, the 11th Meeting of ASEAN Working Group on Coastal and Marine Environment was held during 16th – 17th June, 2010 in Samui Island, Surat Thani in order to monitor the progress of the implementation of AESAN Working Group on Coastal and Marine Environment under the ASEAN Socio – Cultural Community Blueprint, ASCC Blueprint 2009 – 2015. The meeting was reported the progress of the Proposal on Information Exchange on Marine Ecosystems for ASEAN Countries. ASEAN Mechanism to Enhance Surveillance against Illegal Desludging and Disposal of Tanker Sludge at Sea and the Proposal on Climate Change and ASEAN Coastal Areas: Vulnerability, Impact and Adaptation and Asean-Australia Development Cooperation Programme-Regional Partnership Scheme (AADCP-RPS). The meeting also assigned this committee to closely collaborate with other committees such as ASEAN Working Group on Water Resources Management, ASEAN Working Group on Climate Change in the impact of climate change in coastal areas.

Thai – German Trilateral Cooperation Programme on Supporting Laos PDR, Cambodia and Vietnam (GIZ Trilateral Cooperation Programme)

The Government of Federal Republic of Germany and Thailand has signed the Memorandum of Understanding (MoU) to support Lao People's Democratic Republic, Kingdom of Cambodia and Socialist Republic of Vietnam in many areas which were educational knowledge, rural development, small and medium enterprise development and health.



In 2010, support framework for developing educational knowledge in air pollution problem management for Lao People's Democratic Republic was prepared in order to educate officers to understand and be able to resolve the air pollution problems that affected people's lives and health. The mobile air quality monitoring unit was sent to monitor air quality in Vientiane which has stated to have particulate matter problem from traffic and transboundary haze. Moreover, the educational knowledge in monitoring pollutant from exhaust pipe was also strengthened in order to further plan for the measures of air pollution problem management.

Clean Air for Smaller Cities in the ASEAN Region Program



The Government of Federal Republic of Germany and Thailand has organized Clean Air for Smaller Cities Program in the ASEAN Region in 7 countries, 1 or 2 cities in each country which were Cambodia, Indonesia, Lao PDR, Malaysia, Philippines, Vietnam and Thailand. The objectives of the program were to support the development and prepare air and transport pollution management plan, the implementation of the plan, efficiency and co-benefits evaluation to the climate change. It was included experience exchange between participated countries in 4 areas which were 1) roadmap preparation for the development of Clean Air Plan: CAP, 2) the development of CAP, 3) the implementation of CAP, and 4) impact assessment on pollutant emission, greenhouse gas and ambient air quality. Thailand has chosen Chiang Mai Municipality and Nakhon Ratchasima Municipality to be the pilot areas of this program.

In addition, Thailand has prepared the training system in ASEAN region level by developing the appropriate training course for various countries. Moreover, Training Network of that country was established in order to increase capability for managing air quality by applying the method of building capability to promote the growth of trade through the training (Training Maritime Management: TRAINMAR) which consisted of 1) analysis in requirement for the training system development, 2) analysis in the training course development, 3) conducting of the training. The 3 training courses, which were Course Developer, Emission Inventory and Air Quality Monitoring, were conducted in regional level in Bangkok with the participants from 7 member countries of the program.





Regional Environmentally Sustainable Transport Forum

Ministry of Natural Resources and Environment by Pollution Control Department with United Nations Centre for Regional Development (UNCRD) and Ministry of Environment of Japan co-hosted the 5th regional Environmentally Sustainable Transport (EST) Forum 2010 at Royal Orchid Sheraton Hotel, Bangkok during 23rd – 25th August 2010. The objectives of the forum were to exchange knowledge, experience and lessons in environmentally sustainable and environmentally friendly transport and to report the progress in Asian region countries that have implemented in accordance with the components of environmentally friendly transport. There were 200 participants, who were the representatives of 22 Asian region countries, international organization for sustainable development and private sectors.

The participants demonstrated the intention in collaborating between the environment and transport organizations in Asian region in order to manage the safe transport system that meet the requirements and environmentally friendly and sustainable by drafting and approving the Bangkok 2020 Declaration – Towards A New Decade for Sustainable Transport in Asia. The country representatives shall implement the Bangkok Declaration in their countries.



The implementation of International Obligations and Cooperation in pollution problem management in the past demonstrated the effort to develop the mechanisms for implementing the pollution problem management through several related agencies and organizations in country level and international level by adopting various forms of cooperation mechanisms. In the future, the implementation under these international obligations and cooperation will play the vital role in further propelling and expanding the implementation of pollution problem management in Thailand both at national level and international forums.

5. Appendix





Appendix A





Appendix A: Environmental Laws and Regulations in 2010

In 2010, the environmental laws could be classified according to the type of pollution which are water pollution, air and noise pollution, waste and hazardous waste pollution, law related to general environment and local ordinances with a total of 164 volumes as follows.

1. Water pollution law consists of 10 volumes of secondary law enacted in accordance with the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992), 1 volume of Thai Vessels Act B.E. 2481 (1938), 1 volume of Navigation in Thai Waters Act B.E. 2456 (1913) and 2 volume of Industrial Product Standards Act B.E. 2511 (1968).
2. Air and noise pollution law consists of 18 volumes of secondary law enacted in accordance with the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992), 1 volume of Industrial Estate Authority of Thailand Act B.E. 2522 (1979), 2 volumes of The Fuel Oil Controls Act B.E. 2542 (1999), 6 volumes of Fuel Oils Trading Act B.E. 2543 (2000) and 3 volumes of Industrial Product Standards Act B.E. 2511 (1968).
3. Waste and hazardous substances law consists of 2 volume of secondary law enacted in accordance with the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992) and 3 volumes of Hazardous Substance Act B.E. 2535 (1992).
4. General environmental law consists of 6 volumes of secondary law enacted in accordance with the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992), 3 volumes of Factory Act B.E. 2535 (1992), 2 volumes of the Industrial Estate Authority of Thailand Act B.E. 2522 (1979), 1 volume of the Protection of Health of Non-smoker Act B.E. 2535 (1992) and 2 volumes of the Energy Conservation Promotion Act B.E. 2535 (1992).
5. A total of 102 volumes of pollution local ordinances.

Water Pollution Laws Enacted in Royal Government Gazettes B.E. 2553 (2010)

No.	Subject	Main Idea	Date of Enactment	Effective Date
The Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992)				
1.	Notification of the National Environment Board on the determination of the service fee for wastewater treatment of central wastewater treatment facility of Mae Sod Town Municipality, Tak, Hua Khwang Subdistrict Municipality, Maha Sarakham, Mukdahan Town Municipality, Hua Hin Town Municipality, Prachuap Khiri Khan and Pa Tong Town Municipality, Phuket	Determine service fees for central wastewater treatment system to be collected from users of the central wastewater treatment facility of Mae Sod Town Municipality, Tak, Hua Khwang Subdistrict Municipality, Maha Sarakham, Mukdahan Town Municipality, Mukdahan, Hua Hin Town Municipality, Prachuap Khiri Khan and Pa Tong Town Municipality, Phuket under the authority given by the Article 88 of the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 69 D 2 nd June 2010	From the day following the date of enactment in the Royal Government Gazette (3 rd June 2010)
2.	Notification of Ministry of Natural Resources and Environment (No.2) B.E. 2552 (2009) on the determination of standard of wastewater released from pollution sources under the category of swine farm	Amend to add the method of testing of standard of wastewater released from pollution sources under the category of swine farm in No. 7 and No. 8 of the Regulation of Ministry of Natural Resource and Environment on the setting up of standard of wastewater released from pollution source under the category of swine farm dated 7 th November B.E. 2548 (1995) under the authority given by the Article 55 of the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 67 D 15 th January 2010	From the day following the date of enactment in the Royal Government Gazette (16 th January 2010)



No.	Subject	Main Idea	Date of Enactment	Effective Date
3.	Notification of Ministry of Natural Resources and Environment on the determination of standard controlling the release of wastewater from municipal wastewater treatment system	Determine the standard controlling the release of wastewater from municipal wastewater treatment system under the authority given by the Article 55 of the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 69 D 2 nd June 2010	From the day following the date of enactment in the Royal Government Gazette (3 rd June 2010)
4.	Notification of Ministry of Natural Resources and Environment on the determination of municipal wastewater treatment system as the pollution source which must be controlled the release of wastewater into public water sources or environment	Determine the municipal wastewater treatment system as the pollution source which must be controlled the release of wastewater into public water sources or environment under the authority given by the Article 69 of the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 69 D 2 nd June 2010	From the day following the date of enactment in the Royal Government Gazette (3 rd June 2010)
5.	Notification of Pollution Control Department on the classification of water sources in Kwae Noi River	Determine Kwae Noi River starting from the estuary of Kwae Noi River, Moo 1, Lin Chang Village, Pak Preak Subdistrict, Mueng District, Kanchanaburi at 0 Kilometer milestone to Wat Tha Kanun Bridge, Moo 1, Tha Kanun Subdistrict, Thong Phaphum District, Kanchanaburi at 243 rd km milestone to be the second type of water source classification according to the Notification of Ministry of Natural Resources and Environment No. 8 B.E. 2537 (1994) enacted in accordance with the content in the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992) on setting the standard for surface water quality.	Volume 127 Special Part 39 D 26 th March 2010	-



No.	Subject	Main Idea	Date of Enactment	Effective Date
6.	Notification of Pollution Control Department on the classification of water source in Kwaee Yai River	Determine Kwaee Yai River starting from the estuary of Kwaee Yai River, Rimnam Na Mueng Road, Ban Nua Subdistrict, Mueng District, Kanchanaburi at 0 Kilometer milestone to Ban Chao Nuan Bridge 1, the end of Sri Nakarhin Dam, Moo 4, Tha Kradan Subdistrict, Srisawat District, Kanchanaburi at 84 th km milestone to be the second type of water source classification according to the Notification of Ministry of Natural Resources and Environment No. 8 B.E.2537 (1994) enacted in accordance with the content in the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992) on setting the standard for surface water quality.	Volume 127 Special Part 39 D 26 th March 2010	-
7.	Notification of Pollution Control Department on the classification of water source in Prasae River	Determine Prasae River starting from the estuary of Prasae River, Moo 1, Hua Kod Village, Pak Mae Nam Prasae Subdistrict Municipality, Mueng District, Rayong at 0 Kilometer milestone to Ban Khao Wang Chig Bridge, Moo 9, Klong Pamai Road, Krasae Bon Subdistrict, Klaeng District, Rayong to be the third type of water source classification according to the Notification of Ministry of Natural Resources and Environment No. 8 B.E. 2537 (1994) enacted in accordance with the content in the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992) on setting the standard for surface water quality.	Volume 127 Special Part 39 D 26 th March 2010	-



No.	Subject	Main Idea	Date of Enactment	Effective Date
8.	Notification of Pollution Control Department on the classification of water source in Weru River	Determine Weru River starting from the estuary of Weru River, Moo 4, Ban Ang Krapong, Tha Som Subdistrict, Khao Saming, Trat at 0 Kilometer milestone to Wat Kongkaram (Bor), Moo 4, Ban Bor Subdistrict, Klung District, Chanthaburi at 25 th km be the second type of water source classification according to the Notification of Ministry of Natural Resources and Environment No. 8 B.E. 2537 (1994) enacted in accordance with the content in the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992) on setting the standard for surface water quality.	Volume 127 Special Part 39 D 26 th March 2010	-
9.	Notification of Pollution Control Department on the classification of water source in Pangrad River	Determine Pangrad River starting from the estuary of Pangrad River, Moo 8, Chang Kam Subdistrict, Nayaia District, Chanthaburi at 0 Kilometer milestone to town hall area of Moo 1, Ban Tao Poon, Chang Kam Subdistrict, Nayaia District, Chanthaburi at 6 th km milestone to be the second type of water source classification and Pangrad River from town hall area of Moo 1, Ban Tao Poon, Chang Kam Subdistrict, Nayaia District, Chanthaburi at 6 th km milestone to the beginning of Ban Nayaia Bridge, Moo 1, Sukhumvit Road, Nayaia Subdistrict Municipality, Nayaia District, Chanthaburi at 14 th km milestone to be the third type of water source classification according to the Notification of National Environment Board No. 8 B.E. 2537 (1994) enacted in accordance with the content in the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992) on setting the standard of surface water quality.	Volume 127 Special Part 39 D 26 th March 2010	-



No.	Subject	Main Idea	Date of Enactment	Effective Date
10.	Notification of Pollution Control Department on criteria of the design of wastewater collection system and municipal wastewater treatment system	Determine the academic criteria of the design of wastewater collection system and municipal wastewater treatment system as the guideline for the efficient design of wastewater treatment system by government agencies and private sectors as well as people involve in the design of wastewater collection system and municipal wastewater treatment system.	Volume 127 Special Part 72 D 8 th June 2010	–
Thai Vessels Act B.E. 2481 (1938)				
1.	Notification of Marine Department No. 271/2553 on the classification and list of hazardous substances and the standard of release of hazardous substances	Classify and list hazardous substances and determine the standard of release of hazardous substances to the sea under the authority given by the Article 53/2 of the Thai Vessels Act B.E. 2481 (1938) which was amended by the Thai Ship Act (No. 7) B.E. 2550 (2007)	Volume 127 Special Part 125 D 29 th October 2010	From the day following the date of enactment in the Royal Government Gazette (30 th October 2010)
The Navigation in Thai Waters Act B.E. 2456 (1913)				
1.	Notification of Marine Department No. 273/2553 on the criteria of permission on the loading of potential hazardous substances	Abolish the Notification of Marine Department No. 279/2542 on the permission to load potential hazardous substance dated 30 th August B.E. 2552 (2009) in order to determine the criteria on the loading of potential hazardous substances at the same standard set by director-general of Marine Department under his capacity as "Marine Director" under the authority given by the Navigation in Thai Waters Act B.E. 2456 (1913).	Volume 127 Special Part 125 D 29 th October 2010	After forty five days from the date of enactment in the Royal Government Gazette



No.	Subject	Main Idea	Date of Enactment	Effective Date
The Industrial Product Standards Act B.E. 2511 (1968)				
1.	Notification of Ministry of Industry No. 4133 (B.E. 2552) (2009) enacted as stated in the content of the Industrial Product Standards Act B.E. 2511 (1968) on abolishing and determining standard for sanitaryware product of environmental tap : water saving	Abolish Notification of Ministry of Industry No. 2907 (B.E. 2544) (2001) enacted as stated in the content of the Industrial Product Standards Act B.E. 2511 (1968) on determining standards for sanitaryware product of environmental tap : water saving dated 10 th August B.E. 2544 (2001) and issue a new standard for sanitary product, environmental tap : water saving with standard No. TIS 2067 – 2552 under the authority given by the Industrial Product Standards Act B.E. 2511 (1968).	Volume 127 Special Part 33 D 15 th March 2010	-
2.	Notification of Ministry of Industry No. 4134 (B.E. 2552) (2009) enacted as stated in the content of the Industrial Product Standards Act B.E. 2511 (1968) on abolishing and determining standards for sanitaryware product of environmental shower head : water saving	Abolish Notification of Ministry of Industry No. 2906 (B.E. 2544) (2001) enacted as stated in the content of the Industrial Product Standards Act B.E. 2511 (1968) on determining standard for sanitaryware product of environmental shower head : water saving dated 10 th August B.E. 2544 (2001) and issue a new standard for sanitaryware product of environmental shower head : water saving with standard No. TIS 2066 – 2552 under the authority given by the Industrial Product Standards Act B.E. 2511 (1968).	Volume 127 Special Part 33 D 15 th March 2010	-

Air and Noise Pollution Laws Enacted in the Royal Government Gazette B.E. 2553 (2010)



No.	Subject	Main Idea	Date of Enactment	Effective Date
The Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992)				
1.	Notification of the National Environment Board No. 36 B.E. 2553 (2010) on the determination for standards for particulate matters sized smaller than 2.5 microns in the ambient air	Under the authority given by the Article 32 (4) and the Article 34 of the Enhancement and Conservation of Natural Environmental Quality Act B.E. 2535 (1992), the National Environment Board issued the notification to determine standards for particulate matters sized smaller than 2.5 microns in the ambient air as the general criteria in the enhancement and conservation of the natural environmental quality according to the Enhancement and Conservation of Natural Environmental Quality Act B.E. 2535 (1992) by determining that the average value of in 24 hours must not exceed 0.05 milligrams per cubic meter and Arithmetic Mean in 1 year must not exceed 0.025 milligrams per cubic meter.	Volume 127 Special Part 37 D 24 th March 2010	–
2.	Notification of the National Environment Board No. 37 B.E. 2553 (2010) on the determination for standards of the vibration to prevent the impact to buildings	Under the authority given by the Article 32 (5) of the Enhancement and Conservation of Natural Environmental Quality Act B.E. 2535 (1992), the National Environment Board issued the notification to standards of the vibration to prevent the impact to buildings as the general criteria in the enhancement and conservation of the natural environmental quality according to the Enhancement and Conservation of Natural Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 69 D 2 nd June 2010	From the day following the date of enactment in the Royal Government Gazette (3 rd June 2010)

No.	Subject	Main Idea	Date of Enactment	Effective Date
3.	Notification of Ministry of Natural Resources and Environment on the determination for standards of the odor intensity of polluted air released from the pollution sources	The Minister of Natural Resources and Environment, as recommended by the Pollution Control Committee and the approval of the National Environment Board, issue a notification to determine standards of the odor intensity of polluted air released from the pollution sources under the authority given by the Article 55 of the Enhancement and Conservation of Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 3 D 11 th January 2010	After one hundred and eighty days from the date of enactment in the Royal Government Gazette
4.	Notification of Ministry of Natural Resources and Environment on the determination for the classification of some types and some sizes of industrial factories to be the pollution sources which the odor intensity of polluted air must be controlled before releasing to the ambient air	The Minister of Natural Resources and Environment, as recommended by the Pollution Control Committee, issue a notification to determine the classification of some types and some sizes of industrial factories to be the pollution sources which the odor intensity of polluted air must be controlled before releasing to the ambient air under the authority given by the Article 68 of the Enhancement and Conservation of Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 3 D 11 th January 2010	After one hundred and eighty days from the date of enactment in the Royal Government Gazette
5.	Notification of Ministry of Natural Resources and Environment on the determination for the standards of noise level of motor-vehicles	The Minister of Natural Resources and Environment, as recommended by the Pollution Control Committee and the approval of the National Environment Board, issue a notification to determine the standards of noise level of motor-vehicles in order to ensure that the environmental quality will meet the standard under the authority given by the Article 55 of the Enhancement and Conservation of Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 3 D 11 th January 2010	After one hundred and eighty days from the date of enactment in the Royal Government Gazette



No.	Subject	Main Idea	Date of Enactment	Effective Date
6.	Notification of Ministry of Natural Resources and Environment on the determination for the standards of the emission of polluted air from new electricity plants	The Minister of Natural Resources and Environment, as recommended by the Pollution Control Committee and the approval of the National Environment Board, issue a notification to determine the standards of the emission of polluted air from new electricity plants suitable to the technology development and the current state of pollution under the authority given by the Article 55 of the Enhancement and Conservation of Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 7 D 15 th January 2010	From the day following the date of enactment in the Royal Government Gazette (16 th January 2010)
7.	Notification of Ministry of Natural Resources and Environment on the determination for the classification of new electricity plants to be pollution sources which the emission of polluted air into the ambient air must be controlled	The Minister of Natural Resources and Environment, as recommended by the Pollution Control Committee, issue a notification to determine the classification of new electricity plants to be pollution sources which the emission of polluted air into the ambient air must be controlled under the authority given by the Article 68 of the Enhancement and Conservation of Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 7 D 15 th January 2010	From the day following the date of enactment in the Royal Government Gazette (16 th January 2010)



No.	Subject	Main Idea	Date of Enactment	Effective Date
8.	Notification of Ministry of Natural Resources and Environment on the determination for the classification of fuel depots to be pollution sources which the emission of polluted air into the ambient air must be controlled	The Minister of Natural Resources and Environment, as recommended by the Pollution Control Committee and the approval of the National Environment Board, issue a notification to determine the classification of fuel depots to be pollution sources which the emission of polluted air into the ambient air must be controlled. The amendment of laws related to the fuel controls resulted in the change in definition of fuel depots so it is necessary to appropriately amend the notification to determine fuel depots as pollution sources which the emission of polluted air into the ambient air must be controlled under the authority given by the Article 55 of the Enhancement and Conservation of Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 26 D 24 th February 2010	From the day following the date of enactment in the Royal Government Gazette (25 th February 2010)
9.	Notification of Ministry of Natural Resources and Environment on the determination for the standards of benzene emitted vapor from fuel depots	Determine the standard of average benzene emitted vapor from fuel depots during the loading and unloading of fuel from fuel tank trucks in 1 hour must not exceed 17 milligrams total VOCs/ Liter in emitted vapor under the authority given by the Article 55 of the Enhancement and Conservation of Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 26 D 24 th February 2010	From the following date of enactment in the Royal Government Gazette (25 th February 2010)



No.	Subject	Main Idea	Date of Enactment	Effective Date
10.	Notification of Ministry of Natural Resources and Environment on the determination for the standard of Noise level of powerboat	The Minister of Natural Resources and Environment, as recommended by the Pollution Control Committee and the approval of the National Environment Board, issue a notification to determine the standard of Noise level of powerboat by abolishing the Notification of Ministry of Natural Resources and Environment on the determination for the standards of Noise Level of powerboat dated 7 th November 2005 under the authority given by the Article 55 of the Enhancement and Conservation of Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 40 D 30 th March 2010	From the following date of enactment in the Royal Government Gazette (31 st March 2010)
11.	Notification of Ministry of Natural Resources and Environment on the determination for the standards of black smoke of vehicles using the compression ignition engines	The Minister of Natural Resources and Environment, as recommended by the Pollution Control Committee and the approval of the National Environment Board, issue a notification to determine the standards of black smoke of vehicles using the compression ignition engines by abolishing. (1) Notification of Ministry of Science, Technology and Environment No. 2 B.E. 2540 (1997) on the determination for the standards of black smoke from the exhaust of automobiles using diesel engine dated 17 th June B.E. 2540 (1997) (2) Notification of Ministry of Science, Technology and Environment No. 4 B.E. 2541 (1998) on the determination for the standards of black smoke from the exhaust of automobiles using diesel engine dated 9 th September B.E. 2541 (1998) under the authority given by the Article 55 of the Enhancement and Conservation of Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 87 D 16 th July 2010	From the day following the date of enactment in the Royal Government Gazette (17 th July 2010)

No.	Subject	Main Idea	Date of Enactment	Effective Date
12.	Notification of Ministry of Natural Resources and Environment on the determination for the standards of the emission of polluted air from solid waste furnaces	The Minister of Natural Resources and Environment, as recommended by the Pollution Control Committee and the approval of the National Environment Board, issue a notification to determine the standards of the emission of polluted air from solid waste furnaces by abolishing Notification of Ministry of Science, Technology and Environment on the determination for the standards of the emission of polluted air from solid waste furnaces dated 17 th June B.E. 2540 (1997) under the authority given by the Article 55 of the Enhancement and Conservation of Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 87 D 16 th July 2010	From the day following the date of enactment in the Royal Government Gazette (17 th July 2010)
13.	Notification of Ministry of Natural Resources and Environment on the determination for the standards of the emission of polluted air from natural gas separation plants	The Minister of Natural Resources and Environment, as recommended by the Pollution Control Committee and the approval of the National Environment Board, issue a notification to determine the standards of the emission of polluted air from natural gas separation plants under the authority given by the Article 55 of the Enhancement and Conservation of Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 87 D 16 th July 2010	After three years from the date of enactment in the Royal Government Gazette
14.	Notification of Ministry of Natural Resources and Environment on the determination for the classification of solid waste furnaces to be pollution sources which the emission of polluted air into the ambient air must be controlled	The Minister of Natural Resources and Environment, as recommended by the Pollution Control Committee and the approval of the National Environment Board, issue a notification to determine the classification of solid waste furnaces to be pollution sources which the emission of polluted air into the ambient air must be controlled by abolishing Notification of Ministry of Science, Technology and Environment on the determination for the classification of solid waste furnaces to be pollution sources which the emission of polluted air into the ambient air must be controlled dated 17 th June B.E. 2540 (1997) under the authority given by the Article 55 of the Enhancement and Conservation of Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 87 D 16 th July 2010	From the day following the date of enactment in the Royal Government Gazette (17 th July 2010)



No.	Subject	Main Idea	Date of Enactment	Effective Date
15.	Notification of Ministry of Natural Resources and Environment on the determination for the classification of natural gas separation plants to be pollution sources which the emission of polluted air into the ambient air must be controlled	The Minister of Natural Resources and Environment, as recommended by the Pollution Control Committee and the approval of the National Environment Board, issue a notification to determine the classification of natural gas separation plants to be pollution sources which the emission of polluted air into the ambient air must be controlled by defining the definition of "natural gas separation plant" as factories which have the operation in separating natural gas under the Factory Act and determine the natural gas separation factory type 1 to be pollution sources which the emission of polluted air into the ambient air must be controlled under the authority given by the Article 68 of the Enhancement and Conservation of Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 87 D 16 th July 2010	Effective to natural gas separation factories as follows. (1) First type of gas separation factories, after two years from the date of enactment in the Royal Government Gazette (2) Second type of gas separation factories, the following date of enactment in the Royal Government Gazette
16.	Notification of Ministry of Natural Resources and Environment on the determination for the classification of some types of chemical factories to be pollution sources which the emission of polluted air into the ambient air must be controlled	The Minister of Natural Resources and Environment, as recommended by the Pollution Control Committee, issue a notification to determine some types of chemical factories to be pollution sources which the emission of polluted air into the ambient air must be controlled under the authority given by the Article 68 of the Enhancement and Conservation of Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 96 D 10 th August 2010	From the day following the date of enactment in the Royal Government Gazette (11 th August 2010)



No.	Subject	Main Idea	Date of Enactment	Effective Date
17.	Notification of Ministry of Natural Resources and Environment on the determination for the standards of the emission of polluted air from chemical factories	The Minister of Natural Resources and Environment, as recommended by the Pollution Control Committee and the approval of the National Environment Board, issue a notification to determine standards of the emission of polluted air from chemical factories by determining the intensity of polluted air from chemical factories producing Vinyl Chloride and the storage of substance No. 1, 2 – Dichloroethene and Vinyl Chloride and determine the standards for the total emission of polluted air from chemical factories in 1 year under the authority given by the Article 55 of the Enhancement and Conservation of Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 96 D 10 th August 2010	From the day following the date of enactment in the Royal Government Gazette (11 th August 2010)
18.	Notification of Pollution Control Department on the measurement method of the average value of particulate matters sized smaller than 2.5 microns	Determine the other measurement methods of the average value of particulate matters sized smaller than 2.5 microns that are as efficient as the measurement methods of the average value of particulate matters sized smaller than 2.5 microns under the Notification of the National Environment Board No. 36 B.E. 2553 (2010) as follow. 1. Beta Ray Attenuation method 2. Tapered Element Oscillating Microbalance (TEOM) method 3. Dichotomous method	Volume 127 Special Part 84 D 9 th July 2010	–



No.	Subject	Main Idea	Date of Enactment	Effective Date
The Industrial Estate Authority of Thailand Act B.E. 2522 (1979)				
1.	Notification of the Industrial Estate Authority of Thailand Committee on the determination for some types of factories in the industrial estates to install tools or special equipments to automatically monitor the air quality in factory stack B.E. 2553 (2010)	Determine that factories No. 88 under the Ministerial Regulation B.E. 2535 (1992) which was amended by the Ministerial Regulation No. 17 B.E. 2549 (2006) issued under the Factory Act B.E. 2535 (1992) or factories in other numbers which have similar types of pollution sources to install tools or special equipments to automatically monitor the air quality.	Volume 127 Special Part 26 D 24 th February 2010	From the day following the date of enactment in the Royal Government Gazette (25 th February 2010)
The Fuel Oil Controls Act B.E. 2542 (1999)				
1.	Notification of Ministry of Energy on the fuel top loading and unloading for control of fuel vapor B.E. 2553	Determine the fuel top loading of the loading rack at depots, oil tank storage with loading capacity through the pipe or fuel tank trucks and the top loading of fuel tank trucks must be complied with following requirements by designing the system as detailed in this notification.	Volume 127 Special Part 57 D 6 th May 2010	–

No.	Subject	Main Idea	Date of Enactment	Effective Date
2.	Notification of Ministry of Energy on the determination for areas required for the installation of fuel vapor control system (No. 4) B.E. 2553 (2010)	Abolish the Notification of Ministry of Energy on the determination for areas required for the installation of fuel vapor control system (No. 3) B.E. 2552 (2009) dated 18 th May 2009 by determine the installation of fuel vapor control system Type 1 since 31 st December B.E. 2553 (2010) in following areas. 1. Chon Buri 2. Phra Nakhon Si Ayutthaya 3. Rayong 4. Songkhla 5. Samut Sakhon 6. Saraburi 7. Surat Thani	Volume 127 Special Part 68 D 31 st May 2010	From the day following the date of enactment in the Royal Government Gazette (1 st June 2010)
The Fuel Oils Trading Act B.E. 2543 (2000)				
1.	Notification of Department of Energy Business on the determination for characters and quality of benzene B.E. 2553 (2010)	Director-general of Department of Energy Business issued a notification to determine characteristic and quality of benzene in order to increase the efficiency in supervision of fuel quality by abolishing the Notification of Department of Energy Business on the determination for characters and quality of benzene B.E. 2552 (2009) under the authority given by the Article 25 paragraph 1 of the Fuel Oils Trading Act B.E. 2543 (2000).	Volume 127 Special Part 7 D 15 th January 2010	From 1 st February 2010



No.	Subject	Main Idea	Date of Enactment	Effective Date
2.	Notification of Department of Energy Business on the determination for characters and quality of diesel B.E. 2553 (2010)	Director-general of Department of Energy Business issued a notification to determine characteristic and quality of diesel in order to increase the efficiency in supervision of fuel quality by abolishing the Notification of Department of Energy Business on the determination for characters and quality of benzene (No. 2) B.E. 2550 (2007) and the Notification of Department of Energy Business on the determination for characters and quality of diesel (No. 3) B.E. 2551 (2008) under the authority given by the Article 25 paragraph 1 of the Fuel Oils Trading Act B.E. 2543 (2000).	Volume 127 Special Part 7 D 15 th January 2010	From 1 st February 2010
3.	Notification of Department of Energy Business on the determination for criteria, method and condition on the approval of putting the additive in fuel and characters and quality of fuel oils that not in line with the requirements of Department of Energy Business	Director-general of Department of Energy Business issued a notification to determine criteria, method and condition on the approval of putting the additive in fuel and characters and quality of fuel oils that not in line with the requirements of Department of Energy Business by abolishing the notification of Department of Energy Business on the determination for criteria, methods and condition on the approval of putting the additive in fuel and characters and quality of fuel oils that not in line with the requirements of Department of Energy Business B.E. 2550 (2007) under the authority given by the Article 25 paragraph 1 of the Fuel Oils Trading Act B.E. 2543 (2000).	Volume 127 Special Part 14 D 27 th January 2010	From 29 th January 2010

No.	Subject	Main Idea	Date of Enactment	Effective Date
4.	Notification of Department of Energy Business on the determination for characters and quality of basic benzene B.E. 2553 (2010)	Director-general of Department of Energy Business issued a notification to determine characteristic and quality of basic benzene in order to increase the efficiency in supervision of fuel quality by abolishing the Notification of Department of Energy Business on the determination for characters and quality of basic benzene B.E. 2551 (2008) under the authority given by the Article 25 paragraph 1 of the Fuel Oils Trading Act B.E. 2543 (2000).	Volume 127 Special Part 44 D 7 th April 2010	From the following date of enactment in the royal Government Gazette (8 th April 2010)
5.	Notification of Department of Energy Business on the determination for characters and quality of gasohol B.E. 2553 (2010)	Director-general of Department of Energy Business issued a notification to determine characteristic and quality of gasohol in order to increase the efficiency in supervision of fuel quality by abolishing the Notification of Department of Energy Business on the determination for characters and quality of gasohol B.E. 2551 (2008) under the authority given by the Article 25 paragraph 1 of the Fuel Oils Trading Act B.E. 2543 (2000).	Volume 127 Special Part 44 D 7 th April 2010	From the following date of enactment in the royal Government Gazette (8 th April 2010)
6.	Notification of Department of Energy Business on the determination for characters and quality of diesel (No. 2) B.E. 2553 (2010)	Director-general of Department of Energy Business issued a notification to determine characteristic and quality of diesel (No. 2) B.E. 2553 (2010) in order to promote more commercial consumption of bio-diesel by abolishing the Notification of Department of Energy Business on the determination for characters and quality of diesel B.E. 2553 (2010) under the authority given by the Article 25 paragraph 1 of the Fuel Oils Trading Act B.E. 2543 (2000).	Volume 127 Special Part 57 D 6 th May 2010	From 1 st June 2010



No.	Subject	Main Idea	Date of Enactment	Effective Date
The Industrial Product Standards Act B.E. 2511 (1968)				
1.	Notification of Ministry of Industry No. 4092 B.E. 2552 (2009) issued under the content in the Industrial Product Standards Act B.E. 2511 (1968) on the abolishment and determination for standards of large vehicles with the spark ignition engines fueled with natural gas or liquefied petroleum gas on environment : polluted substances from engine – level 1	Minister of Industry issued a notification to abolish the Notification of Ministry of Industry No 3738 B.E. 2550 (2007) issued under the content in the Industrial Product Standards Act B.E. 2511 (1968) on the abolishment and determination for standards of large vehicles with the spark ignition engines fueled with natural gas or liquefied petroleum gas on environment : polluted substances from engine – level 1 dated 19 th April B.E. 2550 (2007) and issue a notification to determine product industrial standards of large vehicles with the spark ignition engines fueled with natural gas or liquefied petroleum gas on environment : polluted substances from engine – level 1 No. TIS 2320 – 2552 under the authority given by the Article 15 of the Industrial Product Standards Act B.E. 2511 (1968).	Volume 127 Special Part 29 D 5 th March 2010	From the date of enactment in the royal Government Gazette (6 th March 2010)



No.	Subject	Main Idea	Date of Enactment	Effective Date
2.	Notification of Ministry of Industry No. 4210 B.E. 2553 (2010) issued under the content in the Industrial Product Standards Act B.E. 2511 on the abolishment of industrial product standards for ethanol and determine for industrial product standards of fuel ethanol	Minister of Industry issued a notification to abolish the Notification of Ministry of Industry No. 3100 B.E. 2545 (2002) issued under the content in the Industrial Product Standards Act B.E. 2511 (1968) on the abolishment of industrial product standards for ethanol dated 16 th August B.E. 2545 (2002) and issued a new notification on determination for industrial product standards of fuel ethanol No. TIS 640 Volume 3 – 2553 under the authority given by the Article 15 of the Industrial Product Standards Act B.E. 2511 (1968).	Volume 127 Special Part 94 D 4 th August 2010	From the date of enactment in the royal Government Gazette (5 th August 2010)
3.	Notification of Ministry of Industry No. 4209 B.E. 2553 (2010) issued under the content in the Industrial Product Standards Act B.E. 2511 on the abolishment of industrial product standards for ethanol and determine for industrial product standards of industrial ethanol	Minister of Industry issued a notification to abolish the Notification of Ministry of Industry No. 3100 B.E. 2545 (2002) issued under the content in the Industrial Product Standards Act B.E. 2511 (1968) on the abolishment of industrial product standards for ethanol dated 16 th August B.E. 2545 (2002) and issues a new notification on determination for industrial product standards of industrial ethanol No. TIS 640 Volume 2 – 2553 under the authority given by the Article 15 of the Industrial Product Standards Act B.E. 2511 (1968).	Volume 127 Special Part 94 D 4 th August 2010	After ninety days from the date of enactment in the Royal Government Gazette

Waste and Hazardous Waste Laws Enacted in the Royal Government Gazette B.E. 2553 (2010)



No.	Subject	Main Idea	Date of Enactment	Effective Date
The Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992)				
1.	Notification of the National Environment Board on fixing service fees on solid waste disposal of Trat Town Municipality, Trat province, Sadao Town Municipality, Songkhla province, Klaeng Town Municipality, Rayong province, Chiang Yeun Subdistrict Municipality, Maha Sarakham province, Ta Klee Town Municipality, Nakhon Sawan and Maha Sarakham Town Municipality, Maha Sarakham province	The National Environment Board as recommended by the Pollution Control Committee set the service fees on solid waste disposal of Trat Town Municipality, Trat province, Sadao Town Municipality, Songkhla province, Klaeng Town Municipality, Rayong province, Chiang Yeun Subdistrict Municipality, Maha Sarakham province, Ta Klee Town Municipality, Nakhon Sawan and Maha Sarakham Town Municipality, Maha Sarakham province according to list 1 – 6 of this notification and the service fees on solid waste disposal would be reviewed every five years. The notification is enacted through authority given under the Article 88 of the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 64 D 20 th May 2010	From the day following the date of enactment in the Royal Government Gazette (21 st May 2010)
2	Notification of the National Environment Board on the determination of the fee for waste disposal service of Khon Kaen Municipality, Khon Kaen, Sukhothai Municipality, Sukhothai, Chumphon Municipality, Chumphon, Sena Municipality, Phra Nakhon Si Ayutthaya, Mae Sod Municipality, Tak, Yala Municipality, Yala, Pattani Municipality, Pattani, Warin Chamrap Municipality, Ubon Ratchathani, Takua Pa Municipality, Pang Nga and Si Sa Ket Municipality, Si Sa Ket province	The National Environment Board as recommended by the Pollution Control Committee set the service fee on solid waste disposal of Khon Kaen Municipality, Khon Kaen, Sukhothai Municipality, Sukhothai, Chumphon Municipality, Chumphon, Sena Municipality, Phra Nakhon Si Ayutthaya, Mae Sod Municipality, Tak, Yala Municipality, Yala, Pattani Municipality, Pattani, Warin Chamrap Municipality, Ubon Ratchathani, Takua Pa Municipality, Pang Nga and Si Sa Ket Municipality, Si Sa Ket province according to list 1-10 of this notification. The Notification is enacted through authority given under the Article 88 of the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 34 D 17 th March 2010	From the day following the date of enactment in the Royal Government Gazette (18 th March 2010)



No.	Subject	Main Idea	Date of Enactment	Effective Date
The Hazardous Substances Act B.E. 2535 (1992)				
1.	Notification of Department of Livestock Development on determining and listing of information, document and evidence for the registration of hazardous substances B.E. 2553 (2010)	Department of Livestock Development enacted the notification on determining and listing information, document and evidence for the registration of hazardous substances as the criteria on submission of document and detailed evidence to use in the registration consideration in order to ensure the efficiency of the operation related to hazardous substances under the responsibility of Department of Livestock Development and facilitate and reduce burden of entrepreneurs in submitting the documents and evidence for the registration of hazardous substance by abolishing the notification of Department of Livestock Development on determining and listing of information, document and evidence for the registration of hazardous substances B.E. 2552 (2009) dated 20th March 2009 under the authority given by the topic 3, paragraph 2 of the Notification of Ministry of Agriculture and Cooperatives on the registration, the issuing of essential document and the renewal of essential document on the registration of hazardous substances under the responsibility of Department of Livestock Development dated 4th November 2008.	Volume 127 Special Part 34 D 17 th March 2010	From the day following the date of enactment in the Royal Government Gazette (18 th March 2010)



No.	Subject	Main Idea	Date of Enactment	Effective Date
2.	Regulation of Department of Agriculture on the examination of document for the registration of hazardous substances under the responsibility of Department of Agriculture B.E. 2553 (2010)	Director - General of Department of Agriculture issue the regulation on the examination of document for the registration of hazardous substances under the responsibility of Department of Agriculture to ensure the accuracy, the quickness and the efficiency in the document examination for the registration of hazardous substance under the Notification of Ministry of Agriculture and Cooperatives on the registration, the certification issuing and the certification renewal of hazardous substances under the responsibility of Department of Agriculture B.E. 2551 (2008) and the Notification of Department of Agriculture on the determination of details criteria and the procedures in registration, certification issuing and certificate renewal of hazardous substances under the responsibility of Department of Agriculture B.E. 2552 (2009).	Volume 127 Special Part 37 D 24 th March 2010	On the date on enactment
3.	Notification of Department of Agriculture on the report, the issuing of report notice, the application for renewal of certificate and the certificate renewals of hazardous substance Type 2 under the responsibility of Department of Agriculture B.E. 2553 (2010)	Director - General of Department of Agriculture issue the regulation on the examination of document for the registration of hazardous substances under the responsibility of Department of Agriculture to ensure the accuracy, the quickness and the efficiency in the document examination for the registration of hazardous substance under the Notification of Ministry of Agriculture and Cooperatives on the registration, the certification issuing and the certification renewal of hazardous substances under the responsibility of Department of Agriculture B.E. 2551 (2008) and the Notification of Department of Agriculture on the determination of details criteria and the procedures in registration, certification issuing and certificate renewal of hazardous substances under the responsibility of Department of Agriculture B.E. 2552 (2009).	Volume 127 Special Part 59 D 14 th May 2010	From the day following the date of enactment in the Royal Government Gazette (14 th May 2010)

General Environmental Laws Enacted in Royal Government Gazettes B.E. 2553 (2010)

No.	Subject	Main Idea	Date of Enactment	Effective Date
The Hazardous Substances Act B.E. 2535 (1992)				
1.	Notification of Ministry of Natural Resources and Environment on category, size and operation procedures of projects or businesses that may severely affect community on environmental quality, natural resources and health aspects, which are required to conduct the environmental impact assessment report B.E. 2553 (2010)	Determine category, size and operating procedures of projects or businesses, which may severely affect community on environmental quality, natural resources and health aspects. These projects or businesses of government agencies, state enterprises or private sectors are required to conduct the environmental impact assessment report by identifying the name of projects or businesses which are received the permission from government agencies according to the laws attached at the end of this notification in accordance with Section 67, Paragraph 2 of the Constitution of the Kingdom of Thailand B.E. 2550 (2007).	Volume 127 Special Part 104 D 31 st August 2010	From the day following the date of enactment in the Royal Government Gazette (1 st September 2010)
2.	Notification of Ministry of Natural Resources and Environment on determination of regulations, method, practices and guidelines on conducting the environment impact assessment report of projects or businesses which may severely affect community on environmental quality, natural resources and health aspects (No.2) B.E. 2553 (2010)	Amend regulations, methods, practices and guidelines on conducting the environmental impact assessment report of projects or businesses which may severely affect community on environmental quality, natural resources and health aspects in Notification of Ministry of Natural Resources and Environment dated 29 th December 2009. Amendment is made to the period calculation of start and end date of the operation stated at the end of the Notification to be clear and consistent with the calculation of submitting report period stated in Section 48, Paragraph 3 and 4 of the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992). The calculation of start and end date stated at the end of the Notification must be complied with the Notification of Office of Natural Resources and Environmental Policy and Planning.	Volume 127 Special Part 110 D 16 th September 2010	From the day following the date of enactment in the Royal Government Gazette (17 th September 2010)



No.	Subject	Main Idea	Date of Enactment	Effective Date
3.	Notification of Ministry of Natural Resources and Environment on determination for areas and environmental protection measures in Krabi B.E. 2553 (2010)	Minister of Natural Resources and Environment with the approval of the National Environmental Board and the Cabinet issue the Notification on determination for areas and environmental protection measures in Krabi to control and resolve environmental problems in these areas under the authority given by Section 45 of the Enhancement and Conservative of National Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 92 D 30 th July 2010	From the day following the date of enactment in the Royal Government Gazette and until 26 th March 2012
4.	Notification of Ministry of Natural Resources and Environment on determination for areas and environmental protection measures in Ban Leam District, Muang District, Phetchaburi, Tha Yang District and Cha-am District, Phetchaburi, Hua Hin District and Pranburi District, Prachuab Khiri Khan B.E. 2553 (2010)	Minister of Natural Resources and Environment with the approval of the National Environmental Board and the Cabinet issue the Notification on determination for areas and environmental protection measures in Ban Leam District, Muang District, Phetchaburi, Tha Yang District and Cha-am District, Phetchaburi, Hua Hin District and Pranburi District, Prachuab Khiri Khan. These areas are determined as pollution control and conservation areas of Phetchaburi and Prachuab Khiri Khan are the areas controlled by environmental protection measures according to this Notification in order to control and resolve environmental problems in these areas under the authority given by Section 45 of the Enhancement and Conservative of National Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 92 D 30 th July 2010	After five years from the date of enactment in the Government Gazette
5.	Notification of Ministry of Natural Resources and Environment on determination for areas and environmental protection measures in Bang Lamung District and Sattahip District, Chon Buri B.E. 2553 (2010)	Minister of Natural Resources and Environment with the approval of the National Environmental Board and the Cabinet issue the Notification on determination for areas and environmental protection measures in Bang Lamung District and Sattahip District, Chon Buri to control and resolve environmental problems in these areas under the authority given by Section 45 of the Enhancement and Conservative of National Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 92 D 30 th July 2010	After five years from the date of enactment in the Government Gazette



No.	Subject	Main Idea	Date of Enactment	Effective Date
6.	Notification of Ministry of Natural Resources and Environment on determination for areas and environmental protection measures in Phuket B.E. 2553 (2010)	Minister of Natural Resources and Environment with the approval of the National Environmental Board and the Cabinet issue the Notification on determination for areas and environmental protection measures in Phuket to control and resolve environmental problems in these areas under the authority given by Section 45 of the Enhancement and Conservative of National Environmental Quality Act B.E. 2535 (1992).	Volume 127 Special Part 92 D 30 th July 2010	After five years from the date of enactment in the Government Gazette
The Factory Act B.E. 2535 (1992)				
1.	Notification of Ministry of Industry on abolishing the Notification of Ministry of Industry on projects or industries that may severely affect community on environmental quality, natural resources and health aspects	Due to the Ministry of Natural Resources and Environment issued the Notification on category, size and operation procedures of projects or businesses that may severely affect community on environmental quality, natural resources and health aspects, which projects or businesses of government agencies, state enterprises or private sectors are required to conduct the environmental impact assessment, it is not necessary to determine projects or businesses that may severely affect community on environmental quality, natural resources and health aspects. Therefore, the Notification of Ministry of Industry on projects or industries that may severely affect community on environmental quality, natural resources and health aspects dated 14 th September 2009 is abolished on 1 st September 2010.	Volume 127 Special Part 112 D 23 rd September 2010	–



No.	Subject	Main Idea	Date of Enactment	Effective Date
2.	Notification of Department of Industrial Works on training course for controlling, transporting and gas filling workers in factory B.E. 2553 (2010)	Department of Industrial Works issue the Notification on training course for controlling, transporting and gas filling workers in factory in accordance with the Notification of Ministry of Industry on regulations, methods, trainings, certificate issuance and registration of controlling, transporting and gas filling workers in factory (No.2) B.E. 2552 (2009) under the authority given by Article 2 of the Notification of Ministry of Industry on regulations, methods, trainings, certificate issuance and registration of controlling, transporting and gas filling workers in factory B.E. 2549 (2006) as amended by the Notification of Ministry of Industry on regulations, methods, trainings, certificate issuance and registration of controlling, transporting and gas filling workers in factory (No.2) B.E. 2552 (2009) issued under the Factory Act B.E. 2535 (1992),	Volume 127 Special Part 87 D 16 th July 2010	From the day following the date of enactment in the Royal Government Gazette (17 th July 2010)
3.	Notification of Department of Industrial Works on determination for categories or types of factory that are required to produce report of the types and quantities of pollutants emission from the factory B.E. 2553 (2010)	Amend the Notification of Department of Industrial Works on determination for categories or types of factory that are required to produce report of the types and quantities of pollutants emission from the factory B.E. 2551 (2008) in order to be clear in producing report of the types and quantities of pollutants emitted from the factory by abolishing the Notification of Department of Industrial Works on determination for categories or types of factory that are required to produce report of the types and quantities of pollutants emission from the factory B.E. 2551 (2008) dated 21 st March 2008 and replacing by this Notification.	Volume 127 Special Part 96 D 10 th August 2010	From the day following the date of enactment in the Royal Government Gazette (11 th August 2010)

No.	Subject	Main Idea	Date of Enactment	Effective Date
4.	Ministerial Regulation on waiving annual fee for factories that utilize waste disposal and materials from operation B.E. 2553 (2010)	Waive annual fee for 5 years for factories that develop operational processes to utilize waste disposal and materials from operation.	Volume 127 Part 52 A 27 th August 2010	From the day following the date of enactment in the Royal Government Gazette (28 th August 2010)
5.	Regulations of Department of Industrial Works on waiving annual fee for factories that utilize waste disposal and materials from operation B.E. 2553 (2010)	Determine request form of annual fee waiver for factories that develop operational processes to utilize waste disposal and materials from operation.	Volume 127 Special Part 127 D 3 rd November 2010	From the day following the date of enactment in the Royal Government Gazette (4 th November 2010)
The Industrial Estate Authority of Thailand Act B.E. 2522 (1979)				
1.	Regulations of the Industrial Estate Authority of Thailand Committee on regulations, method and criteria of land allocation in the industrial estate areas B.E. 2553 (2010)	The Industrial Estate Authority of Thailand Committee issue the Notification on amendments of the Regulations of the Industrial Estate Authority of Thailand Committee on regulations, method and criteria of land allocation for industrial estates by abolishing the Regulations of The Industrial Estate Authority of Thailand Committee on regulations, methods and criteria of land allocation for industrial estates B.E. 2548 (2005) by virtue of Section 23 (1) and Section 39/1 of the Industrial Estate Authority of Thailand Act B.E. 2522 (1979) which was amended by the Industrial Estate Authority of Thailand Act (No.4) B.E. 2550 (2007).	Volume 127 Special Part 78 D 23 rd June 2010	From the day following the date of enactment in the Royal Government Gazette (24 th June 2010)



No.	Subject	Main Idea	Date of Enactment	Effective Date
2.	Regulations of the Industrial Estate Authority of Thailand Committee on regulations, method and criteria of business operation in the industrial estate areas (No.2) B.E. 2553 (2010)	The Industrial Estate Authority of Thailand Committee issue the regulation amendments of the Regulations of the Industrial Estate Authority of Thailand Committee on regulations, method and criteria of business operation in the industrial estate areas by adding following sentences to be Paragraph 4 and 5 of Article 11 of the Regulations of the Industrial Estate Authority of Thailand Committee on regulations, method and criteria of business operation in the industrial estate areas B.E. 2551 (2008): "In Case of projects or businesses of the business operation applicants may severely affect community as stated in the related laws or agencies authorized by law, applicants must produce the environmental impact assessment report for projects or businesses that may severely affect community on environmental quality, natural resources and health aspects and conduct a public hearing to gather citizens' and independent organizations' comments before the Industrial Estate Authority of Thailand consider the business operation further. Applicants is responsible for the public hearing expenses which is set by the Industrial Estate Authority of Thailand in Paragraph 4" under the authority given by Section 23 (1) and Section 41, Paragraph 2 of the Industrial Estate Authority of Thailand Act B.E. 2522 (1979).	Volume 127 Special Part 78 D 23 rd June 2010	From the day following the date of enactment in the Royal Government Gazette (24 th June 2010)

No.	Subject	Main Idea	Date of Enactment	Effective Date
Non-Smokers' Health Protection Act B.E. 2522 (1979)				
1.	Notification of Ministry of Public Health (No.19) B.E. 2553 (2010) on determination for name or category of public places that protect non-smokers' health and determination for part or the whole public places to be smoking area or non-smoking area in accordance with the Non-Smokers' Health Protection Act B.E. 2535 (1992)	Minister of Public Health issue the Notification on determination for name or category of public places that protect non-smokers' health and determination for part or the whole public places to be smoking area or non-smoking area in accordance with the Non-Smokers' Health Protection Act by determination for the public place that protect non-smokers' health to be non-smoking areas and identifying "smoking areas" to be specific by virtue of Section 4 (1), (2) and Section 15 of the Non-Smokers' Health Protection Act B.E. 2535 (1992).	Volume 217 Special Part 40 D 30 th March 2010	From the day following the date of enactment in the Royal Government Gazette
2.	Notification of Ministry of Public Health (No.19) B.E. 2553 (2010) on determination for name or category of public places that protect non-smokers' health and determination for part or the whole public places to be smoking area or non-smoking area in accordance with the Non-Smokers' Health Protection Act B.E. 2535 (1992)	Minister of Public Health issue the Notification on determination for name or category of public places that protect non-smokers' health and determination for part or the whole public places to be smoking area or non-smoking area in accordance with the Non-Smokers' Health Protection Act by determination for the public place	Volume 127 Special Part 40 D 30 th March 2010	From the day following the date of enactment in the Royal Government Gazette



No.	Subject	Main Idea	Date of Enactment	Effective Date
Energy Conservation Promotion Act B.E. 2535 (1992)				
1.	Notification of Ministry of Energy on determination for energy efficiency ratio, energy efficiency standards testing agency and energy efficiency ratio testing methods of high-efficiency air conditioners B.E. 2552 (2009)	Minister of Energy issue the Notification on determination for energy efficiency ratio, energy efficiency standards testing agency and energy efficiency ratio testing methods of high-efficiency air conditioners which the standards and energy efficiency ratio testing methods of high-efficiency air conditioners must be operated according to industrial air conditioner standards for specific rooms for environmental aspect : energy efficiency ratio standard no. ISO 2134 – 2545 under the authority given by Article 2, 4 and 5 of Ministerial Regulations on determination for high-efficiency air conditioners B.E. 2552 (2009) under the Energy Conservation Promotion Act B.E. 2535 (1992) which was amended by Energy Conservation Promotion Act (No.2) B.E. 2550 (2007).	Volume 127 Special Part 16 D 1 st February 2010	From the day following the date of enactment in the Royal Government Gazette (2 nd February 2010)
2.	Notification of Ministry of Energy on determination for energy efficiency ratio, energy efficiency standards testing agency and energy efficiency ratio testing methods of high-efficiency refrigerators B.E. 2552 (2009)	Minister of Energy issue the Notification on determination for energy efficiency ratio, energy efficiency standards testing agency and energy efficiency ratio testing methods of high-efficiency refrigerators which the standards and energy efficiency ratio testing methods of high-efficiency refrigerators must be operated according to industrial refrigerator standards for housing for environmental aspect : energy efficiency ratio standard No. ISO 2186 – 2547 under the authority given by Article 2, 4 and 5 of Ministerial Regulations on determination for high-efficiency refrigerators B.E. 2552 (2009) under the Energy Conservation Promotion Act B.E. 2535 (1992) which was amended by Energy Conservation Promotion Act (No.2) B.E. 2550 (2007).	Volume 127 Special Part 16 D 1 st February 2010	From the day following the date of enactment in the Royal Government Gazette (2 nd February 2010)

No.	Subject	Main Idea	Date of Enactment	Effective Date
Hazardous Substance Act B.E. 2535 (1992)				
1.	Notification of Ministry of Industry on the hazardous substance list (No.7) B.E. 2553 (2010)	Abolish the list of hazardous substances in the list at the end of the Notification of the Ministry of Industry on list of hazardous substances B.E. 2538 (1995) dated 17 th February 1995 as follows: hazardous substance in list B 1 item under the responsibility of the Department of Agriculture which is products of plants' part that not go through the chemical change processes which are used to protect, eliminate, destroy, control insects, weeds, plant diseases and pest or control the growth of plants which are Neem, Citronella, Turmeric, Ginger, Galangal, Marigold, Bitter Bush, Tea Seed, Chili, Celery, Ringworm Bush, Flame Lily and Stemona tuberosa Lour.	Volume 127 Special Part 127 D 3 rd November 2010	From the day following the date of enactment in the Royal Government Gazette (4 th November 2010)
Public Health Act B.E. 2535 (1992)				
1.	Ministerial Regulation of Ministry of Public Health on businesses that are harmful to health (No.6) B.E. 2553 (2010)	Add elderly care service at home that elderly older than 60 years old despite having elderly care facility or employee training facility to be business that is harmful to health.	Volume 127 Special Part 6 D 14 th January 2010	From the day following the date of enactment in the Royal Government Gazette (4 th November 2010)



No.	Subject	Main Idea	Date of Enactment	Effective Date
Energy Industry Act B.E. 2550 (2007)				
1.	Notification of Energy Regulatory Commission on regulations, methods and criteria of constructing buildings, houses, planting trees or others, installing, drilling, digging, land filling, disposing or others that may harm or obstruct the natural gas network B.E. 2553 (2010)	Determine activities that may harm or obstruct the natural gas network. If they are necessary activities, the operators need to request for permission from the authorized offices or licensees and provide reasons for the activities.	Volume 127 Special Part 43 D 5 th April 2010	From the day following the date of enactment in the Royal Government Gazette (6 th April 2010)
2.	Notification of Energy Regulatory Commission on regulations, methods and criteria of constructing buildings, houses, planting trees or others, installing, drilling, digging, land filling, disposing or others that may harm or obstruct the electricity network B.E. 2553 (2010)	Determine activities that may harm or obstruct the electricity network. If they are necessary activities, the operators need to request for permission from the authorized offices or licensees and provide reasons for the activities.	Volume 127 Special Part 43 D 5 th April 2010	From the day following the date of enactment in the Royal Government Gazette (6 th April 2010)
Land Transportation Act B.E. 2522 (1979)				
1.	Notification of the Department of Land Transport on determination for category or type and hazardous cargo loading type that drivers must have class 4 driving license B.E. 2553 (2010)	Determine hazardous cargo loading types that drivers must have class 4 driving license and hazardous cargo loading types which are excluded from having class 4 driving license by determination for 9 hazardous substances.	Volume 127 Special Part 64 D 20 th May 2010	After sixty days from the date of enactment in the Government Gazette (19 th July 2010)



Local Pollution Ordinances Enacted in Royal Government Gazettes B.E. 2553 (2010)

No.	Subject	Date of Enactment
Local ordinances related to food shops and food accumulated sites		
1.	Local ordinance of San Pu Loei Subdistrict Administrative Organization on food shops and food accumulated site B.E. 2552 (2009)	Volume 127 Part 9 D 14 th January 2010
2.	Local ordinance of Tham Phannara Subdistrict Administrative Organization on food shops and food accumulated sites B.E. 2552 (2009)	Volume 127 Special Part 11 D 20 th January 2010
3.	Local ordinance of Pho Samton Subdistrict Administrative Organization on food shops and food accumulated sites B.E. 2552 (2009)	Volume 127 Special Part 11 D 20 th January 2010
4.	Local ordinance of Karaket Subdistrict Administrative Organization on food shops and food accumulated sites B.E. 2552 (2009)	Volume 127 Part 18 D 28 th January 2010
5.	Municipal law of Bang Krasan Subdistrict Municipality on food shops and food accumulated sites B.E. 2552 (2009)	Volume 127 Part 22 D 4 th February 2010
6.	Municipal law of Kled Kaew Subdistrict Municipality on food shops and food accumulated sites B.E. 2552 (2009)	Volume 127 Part 29 D 18 th February 2010
7.	Local ordinance of Buached Subdistrict Administrative Organization on food shops and food accumulated sites B.E. 2552 (2009)	Volume 127 Special Part 25 D 22 nd February 2010
8.	Local ordinance of Pa Klog Subdistrict Administrative Organization on food shops and food accumulated sites B.E. 2552 (2009)	Volume 127 Part 33 D 25 th February 2010
9.	Local ordinance of Nong Bua Subdistrict Administrative Organization on food shops and food accumulated sites B.E. 2552 (2009)	Volume 127 Part 64 D 29 th April 2010
10.	Municipal law of Baan Cheao Lan Subdistrict Municipality on food shops and food accumulated sites B.E. 2552 (2009)	Volume 127 Special Part 58 D 11 th May 2010



No.	Subject	Date of Enactment
11.	Local ordinance of San Ton Muea Subdistrict Administrative Organization on food shops and food accumulated sites B.E. 2552 (2009)	Volume 127 Part 76 D 20 th May 2010
12.	Municipal law of Ta Chong Subdistrict Municipality on food shops and food accumulated sites B.E. 2551 (2008)	Volume 127 Part 96 D 24 th June 2010
13.	Local ordinance of Baan Mai Nong Sai Subdistrict Administrative Organization on food shops and food accumulated sites B.E. 2553 (2010)	Volume 127 Part 99 D 1 st July 2010
14.	Municipal law of Pak Preak Subdistrict Municipality on food shops and food accumulated sites B.E. 2553 (2010)	Volume 127 Part 142 D 16 th September 2010
15.	Local ordinance of Thai Chana Suek Subdistrict Administrative Organization on food shops and food accumulated sites B.E. 2553 (2010)	Volume 127 Part 145 D 23 th September 2010
Local ordinances related to sewage and waste disposal		
1.	Municipal law of San Pu Loei Subdistrict Municipality on collection, transport and disposal of sewage and waste B.E. 2552 (2009)	Volume 127 Part 9 D 14 th January 2010
2.	Local ordinance of Mueng Pan Subdistrict Administrative Organization on sewage and waste disposal B.E. 2552 (2009)	Volume 127 Part 9 D 14 th January 2010
3.	Municipal law of Baan Khong Subdistrict Municipality on sewage and waste management B.E. 2552 (2009)	Volume 127 Special Part 8 D 16 th January 2010
4.	Local ordinance of Wang Hamhae Subdistrict Administrative Organization on sewage and waste disposal B.E. 2552 (2009)	Volume 127 Special Part 10 D 19 th January 2010
5.	Local ordinance of Tham Phannara Subdistrict Administrative Organization on sewage and waste disposal B.E. 2552 (2009)	Volume 127 Special Part 11 D 20 th January 2010
6.	Municipal law of Nong Phueng Subdistrict Municipality on sewage and waste disposal B.E. 2552 (2009)	Volume 127 Special Part 13 D 26 th January 2010

No.	Subject	Date of Enactment
7.	Local ordinance of Karaket Subdistrict Administrative Organization on sewage and waste disposal B.E. 2552 (2009)	Volume 127 Part 18 D 28 th January 2010
8.	Municipal law of Bang Krasan Subdistrict Municipality on sewage and waste disposal B.E. 2551 (2008)	Volume 127 Part 22 D 4 th February 2010
9.	Municipal law of Kled Kaew Subdistrict Municipality on sewage and waste disposal B.E. 2552 (2009)	Volume 127 Part 29 D 18 th February 2010
10.	Local ordinance of Pa Klog Subdistrict Administrative Organization on sewage and waste disposal B.E. 2552 (2009)	Volume 127 Part 33 D 25 th February 2010
11.	Local ordinance of Nong Bua Subdistrict Administrative Organization on sewage and waste disposal B.E. 2552 (2009)	Volume 127 Part 64 D 29 th April 2010
12.	Local ordinance of Tha Klor Subdistrict Administrative Organization on sewage and waste disposal B.E. 2553 (2010)	Volume 127 Part 60 D 22 nd April 2010
13.	Local ordinance of Wang Takien Subdistrict Administrative Organization on sewage and waste disposal B.E. 2553 (2010)	Volume 127 Special Part 58 D 11 th May 2010
14.	Local ordinance of Cha Muoeng Subdistrict Administrative Organization on sewage and waste disposal B.E. 2553 (2010)	Volume 127 Special Part 73 D 11 th June 2010
15.	Local ordinance of Nong Kung Subdistrict Administrative Organization on sewage and waste disposal B.E. 2553 (2010)	Volume 127 Special Part 79 D 25 th June 2010
16.	Municipal law of Ta Chong Subdistrict Municipality on sewage and waste disposal B.E. 2548 (2005)	Volume 127 96 D 24 th June 2010
17.	Municipal law of Ta Chong Subdistrict Municipality on sewage and waste disposal (No. 2) B.E. 2551 (2008)	Volume 127 Part 96 D 24 th June 2010
18.	Local ordinance of Nong Chig Subdistrict Administrative Organization on sewage and waste disposal B.E. 2553 (2010)	Volume 127 Part 108 D 15 th July 2010



No.	Subject	Date of Enactment
19.	Municipal law of Pa Oor Don Chai Subdistrict Municipality on sewage and waste disposal B.E. 2553 (2010)	Volume 127 Part 131 D 26 th August 2010
20.	Municipal law of Pak Preak Subdistrict Municipality on sewage and waste disposal B.E. 2553 (2010)	Volume 127 Part 142 D 16 th September 2010
21.	Local ordinance of Mae Pao Subdistrict Administrative Organization on collection, transport and disposal of sewage and waste B.E. 2553 (2010)	Volume 127 Part 79 D 25 th June 2010
22.	Local ordinance of Baan Leam Subdistrict Administrative Organization on sewage and waste disposal B.E. 2553 (2010)	Volume 127 Part 33 D 10 th June 2010
23.	Local ordinance of Na Mor Sri Subdistrict Administrative Organization on collection, transport and disposal of sewage and waste B.E. 2553 (2010)	Volume 127 Part 123 D 21 st October 2010
24.	Municipal law of Suphanburi Town Municipality on disposal of infectious waste B.E. 2552 (2009)	Volume 127 Part 61 D 22 nd April 2010
25.	Local ordinance of Don Pao Subdistrict Administrative Organization on sewage and waste disposal B.E. 2553 (2010)	Volume 127 Special Part 130 D 11 th November 2010
26.	Local ordinance of Sanam Chaeng Subdistrict Administrative Organization on sewage and waste disposal B.E. 2553 (2010)	Volume 127 Part 169 D 11 th November 2010
27.	Local ordinance of Pala Subdistrict Administrative Organization on sewage and waste disposal B.E. 2553 (2010)	Volume 127 Part 170 D 11 th November 2010

No.	Subject	Date of Enactment
Local ordinances related to product distribution in public areas or on public ways		
1.	Municipal law of Baan Khong Subdistrict Municipality on the control of product distribution in public areas or on public ways B.E. 2552 (2009)	Volume 127 Special Part 8 D 16 th January 2010
2.	Municipal law of San Pu Loei Subdistrict Municipality on the control of product distribution in public areas or on public ways B.E. 2552 (2009)	Volume 127 Part 9 D 14 th January 2010
3.	Local ordinance of Tham Phannara Subdistrict Administrative Organization on product distribution in public areas or on public ways B.E. 2552 (2009)	Volume 127 Special Part 11 D 20 th January 2010
4.	Local ordinance of Pho Sam Ton Subdistrict Administrative Organization on product distribution in public areas or on public ways B.E. 2552 (2009)	Volume 127 Special Part 11 D 20 th January 2010
5.	Local ordinance of Karaket Subdistrict Administrative Organization on product distribution in public areas or on public ways B.E. 2552 (2009)	Volume 127 Part 18 D 28 th January 2010
6.	Municipal law of Bang Krasan Subdistrict Municipality on product distribution in public areas or on public ways B.E. 2551 (2008)	Volume 127 Part 22 D 4 th February 2010
7.	Local ordinance of Lam Hei Subdistrict Administrative Organization on product distribution in public areas or on public ways B.E. 2548 (2005)	Volume 127 Part 33 D 25 th February 2010
8.	Local ordinance of Pa Klog Subdistrict Administrative Organization on product distribution in public areas or on public ways B.E. 2552 (2009)	Volume 127 Part 33 D 25 th February 2010
9.	Local ordinance of Kud Bong Subdistrict Administrative Organization on product distribution in public areas or on public ways B.E. 2553 (2010)	Volume 127 Part 51 D 1 st April 2010
10.	Municipal law of Pak Preak Subdistrict Municipality on the control of product distribution in public areas or on public ways B.E. 2553 (2010)	Volume 127 Part 142 D 16 th September 2010
11.	Local ordinance of Thai Chana Suek Subdistrict Administrative Organization on product distribution in public areas or on public ways B.E. 2553 (2010)	Volume 127 Part 145 D 23 rd September 2010



No.	Subject	Date of Enactment
Local ordinances related to market		
1.	Municipal law of San Pu Loei Subdistrict Municipality on market B.E. 2552 (2009)	Volume 127 Part 9 D 14 th January 2010
2.	Local ordinance of Tham Phannara Subdistrict Administrative Organization on market B.E. 2552 (2009)	Volume 127 Special Part 11 D 20 th January 2010
3.	Local ordinance of Pho Sam Ton Subdistrict Administrative Organization on market B.E. 2552 (2009)	Volume 127 Special Part 11 D 20 th January 2010
4.	Municipal law of Bang Krasan Subdistrict Municipality on market B.E. 2551 (2008)	Volume 127 Part 22 D 4 th February 2010
5.	Municipal law of Kled Kaew Subdistrict Municipality on market B.E. 2552 (2009)	Volume 127 Part 29 D 18 th February 2010
6.	Local ordinance of Pa Klog Subdistrict Administrative Organization on market B.E. 2552 (2009)	Volume 127 Part 33 D 25 th February 2010
7.	Local ordinance of Nong Bua Subdistrict Administrative Organization on market B.E. 2552 (2009)	Volume 127 Part 64 D 29 th April 2010



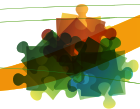
No.	Subject	Date of Enactment
Local ordinances related to the requirement for the establishment of grease trap wastewater treatment in the building		
1.	Municipal law of Baan Khong Subdistrict Municipality on the establishment of grease trap wastewater treatment in the building B.E. 2552 (2009)	Volume 127 Special Part 8 D 16 th January 2010
2.	Municipal law of Bang Krasan Subdistrict Municipality on the establishment of grease trap wastewater treatment in the building B.E. 2551 (2008)	Volume 127 Part 22 D 4 th February 2010
3.	Municipal law of Kled Kaew Subdistrict Municipality on the establishment of grease trap wastewater treatment in the building B.E. 2552 (2009)	Volume 127 Part 29 D 18 th February 2010
4.	Local ordinance of Chedi Luang Subdistrict Administrative Organization on the establishment of grease trap wastewater treatment in the building B.E. 2552 (2009)	Volume 127 Part 55 D 8 th April 2010
5.	Municipal law of Takien Tea Subdistrict Municipality on the establishment of grease trap wastewater treatment in the building B.E. 2551 (2008)	Volume 127 Part 131 D 26 th August 2010
Local ordinances related to the control of smoke and particulate matters from open burning		
1.	Local ordinance of Nong Waeng Subdistrict Administrative Organization on the control of smoke and particulate matters from open burning B.E. 2553 (2010)	Volume 127 Part 135 D 2 nd September 2010
2.	Municipal law of San Pu Loei Subdistrict Municipality on the control of smoke and particulate matters from open burning B.E. 2552 (2009)	Volume 127 Part 9 D 14 th January 2010



No.	Subject	Date of Enactment
Local ordinances related to businesses that are harmful to health		
1.	Municipal law of San Pu Loei Subdistrict Municipality on businesses that are harmful to health B.E. 2552 (2009)	Volume 127 Part 9 D 14 th January 2010
2.	Local ordinance of Karaket Subdistrict Administrative Organization on businesses that are harmful to health B.E. 2553 (2010)	Volume 127 Part 18 D 28 th January 2010
3.	Local ordinance of Tham Phannara Subdistrict Administrative Organization on businesses that are harmful to health B.E. 2552 (2009)	Volume 127 Special Part 11 D 20 th January 2010
4.	Local ordinance of Pho Sam Ton Subdistrict Administrative Organization on businesses that are harmful to health B.E. 2552 (2009)	Volume 127 Special Part 11 D 20 th January 2010
5.	Municipal law of Nong Phueng Subdistrict Municipality on businesses that are harmful to health B.E. 2552 (2009)	Volume 127 Special Part 13 D 26 th January 2010
6.	Municipal law of Bang Krasan Subdistrict Municipality on businesses that are harmful to health B.E. 2551 (2008)	Volume 127 Part 22 D 4 th February 2010
7.	Local ordinance of Bua Ched Subdistrict Administrative Organization on businesses that are harmful to health B.E. 2552 (2009)	Volume 127 Special Part 25 D 22 nd February 2010
8.	Municipal law of Kled Kaew Subdistrict Municipality on businesses that are harmful to health B.E. 2552 (2009)	Volume 127 Special Part 29 D 18 th February 2010
9.	Local ordinance of Pa Klog Subdistrict Administrative Organization on businesses that are harmful to health B.E. 2552 (2009)	Volume 127 Part 33 D 25 th February 2010
10.	Municipal law of Baan Cheo Lan Subdistrict Municipality on businesses that are harmful to health B.E. 2552 (2009)	Volume 127 Special Part 58 D 11 th May 2010
11.	Local ordinance of Nong Bua Subdistrict Administrative Organization on businesses that are harmful to health B.E. 2552 (2009)	Volume 127 Part 64 D 29 th April 2010



No.	Subject	Date of Enactment
12.	Local ordinance of Cha Mueng Subdistrict Administrative Organization on businesses that are harmful to health B.E. 2553 (2010)	Volume 127 Special Part 73 D 11 th June 2010
13.	Municipal law of Ta Chong Subdistrict Municipality on businesses that are harmful to health B.E. 2548 (2005)	Volume 127 Part 96 D 24 th June 2010
14.	Local ordinance of San Ton Muea Subdistrict Administrative Organization on businesses that are harmful to health B.E. 2552 (2009)	Volume 127 Part 96 D 24 th June 2010
15.	Local ordinance of Baan Mai Nong Sai Subdistrict Administrative Organization on businesses that are harmful to health B.E. 2553 (2010)	Volume 127 Part 99 D 1 st July 2010
16.	Local ordinance of Nong Chig Subdistrict Administrative Organization on businesses that are harmful to health B.E. 2553 (2010)	Volume 127 Part 108 D 14 th July 2010
17.	Local ordinance of Wieng Subdistrict Administrative Organization on businesses that are harmful to health B.E. 2553 (2010)	Volume 127 Part 109 D 15 th July 2010
18.	Local ordinance of Baan Pong Subdistrict Administrative Organization on businesses that are harmful to health B.E. 2553 (2010)	Volume 127 Special Part 113 D 28 th September 2010
19.	Local ordinance of Nong Waeng Subdistrict Administrative Organization on businesses that are harmful to health B.E. 2553 (2010)	Volume 127 Part 135 D 2 nd September 2010
20.	Municipal law of Pak Preak Suek Subdistrict Municipality on businesses that are harmful to health B.E. 2553 (2010)	Volume 127 Part 152 D 16 th September 2010
21.	Local ordinance of Thai Chana Suek Subdistrict Administrative Organization on businesses that are harmful to health B.E. 2553 (2010)	Volume 127 Part 145 D 23 th September 2010
22.	Local ordinance of Pratai Subdistrict Administrative Organization on businesses that are harmful to health B.E. 2552 (2009)	Volume 127 Part 154 D 14 th October 2010
23.	Local ordinance of San Klang Subdistrict Administrative Organization on businesses that are harmful to health B.E. 2553 (2010)	Volume 127 Part 165 D 4 th November 2010



No.	Subject	Date of Enactment
Local ordinances related to the control of raising and releasing animals		
1.	Municipal law of Baan Khong Subdistrict Municipality on the control of raising and releasing animals B.E. 2552 (2009)	Volume 127 Part 8 D 16 th January 2010
2.	Local ordinance of Karaket Subdistrict Administrative Organization on the control of raising and releasing animals B.E. 2552 (2009)	Volume 127 Part 18 D 28 th January 2010
3.	Municipal law of Baan Cheo Lan Subdistrict Municipality on the control of raising and releasing animals B.E. 2552 (2009)	Volume 127 Special Part 58 D 11 th May 2010
4.	Municipal law of Trat Town Municipality on the control of raising and releasing animals B.E. 2553 (2010)	Volume 127 Special Part 79 D 25 th June 2010
5.	Municipal law of Nong Khoon Subdistrict Municipality on the control of raising and releasing animals B.E. 2553 (2010)	Volume 127 Special Part 119 D 11 th October 2010
6.	Municipal law of Nong Khoon Subdistrict Municipality on the control of raising and releasing dogs B.E. 2553 (2010)	Volume 127 Special Part 119 D 11 th October 2010
Local ordinances related to the control and eradication of breeding sources of Aedes		
1.	Municipal law of Baan Khong Subdistrict Municipality on the control and eradication of breeding sources of Aedes B.E. 2552 (2009)	Volume 127 Special Part 8 D 16 th January 2010
2.	Local ordinance of Wang Hamhae Subdistrict Administrative Organization on the control and eradication of breeding sources of Aedes B.E. 2552 (2009)	Volume 127 Special Part 10 D 19 th January 2010
3.	Local ordinance of Pho Sam Ton Subdistrict Administrative Organization on the control and eradication of breeding sources of Aedes B.E. 2552 (2009)	Volume 127 Special Part 11 D 20 th January 2010
4.	Local ordinance of Wang Namyen Subdistrict Administrative Organization on the control and eradication of breeding sources of Aedes B.E. 2552 (2009)	Volume 127 Part 36 D 4 th March 2010

No.	Subject	Date of Enactment
5.	Local ordinance of Nai Mueng Subdistrict Administrative Organization on the control and eradication of breeding sources of Aedes B.E. 2552 (2009)	Volume 127 Part 50 D 1 st April 2010
6.	Municipal law of Baan Cheo Lan Subdistrict Municipality on the control and eradication of breeding sources of Aedes B.E. 2553 (2010)	Volume 127 Special Part 58 D 11 th May 2010
7.	Municipal law of Suphanburi Town Municipality on the control and eradication of breeding sources of Aedes B.E. 2552 (2009)	Volume 127 Part 88 D 10 th June 2010
8.	Local ordinance of Kam Niem Subdistrict Administrative Organization on the control and eradication of breeding sources of Aedes B.E. 2553 (2010)	Volume 127 Part 119 D 11 th October 2010
9.	Local ordinance of Nong Waeng Subdistrict Administrative Organization on the control and eradication of breeding sources of Aedes B.E. 2553 (2010)	Volume 127 Part 135 D 2 nd September 2010
10.	Local ordinance of Thai Chana Suek Subdistrict Administrative Organization on the control and eradication of breeding sources of Aedes B.E. 2553 (2010)	Volume 127 Part 145 D 23 rd September 2010
Local ordinances related to the control of annoying incidents		
1.	Local ordinance of Wang Hamhae Subdistrict Administrative Organization on the control of annoying incidents B.E. 2552 (2009)	Volume 127 Special Part 10 D 19 th January 2010



Appendix B



Appendix B Results of Water Quality Analysis in 2010

Table 1 : The Minimum – Maximum and Average Values of Key Water Quality Parameters and Water Quality Deterioration Areas in the Northern Region in 2010

Water Resources	Class	Minimum – maximum, average* values and percentage** of water quality parameters				Water quality deterioration areas	
		DO (mg/l)	BOD (mg/l)	TCB (MPN/100 ml)	FCB (MPN/100ml)	NH ₃ (mg/l)	
Ping	3	4.3 - 9.4	0.4 - 4.2	140 - 90,000	2 - 30,000	0.01 - 0.50	BOD Saphan Khwaen, Muang District, Tak (Aug. ³) TCB Nongbua Tai Subdistrict, Muang District, Tak(Aug), Hod District (May ³) Padad Subdistrict, Muang District (Aug) Mae Taeng District (Aug ³) Chiang Mai FCB Nongbua Tai Subdistrict, Muang District (Feb Aug) Saphan Khwaen, Muang District (Aug) Baan Tak District (Aug) Hod District, Tak (May ⁴ Aug) Jomthong District (Aug) Patan Subdistrict, Muang District (Aug) Mae Taeng District (Aug ⁴) Chiang Mai
		5.3 100%(56/56)	1.0 86%(48/56)	2,630 93%(52/56)	1,060 84%(47/56)	0.19 100%(56/56)	
Wang	3	3.5 - 11.2	1.0 - 7.4	140 - 50,000	20 - 17,000	0.10 - 0.50	BOD Rubber Dam, Lampang Municipality, Lampang (Jun ³) TCB Rubber Dam, Lampang Municipality, (Mar Aug Dec ³) Sobrab District (Aug) Lampang FCB Rubber Dam, Lampang Municipality, Lampang (Mar Aug Dec ⁴)
		7.7 96%(23/24)	1.6 88%(21/24)	1,400 83%(19/23)	300 87%(20/23)	0.23 100%(24/24)	
Yom	3	2.2 - 9.9	0.7 - 9.1	20 - 160,000	20 - 24,000	0.01 - 1.20	BOD Pho Talay District (Aug Nov) Pho Protab Chang District (Aug Nov) Sam Ngam District (Aug) Pichit, Bang Rakham District, Phitsanulok (Mar Jun ² Aug Nov), Thani Subdistrict (Mar) Pak Kwae Subdistrict (Mar) Muang District, Sukhothai TCB Thani Subdistrict, Muang District (Mar Jun ³ Aug) Sawankhalok District (Jun) Srisatchanalai District (Mar) Sukhothai, Baan Nam Khong (Mar) Ban Klong Pho (Aug) Muang District, Song District (Aug) Phrae FCB Pho Talay District (Aug) Pho Protab Chang District (Mar Aug) Sam Ngam District (Jun) Pichit, Bang Rakham District, Phitsanulok (Jun) Thani Subdistrict, Muang District (Mar Jun Dec) Sawankhalok District (Jun ⁴) Sukhothai, Baan Klong Pho, Muang District, Phrae (Aug) Chiang Muan District, Payao (Aug) NH₃ Sam Ngam District, Pichit (Jun) Thani Subdistrict, Muang District, Sukhothai (Mar ⁵)
		7.2 88%(45/51)	2.1 41%(21/51)	1,420 84%(43/51)	900 78%(40/51)	0.19 96%(49/51)	
Nan	3	2.8 - 8.2	0.8 - 3.6	210 - 16,000	50 - 16,000	0.03 - 0.42	FCB Bang Moon Nag District (Mar Jun ⁴ Aug) Taphan Hin District (Mar ⁴ Jun Aug ⁵) Taliang Subdistrict, Muang District (Jun ⁴ Aug) Nai Muang Subdistrict, Muang District (Jun Aug) Pichit, Tha Tong Subdistrict, Muang District (Mar Jun ⁴ Aug) Nai Muang Subdistrict, Muang District (Aug) Phitsanulok, Muang District (Aug ⁴) Wang Sa District (Jun ⁴ Aug ⁵) Tha Wang Pha District (Aug) Nan
		5.3 96%(54/56)	2.6 36%(20/56)	1,380 100%(56/56)	860 68%(38/56)	0.19 100%(56/56)	
Kok	2	4.7 - 8.4	0.2 - 1.5	1,100 - 160,000	80 - 13,000	0.01 - 0.16	TCB Mae Chan (May Aug ³) bridge above Chiang Rai Municipality, Muang District (May Aug ³) Mae Fah Luang Bridge, Maung District (May Aug ³) Chiang Rai FCB Mae Chan District (Aug ⁴) Mae Fah Luang Bridge, Muang District (Aug) Chiang Rai
		7.1 75%(12/16)	0.8 94%(15/16)	2,570 56%(9/16)	420 56%(9/16)	0.06 100%(16/16)	
Class 2 water quality standards		≥ 6.0	≤ 1.5	≤ 5,000	≤ 1,000	≤ 0.5	Deteriorated water quality considered from following criteria DO below 2.0 mg/l OD over 4.0 mg/l TCB over 20,000 units FCB over 4,000 units NH ₃ over 0.5 mg/l
Class 3 water quality standards		≥ 4.0	≤ 2.0	≤ 20,000	≤ 4,000	≤ 0.5	
Class 4 water quality standards		≥ 2.0	≤ 4.0	-	-	≤ 0.5	

Remarks: * Average values calculated from water quality data classified by water sources which have number of data more than or equal to 51 percent

** Percentage of measurements fall under surface quality standards for specific classes (number of standard measurements / total measurements)

In case of water resources with no classification and water resources in class 4, TCB and FCB values show in percentage of measurements under the surface water quality standard of class 3

¹ Area with the lowest DO ² Area with the highest BOD ³ Area with the highest TCB ⁴ Area with the highest FCB ⁵ Area with the highest NH₃

Table 1 : (Continued) The Minimum – Maximum and Average Values of Key Water Quality Parameters and Water Quality Deterioration Areas in the Northern Region in 2010

Water Resources	Class	Minimum – maximum, average* values and percentage** of water quality parameters				Water quality deterioration areas	
		DO (mg/l)	BOD (mg/l)	TCB (MPN/100 ml)	FCB (MPN/100ml)	NH ₃ (mg/l)	
Kuang	3	0.6 - 8.2 6.5 57%(16/28)	0.7 - 4.8 1.3 54%(15/28)	330 - 160,000 16,000 64%(18/28)	70 - 160,000 5,000 43%(12/28)	0.01 - 2.60 0.17 71%(20/28)	DO Pae Sang Bridge (May) Tha Nang Bridge (May ¹) Bridge after the wastewater release point (May) In front of Wang Thong Dam, Muang Nga Subdistrict (May) Muang District, Lamphun BOD Baan Yu Dam (May) Bridge after the wastewater release point (May ²) Muang District, Lamphun TCB Sob Tha Dam (Nov) Baan Yu Dam (Feb Aug ³) Tha Nang Bridge (Aug ³) Bridge after the wastewater release point (Nov) In front of Wang Thong Dam (Feb May Nov ³) Muang District, Lamphun, Sansai District (Aug ³) Doi Saket District (Aug ³) Chiang Mai FCB Sob Tha Dam (May Nov) Baan Yu Dam (Feb May Aug) Tha Nang Bridge (Aug) Bridge after the wastewater release point (May Aug) In front of Wang Thong Dam (Feb May Nov ⁴) Sansai District (Feb Aug Nov) Doi Saket (Aug) NH ₃ Baan Yu Dam (Feb May Nov) Tha Nang Bridge (Feb May) Bridge after the wastewater release point (May ⁵ Nov) In front of Wang Thong Dam (Nov)
Li	2	0.0 - 9.0 7.2 81%(13/16)	0.5 - 3.1 0.9 56%(9/16)	330 - 160,000 12,890 31%(5/16)	70 - 90,000 1,066 50%(8/16)	0.03 - 0.29 0.12 100%(16/16)	DO Wiang Nong Long District, Lamphun (Aug) TCB Mae Tuen Subdistrict, Li District, Lamphun (May ³) FCB Mae Tuen Subdistrict (May ³ Aug) Baan Mai-Sivilai (Aug) Li District, Lamphun
Ing	2	1.5 - 7.9 7.1 63%(10/16)	0.9 - 3.2 1.3 44%(7/16)	20 - 160,000 1,420 84%(43/51)	20 - 42,500 160 88%(14/16)	0.01 - 0.56 0.17 94%(15/16)	DO Jun District, Phayao (Aug ¹) TCB Phaya Mengrai District, Chiang Rai (Aug ³) FCB Phaya Mengrai District, Chiang Rai (Aug ³) NH ₃ Jun District, Phayao (Aug ³)
Mae Chang	2	4.2 - 8.9 6.1 50%(8/16)	1.3 - 3.3 1.6 44%(7/16)	40 - 9,000 1,020 94%(15/16)	20 - 500 150 100%(16/16)	0.06 - 0.40 0.23 100%(16/16)	—
Kwan Phayao	-	2.3 - 10.2 6.9 79%(19/24)	1.2 - 6.9 3.0 8%(2/24)	20 - 17,000 290 100%(24/24)	20 - 3,000 50 100%(24/24)	0.06 - 0.73 0.25 96%(23/24)	BOD In front of Fresh Water Fisher Station (Jun Dec ³) King Ngam Muang Monument (Jun Dec) In Front of Phayao Provincial Waterworks Authority (Jun Dec) Khun Dej Bridge (Dec) Middle of Kwan Phayao (Jun Dec) NH ₃ In front of Phayao Provincial Waterworks Authority (Aug ⁵)
Bueng Boraphet	-	2.0 - 8.6 5.7 80%(16/20)	1.0 - 4.8 2.4 45%(9/20)	8 - 1,600 240 100%(20/20)	2 - 500 60 100%(20/20)	0.01 - 0.56 0.19 95%(19/20)	BOD Baan Nong Duk (May ²) NH ₃ Baan Nern Rakang (Feb ⁵)
Class 2 water quality standards		≥ 6.0	≤ 1.5	≤ 5,000	≤ 1,000	≤ 0.5	Deteriorated water quality considered from following criteria
Class 3 water quality standards		≥ 4.0	≤ 2.0	≤ 20,000	≤ 4,000	≤ 0.5	DO below 2.0 mg/l OD over 4.0 mg/l TCB over 20,000 units FCB over 4,000 units NH ₃ over 0.5 mg/l
Class 4 water quality standards		≥ 2.0	≤ 4.0	—	—	≤ 0.5	

Remarks: * Average values calculated from water quality data classified by water sources which have number of data more than or equal to 51 percent

** Percentage of measurements fall under surface quality standards for specific classes (number of standard measurements / total measurements)

In case of water resources with no classification and water resources in class 4, TCB and FCB values show in percentage of measurements under the surface water quality standard of class 3

¹ Area with the lowest DO ² Area with the highest BOD ³ Area with the highest TCB ⁴ Area with the highest FCB ⁵ Area with the highest NH₃



Table 2 : Results of Heavy Metal Monitoring and Water Quality Deterioration Areas in Northern Region in 2010

Parameter	Minimum – maximum value (mg/l)	Surface water quality standards (mg/l)	Water quality deterioration areas
Cd 4.5%(5/111)*	Undetected – 0.0085	≤ 0.005	<u>Yom River</u> Bang Rakham District, Phitsanulok ² (Jun_0.0059, Aug_0.0085**) <u>Nan River</u> Phrom Piram District, Phitsanulok ² (Aug_0.0066) Nuew Ngam Subdistrict, Muang District, Uttaradit ² (Jun_0.008) Tha Wang Pha District, Nan (Aug_0.007)
Total Cr 0.9%(1/112)*	Undetected – 0.065	≤ 0.05	<u>Nan River</u> Wiang Sa District, Nan (Aug_0.065**)
Mn 2.3%(3/128)*	Undetected – 1.68	≤ 1.0	<u>Nan River</u> Wiang Sa District, Nan (Aug_1.68**) <u>Ping River</u> Mae Tang District, Chiang Mai (May_1.4) <u>Li River</u> Baan Hong District, Lamphun (Feb_1.07)
Ni	Undetected – 0.009	≤ 0.1	-
Pb 2.7%(3/112)*	Undetected – 0.34	≤ 0.05	<u>Ping River</u> Banpotpisai District, Nakhon Sawan (Mar_0.34**) Pradang Subdistrict, Muang District, Tak (Feb_0.053) <u>Nan River</u> Taphan Hin District, Pichit (Jun_0.07)
Zn 0.8%(1/128)*	Undetected – 1.24	≤ 1.0	<u>Ping River</u> Nai Muang Subdistrict, Muang District, Kamphaengphet (May_1.24)
Cu	Undetected – 0.001	≤ 0.1	-
Hg	Undetected	≤ 0.002	-
As	Undetected – 0.006	≤ 0.01	-

Remarks: * Percentage of measurements exceeded standards (number of measurements exceeded standards / total measurements)

** Maximum value

² Area where parameter exceeded standards in 2009 and 2010



Table 3 : The Minimum – Maximum and Average Values of Key Water Quality Parameters and Water Quality Deterioration Areas in the Central Region in 2010

Water Resources	Class	Minimum – maximum, average* values and percentage** of water quality parameters					Water quality deterioration areas	
		DO (mg/l)	BOD (mg/l)	TCB (MPN/100 ml)	FCB (MPN/100ml)	NH ₃ (mg/l)		
Upper Chao Phraya	2	3.4 - 10.0 39%(11/28)	0.8 - 6.6 1.4 32%(9/28)	610 - 1 60,000 2,570 57%(1 6/28)	180 - 1 60,000 460 57%(1 6/28)	0.01 - 0.57 0.23 93%(26/28)	BOD In Buri District, Sing Buri (Feb ² May) Chao Phraya Dam (Jun) ICB Muang District, Ang Thong (Feb Aug), Chao Phraya Dam (Dec) In front of Town Hall, (Aug Dec ³) Muang District, Chainat, Muang District, Nakhon Sawan (Aug) ECB Chao Phraya Dam (Dec) In front of Town Hall, (Dec ⁴) Muang District, Chainat, Payuhakiri District (May) Muang District (Aug) Nakhon Sawan NH₃ Muang District, Sing Buri (May ⁵) Chao Phraya Dam, Chainat (Dec)	
Central Chao Phraya	3	2.3 - 5.7 3.3 45%(9/20)	1.1 - 4.3 2.2 45%(9/20)	450 - 1 60,000 2,820 70%(1 4/20)	180 - 92,000 1,180 85%(1 7/20)	0.02 - 0.89 0.22 95%(1 9/20)	BOD Sam Kok District, Pathum Thani (Dec ³) ICB Pakkred District, Nonthaburi (May Aug) Sam Kok District, Pathum Thani (May), Bang Pa-in District (May Aug ³) Pha Nan Cheng Temple (Feb) Ayudhaya ECB Pakkred District, Nonthaburi (Feb), Bang Pa-in District (Aug) Pha Nan Cheng Temple (Feb ⁴) Ayudhaya NH₃ Pakkred District, Nonthaburi (Aug ⁵)	
Lower Chao Phraya	4	0.1 - 3.8 3.1 65%(15/23)	0.6 - 8.5 1.9 57%(13/23)	450 - 1 60,000 112,400 48%(11/23)	200 - 92,000 22,720 43%(10/23)	0.19 - 1.77 1.03 39%(9/23)	DO Muang District (May Aug) Phra Pradaeng District (May Aug) Samut Prakan, Bangkok Port Authority (May ¹ Dec) Krungthep Bridge (May) Bangkok, Bang Kruey District, Nonthaburi (May) BOD Maung District (Feb May) Phra Pradaeng District (May) Samut Prakan, Bangkok Port Authority (Feb May) Krungthep Bridge (Feb May), Rama I Bridge (Feb May ³) Bangkok, Bang Kruey District, Nonthaburi (May) ICB Muang District (May Aug) Phra Pradaeng District (May Aug) Samut Prakan, Bangkok Port Authority (May ³ Aug ³) Krungthep Bridge (May ³ Aug) Rama I Bridge (Feb May ³ Aug) Bangkok, Bang Kruey District, Nonthaburi (May ³) ECB Muang District (May Aug) Phra Pradaeng District (May Aug ⁴ Dec) Samut Prakan, Bangkok Port Authority (Aug) Krungthep Bridge (Feb May Aug) Rama I Bridge (Feb May Aug) Bangkok, Bang Kruey District, Nonthaburi (May) NH₃ Muang District (Feb May Dec) Phra Pradaeng (Feb May Dec) Samut Prakan, Bangkok Port Authority (Feb May Dec) Krungthep Bridge (Feb May) Rama I Bridge (May ⁵ Dec) Bangkok, Bang Kruey District, Nonthaburi (May)	
Upper Tha Chin	2	2.0 - 6.2 2.6 19%(3/16)	0.9 - 3.5 1.6 19%(3/16)	240 - 90,000 2,200 63%(10/16)	70 - 28,000 1,150 38%(6/16)	0.10 - 0.40 0.16 100%(16/16)	ICB Muang District (Feb ³) Sam Chuk District (Aug) Suphanburi, Hanka District, Chainat (Aug) ECB Muang District (Feb ³ Jun), Sam Chuk District (Feb Aug) Suphanburi, Hanka District, Chainat (Aug)	
Class 2 water quality standards		≥ 6.0	≤ 1.5	≤ 5,000	≤ 1,000	≤ 0.5	Deteriorated water quality considered from following criteria DO below 2.0 mg/l OD over 4.0 mg/l TCB over 20,000 units FCB over 4,000 units NH ₃ over 0.5 mg/l	
Class 3 water quality standards		≥ 4.0	≤ 2.0	≤ 20,000	≤ 4,000	≤ 0.5		
Class 4 water quality standards		≥ 2.0	≤ 4.0	–	–	≤ 0.5		

Remarks: * Average values calculated from water quality data classified by water sources which have number of data more than or equal to 51 percent

** Percentage of measurements fall under surface quality standards for specific classes (number of standard measurements / total measurements)

In case of water resources with no classification and water resources in class 4, TCB and FCB values show in percentage of measurements under the surface water quality standard of class 3

¹ Area with the lowest DO ² Area with the highest BOD ³ Area with the highest TCB ⁴ Area with the highest FCB ⁵ Area with the highest NH₃



Table 3 : (Continued) The Minimum – Maximum and Average Values of Key Water Quality Parameters and Water Quality Deterioration Areas in the Central Region in 2010

Water Resources	Class	Minimum – maximum, average* values and percentage** of water quality parameters				Water quality deterioration areas
		DO (mg/l)	BOD (mg/l)	TCB (MPN/100 ml)	FCB (MPN/100ml)	NH ₃ (mg/l)
Central Tha Chin	3	1.2 - 4.4 2.6 8%(1/12)	1.4 - 3.1 2.6 33%(4/12)	1,300 - 1,600,000 5,490 67%(8/12)	230 - 900,000 1,720 67%(8/12)	0.10 - 0.40 0.16 100%(12/12)
		DO Bang Len District, Nakhon Pathom (Aug ¹), Song Phinong District (Aug) Muang District (Aug Nov) Suphanburi ICB Bang Len District, Nakhon Pathom (Jun), Muang District, Suphanburi (Feb ³ Jun Aug) ECB Bang Len District, Nakhon Pathom (Nov), Muang District, Suphanburi (Feb ⁴ Jun Aug)				
Lower Tha Chin	4	0.8 - 3.9 1.4 43%(12/28)	0.4 - 6.8 3.1 89%(25/28)	1,100 - 16,000,000 16,500 57%(16/28)	230 - 3,500,000 4,000 50%(14/28)	0.10 - 0.50 0.16 100%(28/28)
		DO River estuary (Aug ¹) Srimongkol Temple (Aug Nov) Muang District, Krathum Ban District (Aug Nov) Samut Sakhon, Thienudud Temple (Feb Aug Nov) Bang Chang Nue Temple (Feb Jun Aug Nov) Phokeaw Bridge (Feb Aug) Sam Pran District, Nakhon Chaisir District (Aug Nov) Nakhon Prathom BOD Krathum Ban District (Feb) Thienudud Temple (Feb Jun ²) ICB River estuary (Jun Aug) Srimongkol Temple (Jun Aug) Krathum Ban District (Jun Aug Nov) Thienudud Temple (Jun ³ Aug Nov) Bang Chang Nue Temple (Jun Aug) ECB River estuary (Feb Aug Nov) Srimongkol Temple (Jun Aug) Krathum Ban District (Aug) Thienudud Temple (Jun ⁴ Aug Nov) Bang Chang Nue Temple (Jun Aug) Phokaew Bridge (Jun Aug) Nakhonchaisi (Jun)				
Mae Klong	3	2.7 - 6.9 5.2 80%(32/40)	0.8 - 2.8 1.2 90%(36/40)	330 - 170,000 6,250 75%(30/40)	45 - 14,000 1,150 88%(35/40)	0.01 - 0.75 0.15 95%(38/40)
		ICB River estuary (May) Samut Songkram Hospital (Aug Nov) Muang District, Samut Songkram, Muang District (Feb) Baan Pong District (Aug Nov) Ratchaburi, Tha Maka, Kanchanaburi (Feb May ³ Aug Nov) ECB River estuary (Nov) Samut Songkram Hospital (Aug ⁴ Nov) Baan Pong District (Nov) Tha Maka District (Feb) NH ₃ River estuary (Feb) Bang Khon Tee District, Ratchaburi (Feb ⁵)				
Upper Phetchaburi	2	4.1 - 6.9 5.1 13%(1/8)	0.7 - 2.0 1.1 63%(5/8)	220 - 7,000 1,150 88%(7/8)	18 - 680 160 100%(8/8)	0.01 - 0.47 0.14 100%(6/6)
		-				
Class 2 water quality standards		≥ 6.0	≤ 1.5	≤ 5,000	≤ 1,000	≤ 0.5
Class 3 water quality standards		≥ 4.0	≤ 2.0	≤ 20,000	≤ 4,000	≤ 0.5
Class 4 water quality standards		≥ 2.0	≤ 4.0	-	-	≤ 0.5
Deteriorated water quality considered from following criteria DO below 2.0 mg/l OD over 4.0 mg/l TCB over 20,000 units FCB over 4,000 units NH ₃ over 0.5 mg/l						

Remarks: * Average values calculated from water quality data classified by water sources which have number of data more than or equal to 51 percent

** Percentage of measurements fall under surface quality standards for specific classes (number of standard measurements / total measurements)

In case of water resources with no classification and water resources in class 4, TCB and FCB values show in percentage of measurements under the surface water quality standard of class 3

¹ Area with the lowest DO ² Area with the highest BOD ³ Area with the highest TCB ⁴ Area with the highest FCB ⁵ Area with the highest NH₃



Table 3 : (Continued) The Minimum – Maximum and Average Values of Key Water Quality Parameters and Water Quality Deterioration Areas in the Central Region in 2010

Water Resources	Class	Minimum – maximum, average* values and percentage** of water quality parameters					Water quality deterioration areas	
		DO (mg/l)	BOD (mg/l)	TCB (MPN/100 ml)	FCB (MPN/100ml)	NH ₃ (mg/l)		
Lower Phetchaburi	3	3.6 - 5.4 4.9 75%(12/16)	1.0 - 11.1 2.2 50%(8/16)	1,700 - 130,000 59,560 44%(7/16)	330 - 23,000 1,540 69%(11/16)	0.01 - 1.05 0.18 92%(11/12)	BOD Phetchaburi River estuary (Mar Sep ² Dec) ICB Phetchaburi River estuary (Mar Jun ³ Sep) Bridge before Baan Leam, Baan Leam District (Mar Jun Sep), Klong Krasae Subdistrict, Muang District (Mar ³ Sep Dec) Phetchaburi ECB Phetchaburi River estuary (Mar Jun Sep ⁴) Bridge before Baan Leam (Sep) Klong Krasae Subdistrict (Mar) NH₃ Phetchaburi River estuary (Sep ⁵)	
		1.4 - 6.0 4.9 0%(0/18)	0.8 - 3.1 1.4 50%(10/20)	60 - 3,300 820 100%(20/20)	18 - 490 80 100%(20/20)	0.01 - 0.36 0.10 100%(20/20)		
Kwae Yai	2						DQ Tha Tung Na Dam, Muang District, Kanchanaburi (Feb ¹)	
Kwae Noi	2	3.2 - 7.2 5.3 15%(3/20)	0.6 - 2.5 1.0 80%(16/20)	230 - 330,000 2,080 95%(19/20)	18 - 3,300 260 85%(17/20)	0.01 - 0.23 0.06 100%(20/20)	ICB Kwae Noi River estuary, Muang District, Kanchanaburi (Nov ³)	
							DQ Muang District, Saraburi (Aug ¹) Muang District, Phetchaboon (Feb ¹) BOD Muang District, Saraburi (Aug ²), Muang District (Feb) Lomsak District (Aug) Phetchaboon ICB Muang District (May Aug) Nakhon Luang District (May Aug Dec) Tha Rue District (Feb ³ Aug Dec ³) Ayudhaya, Chai Badan District, Lop Buri (Aug ³), Wichien Buri District (Aug), Nong Phai District (Aug ³) Lomsak District (Aug) Phetchaboon ECB Muang District (Aug) Nakhon Luang District (Dec) Tha Rue District (Feb Dec ⁴) Ayudhaya, Muang District (Nov) Saraburi, Chai Badan District (Aug Nov) Wichien Buri District (Aug) Nong Phai District (Aug) Lomsak District (Aug) NH₃ Nakhon Luang District (Dec), Muang District (Feb ⁵ Aug Nov) Kaengkoi District (Aug Nov) Saraburi, Pattana Nikhom District (Aug Nov) Chai Badan District (Feb Aug Nov), Wichien Buri District (Aug Nov) Nong Phai District (Feb Aug Nov) Muang District (Feb Aug Nov) Lomsak District (Feb Aug Nov) Phetchaboon	
Pasak	3	1.8 - 7.3 3.3 39%(14/36)	0.8 - 5.5 2.9 22%(8/36)	80 - 160,000 4,380 67%(24/36)	10 - 54,000 290 72%(26/36)	0.02 - 1.41 0.81 39%(14/36)		
Lop Buri	3	1.0 - 6.5 3.8 39%(7/18)	0.1 - 7.3 2.1 39%(7/18)	390 - 160,000 2,160 78%(14/18)	180 - 22,000 880 78%(14/18)	0.07 - 2.22 0.27 61%(11/18)	DQ Baan Preak District, Ayutthaya (Dec), Muang District (Aug ¹) Tha Woong District (Aug ¹) Lop Buri BOD Muang District, Ayudhaya (Feb), Muang District, Sing Buri (Feb ² May) ICB Baan Preak District, Ayutthaya (Feb ³ Aug Dec) Muang District, Lop Buri (Aug) ECB Muang District (Feb) Baan Preak (Feb4 Dec) Ayutthaya, Muang District, Lop Buri (Aug) NH₃ Baan Preak District, Ayutthaya (Dec), Muang District (Feb ⁵ Aug Nov) Tha Woong District (Feb Aug Nov) Lop Buri	

Remarks: * Average values calculated from water quality data classified by water sources which have number of data more than or equal to 51 percent

** Percentage of measurements fall under surface quality standards for specific classes (number of standard measurements / total measurements)

In case of water resources with no classification and water resources in class 4, TCB and FCB values show in percentage of measurements under the surface water quality standard of class 3

¹ Area with the lowest DO ² Area with the highest BOD ³ Area with the highest TCB ⁴ Area with the highest FCB ⁵ Area with the highest NH₃



Table 3 : (Continued) The Minimum – Maximum and Average Values of Key Water Quality Parameters and Water Quality Deterioration Areas in the Central Region in 2010

Water Resources	Class	Minimum – maximum, average* values and percentage** of water quality parameters					Water quality deterioration areas
		DO (mg/l)	BOD (mg/l)	TCB (MPN/100 ml)	FCB (MPN/100ml)	NH ₃ (mg/l)	
Noi	3	2.2 - 7.4	0.3 - 5.0	450 - 1 60 000	180 - 22 000	0.02 - 0.66	BOD Pakhai District, Ayudhaya (Feb ²) ICB Bangsai District (May) Pakhai District (May Aug ³) Ayudhaya, Pho Thong District, Ang Thong (Feb May Aug), Bang Rachan District, Sing Buri (May), Muang District, Chainat (Jun ³) FCB Pho Thong District, Ang Thong (May ⁴), Muang District, Chainat (Jun) NH₃ Pakhai District (Dec), Pho Thong District (Dec), Bang Rachan District (Dec ⁵)
		5.1	1.3	4,390	1,000	0.22	
		60%(12/20)	60%(12/20)	60%(12/20)	90%(18/20)	85%(17/20)	
Sakae Krang	3	2.6 - 6.2	1.6 - 5.2	300 - 13 000	130 - 13 000	0.01 - 0.64	BOD Baan E-Teung School Muang District, Uthai Thani (Dec ²) ECB Manorom District, Chainat (Dec ³) NH₃ Manorom District, Chainat (Aug ⁵)
		4.6	2.6	1,550	1,020	0.19	
		75%(9/12)	33%(4/12)	100%(12/12)	92%(11/12)	92%(11/12)	
Pranburi	–	3.2 - 6.4	0.7 - 4.5	230 - 23 000	18 - 2,300	0.01 - 0.39	BOD Wangpong Subdistrict, Pranburi District, Prachuab Khiri Khan (Jun ²) ICB Khao Noi Sub-district, Pranburi District, Prachuab Khiri Khan (Dec ³)
		4.9	1.3	1,490	150	0.16	
		75%(15/20)	70%(14/20)	95%(19/20)	100%(20/20)	100%(15/15)	
Kuiburi	–	3.0 - 6.2	0.8 - 9.5	330 - 22 000	70 - 790	0.01 - 0.35	BOD Kuiburi River estuary Moo 1 Baan Pak Klong Kleay, Bor Nok Subdistrict, Muang District, Prachuab Khiri Khan (Dec ²) ICB Kuiburi River Estuary (Mar ³)
		4.7	1.9	1,320	270	0.13	
		63%(5/8)	50%(4/8)	88%(7/8)	100%(8/8)	100%(6/6)	
Class 2 water quality standards		≥ 6.0	≤ 1.5	≤ 5,000	≤ 1,000	≤ 0.5	Deteriorated water quality considered from following criteria DO below 2.0 mg/l OD over 4.0 mg/l TCB over 20,000 units FCB over 4,000 units NH ₃ over 0.5 mg/l
Class 3 water quality standards		≥ 4.0	≤ 2.0	≤ 20,000	≤ 4,000	≤ 0.5	
Class 4 water quality standards		≥ 2.0	≤ 4.0	–	–	≤ 0.5	

Remarks: * Average values calculated from water quality data classified by water sources which have number of data more than or equal to 51 percent

** Percentage of measurements fall under surface quality standards for specific classes (number of standard measurements / total measurements)

In case of water resources with no classification and water resources in class 4, TCB and FCB values show in percentage of measurements under the surface water quality standard of class 3

¹ Area with the lowest DO ² Area with the highest BOD ³ Area with the highest TCB ⁴ Area with the highest FCB ⁵ Area with the highest NH₃



Table 4 : Results of Heavy Metal Monitoring and Water Quality Deterioration Areas in Central Region in 2010

Parameter	Minimum – maximum value (mg/l)	Surface water quality standards (mg/l)	Water quality deterioration areas
Cd	Undetected – 0.004	≤ 0.005	–
Total Cr	Undetected – 0.014	≤ 0.05	–
Mn 0.7%(1 /134)*	0.02 – 1.2	≤ 1.0	<u>Lop Buri River</u> Muang District, Sing Buri (May_1.2 **)
Ni	Undetected – 0.01	≤ 0.1	–
Pb	Undetected – 0.04	≤ 0.05	–
Zn	Undetected – 0.63	≤ 1.0	–
Cu	Undetected – 0.01	≤ 0.1	–
Hg	–	≤ 0.002	–
As	–	≤ 0.01	–

Remarks: * Percentage of measurements exceeded standards (number of measurements exceeded standards / total measurements)

** Maximum value

² Area where parameter exceeded standards in 2009 and 2010



Table 5 : The Minimum – Maximum and Average Values of Key Water Quality Parameters and Water Quality Deterioration Areas in the Northeastern Region in 2010

Water Resources	Class	Minimum – maximum, average* values and percentage** of water quality parameters					Water quality deterioration areas
		DO (mg/l)	BOD (mg/l)	TCB (MPN/100 ml)	FCB (MPN/100ml)	NH ₃ (mg/l)	
Pong	3	0.5 - 9.5 5.7 76%(39/51)	0.3 - 4.8 1.1 76%(39/51)	20 - 3,500 580 100%(51/51)	18 - 790 120 100%(51/51)	0.01 - 1.50 0.52 49%(25/51)	<u>DQ</u> Kok Si Subdistrict, Muang District (May) Water pumping area at Nam Phong Waterworks Office (May1) Khon Kean <u>BOD</u> South of sugar factory ,Baan Kud Namsai Noi, Nam Phong District, Khon Kean (May2) <u>NH₃</u> Wathanya Resort, Phra Lub Subdistrict (Feb May Jul Dec) Kok Si Subdistrict (Feb May Dec) Water pumping area (Feb May) Muang District, Utumporn Temple (Feb Dec) Thao Mao – Wang Chai Bridge (Feb May Dec) South of sugar factory (Feb5 May Dec) Chao Poo Thung Thaw Shime (Feb May) Nong Wai Dam (Feb May Dec) Water pumping area (May Dec) South of Bueng Huay Jode (Dec) North of Bueng Huay Jode (Dec) Nam Phong District, Khon Kean
Chi	3	2.2 - 7.6 6.6 94%(45/48)	0.2 - 6.0 1.3 65%(31/48)	45 - 160,900 860 96%(46/48)	20 - 3,300 170 100%(48/48)	0.01 - 0.76 0.19 85%(41/48)	<u>BOD</u> Baan Tha Toom (Dec) Baan Din Dum Temple (Dec2) Muang District, Kosum Phisai District (Dec) Maha Sarakham <u>TCB</u> Warin Chamrab District, Ubon Ratchathani (Aug) Muang District, Yasothorn (Feb3) <u>NH₃</u> Baan Din Dum Temple (Feb Aug) Muang District, Kosum Phisai District (Feb May) Maha Sarakham, Muang District (Feb Dec5) Chonnabot District (Feb) Khon Kean
Moon	3	1.2 - 7.8 6.0 88%(63/72)	0.2 - 5.3 1.0 67%(48/72)	20 - 160,900 860 89%(64/72)	20 - 9,000 130 89%(64/72)	0.01 - 0.50 0.11 100%(42/42)	<u>DQ</u> Chokchai District, Nakhon Ratchasima (May1) <u>BOD</u> Satuek District, Buriram (May2 Aug) Chokchai District, Nakhon Ratchasima (May) <u>TCB</u> Baan Tha Pae, Khong Jiem Subdistrict (Aug3) Under Pak Moon Dam (Aug) Khong Jiem District, Phiboon Mungsaharn District (Feb Aug) Had Wattai (Feb) Seri Prachathipatai Bridge (Feb May) Muang District, Warin Chamrab District (Aug) Ubon Ratchathani <u>FCB</u> Baan Tha Pae (Aug) Under Pak Moon Dam (Aug) Above Pak Moon Dam (Feb) Phiboon Mungsaharn District (Feb Aug) Had Wat Tai (Feb) Prachathipatai Bridge (Feb), Tha Toom District, Surin (Aug4)
Songkram	3	4.1 - 8.7 7.0 100%(20/20)	0.6 - 1.5 1.0 100%(20/20)	20 - 4,900 1,130 100%(20/20)	2 - 780 270 100%(20/20)	0.01 - 0.42 0.14 100%(20/20)	—

Remarks: * Average values calculated from water quality data classified by water sources which have number of data more than or equal to 51 percent

** Percentage of measurements fall under surface quality standards for specific classes (number of standard measurements / total measurements)

In case of water resources with no classification and water resources in class 4, TCB and FCB values show in percentage of measurements under the surface water quality standard of class 3

¹ Area with the lowest DO ² Area with the highest BOD ³ Area with the highest TCB ⁴ Area with the highest FCB ⁵ Area with the highest NH₃



Table 5 : (Continued) The Minimum – Maximum and Average Values of Key Water Quality Parameters and Water Quality Deterioration Areas in the Northeastern Region in 2010

Water Resources	Class	Minimum – maximum, average* values and percentage** of water quality parameters					Water quality deterioration areas
		DO (mg/l)	BOD (mg/l)	TCB (MPN/100 ml)	FCB (MPN/100ml)	NH ₃ (mg/l)	
Upper Lamtakong	3	1.6 - 7.2 5.1 90%(18/20)	1.0 - 4.9 2.1 45%(9/20)	40 - 16,000 1,230 100%(20/20)	20 - 2,400 170 100%(20/20)	-	DO Lamtakong water pumping area, Nakhon Ratchasima (May ¹) BOD Lamtakong water pumping area (Aug ³)
Lower Lamtakong	4	0.7 - 6.1 4.1 88%(7/8)	1.6 - 6.4 4.4 50%(4/8)	3,000 - 16,000 15,000 100%(8/8)	20 - 16,000 1,010 88%(7/8)	-	DO Samakki Temple Community, Nai Muang Subdistrict (Feb ¹) Muang District, Nakhon Ratchasima BOD Baan Yong Yaeng, Panao Subdistrict (Feb ² Aug Nov ²) Samakki Temple Community, Nai Muang Subdistrict (Feb) Muang District, Nakhon Ratchasima ECB Samakki Temple Community, Nai Muang Subdistrict (Feb ⁴)
Lampao	2	4.3 - 8.4 5.4 45%(9/20)	0.8 - 2.8 1.9 40%(8/20)	130 - 1,700 700 100%(20/20)	45 - 490 150 100%(20/20)	0.05 - 0.82 0.20 55%(11/20)	NH₃ Rong Kham District (Feb Aug) Kamalasai District (Feb Aug Dec) Baan Don Sanuan (Feb Aug Dec ⁵), Lampao Bridge (Aug) Muang District, Kalasin
Siew	3	1.3 - 7.9 5.7 90%(18/20)	0.7 - 5.8 1.4 65%(13/20)	20 - 4,900 1,030 100%(20/20)	20 - 2,400 160 100%(20/20)	0.01 - 0.44 0.14 100%(17/17)	DO Borabue District, Maha Sarakham (May ¹) BOD Wapee Pathum District (Dec) Borabue District (Dec ³) Maha Sarakham
Loei	3	6.0 - 11.8 7.5 100%(20/20)	0.7 - 4.6 1.2 70%(14/20)	80 - 160,000 4,930 70%(14/20)	2 - 160,000 370 60%(12/20)	0.01 - 0.22 0.05 100%(20/20)	BOD Saikaow Subdistrict, Wang Saphung District, Loei (Jun ²) TCB Baan Mai, Muang District (Jun Aug) Wang Saphung Subdistrict (Jun Aug ³ Dec) Saikaow Subdistrict (Aug) Wang Saphung District, Loei ECB Baan Mai (Jun Aug Dec) Baan Na Arn (Aug) Muang District Wang Saphung Subdistrict (Jun Aug ⁴) Saikaow Subdistrict (Jun Aug) Wang Saphung District, Loei
Class 2 water quality standards		≥ 6.0	≤ 1.5	≤ 5,000	≤ 1,000	≤ 0.5	Deteriorated water quality considered from following criteria DO below 2.0 mg/l OD over 4.0 mg/l TCB over 20,000 units FCB over 4,000 units NH ₃ over 0.5 mg/l
Class 3 water quality standards		≥ 4.0	≤ 2.0	≤ 20,000	≤ 4,000	≤ 0.5	
Class 4 water quality standards		≥ 2.0	≤ 4.0	-	-	≤ 0.5	

Remarks: * Average values calculated from water quality data classified by water sources which have number of data more than or equal to 51 percent

** Percentage of measurements fall under surface quality standards for specific classes (number of standard measurements / total measurements)

In case of water resources with no classification and water resources in class 4, TCB and FCB values show in percentage of measurements under the surface water quality standard of class 3

¹ Area with the lowest DO ² Area with the highest BOD ³ Area with the highest TCB ⁴ Area with the highest FCB ⁵ Area with the highest NH₃



Table 5 : (Continued) The Minimum – Maximum and Average Values of Key Water Quality Parameters and Water Quality Deterioration Areas in the Northeastern Region in 2010

Water Resources	Class	Minimum – maximum, average* values and percentage** of water quality parameters					Water quality deterioration areas
		DO (mg/l)	BOD (mg/l)	TCB (MPN/100 ml)	FCB (MPN/100ml)	NH ₃ (mg/l)	
Un	3	4.1 - 9.1	1.0 - 2.0	50 - 4,900	2 - 1,300	0.01 - 0.44	-
		4.7	1.1	1,470	320	0.15	
Lamchi	3	100%(16/16)	100%(16/16)	100%(16/16)	100%(16/16)	100%(16/16)	-
		2.2 - 6.5	0.9 - 5.2	20 - 16,000	20 - 16,000	-	
Nong Han	-	5.1	1.5	150	40	-	-
		85%(17/20)	65%(13/20)	100%(20/20)	95%(19/20)	-	
Class 2 water quality standards	-	5.5 - 12.2	0.4 - 5.3	2 - 460	2 - 80	0.01 - 0.20	-
		8.6	0.9	50	10	0.05	
Class 3 water quality standards	-	100%(28/28)	88%(23/26)	100%(28/28)	100%(28/28)	100%(26/26)	-
		≥ 6.0	≤ 1.5	≤ 5,000	≤ 1,000	≤ 0.5	
Class 4 water quality standards	-	≥ 4.0	≤ 2.0	≤ 20,000	≤ 4,000	≤ 0.5	-
		≥ 2.0	≤ 4.0	-	-	≤ 0.5	

Remarks: * Average values calculated from water quality data classified by water sources which have number of data more than or equal to 51 percent

** Percentage of measurements fall under surface quality standards for specific classes (number of standard measurements / total measurements)

In case of water resources with no classification and water resources in class 4, TCB and FCB values show in percentage of measurements under the surface water quality standard of class 3

¹ Area with the lowest DO ² Area with the highest BOD ³ Area with the highest TCB ⁴ Area with the highest FCB ⁵ Area with the highest NH₃



Table 6 : Results of Heavy Metal Monitoring and Water Quality Deterioration Areas in Northeastern Region in 2010

Parameter	Minimum – maximum value (mg/l)	Surface water quality standards (mg/l)	Water quality deterioration areas
Cd 3.2%(4/124)*	Undected - 0.0109	≤ 0.005	Chi River Kosum Phisai District, Maha Sarakham (Aug_0.00773) Muang District, Khon Kean (Aug_0.0109**) Chonnabot District, Khon Kean (Aug_0.00758) Lampao River Kamalasai District, Kalasin (Aug_0.00722)
Total Cr	Undected - 0.004	≤ 0.05	–
Mn	Undected - 0.905	≤ 1.0	–
Ni	Undected - 0.089	≤ 0.1	–
Pb	Undected - 0.033	≤ 0.05	–
Zn	Undected - 0.161	≤ 1.0	–
Cu	Undected - 0.04	≤ 0.1	–
Hg 4.5%(1/22)*	Undected - 0.004	≤ 0.002	Phong River Nong Hin water pumping area, Muang District, Khon Kean (Jul_0.004**)
As	Undected - 0.001	≤ 0.01	–

Remarks: * Percentage of measurements exceeded standards (number of measurements exceeded standards / total measurements)

** Maximum value

² Area where parameter exceeded standards in 2009 and 2010

Table 7 : The Minimum – Maximum and Average Values of Key Water Quality Parameters and Water Quality Deterioration Areas in the Eastern Region in 2010

Water Resources	Class	Minimum – maximum, average* values and percentage** of water quality parameters				Water quality deterioration areas
		DO (mg/l)	BOD (mg/l)	TCB (MPN/100 ml)	FCB (MPN/100ml)	NH ₃ (mg/l)
Bang Pakong	3	1.6 - 11.0 6.0 75%(38/51)	0.3 - 2.8 1.0 92%(47/51)	80 - 160,000 1,780 92%(47/51)	20 - 160,000 340 86%(44/51)	0.03 - 1.29 0.17 92%(47/51) DO Baan Srang District, Prachinburi (Feb ¹) ICB Bangpakong Bridge, Bangpakong District (Feb ³), Baan Bang Phra (Aug) Chachoengsao Bridge (Aug ³) Muang District, Chachoengsao, Baan Srang District, prachinburi (Jul) ECB Bangpakong Bridge (Feb ⁴) Motoway Bridge (Aug) Bangpakong District, Baan Pho (Aug) Baan Bang Phra (Aug) Chachoengsao Bridge (Aug) Muang District, Tha Rue Bang Kia District (Aug) Chachoengsao, Baan Srang District, Prachinburi (Jul) NH₃ Bang Nam Preaw District, Chachoengsao (Nov) Baan Srang District, Prachinburi (Jan Jul ⁵ Nov)
Prachinburi	2	1.6 - 6.0 4.0 7%(1/15)	0.8 - 3.5 1.4 27%(4/15)	490 - 92,000 2,480 60%(9/15)	130 - 7,900 410 60%(9/15)	0.39 - 1.29 0.91 27%(4/15) DO Baan Bang Tane, Baan Srang (Nov ¹) Muang District (Jan) Prachinburi ICB Baan Srang Bridge, Baan Srang District (Jul) Muang District (Jan ¹) Prachinburi ECB Baan Srang Bridge, Baan Srang District (Jul ⁴) NH₃ Baan Bang Tane (Jan Jul Nov) Baan Srang Bridge (Jul Nov) Baan Srang District, Muang District (Jul Nov) Sir Maha Pho District (Jul Nov) Kabinburi District (Jul ⁵ Nov) Prachinburi
Nakhon Nayok	3	0.6 - 7.2 4.0 13%(2/15)	0.2 - 3.3 1.0 53%(8/15)	80 - 24,000 2,800 93%(14/15)	20 - 7,900 370 87%(13/15)	0.25 - 1.50 0.98 33%(5/15) DO Baan Srang District, Prachinburi (Nov), Ongkarak District (Jan Aug Nov) Baan Na District (Jan Aug ¹ Nov) Nakhon Nayok ICB Bridge, Muang District, Nakhon Nayok (Aug ³) ECB Ongkarak District (Aug) Bridge, Muang District (Aug ⁴) Nakhon Nayok NH₃ Baan Srang District (Jul Nov ⁵), Ongkarak District (Aug Nov) Baan Na District (Aug Nov) Nakhon Nayok Bridge (Aug Nov) Hin Tung Subdistrict (Aug Nov) Muang District, Nakhon Nayok
Trat	3	4.8 - 7.5 5.5 100%(16/16)	0.1 - 1.8 0.9 100%(16/16)	260 - 54,000 1,160 94%(15/16)	20 - 9,200 180 94%(15/16)	0.03 - 0.67 0.10 94%(15/16) ICB Tha Pra Doo Temple, Kao Saming District, Trat (Aug ³) ECB Baan Dan Kao, Muang District, Trat (May ⁴) NH₃ Baan Dan Kao, Muang District, Trat (May ⁵)
Chanthaburi	3	3.5 - 15.3 7.9 84%(27/32)	0.2 - 9.0 0.9 91%(29/32)	20 - 160,000 4,090 59%(19/32)	20 - 35,000 130 84%(27/32)	0.03 - 0.42 0.13 100%(32/32) BOD Aug Hin Temple, Koh Khwang Subdistrict (Feb) KP Grand Hotel (Feb ²) Tha Luang Bridge, Muang District, Chanthaburi (Feb) ICB Ban Tha Chaleab (Feb) Ang Hin Temple (Feb May ³ Nov) KP Grand Hotel (Feb May ³ Aug Nov ³) Tha Luang Bridge (Feb Aug Nov) Baan Lao Bridge (Aug) Muang District, Tha Luang Lang Temple Makhm District (Aug) Chanthaburi ECB Baan Tha Chaleab (Aug) Koh Khwang Subdistrict (Aug) KP Grand Hotel (Feb Nov ⁴) Baan Lao Bridge (Aug) Muang District Chanthaburi
Class 2 water quality standards		≥ 6.0	≤ 1.5	≤ 5,000	≤ 1,000	≤ 0.5
Class 3 water quality standards		≥ 4.0	≤ 2.0	≤ 20,000	≤ 4,000	≤ 0.5
Class 4 water quality standards		≥ 2.0	≤ 4.0	–	–	≤ 0.5

Remarks: * Average values calculated from water quality data classified by water sources which have number of data more than or equal to 51 percent

** Percentage of measurements fall under surface quality standards for specific classes (number of standard measurements / total measurements)

In case of water resources with no classification and water resources in class 4, TCB and FCB values show in percentage of measurements under the surface water quality standard of class 3

¹ Area with the lowest DO ² Area with the highest BOD ³ Area with the highest TCB ⁴ Area with the highest FCB ⁵ Area with the highest NH₃



Table 7 : The Minimum – Maximum and Average Values of Key Water Quality Parameters and Water Quality Deterioration Areas in the Eastern Region in 2010

Water Resources	Class	Minimum – maximum, average* values and percentage** of water quality parameters					Water quality deterioration areas
		DO (mg/l)	BOD (mg/l)	TCB (MPN/100 ml)	FCB (MPN/100ml)	NH ₃ (mg/l)	
Upper Rayong	3	3.7 - 7.1 5.0 88%(7/8)	0.9 - 4.0 1.1 63%(5/8)	2,400 - 92,000 8,640 63%(5/8)	170 - 28,000 940 63%(5/8)	0.06 - 0.53 0.23 88%(7/8)	ICB Bridge (Feb May ³), Laham Rai Temple Nong Laloek Subdistrict (Nov) Baan Kai District, Rayong ECB Bridge (May ¹), Laham Rai Temple Nong Laloek Subdistrict (May Nov) Baan Kai District, Rayong NH ₃ Bridge Baan Kai District, Rayong (Feb ⁵)
Lower Rayong	4	1.5 - 6.0 4.9 94%(15/16)	0.6 - 2.5 1.4 100%(16/16)	350 - 160,000 73,000 25%(4/16)	20 - 28,000 1,600 56%(9/16)	0.11 - 1.51 0.31 81%(13/16)	DO Piam Pongsam Bridge Muang District, Rayong (May ¹) ICB Baan Pak Klong (Feb Aug Nov) Chalerachai Bridge (Aug Nov) Piam Pongsam Bridge (Feb May ³ Aug ³ Nov) Highway Bridge (Feb Aug Nov) Muang District, Rayong ECB Baan Pak Klong (Aug Nov) Chalerachai Bridge (Aug ⁴ Nov) Piam Pongsam Bridge (May Aug Nov) NH ₃ Baan Pak Klong (Feb) Chalerachai Bridge (Feb May ³)
Prasae	3	3.0 - 10.0 4.9 85%(17/20)	0.4 - 3.5 0.9 95%(19/20)	90 - 92,000 1,320 80%(16/20)	20 - 4,600 210 95%(19/20)	0.03 - 0.36 0.15 100%(20/20)	ICB Pak Nam Pra Sae Subdistrict (Aug ³) Thung Kwai Kin (Aug ³) Na Kwien (May Aug) Klang District, Rayong ECB Pak Nam Pra Sae Subdistrict (Nov ⁴)
Upper Pangrad	3	1.8 - 12.1 6.9 88%(7/8)	0.9 - 9.0 1.2 63%(5/8)	220 - 160,000 8,180 63%(5/8)	130 - 43,000 290 63%(5/8)	0.03 - 0.78 0.10 75%(6/8)	DO Sukhumvit Road Bridge Nayaia District, Nayaia District, Chanthaburi (May ¹) BOD Yan Sue Temple (May) Sukhumvit Road Bridge (Feb ³) Nayaia District, Nayaia District Chanthaburi ICB Sukhumvit Road Bridge (Feb ³ May ³ Nov ³) ECB Sukhumvit Road Bridge (Feb May ⁴ Nov) NH ₃ Yan Sue Temple (May ⁵) Sukhumvit Road Bridge (May)
Lower Pangrad	2	4.0 - 7.4 4.9 25%(2/8)	0.5 - 1.4 0.9 100%(8/8)	20 - 92,000 1,550 63%(5/8)	20 - 35,000 580 50%(4/8)	0.03 - 0.42 0.16 100%(8/8)	ICB Baan Taopoon, Chang Kham Subdistrict, Nayaia District, Chanthaburi (Feb Aug ³) ECB Baan Taopoon, Chang Kham Subdistrict, Nayaia District, Chanthaburi (Feb Aug ³)
Weru	2	4.0 - 7.2 5.1 18%(5/28)	0.2 - 2.7 0.7 86%(24/28)	20 - 9,200 930 96%(27/28)	10 - 5,400 160 89%(25/28)	0.02 - 0.84 0.13 96%(27/28)	ECB Kong Karam Temple (Bor) Mood, Baan Bor, Bor Subdistrict, Klung District, Chanthaburi (Feb ¹) NH ₃ Klong Panom Prik estuary, San Tung Subdistrict, Kao Saming District, Trat (Feb ¹)
Class 2 water quality standards		≥ 6.0	≤ 1.5	≤ 5,000	≤ 1,000	≤ 0.5	Deteriorated water quality considered from following criteria
Class 3 water quality standards		≥ 4.0	≤ 2.0	≤ 20,000	≤ 4,000	≤ 0.5	DO below 2.0 mg/l OD over 4.0 mg/l TCB over 20,000 units FCB over 4,000 units NH ₃ over 0.5 mg/l
Class 4 water quality standards		≥ 2.0	≤ 4.0	-	-	≤ 0.5	

Remarks: * Average values calculated from water quality data classified by water sources which have number of data more than or equal to 51 percent

** Percentage of measurements fall under surface quality standards for specific classes (number of standard measurements / total measurements)

In case of water resources with no classification and water resources in class 4, TCB and FCB values show in percentage of measurements under the surface water quality standard of class 3

¹ Area with the lowest DO ² Area with the highest BOD ³ Area with the highest TCB ⁴ Area with the highest FCB ⁵ Area with the highest NH₃

Table 8 : Results of Heavy Metal Monitoring and Water Quality Deterioration Areas in Eastern Region in 2010

Parameter	Minimum – maximum value (mg/l)	Surface water quality standards (mg/l)	Water quality deterioration areas
Cd	<0.0005 – <0.001	≤ 0.005	–
Total Cr 3.5%(3/85)*	<0.0005 – 0.12	≤ 0.05	Bang Pakong River River Estuary Bangpakong District, Chachoengsao (Nov_0.065) Trat River Baan Dan Koa River Estuary, Muang District, Trat (Nov_0.12**) Prasae River River estuary Moo1 Baan Hua Kode, Pak Nam Prasae Subdistrict, Klang District, Rayong (Nov_0.108)
Mn	<0.05 – 0.82	≤ 1.0	–
Ni	Undetected – 0.067	≤ 0.1	–
Pb	<0.005 – 0.024	≤ 0.05	–
Zn	<0.05 – 0.44	≤ 1.0	–
Cu	Undected – <0.01	≤ 0.1	–
Hg	<0.0005	≤ 0.002	Pangrad River Baan Nayaiaim Bridge, Sukhumvit Road, Nayaiaim Subdistrict Municipality, Nayaiaim District, Chanthaburi (Nov_0.016**)
As 5.6%(1/18)*	<0.01 – 0.016	≤ 0.01	–

Remarks: * Percentage of measurements exceeded standards (number of measurements exceeded standards / total measurements)

** Maximum value

² Area where parameter exceeded standards in 2009 and 2010

Table 9 : The Minimum – Maximum and Average Values of Key Water Quality Parameters and Water Quality Deterioration Areas in the Southern Region in 2010

Water Resources	Class	Minimum – maximum, average* values and percentage** of water quality parameters					Water quality deterioration areas	
		DO (mg/l)	BOD (mg/l)	TCB (MPN/100 ml)	FCB (MPN/100ml)	NH ₃ (mg/l)		
Upper Tapee	2	6.8 - 8.8 7.9 100%(4/4)	0.4 - 1.3 0.8 100%(4/4)	500 - 3,500 2,200 100%(4/4)	140 - 490 290 100%(4/4)	0.01 - 0.10 0.03 100%(4/4)	-	
Lower Tapee	3	4.3 - 7.2 6.5 100%(24/24)	0.5 - 2.2 1.0 92%(22/24)	130 - 16,000 2,160 100%(24/24)	40 - 5,400 340 88%(21/24)	0.01 - 0.22 0.05 100%(24/24)	FCB Tha Thong Pier, Baan Pak Nam, Talad Subdistrict (Aug ¹), Baan Donier (Mar) Muang District, Surat Thani, Chawang District, Nakhon Sri Thammarat (May)	
Phumduang	3	5.1 - 7.2 5.5 100%(16/16)	0.3 - 2.3 0.7 94%(15/16)	40 - 16,000 940 100%(16/16)	40 - 5,400 310 94%(15/16)	0.02 - 0.27 0.09 100%(16/16)	FCB Phumduang Bridge Baan Ta Khun, Baan Ta Khun District, Surat Thani (Aug ⁴)	
Pak Panang	3	3.4 - 8.2 4.8 89%(25/28)	0.8 - 7.7 1.3 61%(17/28)	170 - 16,000 1,260 100%(28/28)	20 - 16,000 300 86%(24/28)	0.01 - 0.34 0.07 100%(28/28)	BOD Ferry Pier, Baan Pak Panang, Pak Panang Subdistrict, Nakhon Sri Thammarat (Jun ² Aug) FCB River estuary Km.0, Phung Tawan Aok Subdistrict, Pak Panang District (Dec), South of Cha- aud Sukhaolban District, Tha Samed Subdistrict, Cha-aud District (Mar ⁴ Jun ⁴ Aug ⁴) Nakhon Sri Thammarat	
Chumphon	-	1.2 - 7.5 5.8 92%(11/12)	0.6 - 3.5 1.1 67%(8/12)	1,300 - 92,000 12,600 58%(7/12)	220 - 54,000 6,350 50%(6/12)	0.03 - 0.29 0.14 100%(9/9)	DO River estuary, Pak Nam Subdistrict, Muang, Chumphon (May ¹) TCB River Estuary (Aug Dec ³) Tha Yang Subdistrict, Muang District (Aug Dec), Tha Sae District (Dec) Chumphon FCB River Estuary (Mar Aug Dec) Tha Yang Subdistrict, Muang District (Aug Dec), Tha Sae District (Dec ³) Chumphon	
Lungsuan	-	5.0 - 8.0 7.0 100%(16/16)	0.4 - 2.2 0.8 94%(15/16)	1,100 - 16,000 2,220 100%(16/16)	170 - 5,400 1,020 94%(15/16)	0.01 - 0.21 0.06 100%(12/12)	FCB Lungsuan River estuary Moo 12 Baan Phung Krajome, Bang Maphrao Subdistrict, Lung- suan District, Chumphon (Aug ⁴)	
Class 2 water quality standards		≥ 6.0	≤ 1.5	≤ 5,000	≤ 1,000	≤ 0.5	Deteriorated water quality considered from following criteria DO below 2.0 mg/l OD over 4.0 mg/l TCB over 20,000 units FCB over 4,000 units NH ₃ over 0.5 mg/l	
Class 3 water quality standards		≥ 4.0	≤ 2.0	≤ 20,000	≤ 4,000	≤ 0.5		
Class 4 water quality standards		≥ 2.0	≤ 4.0	-	-	≤ 0.5		

Remarks: * Average values calculated from water quality data classified by water sources which have number of data more than or equal to 51 percent

** Percentage of measurements fall under surface quality standards for specific classes (number of standard measurements / total measurements)

In case of water resources with no classification and water resources in class 4, TCB and FCB values show in percentage of measurements under the surface water quality standard of class 3

¹ Area with the lowest DO ² Area with the highest BOD ³ Area with the highest TCB ⁴ Area with the highest FCB ⁵ Area with the highest NH₃

TABLE 9 : (CONTINUED) THE MINIMUM – MAXIMUM AND AVERAGE VALUES OF KEY WATER QUALITY PARAMETERS AND WATER QUALITY DETERIORATION AREAS IN THE SOUTHERN REGION IN 2010

Water Resources	Class	Minimum – maximum, average* values and percentage** of water quality parameters					Water quality deterioration areas
		DO (mg/l)	BOD (mg/l)	TCB (MPN/100 ml)	FCB (MPN/100ml)	NH ₃ (mg/l)	
Trang	–	4.2 - 10.9 5.0 100%(20/20)	0.8 - 2.8 1.2 95%(19/20)	50 - 35,000 400 90%(18/20)	10 - 450 120 100%(20/20)	0.01 - 0.38 0.11 100%(20/20)	ICB River estuary Moo 2 Baan Koh Kiem, Kun Tung Tai Subdistrict, Kun Tung District, Trang (Dec) Low-power pumping station Huay Yod Waterworks Moo11 Baan Tha Pradoo, Koh Kob Subdistrict, Huay Yod District Trang (Dec) ³
Upper Pattani	2	4.2 - 7.6 6.9 67%(8/12)	0.9 - 5.6 1.4 50%(6/12)	350 - 35,000 2,950 67%(8/12)	350 - 35,000 2,850 42%(5/12)	0.01 - 0.38 0.09 100%(12/12)	BOD Low-power pumping station of Muang Yala Municipality, Baan Reeboot, Tha Sab Subdistrict, Muang District, Yala (May) ³ ICB Bang Lang Dam, Ban Bang Lang, Bannungsata Subdistrict, Bannungsata District, Yala (Nov) ³ FCB Bang Lang Dam, Baan Bang Lang, Bannungsata Subdistrict, Bannungsata District, Yala (May Aug Nov) ⁴
Lower Pattani	3	3.8 - 7.8 7.1 88%(7/8)	1.3 - 3.8 2.8 38%(3/8)	490 - 20,000 9,120 100%(8/8)	490 - 20,000 9,120 100%(8/8)	0.01 - 0.39 0.13 100%(8/8)	FCB Pattani River estuary, Pattani Pier Moo 8 Bana Subdistrict, Muang District (Feb Aug Nov) Baan A Noa Pulo, Yapee Subdistrict, Yarang District (Nov) ⁴ Pattani
Saiburi	–	4.2 - 7.4 6.8 100%(16/16)	0.9 - 5.0 2.4 25%(4/16)	270 - 92,000 5,940 88%(14/16)	130 - 16,000 1,450 56%(9/16)	0.01 - 0.39 0.11 100%(16/16)	BOD River estuary (May) ³ , Baan Kortor, Manungdalum Subdistrict (May) Saiburi District, Pattani, Srisakorn District, Narathiwat (May) ICB River estuary (Nov) ³ Pattani, Rue Sor District, Narathiwat (Nov) FCB River estuary (Feb ³ Aug Nov), Baan Kortor, Manungdalum Subdistrict (Aug) Saiburi District, Pattani, Ramun District, Yala (Nov) ⁴ , Srisakorn, Narathiwat (May Aug)
Talay Noi	–	0.8 - 7.0 5.1 50%(6/12)	1.3 - 6.3 2.0 50%(6/12)	20 - 7,900 700 100%(12/12)	10 - 4,900 220 83%(10/12)	0.01 - 0.81 0.12 83%(10/12)	DO Talay Noi Village, Phra Nang Tung Subdistrict, Kwuan Kanooon District, Pattalung (Feb Nov) ³ BOD Talay Noi Village (Feb) ³ FCB Talay Noi Village (Feb) ³ Middle of Talay Noi (Nov) NH ₃ Talay Noi Village (Aug) Klong Nang Riem (Aug) ⁵ Kwuan Kanooon District, Pattalung
Talay Luang	–	1.2 - 8.0 6.2 85%(17/20)	1.0 - 7.1 2.1 50%(10/20)	4 - 5,400 730 100%(20/20)	2 - 5,400 180 95%(19/20)	0.01 - 1.23 0.11 90%(18/20)	DO Klong Baan Rong estuary, Ranode District, Songkhla (Nov) Klong Lampam estuary, Muang District, Pattalung (Nov) ³ BOD Klong Baan Rong estuary (May) Middle of Talay Luang (May) ³ Ranode District, Songkhla FCB Baan Pak Phayoon, Pak Phayoon District, Pattalung (Nov) ⁴ NH ₃ Klong Baan Rong estuary (Aug), Learm Chong Thanon, Chong Thanon Subdistrict, Khao Chaisan District, Pattalung (Aug) ⁵
Songkhla Lake	–	0.0 - 9.0 5.7 75%(21/28)	0.9 - 17.1 2.0 43%(12/28)	10 - 540,000 650 86%(24/28)	10 - 540,000 90 82%(23/28)	0.01 - 2.50 0.19 68%(19/28)	DO Klong Samrong estuary, Muang District, Songkhla (Feb) ³ BOD Baan Pak Jaa, Kwuan Soe Subdistrict, Kwuan Nieng District (Nov) Klong U-Tapao estuary, Rattanaaphum District (Feb May) Klong Samrong estuary, Muang District (Feb May Aug ² Nov) Songkhla ICB Klong Samrong estuary, Muang District, Songkhla (Feb May ³ Aug Nov) FCB Koh Yor Bridge, Koh Yor Subdistrict (Nov) Klong Samrong estuary (Feb May ³ Aug Nov) Muang District, Songkhla NH ₃ Baan Pak Jaa, Kwuan Soe Subdistrict, Kwuan Nieng District (Aug) Klong U-Tapao estuary, Rattanaaphum (Aug) Klong Pawong estuary, Had Yai District (Aug) Koh Yor Bridge, Koh Yor Subdistrict (Aug) Klong Samrong estuary (Feb May ³ Aug) Songkhla lake estuary (May Aug) Muang District, Songkhla
Class 2 water quality standards		≥ 6.0	≤ 1.5	≤ 5,000	≤ 1,000	≤ 0.5	Deteriorated water quality considered from following criteria DO below 2.0 mg/l OD over 4.0 mg/l TCB over 20,000 units FCB over 4,000 units NH ₃ over 0.5 mg/l
Class 3 water quality standards		≥ 4.0	≤ 2.0	≤ 20,000	≤ 4,000	≤ 0.5	
Class 4 water quality standards		≥ 2.0	≤ 4.0	–	–	≤ 0.5	

Remarks: * Average values calculated from water quality data classified by water sources which have number of data more than or equal to 51 percent

** Percentage of measurements fall under surface quality standards for specific classes (number of standard measurements / total measurements)

In case of water resources with no classification and water resources in class 4, TCB and FCB values show in percentage of measurements under the surface water quality standard of class 3

¹ Area with the lowest DO ² Area with the highest BOD ³ Area with the highest TCB ⁴ Area with the highest FCB ⁵ Area with the highest NH₃



Table 10 : Results of Heavy Metal Monitoring and Water Quality Deterioration Areas in Southern Region in 2010

Parameter	Minimum – maximum value (mg/l)	Surface water quality standards (mg/l)	Water quality deterioration areas
Cd	Undected – 0.004	≤ 0.005	–
Total Cr 2.6%(1/39)*	Undected – 0.336	≤ 0.05	Talay Noi Klong Nang Riem, Kwuan Kanoon District, Pattalung (Aug_0.336**)
Mn	Undected – 0.40	≤ 1.0	–
Ni 3.3%(1/30)*	Undected – 0.182	≤ 0.1	Talay Noi Klong Nang Riem, Kwuan Kanoon District, Pattalung (Aug_0.182**)
Pb 12.8%(5/39)*	Undected – 0.073	≤ 0.05	Pattani River Tha Sab Subdistrict, Muang District, Yala (Aug_0.072) Talay Noi Talay Noi Village, Phra Nang Tung Subdistrict, Kwuan Kanoon District, Pattalung (Aug_0.051), Klong Nang Riem, Kwuan Kanoon District, Pattalung (Aug_0.073**) Talay Luang Klong Lampam estuary, Muang District, pattalung (Aug_0.053) Songkhla Lake Klong Samrong estuary, Muang District, Songkhla2 (Aug_0.061)
Zn	0.0295 – 0.560	≤ 1.0	–
Cu	0.001 – 0.08	≤ 0.1	–
Hg	Undected	≤ 0.002	–
As	<0.010	≤ 0.01	–

Remarks: * Percentage of measurements exceeded standards (number of measurements exceeded standards / total measurements)

** Maximum value

² Area where parameter exceeded standards in 2009 and 2010

Table 11 : Deteriorate Parameter of Coastal Water in the Inner Gulf of Thailand

Parameter	Minimum – maximum value	Coastal water quality standards	Deteriorated area or monitored area (distance from the coast (m))
Floatable oil and grease 7.1% (1/14)*	Found oil stain	Not visible	Samut Prakan Klong 12 Thanwa estuary (100)
Dissolved Oxygen (DO) 78.6% (11/14)*	0.96 – 3.94 mg/l	Class 1, 3 - 6 not below 4 Class 2 not below 6	Chachoengsao Bang Pakong River estuary (500) Samut Prakan Klong 12 Thanwa estuary (100) In front of dyeing factory Km.35 (100) Chao Phraya River estuary (500) Bangkok Bang Khun Thien (100) Samut Sakhon Tha Chin River estuary (500)** Samut Songkram Mae Klong River estuary (500)
TCB 64.3% (9/14)*	1,700 – 160,000 MPN/100 ml	Class 1-6 ≤ 1,000	Chachoengsao Bang Pakong River estuary (500) Samut Prakan Klong 12 Thanwa estuary (100)** Infront of dyeing factory Km.35 (100) Chao Phraya River estuary (500) Samut Sakhon Tha Chin River estuary (500) Samut Songkram Mae Klong River estuary (500)
PO ₄ 50% (7/14)*	67 – 380 µg-Phosphorus/l	Class 1-2,4 ≤ 15 Class 3,5-6 ≤ 45	Chachoengsao Bang Pakong River estuary (500) Samut Prakan Klong 12 Thanwa estuary (100) Infront of dyeing factory Km.35 (100) Chao Phraya River estuary (500) Bangkok Bang Khun Thien (100) Samut Sakhon Tha Chin River estuary (500)** Samut Songkram Mae Klong River estuary (500)
NO ₃ 42.9 % (6/14)*	61 – 656 µg-Nitrogen/l	Class 1-2 ≤ 20 Class 3-6 ≤ 60	Chachoengsao Bang Pakong River estuary (500)** Samut Prakan Klong 12 Thanwa estuary (100) Infront of dyeing factory Km.35 (100) Chao Phraya River estuary (500) Samut Sakhon Tha Chin River estuary (500) Samut Songkram Mae Klong River estuary (500)
Hg 50% (7/14)*	4.69 – 17.19 µg/l	Class 1-6 ≤ 0.1	Chachoengsao Bang Pakong River estuary (500) Samut Prakan Klong 12 Thanwa estuary (100) Infront of dyeing factory Km.35 (100) Chao Phraya River estuary (500) Bangkok Bang Khun Thien (100) Samut Sakhon Tha Chin River estuary (500) Samut Songkram Mae Klong River estuary (500)**
Fe 100% (14/14)*	330 – 4,408 µg/l	Class 1-6 ≤ 300	Chachoengsao Bang Pakong River estuary (500)** Samut Prakan Klong 12 Thanwa estuary (100) Infront of dyeing factory Km.35 (100) Chao Phraya River estuary (500) Bangkok Bang Khun Thien (100) Samut Sakhon Tha Chin River estuary (500) Samut Songkram Mae Klong River estuary (500)
Mn 71.4% (10/14)*	128 – 1,327 µg/l	Class 1-6 ≤ 100	Chachoengsao Bang Pakong River estuary (500) Samut Prakan Klong 12 Thanwa estuary (100) Infront of dyeing factory Km.35 (100) Bangkok Bang Khun Thien (100)** Samut Sakhon Tha Chin River estuary (500) Samut Songkram Mae Klong River estuary (500)

Remarks: * Percentage of monitoring station which did not meet coastal water quality standards (number of station which did not meet standard / total stations measured during drought and rainy seasons)

** Highest value area of each parameter



Table 12 : Deteriorate Parameter of Coastal Water in the Eastern Gulf of Thailand

Parameter	Minimum – maximum value	Coastal water quality standards	Deterioated area or monitored area (distance from the coast (m))
Floatable Solid 13.7% (21/153)*	Found plastic bags, foam boxes, plastic bottles, cigarette filter and other waste, plankton and yellow sediment	Class 1 – 6 Not objectionable	Trat Chang Island [Salak Phet Bay (100), Bang Bao Bay (100)], Leam Ngob (10), Leam Sok (10) Chanthaburi Pungrad River estuary (500) Rayong Rayong estuary (500), Fisherman Pier (Ban Pae Market) (100) Chonburi Chonburi Bay (100, 500), Chonburi Bay (Oyster Farm) (500), Bang Phra (100, 500) Sichang [Thewawong Pier (100), Phanurangsi (100)], Sriracha (Loi Island) (500), Hua Leam Chabang (100), Leam Chabang Port (500), Na Kluer Market (100), Larn Island (Ta Waen Beach) (500), Chong Samaesarn (100, 500)
Floatable oil and grease 2.6% (4/153)*	Found oil stain	Class 1 - 6 Not visible	Chonburi Sichang (Phanurangsi Pier) (100), Leam Chabang Port (central) (100), Leam Chabang Port (500)
Odor 3.3% (5/153)*	Low-medium (ship fuel odor)	Class 1 – 6 Not objectionable	Rayong Fisherman Pier (Ban Pae market) (100) Chonburi Bangsean (Oceanworld) (10, 100) Sichang (station) (100) Sriracha (Loi Island) (500)
Dissolved Oxygen (DO) 2.0% (3/153)*	1.27 – 3.27 mg/l	Class 1, 3 – 6 not below 4 Class 2 not below 6	Chonburi Chonburi Bay (oyster farm) (500), Ang Sila (oyster farm) (500) Leam Chabang Port (central) (100)**
NO ₃ 27.5% (42/153)*	53 – 592 µg-Nitrogen/l	Class 1-2 ≤ 20 Class 3-6 ≤ 60	Trat Chang Island [Kai Bae Beach (10), Klong Phrao Beach (10,500), Saluk Phet Bay (100), Bang Bao Bay (100)], Trat River estuary-Leam Sok (Banpu) (500), Leam Sok (10) Klong Yai estuary (100, 500) Chanthaburi Prasae River estuary (500), Pungrad River estuary (500)**, Kung Krabane Bay (100), Chanthaburi River estuary (500), Weru River estuary (500), Kung Krabane Beach (10) Rayong Fertiliser company (Map Tha Phut Port) (100), Sai Thong Beach (100), Rayong estuary (500), Klong Klang estuary (500) Chonburi Chonburi Bay (100,500), Chonburi Bay (oyster farm) (100, 500), Ang Sila (pier) (100), Ang Sila (oyster farm) (100, 500) Sichang (station) (100) Udom Bay (fish market) (100, 500). Leam Chabang Port (at the end) (100), North Pattaya (Grand Palace Hotel) (10), South Pattaya (Pak Klong) (10)

Table 12 : Deteriorate Parameter of Coastal Water in the Eastern Gulf of Thailand

Parameter	Minimum – maximum value	Coastal water quality standards	Deteriorated area or monitored area (distance from the coast (m))
NH_3 23.5% (36/153)*	71 – 2,107 $\mu\text{g-Nitrogen/l}$	Class 1,2,4,5,6 ≤ 20 Class 3 ≤ 100	Trat Leam Ngob pier (100), Klong Yai estuary (100, 500) Chanthaburi Prasae River estuary (500), Pungrad River estuary (500), Kung Krabane Bay (500), Chanthaburi River estuary (500), Weru River estuary (500) Rayong Rayong estuary (500), Mae Rum Pueng Bay (10), Arboretum (500), Klong Klang estuary (500) Leam Mae Pim (500) Chon Buri Chon Buri Bay (100, 500), Chon Buri Bay (oyster farm) (100, 500**), Ang Sila (pier) (100), Ang Sila (500), Ang Sila (oyster farm) (100, 500), Bangsean (Ocean World) (100), Sriracha (Loi Island) (100, 500). Udom Bay (fish market) (100, 500) Leam Chabang Port (at the end) (100)
PO_4 21% (32/153)*	16 – 307 $\mu\text{g-Phosphorus/l}$	Class 1-2,4 ≤ 15 Class 3,5-6 ≤ 45	Rayong Baan Nong Feab (100), Sai Thong Bay (100, 500), Phayoon Bay (10) Chon Buri Chon Buri Bay (100, 500), Chon Buri Bay (oyster farm) (100, 500**), Ang Sila (pier) (100), Ang Sila (500), Ang Sila (oyster farm) (100, 500) Bangsean (Ocean World) (10, 100) Bang Phra (500), Sichang (station) (500), Udom Bay (fish market) (500), Leam Chabang Port (at the end) (100), Yacht Club, Pattaya (500) North Pattaya (Grand Palace Hotel) (10) Larn Island (Ta Wean Beach) (10), Jom Thien Beach (central) (10, 500)
TCB 26.1% (40/153)*	1,300 – > 160,000 MPN/100ml	Class 1-6 $\leq 1,000$	Trat Chang Island [(Kai Bae Beach) (10), Klong Phrao Beach (10), Sai Kao Beach (10), Saluk Phet Bay (100), Bang Bao Bay (100)**], Leam Ngob (10), Leam Ngob pier (100) Trat River estuary-Leam Sok (Ban Pu) (500) Leam Sok (10), Klong Yai estuary (100) Chanthaburi Prasae River estuary (500), Chanthaburi River estuary (500), King Krabane Beach (10) Rayong Rayong estuary (500), Sai Keaw Beach (Koh Samed) (10), Pak Klong estuary (500), Phayoon Beach (10) Chon Buri Chon Buri (100)**, Chon Buri (oyster farm) (500)**, Ang Sila (pier) (100), Ang Sila (oyster farm) (500), Bang Phra (100, 500) Sriracha (Loi Island) (100, 500) Udom Bay (fish market) (100, 500), Leam Chabang Port (at the end) (100), Yacht Club, Pattaya (10)

Remarks: * Percentage of monitoring station which did not meet coastal water quality standards (number of station which did not meet standard / total stations measured during drought and rainy seasons)

** Highest value area of each parameter



Table 13 : Deteriorate Parameter of Coastal Water in the Western Gulf of Thailand

Parameter	Minimum – maximum value	Coastal water quality standards	Deteriorated area or monitored area (distance from the coast (m))
Floatable solid 3.6% (6/166)*	Plastic bags, plastic cups and other waste, suspended sediment and dead fishes	Class 1 – 6 Not objectionable	Chomphon Chomphon River estuary, Pak Had Bay (500) Surat Thani Klong Tha Keoi estuary, Tha Chang District (500), Maenam Market Baan Mae Nam (10), Ferry pier, Samui Island (100) Songkhla Songkhla Lake estuary (500), Samilah Beach (10)
Odor 1.2% (2/166)*	Low-medium (smoke from fishing boat and fishy odor)	Class 1 – 6 Not objectionable	Surat Thani Ferry pier, Samui Island (100), Fish market, Koh Phangan (10)
Dissolved Oxygen (DO) 12% (20/166)*	1.5 – 3.76 mg/l	Class 1, 3 – 6 not below 4 Class 2 not below 6	Phetchaburi Klong Baan Bang Taboon estuary [north (500), central (500), south (500)] Klong Baan Leam estuary [(north, oyster farm (500), central (500), south (500))] Chao Samran Beach (500) Puktien Beach (10), Cha-am Beach (central) (visitor center) (10) Cha-am Beach (north) (infront of Long Beach Hotel) (10) Prachaub Kiri Khan Beach in front of Klai Kangwon Palace (10), Sofitel Hotel (10), Beach near Sailom Hotel, Hua Hin (10), Pranburi River estuary (500) Chumphon Baan Saplee, Saplee Bay (500)** Nakhon Sri Thammarat Pak Panang River estuary (500)
NO ₃ 19.3% (32/166)*	35 - 413 µg-Nitrogen/l	Class 1-2 ≤ 20 Class 3-6 ≤ 60	Phetchaburi Klong Baan Taboon estuary [north (500), central (500), south (500)], Klong Baan Leam estuary [north (500), central (500), south (500)**], Cha-am (central) (visitor center) (10) Prachaub Kiri Khan Pranburi River estuary (Kao Ka Lok) (10), Sam Phraya Beach, Sam Roi Yod National Park (10) Chumphon Baan Na Tub, Bang Son (10, 500) Baan Saplee, Saplee Bay (500), Thung Wua Lane Beach (10), Baan Borka (Kho Bay), Sawee District, Klong Sawee estuary (10) Baan Borka (Kho Bay), Sawee District (500), Lungsuan River estuary (500) Surat Thani Samret Beach, Tha Chana District (10), Klong Pumrieng estuary, Chaiya District (500), Klong Tha Keoi estuary, Tha Chang District (500) Klong Tha Keoi estuary (oyster farm) (500), Tapee River estuary, Baan Don Bay (central) (500) Pier in front of district office, Samui Island (100), Maenam Market, Baan Maenam (10), Samui Island [(Chaweng Noi Bay (10), Chaweng Bay (100, 500), Lamai Beach (10), Ferry pier (100)], Phangan Island [fish market (10), Had Rin Bay (500)] Songkhla Pak Rawa floodgate, Ranode District (100), Songkhla Lake estuary (500), Samilah Beach (10)

Table 13 : Deteriorate Parameter of Coastal Water in the Western Gulf of Thailand

Parameter	Minimum – maximum value	Coastal water quality standards	Deterioated area or monitored area (distance from the coast (m))
PO_4 13.3% (22/166)*	16 – 217 $\mu\text{g-Phosphorus/l}$	Class 1-2,4 ≤ 15 Class 3,5-6 ≤ 45	Phetchaburi Klong Baan Bang Taboon estuary [north (500), central (500), south (500)], Klong Baan Leam estuary [north (oyster farm) (500), central (500)**], south (500)], Puktien Beach (500), Cha-am Beach (central) (visitor center) (10, 500) Cha-am Beach (north) (in front of Long Beach Hotel) (10) Prachaup Kiri Khan Beach Beach in front of Klai Kangwon Palace (10), Sofitel Hotel (10), Beach near Sailom Hotel, Hua Hin (10, 500), Pranburi River estuary (500), Pranburi River estuary (Kao Ka Lok) (10), Sam Phraya Beach, Sam Roi Yod National Park (10), Manoa Bay, Area 53 (10), Klong Ban Bang Saphan estuary (500) Chumphon Ban Na Tub, Bang Son Bay (10), Sai Ree Beach (central) (500) Nakhon Sri Thammarat Pak Panang River estuary (500)
NH_3 15.1% (25/166)*	75 – 633 $\mu\text{g-Nitrogen/l}$	Class 1,2,4,5,6 ≤ 20 Class 3 ≤ 100	Phetchaburi Klong Baan Taboon estuary [north (500), central (500), south (500)], Klong Baan Leam estuary [central (500), south (500)**], Prachaup Kiri Khan Beach in front of Klai Kangwon Palace (10), Fish Market Hua Hin (100), Sofitel Hotel (10), Beach near Sailom Hotel, Hua Hin (10, 500), Kao Takieb (10), Pranburi River estuary (500), Pranburi River estuary [(Kao Ka Lok) (10), In front of Evason Resort (10)], Sam Phraya Beach, Sam Roi Yod National Park (10), Baan Bornok (100), Baan Hin Krud (10) Chumphon Thung Wua Lane Beach (10), Lungsuan River estuary (500) Surat Thani Klong Tha Keoi estuary [Tha Chang District (500), oyster farm (500)], Tapee River estuary, Baan Don Bay (central) (500), Ferry pier (Don Sak-Mai) (10) Nakhon Sri Thammarat Kanom Power Plant, Kanom District (100) Panang River estuary (500) Songkhla Songkhla Lake estuary (500)



Table 13 : Deteriorate Parameter of Coastal Water in the Western Gulf of Thailand

Parameter	Minimum – maximum value	Coastal water quality standards	Deterioated area or monitored area (distance from the coast (m))
TCB 11.5% (19/166)*	< 1,100 – 160,000 MPN/100 ml	Class 1 - 6 ≤ 1,000	Phetchaburi Phetchaburi Klong Baan Taboon estuary (north) (500), Klong Baan Leam estuary [central (500), south (500)**], Prachaub Kiri Khan Beach in front of Klai Kangwon Palace (10), Sofitel Hotel (10), Beach near Sailom Hotel, Hua Hin (10, 500), Sam Phraya Beach, Sam Roi Yod National Park (10) Chumphon Lungsuan River estuary (500) Surat Thani Klong Tha Keoi estuary, Tha Chang District (500), Tapee River estuary, Baan Don Bay (central) (500), Klong Kradae, Kanchanadit District [north (500), central (500)] Klong Don Sak estuaru (500), Ferry pier (Don Sak-Mai), Fish market, Phangan Island (10) Nakhon Sri Thammarat Baan Pak Klong, Hua Sai (100) Songkhla Songkhla Lake estuary (500), Samilah Beach (10)

Remarks: * Percentage of monitoring station which did not meet coastal water quality standards (number of station which did not meet standard / total stations measured during drought and rainy seasons)

** Highest value area of each parameter

Table 14 : Deteriorate Parameter of Coastal Water in Andaman Coast

Parameter	Minimum – maximum value	Coastal water quality standards	Deterioated area or monitored area (distance from the coast (m))
Floatable solid 5.8% (6/104)*	Drinking straws, plastic bottles and plastic bags	Class 1-6 Not objectionable	Phuket Surin Beach (10), Kamala Beach (10), Patong Beach [in front of Patong Beach Hotel (10), in front of Patong Bay Hotel (10)], Patong (infront of Dimond Cliff) (10) Satun Pak Bara pier (100)
Floatable oil and grease 1.9% (2/104)*	Found oil stain	Not visible	Phang Nga Baan Tub Lamu, Klong Tub Lamu estuary (100) Phuket Bang Rong Bay (500)
NO ₃ 14.4% (15/104)*	< 21 – 206 µg-Nitrogen/l	Class 1-2 ≤ 20 Class 3-6 ≤ 60	Ranong Charn Damri Beach, Ranong estuary (100), Bangbane Beach (100) Prapas Beach (100) Phang Nga Baan Nam Kem (10), Baan Kuekkak (10) Phuket Bang Tao Beach (10), Patong Beach [in front of Patong Merlin (10)**], in front of Patong Beach Hotel (10), in front of Patong Bay Hotel (10, 500)] Patong (n front Dimond Cliff) (10) Rawai Beach (fisherman viallage) (10) Krabi Nopparat Thara Beach (10), Leam Tong, Phi Phi Island (10) Trang Baan Bor Muang (500)

Table 14 : Deteriorate Parameter of Coastal Water in Andaman Coast

Parameter	Minimum – maximum value	Coastal water quality standards	Deteriorated area or monitored area (distance from the coast (m))
PO_4 8.7% (9/104)*	16 – 66 $\mu\text{g-Phosphorus/l}$	Class 1 – 2, 4 ≤ 15 Class 3, 5 - 6 ≤ 45	Ranong Bangbane Beach (100), Prapas Beach (100) Phang Nga Bang Sak Beach (10) Phra Thong Island (100) Phuket Patong Beach [in front of Merlin (10)**, in front of Patong Beach Hotel (10), In front of Patong Bay Hotel (10)] Trang Chao Mai Beach (central) (10), Yao Beach (south) (10)
NH_3 6.7% (7/104)*	75 – 633 $\mu\text{g-Nitrogen/l}$	Class 1,2,4,5,6 ≤ 20 Class 3 ≤ 100	Ranong Charn Damri Beach, Ranong estuary (100), Bangbane Beach (100)** Phang Nga Baan Khao Pilai (500) Phuket Nai Yang Beach (10), Patong Beach [in front of Patong Merlin (10), in front of Patong Beach Hotel (10), in front of Patong Bay Hotel (10)]
TCB 15.4% (16/104)*	1,600 – > 160,000 MPN/100 ml	Class 1 - 6 $\leq 1,000$	Ranong Charn Damri Beach, Ranong estuary (100), Bangbane Beach (100) Phang Nga Bang Sak Beach (10)**, Baan Tub Lamu, Klong Tub Lamu estuary (100), Baan Koh Korkao (10)**, Baan Nam Kem (10)** Phuket Nai Yang Beach (10), Patong Beach [in front of Patong Merlin (10)**, in front of Patong Beach Hotel (10), in front of Patong Bay Hotel (10, 500)], Karon Beach (in front of Phuket Golden Sand Inn) (10), Rawai Beach (central) (10), Chalong Bay (central) (100) Krabi Nopparat Thara Beach (Klong Hang estuary) (100)

Remarks: * Percentage of monitoring station which did not meet coastal water quality standards (number of station which did not meet standard / total stations measured during drought and rainy seasons)

** Highest value area of each parameter



Appendix C



Appendix C Result of Air Quality Analysis in 2010

Table 1 : Roadside Air Quality in Bangkok in 2010 Classified by Monitoring Stations

Station	Sulfur dioxide (SO ₂)			Nitrogen dioxide (NO ₂)			Carbon monoxide (CO)			Ozone (O ₃)			Particulate Matter of 10 Microns in diameter (PM ₁₀)			Total Suspended Particulate (TSP)			Lead (Pb)		
	1-hr Average Value (ppb)		Average 1 year	1-hr Average Value (ppb)		Average 1 year	8-hr Average Value (ppb)		Average 1 year	1-hr Average Value (ppb)		Average 1 year	24-hr Average Value (µg/m ³)		Average 1 year	24-hr Average Value (µg/m ³)		Average 1 year	1-month Average Value (µg/m ³)		Average 1 year
	Max	Min		Max	Min		Max	Min		Max	Min		Max	Min		Max	Min		Max	Min	
Ministry of Science and Technology, Rama 6 Road	#	#	#	#	#	#	4.9	0.0	0/4/912	1.0	#	#	195.2	54.8	37/195	0.20	0.05	0/43	0.06	0.01	0/10
Department of Land Transport, Phahon Yothin Road	28	0	0/8/064	121	0	0/7/875	3.5	0.0	0/8/425	1.0	109	0	171.6	18.6	15/269	0.20	0.05	0/55	0.07	0.02	0/12
Chulalongkorn Hospital, Rama 4 Road	#	#	#	#	#	#	5.8	0.0	0/7/962	1.3	#	#	147.2	16.5	7/298	0.22	0.04	0/35	0.05	0.01	0/8
Wong Wian 22 Krarakadokom, Santiphab Road	#	#	#	#	#	#	4.2	0.0	0/4/836	1.1	#	#	#	#	#	0.30	0.08	0/45	0.09	0.03	0/11
Thonburi Power Substation, Intra-rapitak Road	30	0	0/8/354	128	0	0/8/320	6.1	0.0	0/8/706	1.1	106	0	69.6	8.3	0/365	0.18	0.04	0/52	0.06	0.01	0/12
Chok Chal Police Station, Lad Phrao Road	28	0	0/8/251	119	3	0/8/329	3.6	0.1	0/8/684	1.2	100	0	75.5	16.3	0/363	0.23	0.06	0/47	0.06	0.02	0/11
Din Daeng National Housing Authority, Din Daeng Road	22	0	0/8/341	126	4	0/8/333	5.6	0.0	0/8/693	1.3	106	0	174.5	16.0	26/342	0.20	0.07	0/45	0.06	0.02	0/10
Standard	300	40	170	30	30	9	100	-	120	50	0.1	0.33	1.5	-	-	0.33	0.1	0.03	0.03	0.03	0.03

Remark : * : number of measurements that exceeded standard/ total measurements
: not monitored



Table 2 : Roadside Air Quality from Temporary Air Monitoring Station in Bangkok in 2010

Monitoring Point	Period	Result	Pollutant				
			Total Suspended Particulate (mg/m3)	Particulate Matter of 10 Microns in diameter (PM ₁₀) (µg/m³)	Lead (µg/m³)	Carbonmonoxide (ppm)	
			24-hr Average	24-hr Average	24-hr Average	1-hr Average	8-hr Average
1. Yommarat Junction Police Booth Phitsanulok Road	4 – 21 Jan	Range	0.09 - 0.21	80.3 - 154.6	<0.005 - 0.07	0.7 - 7.4	0.8 - 4.9
		n / N	0 / 17	2 / 15	0 / 8	0 / 406	0 / 403
2. On Nut T-Junction Police Booth Sukhumvit Road	21 Jan – 8 Feb	Range	0.08 - 0.57	89.9 - 221.6	0.04 - 0.08	0.6 - 9.8	1.1 - 6.2
		n / N	14 / 17	8 / 16	0 / 8	0 / 405	0 / 402
3. Na Ranong Junction Police Booth (Klong Toey) Art Narong Road	8 – 25 Feb	Range	0.11 - 0.17	45.5 - 78.2	0.02 - 0.06	0.3 - 3.0	0.4 - 2.3
		n / N	0 / 16	0 / 16	0 / 8	0 / 404	0 / 401
4. Sriyan Junction Police Booth Samsen Road	25 Feb – 11 Mar	Range	0.10 - 0.18	41.1 - 117.8	0.02 - 0.04	0.5 - 5.2	0.8 - 3.8
		n / N	0 / 11	0 / 13	0 / 6	0 / 338	0 / 335
5. Tien Ruammit Junction Police Booth Ratchadapisek Road	12 – 31 Mar	Range	-	-	-	-	-
		n / N					
6. Bang Kapi Junction Police Booth Su- kapiban 1 Road	1 – 19 Apr	Range	0.14 - 0.24	76.4 - 102.1	0.02 - 0.04	1.0 - 5.6	1.7 - 4.2
		n / N	0 / 18	0 / 6	0 / 9	0 / 406	0 / 403
7. Sathupradit Post Office Sathu Pradit Road	19 Apr – 6 May	Range	0.14 - 0.34	57.6 - 121.6	0.03 - 0.09	0.5 - 4.7	0.7 - 2.9
		n / N	2 / 16	1 / 9	0 / 7	0 / 383	0 / 380
8. Ratchawong Junction Police Booth Yaowarat Road	6 – 25 May	Range	0.09 - 0.17	55.6 - 110.1	0.03 - 0.03	0.4 - 7.8	0.4 - 5.8
		n / N	0 / 3	10 / 12	0 / 1	0 / 249	0 / 240
9. Lam Laung Police Booth Larn Laung Road	31 May – 11 Jun	Range	0.15 - 0.22	74.9 - 109.3	0.03 - 0.06	0.7 - 9.0	1.0 - 6.6
		n / N	0 / 11	0 / 8	0 / 5	0 / 262	0 / 259
10. Mansri Police Booth Bamrungmuang Road	11 – 28 Jun	Range	0.10 - 0.17	53.1 - 59.3	0.02 - 0.15	1.6 - 9.1	2.0 - 6.8
		n / N	0 / 17	0 / 5	0 / 7	0 / 408	0 / 405
11. Pratunam Police Booth Ratchaprarop Road	29 Jun – 15 Jul	Range	0.03 - 0.52	53.8 - 181.6	0.03 - 0.12	1.0 - 4.5	1.4 - 4.0
		n / N	5 / 16	6 / 16	0 / 8	0 / 72	0 / 69
12. Bang Lampoo Police Booth Prasumain Road	15 Jul – 2 Aug	Range	0.06 - 0.09	28.4 - 50.8	0.01 - 0.16	0.5 - 5.9	0.7 - 3.7
		n / N	0 / 17	0 / 16	0 / 8	0 / 431	0 / 428
13. Siphaya Police Booth Siphaya Road	3 – 18 Aug	Range	0.07 - 0.17	34.3 - 81.5	0.02 - 0.11	1.0 - 4.5	1.2 - 3.7
		n / N	0 / 16	0 / 16	0 / 8	0 / 44	0 / 41
14. Wong Wien Yai Police Booth Prachatipok Road	19 Aug – 6 Sep	Range	0.08 - 0.16	45.9 - 91.9	0.02 - 0.21	0.3 - 6.4	0.9 - 3.7
		n / N	0 / 16	0 / 16	0 / 8	0 / 93	0 / 90
15. Wong Sawang Junction Police Booth Bangkok-Nonthaburi Road	6 – 23 Sep	Range	0.09 - 0.27	26.2 - 119.7	0.02 - 0.08	0.8 - 6.5	1.1 - 4.5
		n / N	0 / 16	0 / 17	0 / 8	0 / 384	0 / 381
16. Thanon Tok Junction Police Booth Rama 3 Road	24 Sep – 11 Oct	Range	0.07 - 0.19	35.9 - 89.3	0.02 - 0.10	0.5 - 6.5	1.1 - 4.4
		n / N	0 / 17	0 / 17	0 / 9	0 / 335	0 / 333
17. Bangkok Christian Hospital Silom Road	11 – 28 Oct	Range	0.03 - 0.08	23.0 - 60.4	0.01 - 0.04	0.5 - 3.4	0.6 - 2.5
		n / N	0 / 15	0 / 17	0 / 7	0 / 407	0 / 405
18. Ma Boon Krong Junction Police Booth Rama 1 Road	28 Oct – 15 Nov	Range	0.11 - 0.20	65.3 - 126.0	0.06 - 0.14	0.8 - 4.8	1.1 - 4.2
		n / N	0 / 16	3 / 17	0 / 8	0 / 429	0 / 428
19. Ramkhamhaeng Junction Police Booth Ramkhamheang Road	15 Nov – 2 Dec	Range	0.06 - 0.19	33.3 - 124.9	0.02 - 0.10	0.6 - 8.1	0.8 - 4.8
		n / N	0 / 14	1 / 17	0 / 6	0 / 395	0 / 392
20. Land Development Department Pahon Yothin Road	6 – 20 Dec	Range	0.07 - 0.21	39.0 - 130.7	0.02 - 0.09	0.4 - 4.6	0.6 - 3.6
		n / N	0 / 11	1 / 9	0 / 5	0 / 305	0 / 299
21. Victory Monument Police Booth Ratchawithi Road	20 Dec 10 – 4 Jan 11	Range	0.14 - 0.25	69.7 - 147.2	0.03 - 0.14	0.6 - 4.9	1.0 - 3.5
		n / N	n / N	1 / 13	0 / 6	0 / 361	0 / 358
Standard			0.33	120	1.5*	30	9

Remarks: * : 1-month average
 n : number of measurement that exceeded standard
 N : total measurements
 - : not monitored

Table 3 : Air Quality in General Bangkok Area in 2010 Classified by Monitoring Stations

Station	Sulfur dioxide (SO ₂)			Nitrogen dioxide (NO ₂)			Carbon monoxide (CO)			Ozone (O ₃)			Particulate Matter of 10 Microns in diameter (PM ₁₀)			Total Suspended Particulate (TSP)			Lead (Pb)		
	1-hr Average Value (ppb)		Average 1 year	1-hr Average Value (ppb)		Average 1 year	8-hr Average Value (ppb)		Average 1 year	1-hr Average Value (ppb)		Average 1 year	24-hr Average Value (µg/m ³)		Average 1 year	24-hr Average Value (µg/m ³)		Average 1 year	1-month Average Value (µg/m ³)		Average 1 year
	Max	Min	Time > std.*	Max	Min	Time > std.*	Max	Min	Time > std.*	Max	Min	Time > std.*	Max	Min	Time > std.*	Max	Min	Time > std.*	Max	Min	Time > std.*
Bansomdejchao-praya Rajabhat University, Thonburi District	24	0	0/8.582							116	0	0/8.588	19			0.15	0.03	0/50	0.06	0.01	0/11
Raburana Post Office, Ratburana District	39	0	0/7.977							101	1	0/8.254	19			0.20	0.03	0/56	0.07	<0.005	0/12
Thai Meteorological Department, Bang Na District	34	0	0/8.114							98	0	0/8.166	15			0.15	0.03	0/54	0.15	0.02	0/12
Chandrakasem Rajabhat University, Chulachak District	18	0	0/8.307							103	4	0/8.340	23			0.15	0.02	0/53	0.06	0.01	0/11
Klongjan Community Housing, Bang Kapi District	32	0	0/8.271							100	0	0/8.331	20			0.14	0.02	0/54	0.06	0.01	0/12
Huay Kwang National Housing Authority Siam, Huay Kwang District	22	0	0/8.336							116	3	0/8.332	31			0.22	0.03	0/53	0.07	0.01	0/12
Nongrit Wilaaya School, Yamawa District	26	0	0/8.242							93	0	0/8.207	19			0.13	0.03	0/49	0.05	0.02	0/10
Singharat Playakom School, Bang Khuntien District	27	0	0/8.288							86	0	0/8.200	15			0.19	0.03	0/49	0.09	0.01	0/10
The Government Public Relations Department, Phayathai District	17	0	0/8.475							117	0	0/7.818	21			0.15	0.02	0/54	0.07	0.01	0/12
Bodindecha (Sing Singhasen) School, Wang Thonglang District	21	0	0/8.300							120	1	0/8.298	20			0.20	0.02	0/53	0.06	0.01	0/12
Standard	300		40	170		30	30		-	9		100	-	120	50	0.33		0.1	1.5		-

Remark : * : number of measurements that exceeded standard/ total measurements



Table 4 : Air Quality in Vicinity Area of Bangkok in 2010 Classified by Monitoring Stations

Province	Station	Sulfur dioxide (SO ₂)			Nitrogen dioxide (NO ₂)			Carbon monoxide (CO)			Carbon monoxide (CO)			Ozone (O ₃)			Particulate Matter of 10 Microns in diameter (PM ₁₀)												
		1-hr Average Value (ppb)		Average 1 year	1-hr Average Value (ppb)		Average 1 year	1-hr Average Value (ppb)		Average 1 year	8-hr Average Value (ppb)		Average 1 year	1-hr Average Value (ppb)		Average 1 year	24-hr Average Value (µg/m ³)		Average 1 year										
		Max	Time > std.*		Max	Min	Time > std.*	Max	Min	Time > std.*	Max	Min	Time > std.*	Max	Min	Time > std.*	Max	Min	Time > std.*										
Samut Prakan	Vocational Rehabilitation Center for Disable people, Prapadang District	29	0	0/8,116	1	109	1	0/8,142	19		5.2	0.0	0/7,992	0.2		2.3	0.0	0/8,254	0.2		158	0	19/8,007	16		147.7	18.2	5/338	59.2
	South Bangkok Power Plant, Muang District	23	0	0/7,249	2	102	0	0/7,696	12		2.6	0.0	0/8,062	0.5		2.2	0.1	0/8,424	0.5		157	0	60/7,971	26		120.9	12.4	1/339	23.7
	The Residential House of Department of Mineral Resources, Prapadang District	43	0	0/5,790	4	97	0	0/5,954	15		3.9	0.0	0/5,530	0.5		3.4	0.1	0/5,786	0.5		143	0	22/6,020	19		170.2	16.0	3/244	37.6
	Samut Prakan City Hall, Muang District	19	0	0/8,047	3	110	2	0/8,162	30		4.6	0.1	0/8,263	0.9		2.9	0.3	0/8,619	0.9		98	0	0/7,976	12		160.8	22.8	13/345	44.9
	Bangplee National Housing Authority, Bangplee District	18	0	0/7,671	2	88	0	0/7,981	13		2.9	0.0	0/7,723	0.5		2.3	0.0	0/8,034	0.5		168	0	24/8,016	27		136.7	13.1	2/341	35.5
Pathum Thani	Bangkok University, Rangsit Campus, Klong Laung District	46	0	0/8,136	4	74	0	0/8,139	16		2.5	0.0	0/8,091	0.6		1.8	0.1	0/8,375	0.6		100	0	0/8,087	15		123.4	10.3	1/343	38.1
Samut Sakhon	Samut Sakhon Highway District, Kratumban District	102	0	0/8,054	9	120	1	0/8,205	20		4.9	0.0	0/8,234	0.9		3.7	0.0	0/8,584	0.9		125	0	20/8,259	17		71.4	16.0	0/359	34.7
	Samut Sakhon Provincial Administration, Muang District	127	0	0/8,193	8	78	0	0/8,271	15		4.5	0.1	0/8,280	0.8		2.6	0.2	0/8,634	0.8		121	0	34/8,145	19		87.8	14.5	0/358	35.2
Nonthaburi	Electricity Generating Authority of Thailand, Bangkray District	40	0	0/5,745	5	130	0	0/5,827	19		6.5	0.0	0/5,830	0.7		3.2	0.0	0/6,112	0.7		107	0	5/5,833	17		132.0	15.9	3/256	38.5
	Sukhothai Thammathirat University, Pakkred District	39	0	0/8,335	4	98	0	0/8,266	18		3.0	0.0	0/8,307	0.6		2.4	0.0	0/8,634	0.6		104	0	4/8,337	15		79.1	14.3	0/358	36.0
Standard		300		40	170		30	30		-	9		-	100		-	120		-	120		120		-	50				

Remark : * : number of measurements that exceeded standard/ total measurements
: not monitored

Table 5 : Air Quality in Provincial Area in 2010 Classified by Monitoring Stations

Region	Station	Sulfur dioxide (SO ₂)				Nitrogen dioxide (NO ₂)				Carbon monoxide (CO)				Ozone (O ₃)				Particulate Matter of 10 Microns in diameter (PM ₁₀)			
		1-hr Average Value (ppb)			Average 1 year	1-hr Average Value (ppb)			Average 1 year	8-hr Average Value (ppb)			Average 1 year	1-hr Average Value (ppb)			Average 1 year	24-hr Average Value (ug/m ³)			Average 1 year
		Max	Min	Time > std.*		Max	Min	Time > std.*		Max	Min	Time > std.*		Max	Min	Time > std.*		Max	Min	Time > std.*	
North	Chiang Mia City Hall, Muang District, Chiang Mai	14	0	0/8.059	1	57	0	0/8.125	9	3.4	0.0	0/8.132	0.5	2.8	0.0	0/8.468	0.5	274.8	9.7	19/352	44.9
	Yupparaj Witayakom School, Muang District, Chiang Mai	20	0	0/7.992	1	128	0	0/8.221	18	5.7	0.0	0/7.898	0.7	3.7	0.0	0/8.255	0.7	291.1	12.4	25/361	50.8
	City Pillar Shrine, Muang District, Lampang	10	0	0/8.231	0	97	0	0/8.077	23	5.3	0.0	0/8.243	0.5	3.7	0.0	0/8.617	0.5	188.2	7.8	17/349	43.7
	Sob Pad Health Center, Mae Moh District, Lampang	17	0	0/7.790	1	51	0	0/7.807	4	3.6	0.0	0/7.410	0.3	3.0	0.0	0/7.774	0.3	171.0	7.4	11/343	40.8
	The Si Health Center, Mae Moh District, Lampang	18	0	0/5.958	1	88	0	0/7.122	4	3.3	0.0	0/6.286	0.4	3.1	0.0	0/6.425	0.4	190.1	7.4	19/292	48.6
	Mae Moh Provincial Waterworks Center, Mae Moh District, Lampang	16	0	0/7.576	1	42	0	0/6.857	3	3.1	0.0	0/6.718	0.4	2.6	0.0	0/6.796	0.4	154.0	4.6	3/324	36.6
	Nakorn Sawas Technical College, Muang District, Nakhon Sawan	17	0	0/5.605	4	63	0	0/6.943	10	4.5	0.0	0/6.224	0.7	3.6	0.0	0/6.333	0.7	107.9	7.6	0/293	42.8
	Department of Natural Resources and Environment Provincial Center, Muang District, Chiang Rai	#	#	#	#	#	#	#	#	3.5	0.0	0/8.359	0.8	2.6	0.2	0/8.745	0.8	267.1	11.2	40/364	54.8
	Department of Natural Resources and Environment Provincial Center, Muang District, Mae Hong Son	#	#	#	#	#	#	#	#	5.3	0.0	0/7.154	0.7	4.7	0.0	0/7.492	0.7	505.5	6.5	38/359	51.8
	Nan City Hall, Muang District, Nan	10	0	0/8.133	1	56	0	0/8.278	5	3.0	0.0	0/8.215	0.6	2.0	0.1	0/8.477	0.6	187.2	7.1	20/362	44.0
	Provincial Administrative Organization Stadium, Muang District, Lamphun	15	0	0/8.199	1	63	0	0/8.322	6	2.9	0.0	0/8.343	0.4	2.1	0.0	0/8.721	0.4	343.0	9.5	41/363	58.1
	Phare Meteorological Office, Muang District, Phare	12	0	0/5.394	1	37	0	0/5.420	4	2.2	0.1	0/5.361	0.5	2.1	0.1	0/5.627	0.5	106.0	3.2	0/228	30.7
	Kwan Phayao Knowledge Park, Muang District, Phayao	8	0	0/3.976	0	25	0	0/4.121	4	1.2	0.1	0/4.090	0.3	0.9	0.1	0/4.268	0.3	126.7	2.1	1/162	34.9
	Permanent Secretary House, Muang District, Khon Kaen	35	0	0/7.607	2	176	0	1/8.110	20	4.0	0.0	0/8.115	0.7	3.1	0.0	0/8.446	0.7	94.7	9.9	0/347	35.8
	21 st Military Circle House, Muang District, Nakhon Ratchasima	14	0	0/5.459	1	74	0	0/5.454	18	3.9	0.0	0/5.467	0.6	2.9	0.1	0/5.716	0.6	116.0	15.2	0/231	44.3
North East																					



Table 5 : (Continued) Air Quality in Provincial Area in 2010 Classified by Monitoring Stations

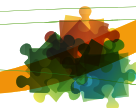
Region	Station	Sulfur dioxide (SO ₂)			Nitrogen dioxide (NO ₂)			Carbon monoxide (CO)			Ozone (O ₃)			Particulate Matter of 10 Microns in diameter (PM ₁₀)		
		1-hr Average Value (ppb)		Average 1 year	1-hr Average Value (ppb)		Average 1 year	8-hr Average Value (ppb)		Average 1 year	1-hr Average Value (ppb)		Average 1 year	24-hr Average Value (ug/m ³)		Average 1 year
		Max	Min		Max	Time > std.*		Max	Min		Max	Min		Max	Min	
Central	Ayudhaya Witthayalai School, Ayudhaya District, Phra Nakhon Si Ayutthaya	29	0	0/8.297	98	0	0/8.252	5.7	0.0	0.7/978	3.6	0.0	0/8.287	1.49	0	5/8.337
	Na Phralan Police Station, Chalerm Phrakiat District, Saraburi	12	0	0/8.237	89	0	0/7.694	2.5	0.0	0/8.270	1.6	0.1	0/8.635	122	0	40/8.129
	Kao Noi Fire Station, Muang District, Saraburi	44	0	0/7.733	96	0	0/7.696	2.0	0.0	0/7.788	1.6	0.0	0/8.156	116	0	2/7.754
	1 st Medical Engineering Center, Muang District, Ratchaburi	58	0	0/8.247	49	0	0/8.148	2.2	0.0	0/8.298	1.5	0.0	0/8.655	1.40	0	4/8.209
	Tasit Subdistrict Administrative Organization, Pluak Daeng District, Rayong	90	0	0/7.728	77	0	0/8.174	2.4	0.0	0/8.131	1.5	0.0	0/8.402	1.30	0	9/8.448
East	Map Ta Phut Health Center, Muang District, Rayong	75	0	0/8.292	71	0	0/8.271	2.6	0.0	0/8.312	1.7	0.0	0/8.653	1.27	0	1/8.166
	Telephone Service Center, Muang District, Rayong	25	0	0/7.515	62	0	0/7.402	2.1	0.0	0/7.576	1.6	0.1	0/7.836	1.41	0	9/7.571
	Field Crops Research Center, Muang District, Rayong	37	0	0/7.017	53	0	0/6.992	1.4	0.0	0/7.027	1.1	0.1	0/7.214	1.33	0	32/6.993
	Laem Chabang District Administration Stadium, Sriracha District, Chon Buri	56	0	0/8.152	115	0	0/8.173	1.6	0.0	0/8.109	1.1	0.0	0/8.513	110	0	1/8.018
	Sriracha Municipal Youth Center, Sriracha District, Chon Buri	42	0	0/7.428	50	0	0/7.453	3.0	0.0	0/7.553	2.4	0.0	0/7.806	1.23	0	10/7.442
South	General Education Office, Muang District, Chon Buri	17	0	0/8.346	68	0	0/8.345	2.4	0.0	0/8.243	1.8	0.0	0/8.588	113	0	9/8.128
	Wangyen Subdistrict Administrative Organization, Plangyao District, Chachoengsao	73	0	0/8.166	33	0	0/8.219	3.1	0.0	0/8.161	2.1	0.0	0/8.491	1.21	0	23/8.259
	City Hall, Muang District, Surat Thani	12	0	0/7.066	32	0	0/7.308	6.1	0.0	0/7.250	2.4	0.0	0/7.527	72	0	0/7.035
	Health Service Center, Muang District, Phuket	10	0	0/8.158	42	0	0/8.179	2.3	0.0	0/8.213	1.5	0.0	0/8.542	77	0	0/8.171
	Hat Yai District Municipality, Hat Yai District, Songkhla	11	0	0/7.864	81	0	0/8.020	1.8	0.0	0/8.289	1.2	0.0	0/8.619	78	1	0/7.893
South	Narathiwat City Hall, Muang District, Narathiwat	#	#	#	#	#	#	3.5	0.0	0/8.221	1.2	0.0	0/8.542	#	#	#
	Rong Pithee Chang Pueng Square, Muang District, Yala	#	#	#	#	#	#	3.8	0.0	0/7.811	1.3	0.1	0/8.043	#	#	#
Standard		300		40	170		30	30		-	9		100		120	50

Remark : * : number of measurements that exceeded standard/ total measurements

: not monitored

Appendix D





Glossary/Abbreviation

Abbreviation	English
DO	Dissolved Oxygen
FCB	Fecal Coliform bacteria
TCB	Total Coliform Bacteria
BOD	Biochemical Oxygen Demand
NH ₃	Ammonia
mg/l	milligrams per liter
ml	milliliter
MPN	Most probable number
Cd	Cadmium
Cr	Chromium
Mn	Manganese
Ni	Nickel
Pb	Lead
Zn	Zinc
Cu	Copper
Hg	Mercury
As	Arsenic
VOCs	Volatile Organic Compounds
PO ₄ -P	Phosphate - Phosphorus
NO ₃ -N	Nitrate - Nitrogen
Temp.	Temperature
SS	Suspended Solid
pH	Potential of Hydrogen ion
NH ₃ -N	Ammonia - Nitrogen
Total Cr	Total Chromium
Cr ⁶⁺	Hexavalent Chromium
CN ⁻	Cyanide

Glossary/Abbreviation (Continue)

PCBs	Polychlorinated Biphenyls
PM ₁₀	Particulate Matter 10 Micron
O ₃	Ozone
TSP	Total Suspended Particulate Matter
SO ₂	Sulphur dioxide
NO ₂	Nitrogen dioxide
CO	Carbon monoxide
ppb	Part per billion
ppm	Part per million
ppt	Part per thousand
L _{eq}	Equivalent Continuous Sound Pressure Level
dBA	Decibel A
%w/w	weight by weight
NO _x	Nitrogen oxide
SAR	Sodium Absorption Ratio
%ESP	Exchangeable Sodium Percentage
ECe	Electrical Conductivity of Saturation Water Extract



Appendix E

Name List of Thailand State of Pollution Report Working Group 2010

Editorial Consultants

- | | |
|-----------------------------|--|
| 1. Dr. Supat Wangwongwatana | The Secretary - General of the Office of Natural Resources and Environmental Policy and Planning |
| 2. Dr. Wijarn Simachaya | Director General of Pollution Control Department |
| 3. Mrs. Sunee Piyapanpong | Deputy Director General of Pollution Control Department |

Thailand State of Pollution Report Working Group

Chairman of the Working Group

- | | |
|--------------------------|---|
| 1. Mr. Worasart Apaipong | Deputy Director General of Pollution Central Department |
|--------------------------|---|

Representative of Department of Groundwater Resources

2. Mr. Banjong Promchan
3. Mr. Anirut Ladawadee

Representative of Office of Permanent Secretary Ministry of Natural Resources and Environment

4. Ms. Warewan Rodrawee

Representative of Planning Analysis and Evaluation Division, Pollution Control Department

5. Mrs. Kanchalee Navickabhum

Representative of Waste and Hazardous Substances Management Bureau, Pollution Control Department

6. Ms. Lakkana Julsaeng
7. Mr. Imran Hayeebaka

Representative of Air Quality and Noise Management Bureau, Pollution Control Department

8. Ms. Sirirat Yensong

Representative of Water Quality Management Bureau, Pollution Control Department

9. Ms. Sasithorn Prapasee

Representative of Environmental Quality and Laboratory Division, Pollution Control Department

10. Mr. Prasith Simcharoen

Representative of Inspection and Enforcement Division, Pollution Control Department

11. Ms. Karnsinee Duangdee

Representative of Legal Division, Pollution Control Department

12. Mr. Watchara Punnaravikij

Representative of Office of the Secretary, Pollution Control Department

13. Mr. Nichon Kongpet

14. Mr. Thirachewin Boonmee

Representative of Management System Development Group, Pollution Control Department

15. Ms. Trongkamol Kaewmesri

Secretary Division of Thailand State of Pollution Report Working Group

- | | |
|-------------------------------|-------------------------------|
| 16. Mrs. Nanthiwa Pitayaniyom | Staff and Secretary |
| 17. Mrs. Kewalin Wongsetsiri | Staff and Assistant Secretary |
| 18. Ms. Lalana Plengsiang | Staff and Assistant Secretary |

Editorial Staff

- | | |
|---|----------------------------------|
| 1. Ms. Wassana Jangprajak | 2. Mr. Aram bhandhuwanna |
| 3. Mr. Cherdchai Worakaensai | 4. Mr. Manorat Rittem |
| 5. Ms. Prapaisri Asanarattanajinda | 6. Mr. Surin Aree |
| 7. Mr. Suppajit Sukkunta | 8. Mrs. Sirinart Pongyart |
| 9. Dr. Pattanan Tarin | 10. Ms. Makara Tappoon |
| 11. Ms. Chalalai Rungruang | 12. Mr. Teerawat Udomjindasawas |
| 13. Ms. Chariya Kongcharoen | 14. Ms. Sineenat Chawna |
| 15. Mr. Sirisak Kumkong | 16. Dr. Chuthamat Rattikansukha |
| 17. Ms. Chonchanok Arunlert | 18. Mr. Palawut Noikeaing |
| 19. Dr. Nuanchan Singkran | 20. Ms. Wannipa Guayjarempanishk |
| 21. Mr. Nattawut Intorn | 22. Mr. Akaluk Yenpiam |
| 23. Ms. Nantawan V Singhakachen | 24. Ms. Wassana Toruksa |
| 25. Ms. Waroonphan Mittrjit | 26. Ms. Piraporn Petchtong |
| 27. Ms. Siwaporn Rungsiyanon | 28. Dr. Kessinee Unapumnu |
| 29. Mr. Nuttawat Rithruangnam | 30. Ms. Sirirat Yensong |
| 31. Ms. Matika Prachamanitkul | 32. Dr. Chanan Tiranarat |
| 33. Mrs. Apiporn Ketkanokwarakit | 34. Ms. Karnsinee Duangdee |
| 35. Mr. Watchara Punnarawikij | 36. Mr. Punntorn Kawyord |
| 37. Mr. Rachain Rachaphila | 38. Ms. Ornjira Chaibundit |
| 39. Ms. Sineenart Wannasri | 40. Ms. Kanignun Kotchadat |
| 41. Dr. Rittikrai Bhavabhutanonda Na Mahasarakham | 42. Mr. Anirut Ladawadee |





Pollution Control Department
 Ministry of Natural Resources and Environment
 92 Soi Phahon Yothin 7 , Phahon Yothin Rd., Sam Sen Nai,
 Phayathai, Bangkok 10400 Thailand
 Tel.(+66) 2298 2000 Fax.(+66) 2298 2002
<http://www.pcd.go.th>

