PRIVATIZATION OF SEWAGE TREATMENT IN CHINA'S COASTAL CITIES: ENVIRONMENTAL POLICIES, INTERNATIONAL EXPERIENCE, AND POLICY IMPLICATIONS FOR GUANGZHOU

by
Chinlim Ong

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Signature of Author: _____
Department of Chemical Engineering
January 19, 1996

Certified by: _____
Paul F. Levy
Adjunct Professor of Environmental Policy
Department of Urban Studies and Planning
Thesis Supervisor

Accepted by _____
Richard de Neufville
Professor of Civil Engineering
Chairman. Technology and Policy Program

Accepted by _____
Robert E. Cohen
Professor of Chemical Engineering
Chairman, Committee for Graduate Students

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ABSTRACT

Decades of political and economic activities that paid no regard to the environment have resulted in a multitude of enduring environmental problems confronting modern China. The wealthy and economically vibrant coastal cities suffer from an array of environmental problems as a result of rapid urbanization and industrialization. The central question posed by this thesis is whether privatization is an effective policy option to address water pollution due to untreated urban wastewater in China's coastal cities. Guangzhou city, the metropolis of southern China, is the focus of the study. In Guangzhou, a substantial amount of residential wastewater is not treated before being discharged into tributaries of the Pearl River. Although well-established technologies for treating residential sewage exist, current environmental policies and government commitment remain inadequate in providing the necessary sewage treatment infrastructure. Experience in other countries has demonstrated that by mobilizing resources from the private sector, privatization is a policy option that could enable technological solutions to treat urban sewage. Small-scale lease and concession contracts are the most promising form of privatization applicable to sewage treatment in Guangzhou. China's value systems, its political and institutional structure, and economic and technological rationality are three complementary categories of issues that need to be addressed in order to ensure the success of privatizing sewage infrastructure. These factors form integral parts of the privatization strategy, which must provide rational solutions that are implementable in the political and social context of China. '*Rational incrementalism*' will be the key theme of the implementation strategy that seeks to attain gradual privatization, promote the mobilization of domestic resources, increase environmental awareness of the populace, and enhance the technical capability of environmental agencies.

Thesis Supervisor: Paul F. Levy
Title: Adjunct Professor of Environmental Policy, Urban Studies and Planning

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CHAPTER 1
INTRODUCTION AND OVERVIEW

1.1 BACKGROUND

Since the late 1970s, economic reform in China has achieved remarkable progress in many ways. However, there are rising concerns that China will be confronting a severe environmental crisis amid this euphoria over China's seemingly unlimited economic potential. China is 'besieged' by a multitude of environmental problems that include deforestation, soil erosion, groundwater pollution, and air pollution. Some environmental problems are most acute in the urban centers, particularly in the coastal cities. Although these cities have experienced the highest growth since the onset of economic reform, environmental management has lagged behind severely. In Guangzhou city for instance, less than 15 percent of residential wastewater was treated in 1990. Only a few major cities such as Beijing and Shanghai have seen the construction of large scale centralized urban sewage treatment facilities in the late 1980s.

Environmental planning and management in China did not come into existence until only about twenty years ago. Current efforts in managing environmental problems are plagued by inefficiencies, inadequate financial resources. A recent World Bank study estimated that China will require about US$ 100 billion of investment in infrastructure for water and sanitation between 1995-2004 , equivalent to about 1 percent of its GDP for the same period. It seems unlikely that the Chinese government alone can afford this amount of investment. Privatization appears to be a feasible alternative. It is against this backdrop that the possibility of privatization as a means to speed up the management of urban sewage in the coastal cities is explored. Guangzhou city will be the focus of investigation.

1.2 QUESTIONS TO BE ADDRESSED

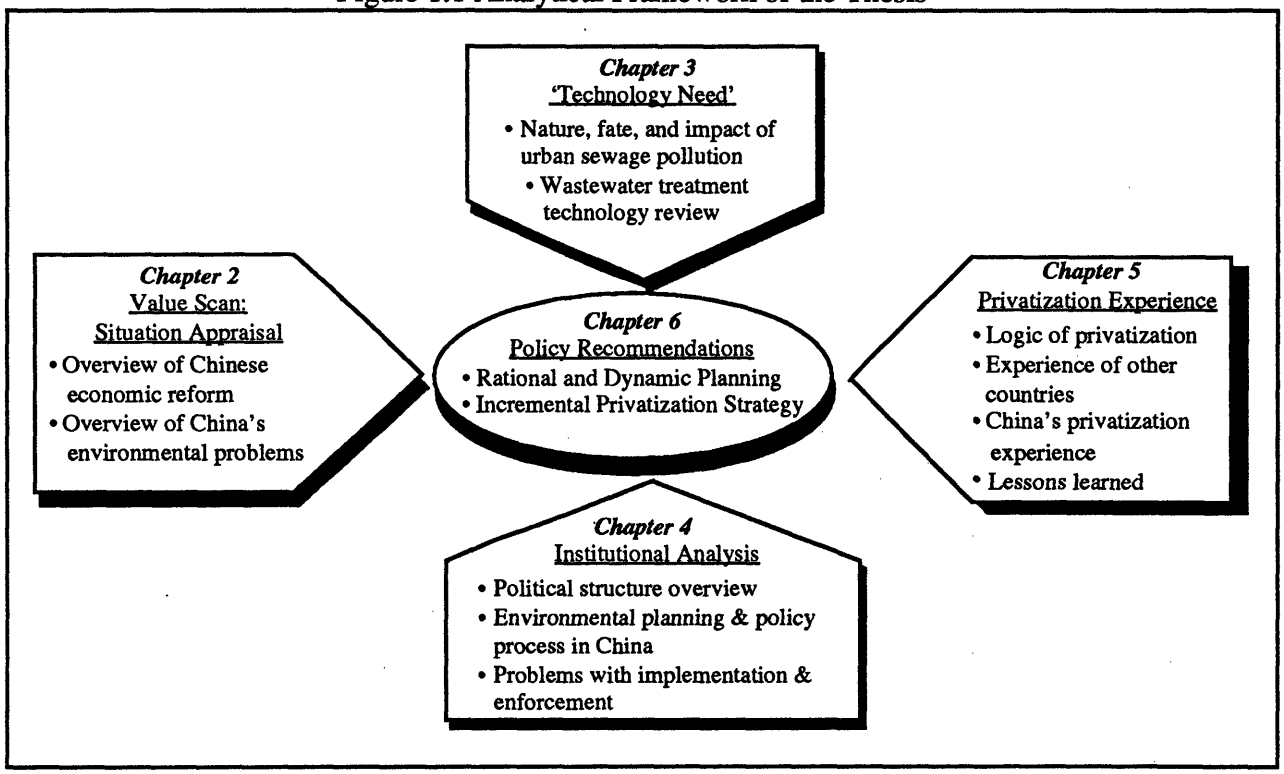
The central questions of this thesis are: Can privatization offer an efficient alternative to manage urban waste water pollution in China's coastal cities? What are the necessary policy and regulatory issues that need to be addressed for privatization to be considered a feasible solution? Related secondary questions include:

- What technology is available to treat urban sewage?
- What are the problems with existing institutional and policy structure in managing water pollution in China?
- What are the lessons learned from the privatization experience of other countries and China?

1.3 METHODOLOGY

The thesis will begin by exploring the important role of coastal cities in China's economic development, arguing that managing environmental problems in these cities is one of the fundamental steps in managing China's innumerable environmental problems (Chapter 2). An assessment of the nature and impacts of urban waste water pollution in the Guangzhou will then be conducted to verify the rationale for sewage treatment (Chapter 3). The politics of environmental law and policy in China will be analyzed to identify inadequacies and inefficiencies in the current system (Chapter 4). Lessons for sewage treatment privatization will be drawn from study of the experience of infrastructure privatization in China and other countries (Chapter 5). These analyses will provide the foundation for identifying policy and institutional reforms that are needed to enable privatization of sewage management in Guangzhou (Chapter 6). Figure 1.1 summarizes the analytical framework of this thesis.

Figure 1.1 Analytical Framework of the Thesis



CHAPTER 2:
OVERVIEW OF CHINA'S COASTAL CITIES AND ENVIRONMENTAL PROBLEMS

This chapter provides an overview of China's economic reform since the late 1970s, the important roles of coastal cities in this reform, and an overview of China's environmental problems. These materials will serve as the context in which the thesis will be based. Acknowledging the multitude of environmental problems confronting China and the formidable tasks in addressing them, this chapter identifies the extent of environmental pollution in major China cities. It attempts to show that given the important role of coastal cities in China's development, addressing environmental problems in these cities is a critical part of managing China's environmental problems.

2.1 Overview of China's Economic Reform

China's economic reform officially began in December 1978 as the key outcome of the Third Session of the Eleventh Central Committee of the Chinese Communist Party (CCP). Throughout the past 17 years, the approach of Chinese reform can be characterized as gradual and experimental, as crystallized in Chinese paramount leader Deng Xiaoping's saying, "crossing the river by feeling the stones under the feet". The performance of Chinese economy since has been remarkable, about 9 percent annually, quadrupling in size [Ref 1]. Substantial improvements in living standards, especially in the major coastal cities and a reduction in poverty were also achieved. A vibrant non-state economic sector has also emerged as the key impetus to Chinese economic development. The reform process in nevertheless incomplete. Numerous structural and policy issues remained unresolved. The more notable issues include the lack of effective infrastructure (institutional, instrumental) for macroeconomics stabilization, the weak legal and regulatory framework, the continued poor performance of the state-owned-enterprises (SOEs) and the rapidly deteriorating state of natural environment.

There are three major stages in Chinese economic reform since the official endorsement of the program in the CCP Plenum in late 1978, namely (i) rural/agricultural reform from 1979 to 1982, (ii) opening of domestic market to foreign trade and capital in 1979 and (iii) urban industrial reform in 1984 [Ref 2]. These stages are the main thrusts of Chinese economic reform in acquiring 'socialist modernization' [Ref 3] although a well defined plan was not apparent in the beginning. This reform was believed to be the vision of the Chinese paramount leader, Deng Xiaoping, in which China will be transformed into a wealthy and powerful country [Ref 4].

2.1.1 Agricultural Reform

The implementation of the 'production responsibility system' is the basis of agricultural reform in the 1979. This scheme allowed farmers and households to lease land from the state, manage and operate the activities without much administrative control from the state. This 'decollectivization' effectively liberated the ownership (i.e. property rights) of farmland from the people's commune, typically consisting of 20-30 rural families, to individual households. The farmers were also allowed to sell products via two channels. After selling the assigned quotas at predetermined prices to the state, the farmers could sell the remaining in the market at market determined prices. Official procurement prices of 18 basic agricultural products were also increased to assist the farmers in the rural sector. The 'freeing up' of agricultural market from a state monopoly and the increase in selling prices has resulted in rapid growth of agricultural production. Between 1978 to 1984, gross value of crop output grew by 6.8 percent per year while grain output grew at 5.0 percent, both much higher than in the past two decades [Ref 9]. The success of agricultural reform however, has also resulted in undesirable environmental effects. The increased use of chemical fertilizers, pesticides and herbicides to enhance yield has resulted in run-offs that contain large amount of chemical contaminants. Irrigation subsidies resulted in over usage of water and rapid declines of water tables in the arid northern region.

Another important aspect of rural reform was the liberalization of control on township and village enterprises (TVEs). Allowing these enterprises to produce and sell industrial goods outside the central planning systems had encourage rapid growth of the TVEs. However, because of the limited financial strengths, little pollution abatement efforts were carried out by these small enterprises. Severe pollution by these TVEs is very common.

2.1.2 Trade and Foreign Investment

The second component of reform was the freeing of state control in international trade and the opening of the domestic market to foreign investment. The responsibilities of handling international trade transactions were transferred from the Bank of China (BOC) to regional corporations. The Chinese currency was subsequently devalued to reflect the more 'accurate' international exchange rate. Special Economic Zones (SEZs) were set up in several strategic coastal cities, including Shenzhen, Zhuhai and Shantou of Guangdong Province (next to Hong Kong), and Xiamen of Fujian Province (next to Taiwan), to facilitate foreign investment involved in export-oriented manufacturing. Another 15 coastal cities were "opened" subsequently to promote international trade and foreign investment. A foreign exchange retention system, which allowed the retention of earned exchange, was also established for exporting firms. To facilitate foreign investors in obtaining foreign currencies, swaps markets were created in the late 1980s.

This has further freed the control of foreign exchange from the BOC. The further integration of Chinese economy with the world has resulted in huge increase in trade. By 1992, Chinese exports of manufactured goods reached about US$ 62 billion, up from US$ 5 billion in 1978.

2.1.3 Industrial Reform

Experiments with urban industrial reform, the third stage of Chinese economic reform, began with the introduction of 'innovative measures' in 1979 [Ref 3]. These measures, aimed at giving more autonomy to enterprises, included the partial retention of profits by enterprises. The enterprises were also given more freedom to determine production quantity and make other operational decisions. Incentive systems were also designed to better relate managers' and workers' pay to enterprise performance. These enterprises were allowed, like the rural farmers, to sell the goods through the official procurement and free market channels. Profit repatriation to the state was replaced by taxation on enterprise in 1984-85. In 1986, the 'contract responsibility system' was introduced, allowing enterprises to negotiate with the state to determine tax liabilities. Income in excess of negotiated tax payments could be re-channeled back to the enterprises for reinvestment or compensation for workers and managers [Ref 2].

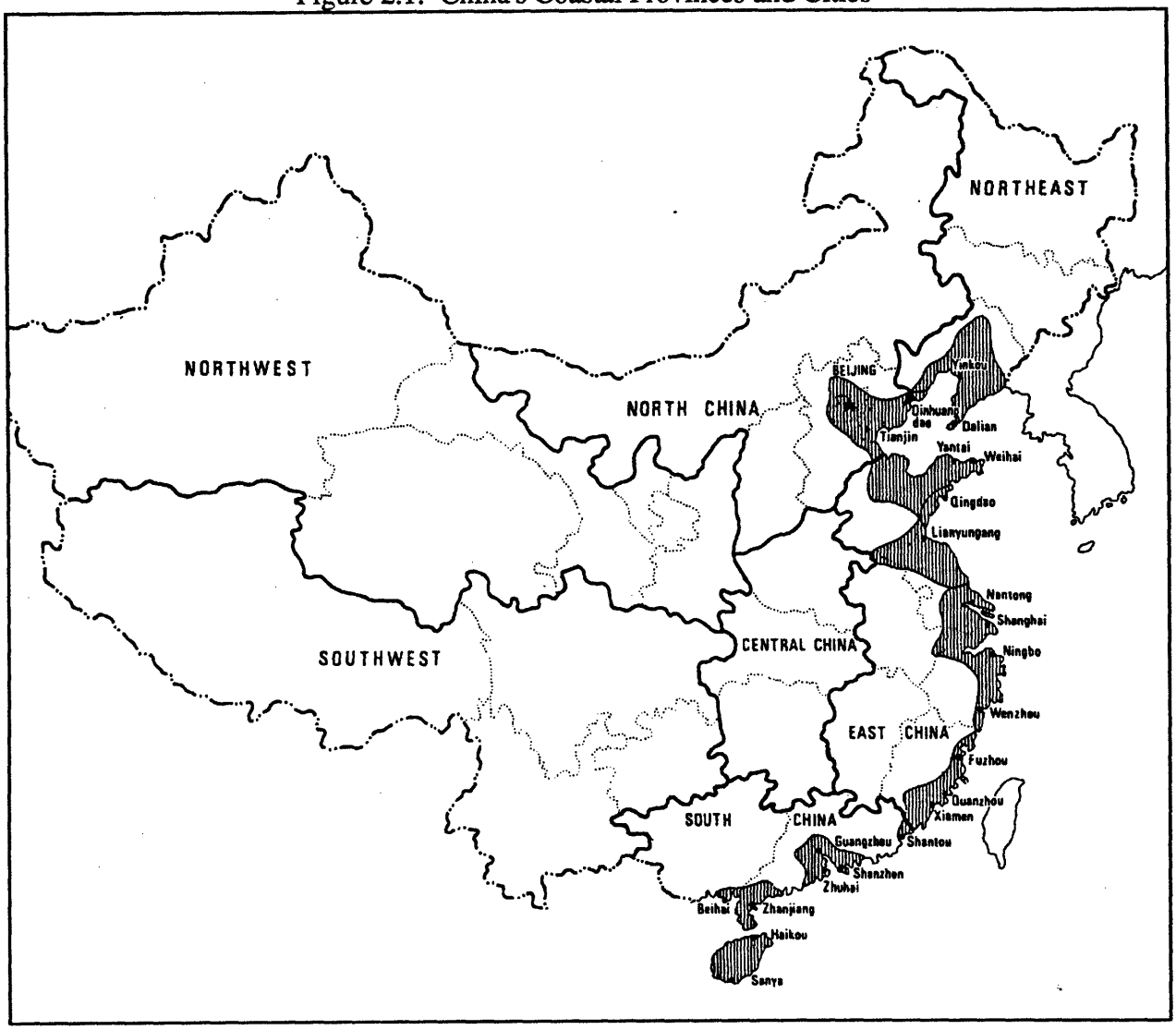
It is noted that the economic reform in China has been a highly experimental one, characterized by several 'political realignments' throughout the years of reform. These 'realignments' are manifestations of the ideological struggles between the 'liberal' and 'old-guard' factions within the CCP. Only until recently, the market oriented approach was given official endorsement at the CCP Congress in 1992, symbolizing the victory of the 'liberal' over the 'old-guard'. The overall achievement of economic reform is, however, incomplete. Economic growth has been extremely uneven with the coastal provinces prospering at far higher rates than the inner regions. Development in environmental planning and management has also lagged behind greatly economic development, resulting in continuous environmental degradation.

2.2 Roles of Coastal Region and Cities in China's Economic Reform

2.2.1 Coastal Regions

China's coastal region consists of the provinces and two special city districts located along the eastern shoreline of China. The island of Hainan is also part of this coastal region. All the Special economic zones and 'opened' coastal cities lie in these coastal provinces, which are, from north to south: Liaoning, Heibei, Shantong, Jiangsu, Zhejiang, Fujian, Guangdong, Guangxi, and Hainan (see Figure 2.1). In total, these provinces occupy about 1.3 million square km or 13.5 percent of

Figure 2.1: China's Coastal Provinces and Cities



China's total land area, house a total population of about 480 million (40.5 percent of total) and account for some 60 percent of China's GDP in 1993 [Ref 5].

These coastal provinces have been the growth engines since the onset of China's economic reform. Most of China's economic development has taken place in cities in these provinces, a direct consequence of China's 'open-door' policy which emphases the strategic roles of the coastal cities in attracting foreign investment, technology and managerial skills. The region has thus

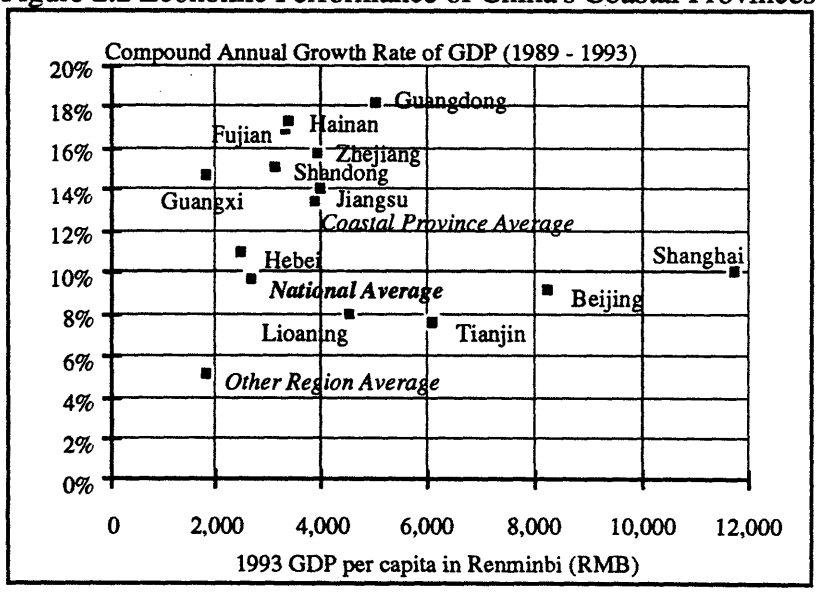
experienced rapid growth in past decade, with some provinces exhibited growth far larger than the national average. Figure 2.2 illustrates the growth of the coastal provinces[1] [Ref 5, pp. 32, 35].

2.2.2 Special Economic Zones (SEZs) and Coastal Cities

Within the coastal provinces, the SEZs and cities are the foci of economic development. Two key purposes of coastal cities as catalysts to China's economic development were frequently cited [Ref 6, pp. 11]:

- They are the linkages between the domestic and international markets: the transfer of foreign technology, capital and management systems into the inner hinterlands, and the transfer of raw materials and agricultural products from the hinterlands to the international markets take place via these cities; and
- they are the forerunners in China's experiment with 'socialistic-free market' economy.

Figure 2.2 Economic Performance of China's Coastal Provinces



The State Council of the Chinese government began exploring the idea of establishing an 'Export Commodities Production Base' in Shenzhen municipality in Guangdong province in February 1979 [Ref 7, Chapter 22]. The term 'Special Economic Zones' were subsequently adopted by the Party Central of the CCP in May 1980 to replace 'Export Commodities Production Base'. The establishment of four SEZs - Shenzhen, Zhuhai, Shantou, and Xiamen - was formally approved on August 26, 1980 in the fifteenth meeting of the Standing Committee of the Fifth National People's Congress (NPC). Four years later, on April 6, 1984, the decision to open fourteen coastal cities to foreign investment was put forward by the State Council. These cities are, from north to south: Dalian, Qinhuangdao, Tianjin, Yantai, Qingdao, Lianyungang, Nantong, Shanghai, Ningbo, Wenzhou, Fuzhou, Guangzhou, Zhanjiang and Beihai. On April 13, 1988, the first session of the Seventh NPC

[1] Renminbi (RMB) is China's local currency. The exchange rate as of January 5, 1996 is RMB 8.3 to US$ 1 (The Wall Street Journal).

established the provincial status of Hainan Island (used to be a part of the Guangdong province) and at the same time converting it into a SEZ. In total, five SEZs and fourteen coastal cities became the driving forces of China 'open door' economic development.

Table 2.1 Major Statistics of SEZs and Coastal Cities

		Urban Area (sq. km) 1988	Urban Population (million) 1988	Compound Annual Growth of Urban Industry Output 1985-88	Share of Total China's Exports 1988	Cumulative Actual Investment ($ million) 1984-1990
SEZs						
Xiamen		555	580	29.7%	1.2%	495
Shantou		245	801	33.2%	1.4%	242
Shenzhen		328	322	48.6%	25.1%	1,924
Zhuhai		654	191	71.9%	2.1%	361
Hainan	Haikou	218	334	34.1%	0.2%	-
	Sanya	1,887	342	29.6%	-	-
Coastal Cities						
Dalian		2,915	2,329	14.0%	10.5%	444
Qinhuangdao		363	478	17.5%	2.8%	39
Tianjin		4,276	5,622	6.6%	3.2%	375
Yantai		835	778	19.1%	0.2%	37
Qingdao		1,103	2,007	13.0%	5.5%	125
Lianyungang		830	499	12.0%	0.6%	21
Nantong		121	437	10.3%	0.3%	46
Shanghai		749	7,327	2.3%	15.4%	1,455
Ningbo		1,033	1,062	12.9%	0.8%	56
Wenzhou		187	552	12.6%	0.1%	10
Fuzhou		1,043	1,251	21.8%	1.0%	201
Guangzhou		1,444	3,491	15.2%	8.5%	762
Zhanjiang		1,460	989	34.0%	3.3%	120
Beihai		275	190	14.1%	0.2%	16
Share of Total China		0.2%	2.7%	-	82.4%	39.1%
Total China		9.60E+06		13.5%	47,520	17,193

Table 2.1 lists the major economic and social statistics of the SEZs and the fourteen 'opened' coastal cities [Ref 6, pp. 312-315; Ref 7, pp. 188]. In total, these urban centers accounted for 0.2 percent of China's land area, and housed a population of 30 million. Output of urban industry in these cities, except Tianjin and Shanghai, has seen double digit annual growth between 1985 and 1988. Their high share (82 percent) of China total export value is explained by the fact that these cities are also major export processing ports of China. These cities also accounted for about 39 percent of cumulative actual foreign investment in China. These cities thus played an instrumental role in China's economic reform.

2.3 Overview of China's Environmental Problems

Environmental degradation and its impacts have become increasingly evident as China continues to develop rapidly. It has been commented that the root causes of current environmental problems in

China are the communist policies of high birth rate, intensive industrialization, and agricultural production gain [Ref 10]. These policies had totally disregarded the impacts of human activities on the environment. China is now confronted with a wide spectrum of environmental problems that include water pollution, air pollution, problems with managing industrial and household wastes, deforestation, grassland degradation, soil erosion, and loss of biodiversity. The seriousness of these environmental problems is further complicated by the severe lack of technological, financial and institutional capabilities to manage them. Very little emphasis has been placed on environmental management, as reflected by the small amount (about 0.7 percent of GDP) of environmental budget allocated in 1991. Until very recently, the National Environmental Protection Agency still believed that China could rely solely on foreign assistance to solve China's environmental problems [Ref 10]. The following subsections briefly discussed three pollution problems in China.

2.3.1 Water Pollution

Water pollution is the most pressing environmental problems in China because of its widespread impacts on human health, industrial and agricultural productivity. Industrial waste discharge remains the primary cause of water contamination. Although about 82 percent of the total industrial waste water discharge (36 billion ton in 1993, [Ref 5, pp. 668]) was treated, the remaining untreated discharge contained a variety of highly hazardous chemical such as heavy metals (mercury, cadmium, lead and chromium), cyanides, phenols and petroleum residuals [Ref 12, pp. 34-35]. On the other hand, less than 20 percent of residential waste water is treated before discharging into rives, lakes and the oceans. Pesticide and fertilizer run-offs have also contributed to water pollution. China's national statistics had indicated that almost 25 percent of all river water and about 86 percent of rivers flowing through urban areas were unsuitable for irrigation or domestic use. Recent surveys of groundwater quality in 47 cities revealed that 43 cities were dependent on groundwater with contamination levels above the national standards.

2.3.2 Air pollution

Heavy reliance on coal as a form of energy (76 percent of total industrial energy supply) remains the major cause of air pollution in China. The problems are aggravated by over consumption and inefficient use. Uncontrolled emissions from motor vehicles worsen the air pollution problems in urban centers. Current atmospheric pollution levels in China are similar to those in the developed nations in the 1950s. Concentrations of air pollutants in several major cities such as Beijing, Shanghai, Shenyan, and Xian had persistently exceeded recommended ambient standards for sulfur dioxide and particulate in the late 1980s [Ref 11]. Acid rain is another environmental problem associated with coal combustion. Many of the industrialized and densely populated

coastal cities have experience acid rain in more than half of the total rainfalls. The southwest region of China has experienced the most severe acid rain phenomena, with recorded acidity of rain water consistently below pH 5 [Ref 12, pp. 35-36]. The low prospects of coordination between energy and environmental policies is believed to be the basic impediment to managing air pollution associated with energy production in China.

2.3.3 Problems with Industrial and Residential Waste Disposal

In 1993, a total of 617 million ton of waste was generated by the various industry sectors. Of these, about 40 percent was reused, 25 percent was properly disposed off, 43 percent was 'stored', and the remaining 22 million ton discharged into the environment without proper treatment [inferred from Ref 5, pp. 678]. By 1993, a total of 6 billion ton of industrial waste was accumulated [Ref 5, pp. 679]. This waste occupied a total area of about 520 sq. km in the vicinities surrounding the enterprises and industries that have produced it. On the other hand, the traditional method of organic recycling that existed between the urban-rural zones has also declined. In the past, urban residential exports to the rural agricultural zones were used as fertilizers, fowl and animal feed. By the mid-80s however, the network of collection, transportation and distribution collapsed as farmers switched to chemical fertilizers and pesticides to achieve more rapid harvests. The failure to recycle urban residential waste not only further burdened the already inadequate urban waste management systems, but increased usage of chemicals in the agricultural sector also resulted in run-off which worsened river pollution.

2.4 HIGHLIGHTS OF ENVIRONMENTAL PROBLEMS IN COASTAL CITIES

A review of the available environmental statistics revealed the acute pollution problems in the China's coastal cities. It is noted that national level environmental statistics are generally unavailable and incomplete, reflecting the lack of information gathering, compilation and communication within the various governmental agencies. Urban air pollution and urban sewage treatment capacity were briefly discussed here.

Figure 2.3 shows the mean concentration of atmospheric sulfur dioxide and particulate in four major cities in China [Ref 11]. Mean concentrations persistently remained above the official recommended levels. Particulate concentrations were on average, at an alarming level of four times higher than the recommended. This had adverse health impacts on the urban population: the death rate from chronic obstructive pulmonary disease in China is five times higher than in the United States [Ref 13]. For example, death due to lung cancer had reportedly increased by 50 percent in the 1970s in Tianjin, a heavily industrialized coastal city in the north [Ref 12, pp. 147].

Figure 2.3 Mean Concentration of Air Pollutants in Major Chinese Cities

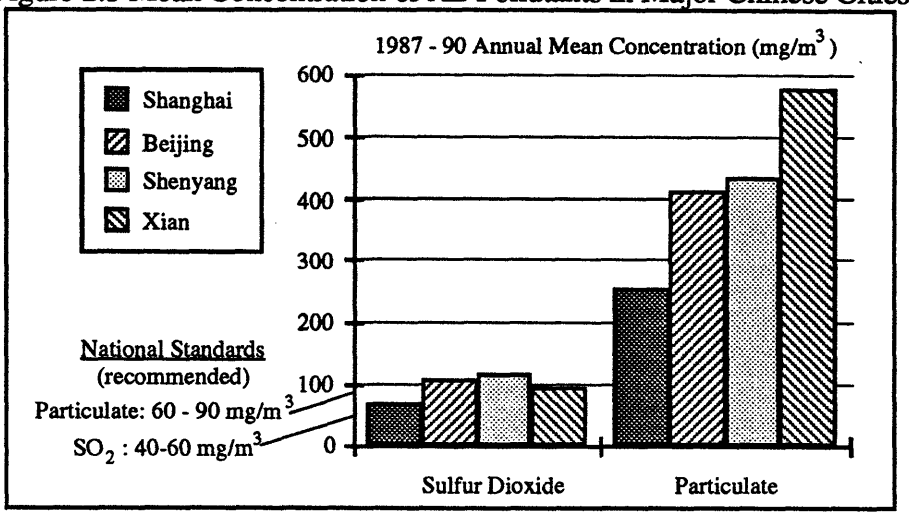
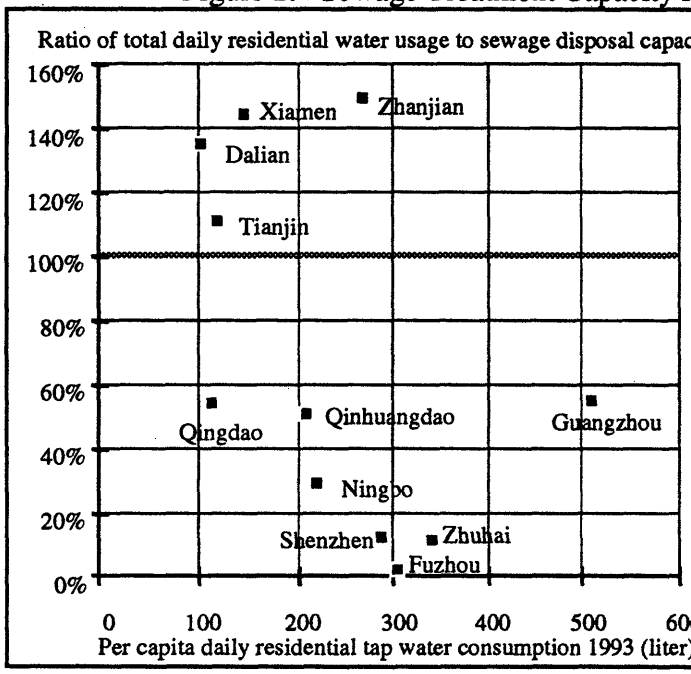


Figure 2.4 Sewage Treatment Capacity in Selected Coastal Cities, 1993



	Residential Population with access to tap water (million)	Annual Residential water supply (million ton)
Fuzhou	1.276	143
Zhuhai	0.431	55
Shenzhen	0.877	94
Ningbo	0.974	80
Guangzhou	3.53	662
Qingdao	1.477	63
Qinhuangdao	0.544	43
Tianjin	5.256	237
Zhanjiang	0.495	50
Xiamen	0.694	38
Dalian	2.487	95

A simple analysis of available statistics [Ref 5, pp. 313-317] of urban water services provides some indications of the state of sewage treatment in the major coastal cities. Figure 2.4 depicts the relationship of sewage disposal capacity to residential water consumption. Most cities have insufficient sewage treatment capacity with respect to tap water consumption. Actual levels of untreated urban waste water are higher than indicated here because industrial waste water discharge is not included in this analysis. Untreated urban sewage continued to pollute the various water resources such as lakes, rivers and groundwater sources in these urban centers. For instance, it

was estimated that the Huangpu and Suzhou rivers received some 5.2 million ton of industrial and residential waste water daily [Ref 14, pp. 142]. Consumption of contaminated water form these rivers was believed to be the major cause of half a million cases of hepatitis A in Shanghai in 1988.

This chapter highlighted the important roles of the coastal cities in China's economic development and pointed out examples severe environmental degradation in these cities. The environmental problems confronting these densely populated urban centers, including severe air pollution and water pollution due to untreated residential and industrial sewage, are results of overemphasis on economic activities and ill-conceived urbanization without due regards to the protection of urban environment. In addition to the continuous environmental degradation, these problems also pose adverse health impacts on the urban population. The rapid accumulation of wealth due to economic development in these coastal cities has made available potential financial resources to cope with urgent environmental problems in these cities. The central and local governments should thus provide favorable policy and regulatory conditions to promote the mobilization of private financial resources to provide the appropriate levels - technologically and economically feasible levels - of environmental infrastructure to address environmental problems in the coastal cities, as part of the national efforts to manage China's environmental problems.

CHAPTER 3
WASTEWATER PROBLEMS IN GUANGZHOU AND TECHNOLOGICAL SOLUTIONS

This chapter briefly surveys the range of urban problems confronting Guangzhou city, focusing on the issue of untreated urban sewage. A short review of wastewater treatment technology will follow to identify technological options available to address wastewater problems in Guangzhou.

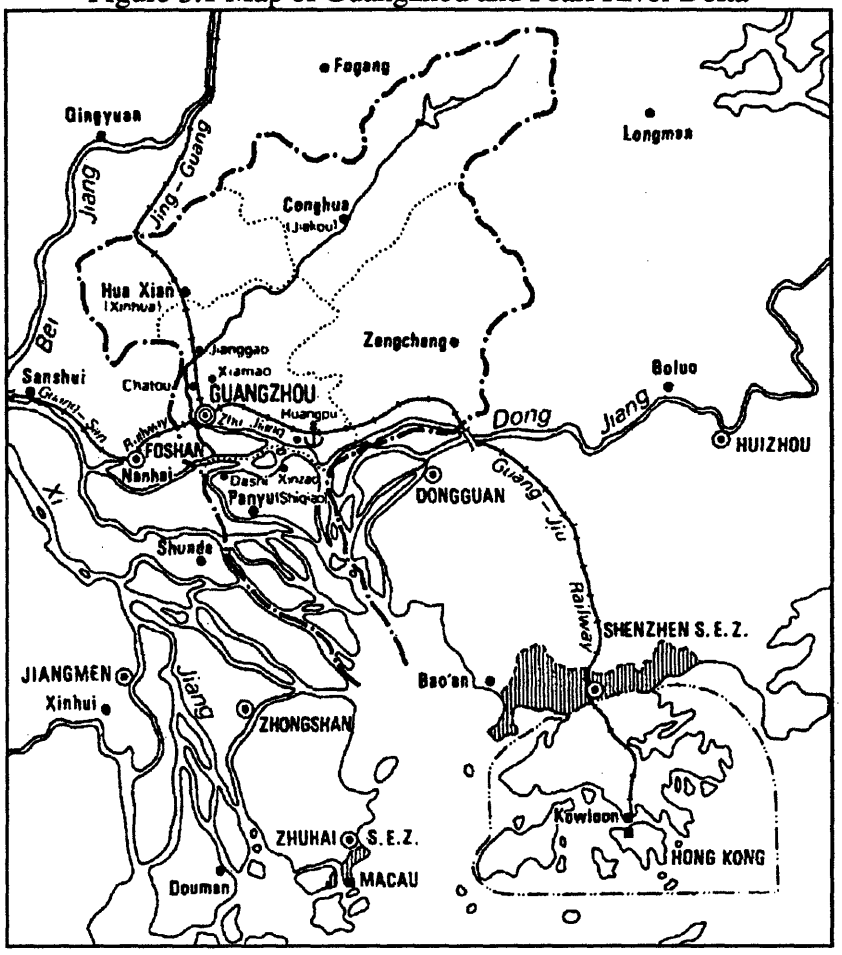
3.1 A SURVEY OF GUANGZHOU CITY AND ITS URBAN WASTEWATER PROBLEMS

3.1.1 Overview of Guangzhou City [Ref 1]

Guangzhou is situated in the northern fringe of the fertile and populous Pearl River (*Zhu Jiang*) Delta (see Figure 3.1). Bounded by the 'North River and West River' (*Bei Jiang* and *Xi Jiang*) on the west and the hilly terrain on the north, the city has developed in a southeast direction towards the mouth of the river. Being the sixth largest city (*shi*) in China, Guangzhou is the largest city and port in southern China. It is the political, economic, industrial, and communication center of the Guangdong province. Guangzhou's position as the leading metropolis of southern China was further strengthened as it become the most attractive city to foreign investment among the fourteen 'opened' coastal cities. The city's geographic boundary was redefined in 1988 to align with its economic development plan. It now encompasses an area of 7,434 square kilometers (sq. km), comprising eight urban districts and four counties (*xian*). The urban districts occupy a total of 1,443 sq. km with 92.1 sq. km belonging to the main city. By the end of 1988, Guangzhou city had a total population of close to six million, 3.5 million of whom lived in the urban district, which included about 2.8 million inhabitants in the main city.

Since the beginning of economic reform in 1978, Guangzhou has benefited greatly from its proximity to Hong Kong and Macau, as well as to the SEZs of Zhuhai and Shenzhen. Investment form overseas Chinese from Hong Kong and Macau has vitalized economic and social development of the City. Guangzhou has been the 'southern window' of China due to its strategic location at the intersection of the West, North, and East (*Xi*, *Bei* and *Dong*) tributaries of the Pearl River, waterways that provide access to the South China Sea. Large volumes of trade flow through its deep-water port facilities at Huangpu, the seaport of international commerce. Three urban centers in Guangzhou, including the Huangpu Economic and Technical Development Zone (ETDZ), are the engines of growth of the city. These regions are hosts to a wide range of manufacturing, trade, financial, and industrial research activities. Industries operating in Guangzhou include textiles, chemicals, consumer products, shipbuilding, metallurgy, furniture,

Figure 3.1 Map of Guangzhou and Pearl River Delta

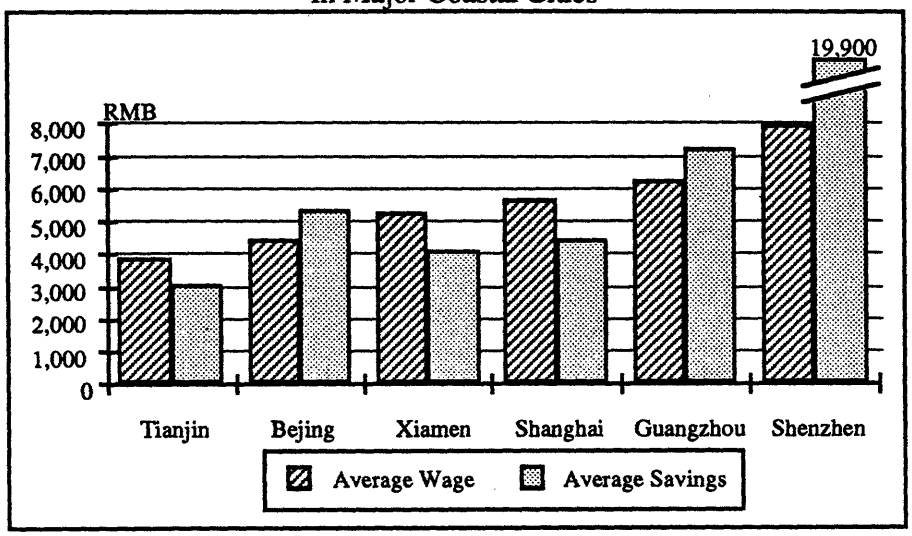


electrical, and electronics. In Huangpu ETDZ alone, 318 joint venture projects worth RMB 1.2 billion and 115 foreign investment projects worth US$ 160 million were initiated by the end of 1989, five years after the ETDZ was in operation. These years of rapid economic development and industrialization have brought wealth to the population of Guangzhou. Figure 3.2 compares the per capita annual wage rate and savings of major cities in China in 1993. The population of Guangzhou is among the most affluent in the country.

3.1.2 Land Use and Housing as Key Urban Problems

The chronic lack of public investment in infrastructure and uncoordinated development have left the city with a range of urban problems. Years of accelerated economic development without well-conceived urban planning have worsened urban ills. Apart from the problem of untreated wastewater, two key problems are briefly discussed here to further illustrate the neglected state of environmental conditions in the city.

Figure 3.2: 1993 Average Annual Wage and Savings of Population in Major Coastal Cities

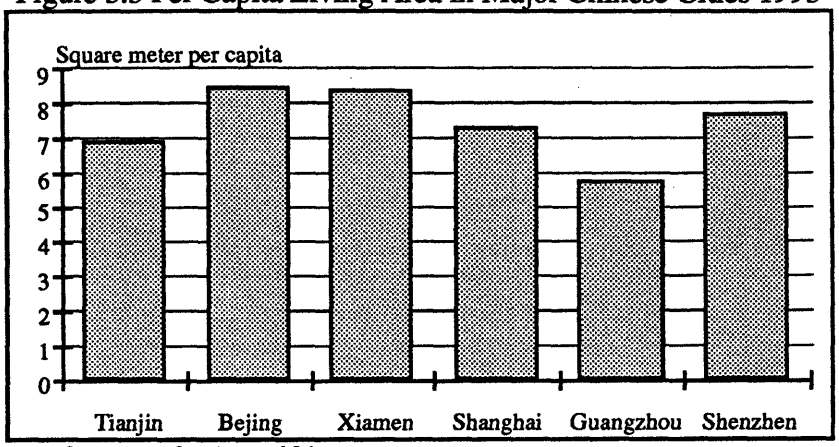


Land use in Guangzhou has been not been well-managed. Strong emphasis on industrial activities has no regard for amenities and improvement of living conditions. Industrial land use accounted for some thirty percent of the city area, far larger than the average of fifteen percent in other countries. Furthermore, these industrial activities are concentrated in the urban areas - about fifty six percent of the enterprises are located in the urban centers. On the other hand, only small portion of land has been allocated for facilities such as hospitals (1%), housing apartments (9%), schools (12%), roads (2.6%), and commercial buildings (4%) [Ref 1, Table 12.2 pp. 252]. Inefficient use of land in urban areas further complicates the problems. Most buildings, including factories, housing apartments, and offices were build to low heights. The average height of buildings in Guangzhou's urban areas was only 1.9 stories in 1988. Poor land management and failure to coordinate land use with economic development resulted in problems such as traffic congestion and environmental pollution.

Guangzhou city is also confronted with an acute shortage of residential housing. Its per capita living space of about 5.8 square meter per person [Ref 2, Table 10-16, pp. 321] is one of the lowest among the key cities in China (see Figure 3.3). The primary cause of the acute housing shortage is the housing allocation system. Construction and allocation of housing are the responsibilities of the work/production units. Workers and administrators belonging to units that have strong financial resources to build new apartments have their housing needs well taken care of while those working with smaller units did not have sufficient housing. Under this administrative system of housing allocation, heavy government subsidies reduced the costs borne by inhabitants. Continuous subsidies created increasing financial burden on the state enterprises, in turn draining

financial resources from the government. This led to a 'low-level-equilibrium-trap' of public housing provisions in Guangzhou [Ref 1, pp. 252-254].

Figure 3.3 Per Capita Living Area in Major Chinese Cities 1993



Ref 2, Table 10-16, pp. 321

3.1.3 Urban Wastewater Problems in Guangzhou

The city of Guangzhou has the highest water usage rate per capita among the key cities in China high usage rate. Table 3.1 compares the consumption rates it the cities. However, there has been little systematic efforts on the part of the municipal government in treating residential sewage wastewater, most of which ends up in the tributaries of the Pearl River. Organic compounds - measured by the biochemical oxygen demand (BOD), chemical oxygen demand (COD), and ammonia - are the primary constituents of the untreated residential sewage. As indicated in Figure 3.4, only in the late 1980s has there been some, albeit small residential wastewater treatment in Guangzhou. Construction and operation of sewage treatment facilities have been the responsibilities of the municipal government. Insufficient funding from the central government and low emphasis on the development of infrastructure provisions have left the city government with little resources and commitment to deal with untreated residential wastewater. On the other hand, encouraged by the 'pollution-charge' regulations (discussed in Chapter 4), an increasing proportion of industrial wastewater was treated by on-site treatment plants before discharge.

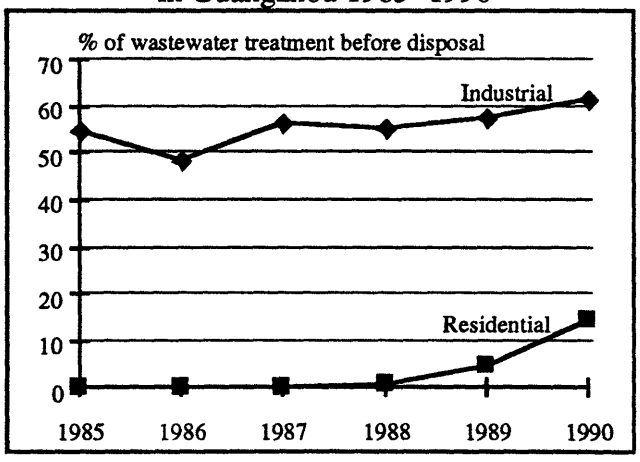
The Environmental Protection Office of Municipal Guangzhou estimated that annual discharge of residential wastewater into the Pearl River system has been increasing at about 10 percent annually, causing serious contamination in this river which is also the major source of drinking and industrial water of the city. A examination of Guangzhou's drinking water quality reveals that concentrations (in mg/l) of some constituents were below national standards. The high ammonia nitrogen concentration and BOD were results of contamination from untreated residential sewage. Improvements in the treatment of industrial wastewater on the other hand, resulted in declining inorganic and metallic content in the drinking water (Table 3.2 and Figure 3.5).

Table 3.1 Averavge Daily Water Consumption and Sewage Pipe 'Density' in Major Cities 1993

	Water Consumption			Sewage Pipe
	Industrial (MGD)	Residential (MGD)	Per Capita liter/day	km/sq km
Guangzhou	1596	477	514	6.37
Haikou	39	40	429	5.09
Zhuhai	61	39	347	3.63
Beihai	17	11	313	6.64
Fuzhou	42	103	308	9.87
Shenzhen	108	68	293	8.65
Zhanjiang	54	36	274	4.51
Shantou	37	53	241	9.83
Beijing	207	403	234	5.70
Ningbo	90	58	225	8.56
Qinhuangdao	36	31	217	6.80
Shanghai	430	515	206	6.80
Lianyungang	40	17	153	4.27
Xiamen	38	27	150	4.58
Nantong	59	18	147	3.64
Yantai	34	20	141	6.79
Wenzhou	25	22	138	5.61
Tianjin	243	171	123	8.49
Qingdao	62	46	117	7.35
Dalian	74	68	104	3.37

Reference 3, Table 10-9, Page 314

Figure 3.4 Percentage of Wastewater Treatment in Guangzhou 1985 -1990



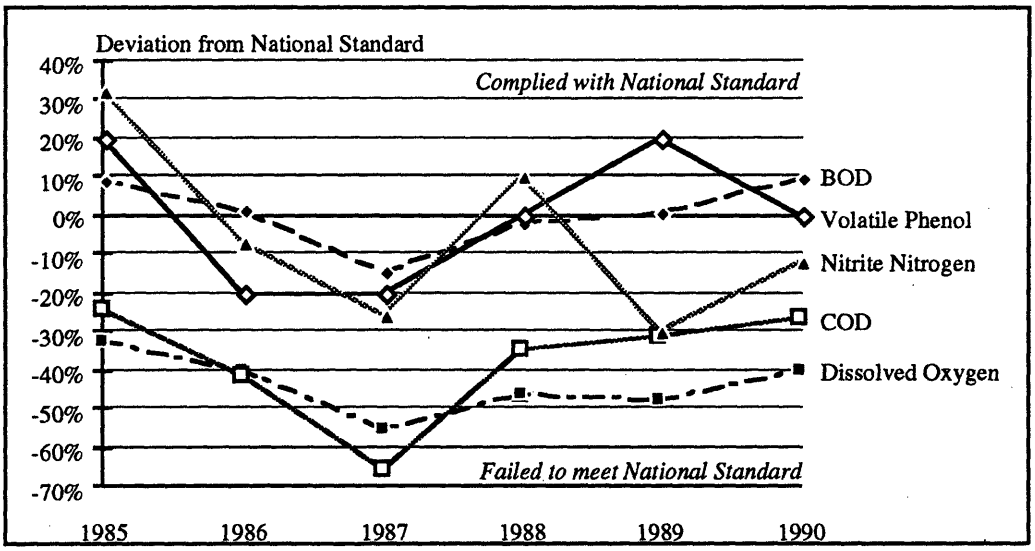
Reference 4, pp 55

Table 3.2 Drinking Water Quality in Guangzhou

	National Standard	1985	1986	1987	1988	1989	1990
pH Value	6.5-8.5	7.06	7.14	6.92	6.99	7.13	7.14
	(mg/liter)						
Dissolved Oxygen	≥ 6	4.05	3.61	2.67	3.21	3.14	3.6
COD	≤ 4	4.98	5.67	6.63	5.38	5.26	5.06
BOD	≤ 3	2.74	2.97	3.45	3.07	2.98	2.72
Ammonia Nitrogen	≤ 0.5	2.37	2.42	1.94	2.47	1.72	1.44
Volatile Phenol	≤ 0.005	0.004	0.006	0.006	0.005	0.004	0.005
Petroluem Compound	≤ 0.3	0.25	0.16	0.15	0.17	0.14	0.12
Nitrite Nitrogen	≤ 0.1	0.068	0.107	0.126	0.090	0.130	0.112
Nitrate Nitrogen	≤ 10	0.44	0.85	0.71	0.77	0.91	0.86
Cyanide	≤ 0.05	0.005	0.003	0.002	0.001	0.001	0.001
Arsenic	≤ 0.04	0.004	0.004	0.003	0.003	0.002	0.004
Cadmium	≤ 0.05	0.00020	0.00012	0.00006	0.00013	0.00004	0.00016
Chormium	≤ 0.02	0.001	0.003	0.004	0.000	0.000	0.000
Copper	≤ 0.001	0.007	0.008	0.01	0.008	0.006	0.006
Lead	≤ 0.05	0.0083	0.0105	0.0037	0.0047	0.0035	0.0050
Mercury	≤ 0.0005	0.00012	0.00008	0.00009	0.00011	0.00010	0.00003

Reference 4, Page 35

Figure 3.5 Deviation of Guangzhou Drinking Water Quality from National Standard 1985 - 1990



3.2 WASTEWATER TREATMENT TECHNOLOGY AND DECISION CRITERIA

This section provides a brief overview of typical wastewater treatment technology in application. Major steps and objectives of key treatment stages are presented. Empirical correlation of cost-performance of large scale wastewater treatment plants are also cited to provide an indication of the trade-off between costs and benefits of operating wastewater treatment works. The primary purpose of this review is to identify suitable and cost-effective technologies for the treatment of

residential sewage in Guangzhou city. An integrated approach to planning for wastewater treatment is suggested in order to determine the optimal engineering arrangement at the city level.

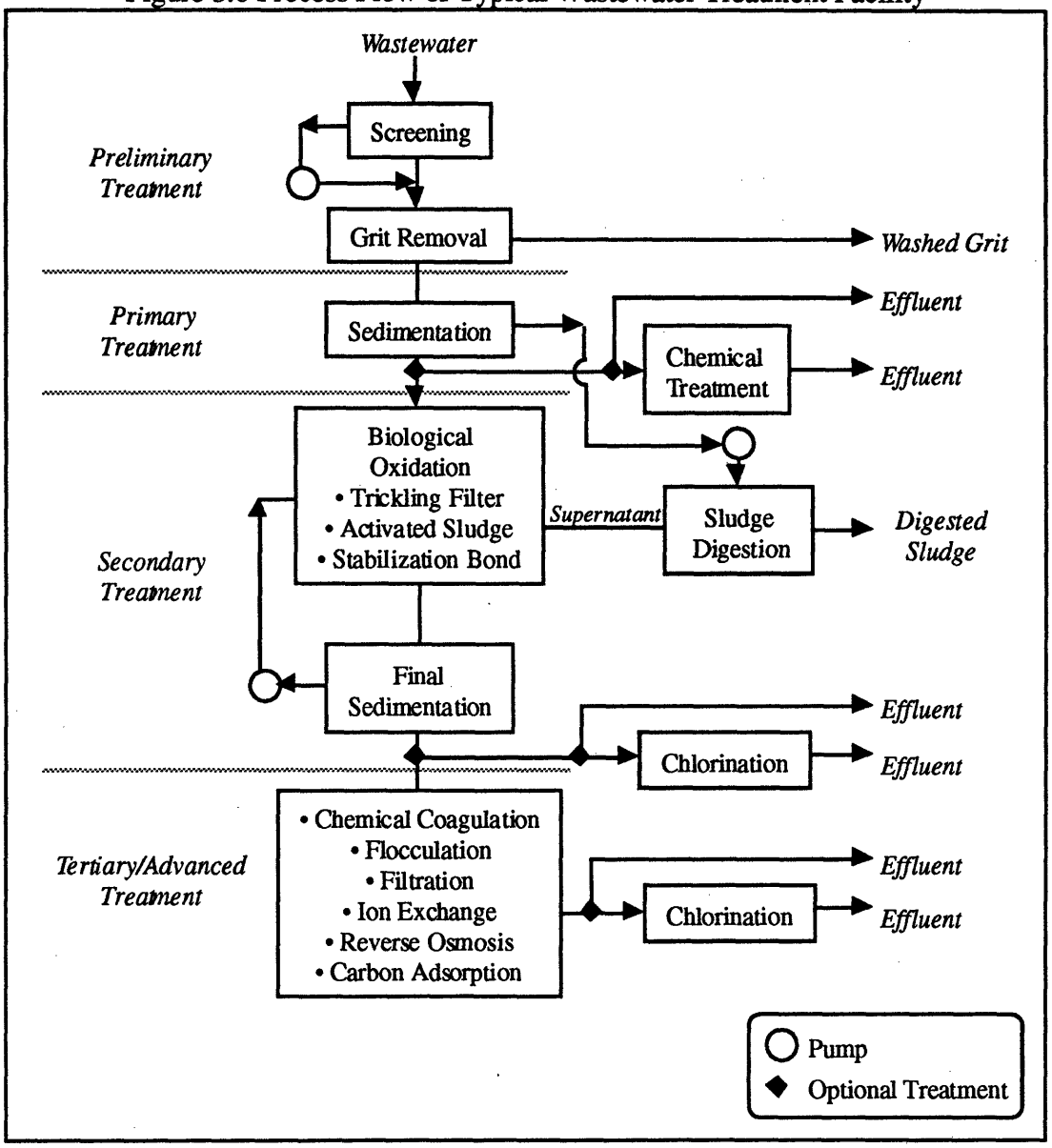
3.2.1 Organic Waste in Water and Impact on Aquatic Environment

The Pearl River system is the eventual destination to which most wastewater in Guangzhou city, both untreated and treated, is discharged. A large quantity of untreated residential wastewater, containing suspended and dissolved organic wastes as the main constituents, disrupts the natural ecological balance of the river's aquatic environment. Organic substances are present in human excreta, food remains and other plant and animal remains that are typical components of residential wastewater. This matter is digested by bacteria and other simple organisms in the presence or absence of oxygen - aerobic oxidation or anaerobic oxidation. Water usually contains atmospheric oxygen and aerobic processes are possible in an aquatic environment. When untreated residential sewage containing organic materials is discharged to the rivers, dissolved oxygen in the water is depleted by the micro-organism in oxidizing the organic materials. If the pollution is larger than the natural 'regenerative capacity', i.e. the maximum aerobic oxidation capacity, anaerobic oxidation will take place, producing obnoxious gases such as ammonia and hydrogen sulfide. The onset of anaerobic oxidation will also imply that no more dissolved oxygen is left for other living organisms: fish will die. Suspended organic materials that eventually settle will also disrupt the ecological activities at the river bed [Ref 3, pp. 159-162]. High concentration of dissolved nutrients - compounds such as nitrogen and phosphorus that are essential to the growth of plants and single cells organisms - might also cause or accelerate the process of *eutrophication*, a process in which the water becomes organically enriched, leading to overgrowth of aquatic weeds, transformation to marsh land, and eventually to dry land [Ref 4, pp. 1213]. The high content of ammonia nitrogen and BOD, and the low oxygen content of Guangzhou's drinking water, which is derived primarily from Pearl River, is a testimony to the environmental impacts of the untreated residential sewage.

3.2.2 Overview of Wastewater Treatment Technology

Wastewater collected from municipalities must eventually be return to the receiving waters, such as rivers and ocean, or to land, which natural decay of waste will take place. The primary purposes of wastewater treatment is to provide chemically favorable conditions in which the natural process of decay can be expedited and to remove toxic materials that natural systems cannot eliminate. Simply put, wastewater treatment is a series of physical, chemical, and biological processes that render the wastewater more suitable for discharge to the natural environment. However, the extent to which contaminants in the wastewater must be removed before disposal in order to protect the environment is specific to each situation [Ref 3, pp. 159, Ref 4, pp. 2]. There are several key

Figure 3.6 Process Flow of Typical Wastewater Treatment Facility



stages in wastewater treatment (Figure 3.6 shows the flow process of a typical treatment plant) an depending on the quality requirement of final discharge, combinations of the stages are employed [Ref 3 pp. 164-165, Ref 4, pp. 128-129, pp. 1173-1174, Ref 5, pp. 320-323]:

- Preliminary Treatment

  This is the physical separation of contents in wastewater, typically larger solid constituents, that may pose mechanical problems in the treatment processes and operations. Examples of operations include screening and comminution for the removal of debris and rags, grit removal

for the elimination of coarse suspended particles, and floatation for the removal of large quantity of oil and grease.

- Primary Treatment and Chemical Processes

  In this stage, a portion of suspended solid and organic matters that escape preliminary treatment process is removed by physical separation operations such as screening and sedimentation. Some portion of nutrients, heavy matters, toxins, and pathogens is also removed together with the suspended particulate. However, finer particulate matters will not be removed. Primary treatment alone is not an adequate means to significantly decrease the organic contents of residential wastewater, and thus the effluent from this stage needs to be further treated. Primary treatment could be enhanced by the addition of chemical coagulants such as metal salts and/or organic polyelectrolytes. These chemicals, added in low or high dosages, increase the total amount of suspended solid, BOD and phosphorus removal during the process.

- Secondary Treatment: Biological Oxidation

  The primary objective of the secondary treatment process is the aerobic oxidation of biodegradable organic matters, both dissolved and in suspended particulate form, in the wastewater. Several variations of biological oxidation, each with different cost-performance characteristics, are commonly used. These operations include activated sludge, fixed-film bioreactor (also known as trickling filter), lagoon systems (also know as stabilization ponds) and sedimentation. Gas-liquid mass transfer is required to supply oxygen to the biological oxidation processes, which also helps to remove some of the volatile organic compounds dissolved in the wastewater. Frequently, secondary treatment is the final treatment stage before the wastewater is discharge into the environment. Disinfection through chlorination of wastewater is usually included just before the wastewater is return to the receiving media. Sometimes, the control of nutrients is also incorporated into the secondary treatment stage. This can be achieved by chemical processes such as precipitation of phosphorus with the addition of metal salts or biological denitrification.

- Tertiary or Advanced Treatment

  Advanced treatment, usually as add-on, is used after the secondary treatment when removal of specific constituents in wastewater is required under special circumstances. The constituents concerned can be nutrients, toxic compounds, remaining organic materials and suspended solids. Operations for tertiary treatment include chemical coagulation, flocculation, sedimentation, filtration, and adsorption by activated carbon. Ion exchange and reverse osmosis are sometimes employed to removed particular types of ions in the wastewater.

- Sludge Disposal

  Sludge refers to the solid matter that is withdrawn from the primary treatment process. The simplest process of sludge removal is to use it on agricultural land as manure, usually in

partially dried form. Anaerobic digestion of sludge in closed tanks maintained at about 30°C is also a commonly used method which produces methane gas as a by-product. Finely divided dehydrated sludge can be also combusted although this method is not widely adopted.

- Wastewater Reuse and Reclamation

  Increasing scarcity of water resources due to rapid rise in consumption and diminishing fresh water supply has made the reuse and reclamation of wastewater an attractive option. Some possible applications of reclaimed wastewater include agriculture irrigation, industrial process water, groundwater replenishment, recreational uses (such as lakes, fisheries, snowmaking), non-potable urban uses (such as fire fighting, toiler flushing), and potable reuse. Most current treatment technologies for wastewater reuse and reclamation are essentially those stages described above. In some instances, additional operations are needed to remove specific types of physical and chemical contaminants, and to inactivate or remove microbiological pathogens.

3.2.3 Indicative Cost-Performance Analysis

In 1990 and 1991, over one hundred wastewater treatment works in the US were surveyed to compare the performance and cost of operating and managing these facilities [Ref 5, pp. 324-332]. Ten categories of large scale treatment plants of 20 million gallon per day (MGD), ranging from simple primary treatment process to systems complete with advanced treatment operations, were used to classify the treatment plants surveyed. These large scale treatment systems are cost-effective solutions for densely populated cities such as Guangzhou. A citation of the survey results (cost and performance) and analysis is found in Appendix 1. The performance parameter most relevant to the treatment of residential wastewater is the difference in content of organic materials, measured by BOD values, of the influent and effluent streams. Empirically, capital cost and annual operation and maintenance (O&M) cost can be expressed as logarithmic functions of the percentage of BOD remaining in the effluent. Annualized total annualized cost - including both capital and O&M cost - can also be expressed in similar manner. The cost-performance relationships are as follows, based on the least-square regression approach:

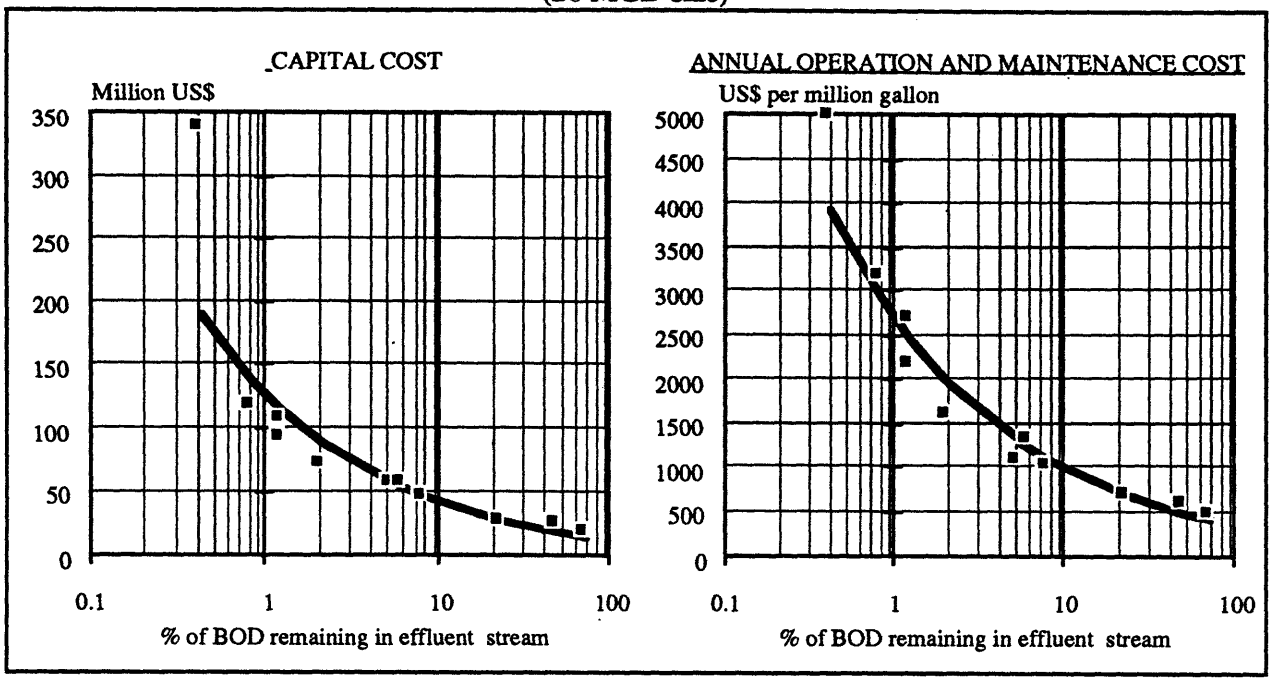
$$\textit{Capital Cost of a 20 MGD plant (million US\$)} = \frac{15.54}{\alpha^{0.456}}$$

$$\textit{Annualized Total Cost (\$/MG)} = \frac{390}{\alpha^{0.42}}$$

where α = amount of BOD in effluent stream, expressed as a percent of inffluent BOD.

Figure 3.7 shows the cost-performance logarithmic plots of the surveyed treatment plants including actual data and the functions expressed by the above equations. This cost-performance

Figure 3.7 Capital and Annualized O&M Cost of US Wastewater Treatment Facilities (20 MGD size)



expressions can be used to generate indicative range of cost for treating residential wastewater in Guangzhou city. It is noted that US cost estimates can only provide at best approximate indications to the actual costs that might be involved. The expressions are only relevant to plant size of 20 MGD. Economy of scale, in terms of decreasing unit capital and O&M cost of treatment, is experienced for larger plant sizes (inferred from Ref 6, Chapter 30).

3.2.4 Decision Considerations

The above cost-performance relationships provide a 'quick-and-dirty' means by which the cost of treating wastewater can be estimated. However, other considerations are also necessary when considering engineering options that would optimize wastewater treatment for the whole city. The capacity and type of each treatment plant is specific to the geographic location, regional loading characteristics, fate of wastewater, and natural regenerative capacity of the aquatic environment that the plant is situated. For example, smaller treatment plants will be needed in less populated regions. Stabilization ponds, a cheaper alternative for the biological oxidation process, can be used instead of activated sludge or trickling filter processes when large areas of land are available. Planning for new treatment facilities should thus be coordinated with land urban development program. An integrated planning approach is needed in managing the wastewater treatment systems at the regional level to optimize financial resource allocation and cost-effective operations.

Some considerations that Guangzhou government needs to make in making engineering decisions for regional wastewater treatment work include:

- In view of the shortage of scientific information about the sources, fate, and environmental and health impacts of untreated wastewater, more data collection, monitoring, and research need to be conducted to establish the necessary information base for planning and decision making. The scope of the studies should cover, ideally, the Pearl River Delta region, identifying the impacts of untreated wastewater on open discharge as well as groundwater system. The key objective of this research is to determine the optimum location of treatment plants, the capacities of the plants, the levels of treatment for each plant, possible reuse of wastewater, sludge disposal options, and most importantly, which plant should be constructed first.
- That Pearl River is the key source of water to the city, treating wastewater before discharging it into the river will reduce the cost of treating water supply, especially when wastewater is discharged at the upstream. Environmental impact aside, the cost of wastewater treatment should be compared with the cost of providing clean drinking and industrial water, to determine the best way to allocate financial resources, i.e. if investment should be made to improve wastewater treatment or for clean water treatment. Health hazards caused by the drinking of contaminated water should also be studied to determine the potential benefit of treating wastewater.
- The option of reclamation of treated residential wastewater for reuse in the industry should be considered. Reliance on 'fresh' water supply could be decreased, reducing the total cost of treating clean water if reuse of treated wastewater is adopted. Water quality demanded by industry users need to be established to determine the extent of treatment needed. Again, this will involve a trade off between treating clean water and wastewater.

Guangzhou is the largest and one of the most 'economically prosperous' in Southern China, making the prospect of mobilizing private financial resources to address infrastructure inadequacy higher. Like other major Chinese cities, Guangzhou is confronted by urban problems such as poor land use, housing shortage and low treatment of residential of sewage. In 1990, only about 14% of residential wastewater was treated before discharging into the estuaries of the Pearl River, which is also the primary source of drinking and industrial water of the city. Not only has the organic content of Guangzhou city's drinking water been persistently beyond the national limits, posing health risks for the consumers, high concentration of organic materials from untreated residential wastewater severely affect the ecological balance of the aquatic environment of Pearl River. A variety of technological solutions for the treatment of residential wastewater exist. The primary objective of treating Guangzhou's residential wastewater is to reduce the concentration of organic materials, as measured by the biochemical oxygen demand (BOD). Making technological

decisions inevitably involves trade-off between performance and affordability. The key is to determine the most cost-effective approach to meet needs of specific situation. Capital and O&M cost information of wastewater treatments in the US provides good 'first-cut' estimation of the cost of constructing and operating 20 MGD plants of various performance. Guangzhou government needs to address the problem on untreated residential sewage in an integrated manner, in order to optimize the city's sewage treatment works under the constraint of limited financial resources. There is a need to establish sound scientific understandings of the health and environmental impacts of untreated residential wastewater in Pearl River Delta in order to better prioritize and access the potential benefits of investment in treatment works.

CHAPTER 4
CHINA'S ENVIRONMENTAL POLICY AND INSTITUTIONAL ANALYSIS

4.1. China's Political Structure and Institutions

4.1.1 Constitution

China's constitution is essentially descriptive rather than normative. It has undergone frequent changes and amendments. Four constitutions have been promulgated since 1949 [Ref 3, pp. 46]. The first constitution was adopted in 1954, and the subsequent ones in 1975, 1978, and 1982. In the earliest version, China was described as "a socialist state under the democratic dictatorship of the proletariat led by the working class, and based on an alliance of workers, peasants and intellectuals." In 1988, the 1982 constitution was amended to permit a private economy to exist and grow within the limits prescribed by law and to enable land use rights to be transferred through legitimate means. Nevertheless, China's political structure remains that of an authoritarian one-party state ruled by the Chinese Communist Party [Ref 1].

4.1.2 Administrative Structure

China is divide into twenty two provinces, five autonomous regions and three municipalities comprising of Beijing, Tianjin and Shanghai. Below the provincial level, the administration is further divided into prefectures, counties and cities. Counties are further divided into townships and cities into districts. By 1991, there were 151 rural prefectures, 187 prefectures-levels cities, 289 county-level cities and 1894 counties [Ref 1, pp. 7]. Excluding the three municipalities, there are 517 cities and 662 districts. The provincial, autonomous and municipalities government report directly to the State Council.

4.1.3 State Council

The State Council is the highest administrative organ in China. It is in effect the cabinet, the highest executive agency. It has a term of five years, running concurrently with that of the National People's Congress (NPC). The members in the State Council are determined by the NPC, acting under the recommendation of the Chinese Communist Party. It is headed by a premier (or prime minister) who leads an executive board that presides over the State Council. This executive board typically comprises about fifteen members that include the premier, deputy premiers, state councilors and a secretary general. Below the executive board of the State Council are thirty eight ministries and commissions, the People's Bank of China, and the auditor-general of the auditing administration. There are also thirteen bureau and five functional offices under the

State Council. The State Council reports to the NPC or its Standing Committee when the NPC is not in session [Ref 2, pp. 70-71].

4.1.4 National People's Congress (NPC)

The supreme organ of state power is, in theory, the National People's Congress (NPC). In the 1954 Constitution, NPC and the local people's congresses are the organs through which the people exercise state power. The NPC and the local people's congresses and other state organs applied the principles of democratic centralism. The NPC enacts laws and treaties, nominates the executive of the State Council and approves the Constitution. It has about three thousand members elected from the local people's congresses every five years, usually in March-April. Between the annual NPC sessions, the power rests with the Standing Committee, comprising about two hundred members. The Standing Committee, which typically meets bimonthly, drafts law, approves state budgets, and operates NPC's affairs when NPC is in recess. Members of the Standing Committee are disallowed from holding positions in the government and judicial organs. In practice, the NPC has never acted as the true source of power. It has served as a rubber stamp, approving decisions made by the Communist Party. All candidates in the NPC are also expected to support the leading role of the Communist Party. There are eight special committees under the NPC that include the Committee for Environmental and Resource Protection. The NPC is also responsible for the election of the President and Vice President of China.

4.1.5 Chinese Communist Party (CCP)

The Chinese Communist Party (CCP) was founded in Shanghai in 1921 and was the founding party of the People's Republic of China in 1949 after defeating the Nationalist Party (Guomintang) in the civil war. Theoretically, CCP adopts Marxist-Leninist and the thoughts of Mao Zedong as the party's ideology. Its ultimate objective is the creation of a communist social state in China. By 1994, the CCP had about 52 million members, accounting for about 4.3% of total population. In many cases, party membership guarantees prosperous material and professional life. Party membership is imperative to career advancement in certain positions in the government service.

The main decision making body of the CCP is the Central Committee, comprising 189 full members and 130 alternates since 1992. This Central Committee is elected at the National Party Congress held every five year, typically in the Fall, just before the first session of a new National People's Congress. The current Central Committee is the fourteenth committee in the history of the CCP. The Central Committee meets in plenary session about twice a year, the latest one held in September 1995. The main agenda of plenary sessions is the formulation of China's economic

policies and development plans. During the interim between plenary sessions, most of the Central Committee's power is vested in a politburo of 15-20 members.

The Constitution of the CCP adds a further tier of centralized leadership in the Central Committee. The Standing Committee of the politburo, consisting of 5-7 members, is the highest and most powerful authority in China. Typical members of the Standing Committee of the politburo consists of CCP's secretary general, the prime minister and his deputies of the State Council, key military representative, chairperson of the National People's Congress, and the chairperson of the Chinese People's Political Consultative Conference.

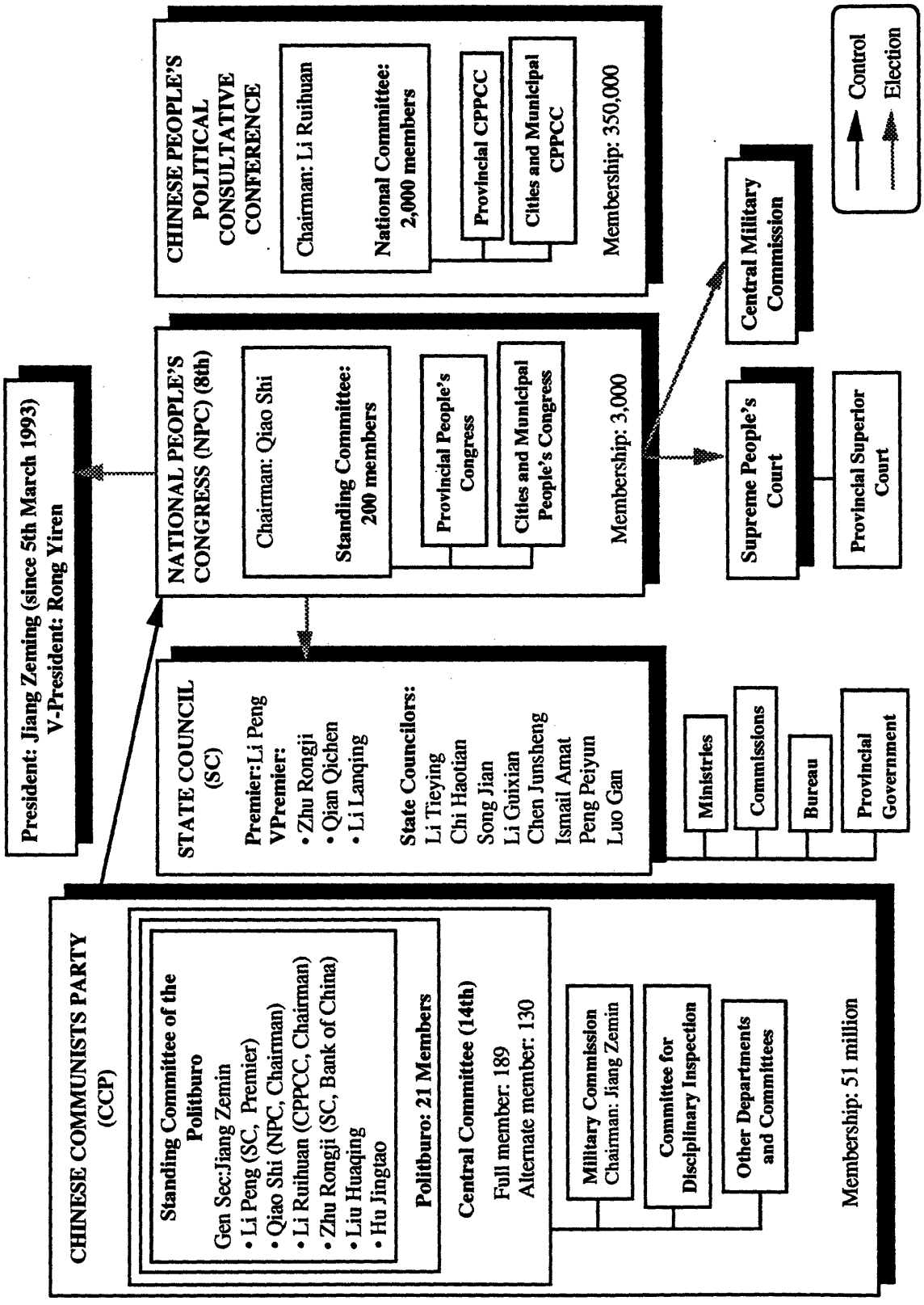
Three other organizations concurrently exist in the Central Committee. The Central Commission for Disciplinary Inspection is responsible for the internal discipline while the Central Secretariat is responsible for day-to-day operation of the CCP. The Central Military Commission shares its responsibility of controlling the army with the State Military Commission. Although there has been much discussion of the "separation of functions" of the CCP and the government, in practice, there is no distinction since top party leaders are also top officials in the government functions. The CCP is thus in effect, also the government of China.

4.1.6 Chinese People's Political Consultative Conference (CPPCC)

Led by the CCP, the CPPCC is an organization formed by delegates from CCP, the eight democratic parties, non-party democrats, grassroots organizations, delegates from various minorities and representatives from Taiwan, Hong Kong and Macao, academics, and scholars. There are currently about 2100 members in the CPPCC's National Committee, which is elected every five years, and meets annually. CPPCC participate in political consultation through its National Committee members' attendance in the annual NPC sessions as non-voting deputies. Also known as the 'think tank' to the government, CPPCC is involved in the development of major state policies. In theory, the CPPCC is also a watch dog organization of the CCP and the government by providing criticisms and suggestions to major policy decisions.

Figure 4.1 summarizes the interactions of the political structure of China, highlighting the concurrent appointments of top CCP members in the key governmental organs and functions.

Figure 4.1 China's Political and Government Structure



4.2 Politics of Policy Process in China

Although the CCP seeks to exercise absolute control over the various state organs to perpetuate the party ideology, factional politics within the CCP shape the policy process in China in practice. Ross [Ref 4, Chapter VI] provided a very succinct yet comprehensive review of the politics of policy process in China with regards to China's environmental policy. This section summarizes Ross's analysis of the reform period beginning in the late 1970s.

4.2.1 Factional Politics in the CCP

The CCP undoubtedly does not live up to the Leninist ideal of a united party comprising of selfless members. Two main opposing camps of thoughts were apparent in the CCP leadership after the purge of Maoist supporters in 1978. The struggle over ideology and power within the CCP centered on the pragmatists (or reformers) and the conservatives (the readjusters or the hard-liners). The pragmatists, led by the legendary party patriarch Deng Xiaoping, favored major reforms towards a market economy with a socialist essence. The conservatives, led by the late heavyweight party senior Chen Yun, supported modifications of central planning on the basis of heightened discipline. The two factions have engaged in a never ending game of factional politics, in which key leaders would attempt to purge supporters of the opposing camp and replace them with their own followers when circumstances permitted. Because the Standing Committee of the Politburo is taken up by key CCP figures, its composition often reflects the power distribution between the two factions. That the CCP monopolizes Chinese government, the identity of the dominant faction and its ability to influence at a certain point in time have critical bearings on the agenda-setting process. For example, the passage of the first ever Environmental Protection Law (for trial implementation) and the Forestry Law in 1979 signified the victory of the reformers over the conservatives. These statutes began to lay the legal foundation for defining and enforcing property rights and distinguishing between lawful and illegal behavior.

Internal competitions between the two opposing factions continues today, though the reformers appeared to have gained an upper hand with the recent death of Chen Yun. This continuous struggle had seen several abrupt policy realignments - predominantly in economic reform - in the 1980s as the leaders of the opposing camps seized opportunities to build support. The intense competition had forced the factions to expedite policy implementation in order to consolidate their position as soon as circumstances arose. In short, China's policy agenda is the manifestation of factional politics within the CCP.

One of the 'unintended' outcomes of this factional struggle for power has been the increasing role of intellectual, academics and scientists in influencing policy directions. In the process of political

rivalry, each faction assembled a pool of advisers and publicists to refine its preferences, substantiate its ideology, and advance its motive via the media. The reformers have been adopting advisers that had good appreciation of the sciences and academia. Deng had formulated a reform in science policy in the mid 1970s with support from officials in the Academy of Sciences. Several high ranking officials in the State Science and Technology Commission and the Academy of Social Sciences began to lead the development of environmental policy in the early 1980s. The proliferation and institutionalization of professional and academic societies such as the Chinese Society of Environmental Economics gradually participated in influencing their patrons in the CCP. Although these organization were subordinated to the various governmental agencies, they became increasingly important in brokering ideas between the intellectual communities and the CCP.

4.2.2 Provincial Governments and the Military

Beyond the power center of the CCP and the State Council, provincial governments also possess substantial influence over the policy implementation process. The provincial governments are legitimate entities with sizable human and financial resources at their disposal and are remarkably resistant to policy objectives that are unfavorable to them. The power of the provincial governments lies with their permanence and their control of information and expertise over their own sphere of influence. The economic reform which stresses development in the various coastal provinces has in effect decentralized and further diffused the control that the central government has over the provinces. There are increasing tensions between the central government and the provinces, as well as among the provinces, as each province pursues its own modified version of the 'central plan' to advance its economic development objectives.

The military - the People's Liberation Army (PLA) - has a traditionally strong, albeit declining influence over the politics of the CCP, and thus on the policy agenda of China. Deng 'demilitarized' the politics when he was the chief-of-staff of the PLA by successively ousting PLA representatives in the top hierarchy of the CCP and the administration. The latest 'retirement' of Yang Shangkun, who had a strong tie with the PLA, from the country's Presidency and the simultaneous election of Jiang Zeming to Presidency, the chairmanship of the Party Military Commission, and the chairmanship State Military Commission signified a new low of military influence within the CCP.

4.2.3 Grassroots Participation in the Policy Agenda

Participation of the populace in the policy process was typically reactive, although these reactions had subtle impacts on policy directions. Mobilization of the masses through political campaigns and pilot programs, in the name of public policy, had been used very frequently by the rival

factions within the CCP to harness popular support for their ideology. The success or failure, judged by the extent of public support to these political campaigns and pilot programs, impacted the power balance of the rival factions. The implementing faction thus had incentives to ensure that its efforts were well received. Initial public responses were monitored and feedback to the leaderships and policy adjustment made accordingly to the predisposition of the populace. On the other hand, the role of the National People's Congress (NPC) as a channel for public participation in the policy making process is becoming more important. It has been observed that the NPC has acquired more opportunities in questioning and voicing discontents towards official policies.
In the Environmental Protection Law (EPL) of 1979 (for trial implementation), the legal right of citizens to act as pollution monitors was affirmed. Citizens were empowered to supervise or influence the policy process on issues affecting their livelihood. The 1980s had seen numerous local protests against pollution by enterprises. Some of these protests eventually led to relocation of the related enterprises. Open criticisms of slack enforcement against polluting industries also became relatively common. Nevertheless, the authoritarian CCP leadership continues to forbid the formation of civil environmental group in China. Public participation in environmental problems would still be very much limited and remained focused on the most visible and adverse ones.

4.2.4 International Influence

International influence on environmental policy process has been gradual yet more significant relative to other sectors because of the less politicized nature of environmental issues. Most of the influence has been in the form of technical assistance and policy consultation. This gradual openness to foreign assistance and advise had been a tangential outcome Deng's initiatives to establish economic and political ties with the developed nations. China also felt to some extent, obliged to honor its international responsibilities following its admission into the United Nations and formalized a statement on environmental policy for the United Nations Conference on the Human Environment in Stockholm in 1972. Although it was a little more than a set of self-serving statements proclaiming the superiority of Maoist ideology, it led to the establishment of a staff office on environmental protection under the State Council. This marked the beginning of environmental planning in the modern China.

Subsequent international influences on China's environmental policy typically came in the form of 'carrots and sticks'. Financial assistance from international agencies' such as the World Bank and the Asian Development Bank required China to incorporate environmental assessments in project evaluation. More importantly, these agencies, which lately included the Global Environmental Facility of the World Bank [Ref 5 pp. 30-38], also began to fund environmental improvement programs such as grassland improvements, pollution control and water sanitation projects. The

early 1990s saw a surge in bilateral assistance from the governments of the US and Japan [Ref 6, pp. 39-43]. Both countries had funded the establishment of environmental research centers in China. The Japanese government, through its Ministry of International Trade and Industry, has further budgeted some $183 million for pollution control projects for the period of 1995-2000.

Although increasing international assistance is being made available to China's environmental sector, accumulated amount of foreign aids are minute when compared to the total environmental needs of China. Furthermore, given China's traditional resistance to direct foreign intervention with its domestic policy issues, international influence on environmental policy in China, most of which bears a scientific and technical content, would be at best gradual and indirect.

4.3 Evolution of Environmental Planning and Policy

As noted, the Leninist-Maoist central planning approach that allocates resources via production objectives had fundamentally neglected the impacts of economic activities on the environment. Although several "environmental" pilot programs and campaign were mobilized under Mao's rule, these events were often results of political ploys in the unending game of factional politics within the CCP. A rational and comprehensive approach to environmental planning and management in modern China did not get onto the national agenda until 1973, one year after the 1972 UN Conference in Stockholm. This section provides a synopsis of the evolution of environmental policy after 1972 [Ref 7, Chapter 10; Ref 8, pp. 15-17, pp. 59-62].

4.3.1 The "Start-Up" Years 1972-1978

China's Cultural Revolution that started in 1966 began to slow down when the UN Conference in Stockholm was held in 1972. The Chinese government became very aware of the considerable environmental damage caused by a decade of inefficient economic policies. A reassessment of the national environmental policy was undertaken, in part prompted by China's participation in the Stockholm Conference. 1972 marked the beginning of a new era of environmental management in modern China, in which scientific and technical activities took the lead. A steering committee under the State Council was established to help protect the Guanting Reservoir which supplies water to Beijing. A conference in stack dust removal was also held in Shanghai in April 1972 to address the worsening air pollution caused by major industries. The most significant event was the establishment of the first environmental research institute in the Heliongjian province. Research institutes and programs were subsequently founded in several Chinese universities.

In 1973, the National Environmental Protection Agency (NEPA) was founded and environmental planning was incorporated into the national plan. China also held its first ever National Conference on Environmental Protection and many conferences were held simultaneously in several provinces. These conferences culminated in the establishment of environmental protection bureau at various levels of the government. Shortly afterwards in the same year, the "Three Wastes" - solid, water, and gaseous wastes - campaign was initiated in the familiar style of past political campaigns. The main objective of this campaign was to encourage the reduction of industrial wastes through conscious recycling by the production units. Pollution caused by industrial and residential waste water was monitored and techniques to purify industrial gaseous discharge were investigated. The campaign however, fell short of being successful because of the Chinese government's belief that environmental damages were inevitable consequences of economic development and, just like experiences in developed countries had indicated, degradation would worsen before it become better (the Kuznet Curve effect). The "Three Waste" campaign thus did not receive a whole-hearted commitment from the central government.

Due to the general lack of experience, technical expertise, and implementation capabilities and the continuous political turmoil caused by the Culture Revolution, China's environmental planning efforts were fragmented and incomplete during the start-up years. Nationwide, comprehensive and in depth environmental planning was nonexistent although some sporadic investigations and assessments were performed.

4.3.2 The Experimental Phase 1978-1985

1978 was the official year in which pragmatic economic reform towards a socialistic market economy began. The initial efforts in environmental planning were revitalized. In the National Environmental Protection Research Conference held in Taiyuan in the same year, it was decided that pollution prevention at the regional level would be given the highest priority. Many regional projects in environmental assessments and pollution prevention strategy began after this conference. These regions included the Sugari River, the Xiang River, the Bohai and Yellow Sea region, the Huangpu River, and the Shenyan region. In the meantime, environmental research institutes and central monitoring systems were established in all provinces except Tibet. Major environmental research projects were also included in the national science and technology long range plan.

In 1979, the EPL was promulgated. This objective of this "trial implementation" was to get a badly needed law into effect quickly, as a 'perfect' law would take too long to design and enact. Deng admitted the incompleteness but stressed that China needed to experiment with a 'working

law' so that initial shortcomings could be identified and rectified after trial implementation. Many new laws addressing specific subsectors such as the Marine Environmental Protection Law (1982), the Forestry Law (1984) and the Water Pollution Prevention and Control Law (1984) were subsequently enacted.

A development strategy that called for "low waste-high efficiency" planning became apparent in 1982. The concept of "harmonious development" - a process in which "natural rebirth and economic rebirth process work together", or in more common term, sustainable development - was adopted into environmental planning. In essence, this concept called for more efficient consumption of materials and energy and stated that each region should generate industrial waste at rates within the regeneration capacity of the environment. Regional industry structures should be modified to retard or stabilize environmental degradation. This concept was implemented through sustainable agricultural programs, also known as 'ecological agriculture' and by 1990, some nine hundred locations for ecological agriculture experiments were established all over China.

The experimental period was characterized by the incorporation of environmental planning into national economic development. Research into the theories and methods of environmental planning were launched. The regional studies initiated in the late 1970s had also generated very important information for the environmental planning process.

4.3.3 The 'Expansion' Period 1985-1990

After a decade of exploration and experimentation, the Seventh Five-Year National Plan (1985-1990) saw an expansion of environmental activities in China. Environmental Protection was given a full chapter in the Seventh Five-Year Plan and progress was made on several fronts. A total of twenty one laws and regulations in areas such as nature reserve conservation, pollution control, and construction project management took effect. The most important of these was the promulgation of the EPL after ten years of trial implementation. The completion of the first nationwide survey of industrial pollution in 1988 signified a shift of environmental protection efforts to pollution control in the economic zones and industrialized urban centers. This new focus was also evident from the new laws and regulations related to industrial pollution control. Another new development aspect was the establishment of several national wildlife and nature reserves in the mid 1980s. The late 1980s also saw more active participation in international environmental movements. In 1989, China's delegations participated in the ozone layer protection conference as well as the Basel conference on toxic waste. In the following year, China hosted the international conference on the integration of economic development and the environment in Beijing.

As with other forms of planning in China, environmental planning has undergone a fair degree of decentralization since the early 1980s. Beginning in the mid 1980s, planning goals has become more localized in that regional environmental planning would need to take into account local needs, state of the local environment, economic activities and available resources to address environmental problems. The total maximum allowable pollution level in the region was to be determined, and all pollution had to be capped below this maximum quantity. Intra-regional relocation of industry activities was encouraged to minimize pollutant concentration. A policy instrument accompanying the decentralization was the responsibility system: All provincial environmental protection agencies were accountable for meeting their own pollution control targets set by themselves.

4.3.4 Agenda for Change: The 1990s

After more than fifteen years of realization, fact finding, problem definition, rule setting, and experimentation, the early 1990s saw increased momentum in environmental project implementation and international participation. Although China has come a long way in this learning-by-doing approach to environmental planning, substantial work still needs to be carried out in terms of specific policy implementation and enforcement. To expedite policy formulation, a team comprising sixteen experts was established in August 1991 to assist NEPA. A scientific consultation group was later set up in September to provide policy guidance. An Environmental Protection Commission was also established in the NPC in March 1993, creating an additional channel for participation in policy consultation. Changes in policy and institutional structure were also made to improve policy coordination among the various state agencies, levels of government and the judiciary system. Nevertheless, existing implementation and enforcement of environmental policy still suffer considerable difficulties, as would be discussed in subsequent sections.

In 1990, the National Environmental Protection Council and the State Commission identified 140 pollution control projects slated for implementation during the Eighth Five-Year Plan (1990-1995) period. Funding for these proposed projects would have to be raised from polluting enterprises, the pollution control organs and local government. On March 25, 1994, the State Council approved its "Agenda 21" for sustainable development. This plan, a follow-up to the 1992 UN Conference on Environment and Development (UNCED) in Rio, is an extensive fifteen year program detailing China's sustainable development Strategy [Ref 6, pp. 26]. Containing a series of multi-sector projects and programs, this plan was drafted by a State Science and Technology Commission (SSTC) leading group chaired by Deng Nan, the SSTC vice chair and Deng Xiaoping's daughter. This involvement of China's paramount leader's daughter accentuated central leadership's political commitment in environmental development. On a more skeptical note however, Deng Nan's involvement undoubtedly increases the credibility of China's commitment,

making its "Agenda 21" more attractive to potential foreign private sector seeking investment in China's environmental sector. Of the series of program and projects, 62 "priority projects" were designated for implementation in the Ninth Five-Year Plan (1996-2000). China's government has pledged to provide 60 percent of the total $4 billion investment required for these projects, while the remaining 40 percent is to be sought from the international community.

Strategically linked to China's earnest request for foreign assistance in the environmental sector was its active participation in international environmental movements. Several major international environmental conferences were hosted in Beijing in the early 1990s. In the First Ministerial Conference of Developing Countries on Environment and Development held in Beijing in June 1991, the Chinese government launched its bid for leadership of the developing countries for environmental issues. China also claimed that it was the first country to prepare a comprehensive development plan, its "Agenda 21", in accordance with the post UNCED goals of establishing a sustainable development. By positioning itself as a fervent proponent and participant in environmental movement, China hopes to attract substantial international attention and consequently technical and financial assistance from the developed countries.

4.4. ENVIRONMENTAL LAW

The evolution of Environmental Law of China has been intimately intertwined with evolution in environmental policy and planning. As discussed, the policy process in China has been a direct result of factional politics within the CCP. Constant policy realignments due to vicissitudes of political competition created undesirable instability in the governance system. Deng and other leaders in the post-Mao era actively attempted to regularize the policy making process and shield the policy process from the uncertainties in factional politics. They have engaged in reforming the judicial systems and enacting new laws. Well established laws and regulations would ensure consistency, predictability, objectivity, and more importantly, stability in the governance systems. In the past, policy decisions were typically put into effect through government decrees and circulars, but these were often subjected to inconsistent interpretations and had also created opportunities for manipulation by the agencies carrying out the implementation. The existence of defined laws and statutes reduced these distortions and abuses. The series of environmental laws enacted in the 1980s had also empowered the regulatory agencies in enforcing the national environmental objectives. The legal framework provided by China's Environmental Law also sought to define property rights, offer a means in which environmental externalized such as industrial pollution could be addressed, and provide a channel for dispute resolution. Nevertheless, China's Environmental Law still suffers limitations in practice.

4.4.1 Legal Framework of Environmental Law

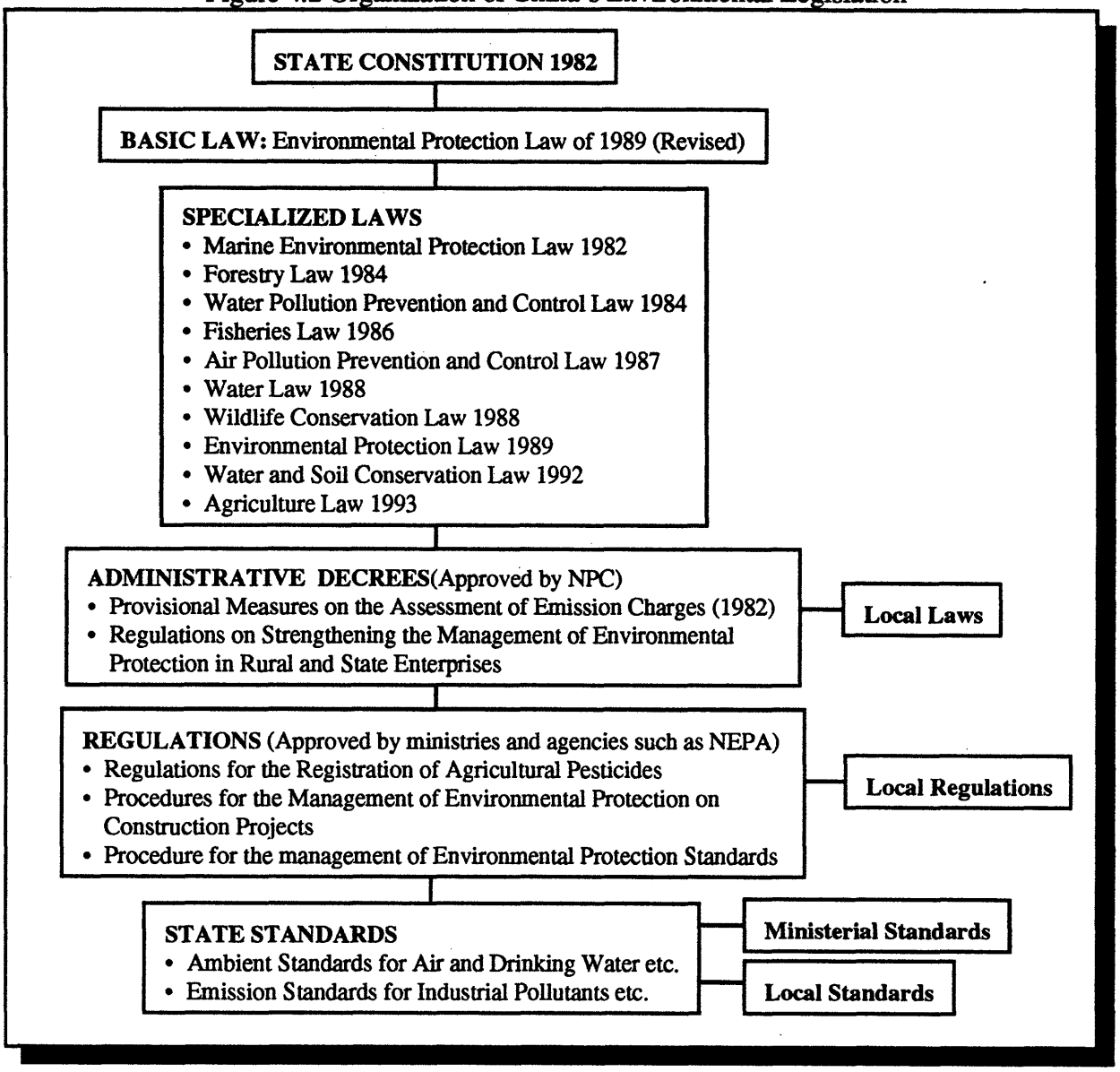
Five basic sources of law provided the legal foundation of Environmental Law in China, four of which are described in the following section [Ref 8, pp. 44-49]. The fifth source of environmental law is the international environmental treaties and conventions that China has signed. China's Environmental Law was founded on four guidelines that call for the integration of economic development and environmental management, the prevention and reduction of pollution, the application of the "polluters pay" principle, and the involvement of the public in the environmental planning process. Figure 4.2 indicates the structure of environmental legislation in China.

- Constitution of China and Other Basic Laws

  The environmental clause of the Constitution of the PRC and other related basic laws occupy the highest position in the legal framework of environmental protection in China. Article 26 of the Chinese Constitution establishes the constitutional functions and responsibilities of Chinese government in environmental management. Provisions in Article 9 confers the Chinese government and the rural collectives rights and authorities to regulate exploitation and development of natural resources. Two basic laws related to environmental protection are the General Principles of Civil Law of the PRC and the Criminal Law of the PRC. The former establishes the civil liability for environmental damages when these damages affect other citizen. The Criminal Law imposes criminal liability for some severe environmental damages.
- The Environmental Protection Law of 1989 and Other Provisions

  The EPL of 1989, first promulgated in 1979 for trial implementation, provides the broad legal principles for environmental protection in China. It comprises six chapters and a total of forty seven articles:
  - Chapter 1 (Article 1 to 8) defines the scope, nature of environmental protection, and the responsibilities of regulatory agencies, production unit, and individuals in environmental protection;
  - Chapter 2 (Article 9 to 15) defines the relationships of agencies involved in environmental monitoring and management;
  - Chapter 3 (Article 16 to 23) defines the scope and responsibilities of government agencies involved in the protection and improvement of environmental qualities;
  - Chapter 4 (Article 24 to 34) defines the duties of industries and enterprises in the management, prevention, and treatment of industrial pollution;
  - Chapter 5 (Article 35 to 45) delineates the legal obligations of enterprises in complying with environmental laws and outlines the possible disciplinary actions that can be taken against noncompliance;
  - Chapter 6 (Article 46 to 47) contains the appendix that defines the relationship of China's EPL with International Treaties and the abolishment of the 1979 Environmental Law.

Figure 4.2 Organization of China's Environmental Legislation



Numerous laws addressing specific sectors and aspects of environmental management and protection have proliferated since 1979 based on the general framework provided by the Environmental Protection Law. These laws intended to extend the scope of the government authority to areas not included in the basic laws. Areas addressed by these laws include the protection and management of natural resources, enforcement of pollution prevention, levying emission charges. Civil and criminal provisions were also incorporated into environmental protection. Some of these laws include the Forestry Law, the Marine Environment Protection Law, the Mineral Resource Law, and the Water Pollution Prevention and Control Law. By

early 1990s, there were over one hundred separate laws and regulations related to environmental protection. Appendix 2 lists the environmental laws in China.

- Environmental Regulations Promulgated by the State Council and Subordinated Agencies
  The State Council, its subordinating ministries and commissions, have promulgated numerous directives, decisions and legal documents with the binding force of law in order to implement the environmental plans and policies passed by the NPC and its Standing Committee. These regulations have been directed to various aspects of environmental management that include pollution control, requirements in special economic zones, and forest regulations.
- Provincial, Autonomous Region and City Environmental Regulations
  The various people's congresses in the provinces, autonomous regions, and the three municipalities are empowered to legislate environmental regulations and directives that meet local needs. These regulations however, are to be constrained by the national environmental law promulgated by the NPC, the State Council, the various ministries, and state commissions.

4.4.3 The next wave of environmental legislation [Ref 6, pp. 30-33]

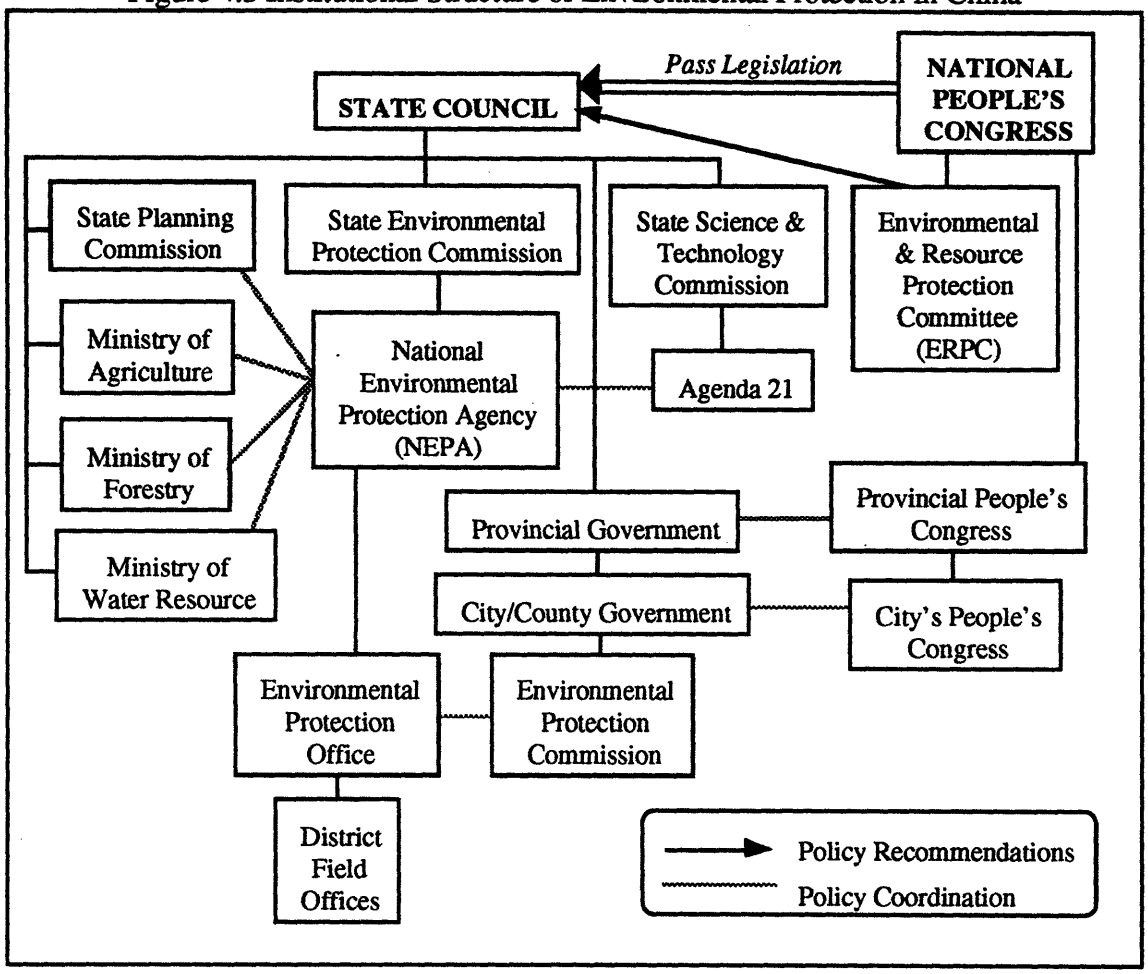
By early 1990s, there was already a fairly extensive set of environmental legislation and standards in China. However, these regulations were still weak and not comprehensive. Existing enforcement is also inadequate, particularly at the grassroots level. A new wave of environmental legislation hoped to overcome these shortcomings. In 1994, the Environmental Protection Commission of the NPC was renamed Environmental and Resource Protection Committee (ERPC). ERPC planned to introduced a series of ambitious changes to the existing legislation. Qu Geping, who has been the director of NEPA for many years, now leads the ERPC, announced in mid 1994 that the ERPC will recommend fourteen new or revised environmental laws to the NPC for enactment. At the same time, the State Council and various administrative agencies will also draft stricter and more specific regulations and standards to strengthen new statutes. These changes are expected to create a substantially tougher environmental regulatory regime in China.

4.5 Policy and Law Implementation

4.5.1 Administrative and Legal Channels for Enforcement

The authority in enforcing China's environmental policies and laws was, through the EPL of 1989, bestowed upon several governmental agencies, private non governmental entities and individual citizens, particularly those affected by environmental damages. The highest governmental agency is the State Environmental Protection Commission (SEPC), formed under the jurisdiction of the State Council in 1984. This commission, comprising representatives from other ministries and commissions, meets four times a year. In 1988, NEPA was promoted to the departmental level

Figure 4.3 Institutional Structure of Environmental Protection in China



and subordinated directly to the control of the State Council. This gave NEPA more authority and autonomy to coordinate environmental policies among the various ministries. NEPA also became the main supporting organ of the SEPC. At the provincial and municipal levels, local environmental protection departments would carry out the enforcement. Other agencies and administrations are also obliged to be involved in environmental protection and management. Departments for pollution prevention were set up in various government functions such as the armed forces, the public security, and the civil aviation administration to engage in prevention activities stipulated by the EPL of 1989. Ministries related to natural resources such as mining, forestry, and agriculture, are also responsible for the protection of their respective resources.

Judicial enforcement of the environmental laws is brought about through the Local People's Court, Special People's Courts, and the Supreme People's Court. Non-governmental entities and citizens can bring cases of environmental infraction before these courts according to the rules set by the Civil Procedure Law. Five enforcement actions - warning, fine, cessation of operation, shutdown,

and disciplinary action - could result if the party responsible for pollution is found guilty. Non-governmental entities and citizens can also report pollution by state-owned-enterprises directly to the local environmental protection bureau. Several cases of complaints and had been cited and the outcome (in terms of prevention and compensation) had been reportedly encouraging. Figure 4.3 shown the institutional structure of environmental protection in China.

4.5.2 Implementation Strategies

Ross [Ref 4, pp. Chapter I] has identified three distinct approaches in which environmental policies could be implemented in China:

- Bureaucratic-Authoritative Implementation

  This approach is a highly centralized process in which key decisions for the whole country are made by the CCP elites in the State Council and the State Planning Commission. Priorities for implementation are complied in the form of plans and directives that are then communicated downwards through the bureaucratic systems for uniform implementation nationwide. In the absolute sense, these orders must be strictly observed by the lower ranking officials. This command-and-control approach is the most common way in which policy decisions are made and implemented. The involvement of the CCP is paramount because values and ideology of key party leaders are reflected in the decisions and the mechanisms of implementation. The fact that decisions are made by the party core while implementation is highly dependent on the bureaucracies means that there is a high tendency for bureaucrats to influence the decision by manipulating the upward flow of information and to modify the implementation mechanisms in favor of their personal objectives.
- Campaign Implementation

  Campaigns typically involved a broad participation of the populace for a short time span. These mobilizations are outside the bureaucratic processes of the governmental structure and are the product of the CCP. Campaigns are often seen as the least-cost and quickest approach for key factional leader to mobilize the masses against political rivals or the sluggish bureaucracy. The initiation of a campaign is thus very much a political decision, typically used by the pro-Maoist faction to revitalize their ideology in the populace. In campaigns, values of the party elites are typically forced into acceptance by the populace by coercion and 'moral suasion'. As the extent of value congruence impacts the fate of a campaign, strong linkages between the party leadership and the populace are critical. These linkages nevertheless, tend to be short-lived and weak, risking the collapse of the central political authority.
- Market Mechanisms

  Although economic reform towards a market economy has expanded the role of market mechanisms in environmental management, current applications are still very limited in China.

This is partly due to fact that only pseudo markets (due to price controls) exist in some 'strategic sectors' that are closely related to natural resources (such as the energy sector), and also because the current fiscal and monetary infrastructure is not ready for a market economy.

4.5.3 Policy Measures

Several measures compliment the policy and legal framework of environmental management in China [Ref 9, pp. 65-71]:

- Environmental Impact Assessments (EIAs)

  Several environmental laws require that EIAs be carried out for new construction projects. The EIA requires the investigation of potential environmental impacts of the project, the analysis of the pollution prevention technique and equipment. Project cannot be started without official approval of the EIA statement. However, the EIA system suffers several flaws. Some local government officials have reportedly intervened and influenced the EIA processes. In other instances, EIAs were only carried out after the projects had begun in order to fulfill the legal requirement. Under existing legal guidelines, an EIA needs not include discussions of alternatives to the proposed projects. Avenues for public participation in the EIA process are also limited. In many cases, EIAs were only limited to the immediate vicinity of the project, without due consideration of potential impacts on regional environment.

- "Three Simultaneous Actions" Measure

  This policy measure requires that the "design, installation, and operation" of pollution control facilities parallel the same stages in the development of manufacturing plants. Enterprises can only begin operating the plants after the pollution control facilities are duly inspected by environmental protection agencies. This measure has also experienced several shortcomings: Some of the pollution prevention technologies were not cost-effective, and were either not put into operation or dismantled after the inspections and approvals by local environmental authorities. Effective and continuous project review, monitoring, and management by local environmental protection agents are thus key to the success of this policy measure.

- Pollutant Discharge Licensing

  Although the 'license-to-pollute' scheme is designed to regulate discharge of water, gaseous and solid waste, there is currently no adequate legal foundation for such a scheme. Inconsistencies and overlaps exist between this pollution permit scheme and other pollution prevention measures. Inadequate monitoring and measurement equipment are also hampering the effective enforcement of this scheme.

- Pollution Control Within Dateline

  Article 29 of the EPL of 1989 mandated that heavily polluting state enterprises must implement pollution controls within the dateline stipulated by the NEPA. State enterprises in three types

of pollution zones - by geographic region, industry sector, and point source - are addressed by this legal requirement. One of the key impediments to this policy measure is the unavailability of cost-effective pollution prevention technology that meets the compliance deadline.

- Emission Charges

  According to provisions in the EPL of 1989, enterprises that exceed national or local emission standards are liable for two-tier pollution charges. The pollution charges are set higher than the costs of pollution prevention at the allowable emission level, thus creating economic incentives for the enterprises to engage in pollution prevention. An important advantage of this measure is that the collected emission charges will be used for environmental protection activities. According to the Regulations on the Emission Fee Management, 80 percent of the collection must be used to subsidize pollution control. The remaining collection will be used to fund operations of NEPA and local environmental protection agencies. Nevertheless, the existing emission charge system based on the Provisional Measures for the Assessment of Emission Charge issued by the State Council in February 1982 only applies to a limited range of pollutants. There has also been a general lack of consistent application and enforcement of the fee structure. Appendix 3 shows the emission charge structure.

4.5.4 Problems

Many gaps exist in current system of environmental laws in China because these laws were enacted within the framework of the State Plan, which emphasized economic development and production allocation. Although efforts have been directed to coordinate environmental policies with the State Plan, some provisions of the laws contained ambiguities that made enforcement difficult. For examples, Article 34 and 37 of the EPL 1989 that obligate the employment of pollution prevention technologies could be interpreted to be application only to state owned enterprises. The applicability to private enterprises was uncertain. Article 39 of the same law that imposes shutdown of heavy polluting state enterprises, requires that local government and the respective ministry of the enterprises to grant approval before NEPA can enforce the order. This ill defined authority structure severely handicapped NEPA's effectiveness to implement laws and regulations. Although civil and criminal liabilities had been included into existing legislation, China still needs more specific criminal provisions - such as clearer delineation of specific liabilities of the polluting enterprises, forms and magnitude of penalties for pollution offenses - in order to better define the accountability of the polluters. More comprehensive and accurate systems of pollution charge are also needed to cover larger category of pollutants as well as to reflect the real costs of environmental damage and pollution prevention. Furthermore, the scope of existing legislation needs to be expanded to include other pollutants and sources - such as hazardous wastes disposal and small rural enterprises - that are inadequately governed by current regulations.

The trend towards decentralization of implementation and enforcement has been one of the causes of managerial problems. Transferring administrative controls to provincial environmental agencies effectively reduced the authority of environmental agencies over state enterprises because the enterprises were only responsible to central governmental organs. Decentralization has also witnessed the increase of corruption and nepotism at the provincial level, although these were also results of economic decentralization. Competition among 'established' ministries (forestry, energy, agriculture) and the relatively new NEPA to control various aspects natural resources protection also created tensions.

Although the Chinese government is committed to reforming the policy and legislative regime to better address the wide array of environmental problems and has achieved substantial progress, little budgetary resources have been directed when compared to what that is required. In the 1980s, a board of environmental specialists presented a few environmental spending options and the potential achievements to the State Council:

- 0.5 % of GNP: degradation continues
- 1 % of GNP: degradation stops, but no improvement
- 1~1.5% of GNP: modest improvements in areas such as improving water quality to all cities
- 2.5% of GNP: major improvements in all sectors

Nevertheless, total environmental expenditures remained below one percent in the 1980s. Although total values of spending (in nominal terms) in the pollution prevention sector has almost doubled by 1992, spending has not exceeded the official goal of one percent of GNP (about $5.5 billion in 1992 dollars) because of the high inflation rates in the late 1980s and early 1990s. This inability of the Chinese government to adequately invest in environmental protection and management reflected the lower priority of environmental objectives over other sectors, as well as the general weakness of the Chinese fiscal system. Although the Chinese government has pledged to commit about $35 billion for the period till 2000 in environmental programs, most western scholars are skeptical if this would eventually be realized. In any case, China is hoping to derive substantial financial assistance from the international community.

Many western observers also feel that China's environmental sector reform is caught in the middle of a painful and gradual transition. On one hand, the command-and-control style of environmental management is constantly losing its authority and effectiveness because of decentralization and the shift towards market economy. On the other hand, market mechanisms to control environmental degradation cannot be successfully implemented because a market economy has not fully emerged.

The shift to a market economy is hampered in several aspects because of price fixing and the general lack of administrative infrastructure such as taxation and monetary systems.

In short, although China's experience with environmental management has come a long way since 1972, many inadequacies still plague the existing system. A closer look at environmental management in Guangzhou city also shows implementation gaps at the grassroots level.

4.6. ENVIRONMENTAL MANAGEMENT IN GUANGZHOU

Provisions in the EPL of 1979 and later 1989 allowed for decentralization for environmental management and pollution control in China. Decentralization is inevitable because of the large geographic scope of the country and the diversity of environmental problems. Environmental management thus needs to take into account local environmental variations, social needs and economic structure. Decentralization offered greater autonomy for local authorities to define and coordinate policies and to determine the most efficient ways to implement and enforce them. Local environmental agencies and their field personnel are thus the effectuators of national environmental policies. The overall success of national environmental policies therefore relies critically on the success of implementation at the grassroots level. Guangzhou city's experience in environmental management and water pollution control provides a representative example for assessing the effectiveness of policy implementation [Ref 10,11,12].

4.6.1 Legal Framework and Scope of Environmental Management

According to the EPL, local governments at the provincial and city levels are granted great flexibility in designing and implementing environmental policies that attend to the needs of their regions, subjected to the requirement that environmental and pollution standards set by local authorities must fall within the national limits. To empower local authorities, major party officials in the local governments are also assigned the responsibilities of environmental management. The city government of Guangzhou operates its environmental management functions under this broad legal setting.

Integrating environmental planning with city development planning is the key strategy of Guangzhou Government in environmental management. This approach allows for greater policy coordination among the various functions of Guangzhou Government and provides a mechanism for conflict resolution, reflecting the pragmatism of subordinating environmental protection to economic development. The scope of pollution protection in Guangzhou Government's environmental agenda includes the control of air, water, and noise pollution, with particular emphasis on industrial pollution. Policy coordination between environment management and

economic development is seen as an effective means to control new industries and enterprises that will introduce pollution into the city.

Guangzhou's environmental agency has targeted its efforts at five specific areas, which are:

- Improving the city planning process to better address the impacts of industrial pollution at the regional level;
- Addressing pollution problems in aging enterprises by introducing prevention technology;
- Controlling new industrial sources of pollution by licensing and ensuring compliance with emission standards;
- Controlling level of industrial pollution by imposing emission charges; and
- Controlling automobile emission.

Interestingly, this action list indicates that priority is given to addressing the 'low-hanging-fruits' - in particular pollution that typically originate from large industrial sources that can afford prevention technology and emission charges - which the present institutional structure and processes are better prepared to deal with.

4.6.2 Institutional Structure and Policy Process

The institutional setting for environmental protection parallels that at the state level in that the policy making function is separated from the administrative function. The policy making process also shares some similarities.

The highest policy making and coordinating body in Guangzhou is the Environmental Protection Committee (EPC) which is part of the city's governance structure. It comprises leading officials from all municipal agencies and is headed by the mayor. There are more than twenty agencies in the committee including the City Planning Agency, the City Economic Development Agency, and the City Industrial-Commercial Office. In practice, this committee has become a forum in which conflicts in environmental policies among the various agencies are resolved and a channel in which policy implementation and regulatory enforcement are coordinated. The role of the EPC is thus more that of a policy mediator and coordinator than policy maker. Its actual authority in environmental protection is therefore limited.

The key administrative organ of the EPC is the Environmental Protection Office (EPO). The EPO is empowered to suggest and draft new regulations that meet local needs. These local environmental laws are then submitted to the Guangzhou Municipal's People's Congress for endorsement and subsequently to the Provincial People's Congress for approval before they are

put into effect. Since 1979, a total of sixteen new regulations were proposed by EPO and all of these were passed into law eventually. Like the institutional settings in the central government in which NPC and CPPCC are channels for public participation and monitoring, the Guangzhou Municipal's People's Congress and the Political Consultative Conference represent the people of Guangzhou to perform supervision of the city government policy process.

EPO is also the key organ that carries out monitoring and regulatory enforcement in the city. There are 6 functional units within EPO that perform monitoring, law enforcement, research, public relation, public education, and operations of pollution control facilities. The major units for pollution control are the Inspection of the Pollutants Disposal Department and the Environmental Monitoring Stations. These units sometimes join forces with the Maritime Safety Office and Public Security Department to enforce environmental regulations. There are a total of 12 field environmental protection offices (eight districts and four counties) in Guangzhou under the EPO. The most basic administrative units of within these grassroots offices are the Neighborhood Committees, comprising of both full-time and part-time "street-level" regulators. These committees are responsible for monitoring compliance and enforcing regulations in the districts and counties. Private individuals are also allowed, by the EPL, to report pollution incidents to the Division of Supervision and Management of the EPO to seek legal actions against the polluters.

4.6.3 Pollution Control and Emission Charges

Decentralization of authority has allowed the Guangzhou government to set its own priorities in environmental protection. The city government has chosen to focus on addressing problems in air and water pollution over other environmental issues such as noise pollution and nature reserve conservation. Emphasis was placed on prevention, more specifically preventing the growth of new pollution sources rather than control of existing pollution. New industrial plants are required to meet stringent pollution standards before construction permits are issued. On the other hand, existing industrial sources of pollution are given more flexibility in meeting pollution standards.

Following the issuance of the Provisional Measures for the Assessment of Emission Charge in February 1982, the EPO introduced emission charges in 1984 to control industrial pollution via economic incentives. Industries that exceed pollution standards set by the EPO are obliged by law to pay emission charges as penalties or fines. Under the EPL, EPO is allowed to retain twenty percent of the collected fees to fund its annual budget while the remaining eighty percent is to be invested in pollution prevention facilities in the affected enterprises. This system has created strong motivations for EPO to enforce pollution control and has been particularly effective in controlling industrial water pollution. As discussed in Chapter 3, the percentage of treated

industrial waste water has increased over the years and the water quality of Pearl River was brought under control amid a period of rapid industrialization in the late 1980s. In the period of 1986-90, a total of RMB 194 million was collected by EPO in water pollution offenses.

4.6.4 Appraisal of Implementation Effectiveness

Although achievements in water and air pollution control in Guangzhou's industrial sector is commendable, implementation of environmental policy and regulations is still far from being comprehensive and effective in several broad areas. Some of these gaps in implementation include:

- The geographic scope of EPO's jurisdiction has been very much limited to the Guangzhou metropolitan area. Industrial and residential sources outside the Guangzhou metropolitan area have also contributed substantially to water pollution in the Pearl River. Pollution from these sources need to be controlled in order to fully address the problem. It was only the late 1980s that rural townships and villages were brought under EPO's control. Because of the geographical dispersion of the typically small township-and-village enterprises, the tangible benefits of controlling these enterprises far outweighed the cost of monitoring and enforcement. Furthermore, existing set up within the EPO and its field offices is inadequate to address environmental problems in these areas. In contrast, pollution control within large industrial enterprises has been more successful because most of these large entities fall within the jurisdiction of the EPO. Indeed, most of the industrial pollution has come from these large factories. It has been reported that since 1986, about twelve factories contributed to about fifty percent of total waste water discharge [Ref 13, pp. 84]. The emission charge system has also motivated EPO to control pollution from these sources.
- Emission charges collected by the EPO has become an independent source of finance. In 1990 alone, a total of RMB 45 million was collected by EPO from all pollution offenses. This amount exceeded greatly the annual budget of several millions RMB received from the city government before 1984. EPO now has the financial strength to invest in the expansion of human resources and technical capabilities, enabling it to better implement and enforce environmental policy. However, the paradox is that future EPO income from emission charges is contingent upon continuous industrial pollution above allowable standards. This is unlikely to be a sustainable in the long run as industry will gradually reduce emissions by introducing pollution prevention facilities. Old, inefficient state-enterprises in Guangzhou will also be phased out by new industrial ventures. New enterprises with pollution prevention facilities will not need to pay emission charges when they begin operation, thereby further reducing the sources of pollution fee. New incentive instruments, particularly market mechanisms such as pollution permits, will have to be developed in the long run. As the number of enterprises

increase in Guangzhou, these new instruments also need to address total industrial emission in the region beside limiting the pollutant concentrations in waste discharge.

- The EPO does not enjoy absolute authority in regulating pollution activities because of the 'informal authority structure' within the Chinese socialists system. For example, EPO officials were not able to conduct a site inspection of the Retired Air Force Personnel Recreation Club because many of the club members are high ranking communists party members. In another instance, EPO officials could not monitor the waste water discharge of the Guangzhou Paper Manufacturing Factory because the factory director had a higher administrative rank than the EPO director [Ref 14].
- The existing institutional set up discourages the control of water pollution in the residential sector. Not only is controlling the residential sector outside the Guangzhou metropolitan area difficult, controlling residential water discharge within Guangzhou is also not favored by current set-up. Control of urban sewage cannot be achieved by mere monitoring, inspection, and point prevention and treatment. It requires revamping the existing sewage collection and treatment systems, responsibility that falls outside EPO's jurisdiction. This calls for huge capital investment on the part Guangzhou city government, something that it is not prepared to undertake. Although providing the necessary infrastructure is the fundamental solution to controlling urban residential sewage, the general lack of taxation systems seriously limited the ability of the Chinese government to raise fund for national expenditure in which spending on sewage infrastructure is among the lowest priorities. Systems to collect water and sanitation service charges from households are also non-existent, leading to the syndrome of "low-level equilibrium trap" [Ref 15] that is typical of infrastructure services in developing countries.
- The extent to which environmental policy is successfully implemented and enforced greatly depends on the performance of the field administrators and regulators operating at the county and district levels. At least two interrelated factors are key to the performance at the grassroots level: a well established control and incentive system within the governance structure of the EPO and the attitude and values of the field personnel. The latter is in turn dependent upon the perceived level of financial, political and technical support from higher authority. The failure to achieve effective implementation other than in industrial pollution control could be explained in large part by the low morale and value incongruence of the field personnel. A research on implementation gaps in three Chinese cities including Guangzhou [Ref 11] indicated that field personnel's capabilities and misgivings in environmental management severely affected their ability and willingness to enforce environmental regulations. The following section will highlight the key findings of this research in the context of identifying the weaknesses of existing institution setting.

4.6.5 Institutional Weaknesses at Field Office Level

Environmental control at the field office level involves a substantial degree of discretion on the part of the office management and the regulators carrying out the monitoring and inspection. These field regulators are typically working in geographically dispersed locations without direct supervision and thus are prone to subjective decisions, especially when there is a lack of standard procedure and when the regulators are themselves not environmentally sympathetic. Research was conducted in Guangzhou, Zhenzhou, and Nanjing between October 1990 and October 1993 by several Hong Kong university researchers to study the impediments to effective policy implementation at the grassroots level [Ref 11]. Several institutional weaknesses that affected the effective implementation of environmental policy were identified:

- There was a general lack of technical training and support for the field regulators, who were responsible for site inspection and pollution monitoring. Their basic tasks involved the collection and measurement of discharge samples. The only formal training that field regulators received was reportedly a one-week pre-work seminar and they were expected to learn the technical skills - the sampling procedure, the use of chemicals and monitoring equipment etc. - on the job when working with experienced regulators. This opened the possibility of arbitrary technical practice among the regulators. This problem was further exacerbated by the lack of formalized rules, legal support, and heavy workload.
- The general lack in technical competency also resulted in another problem. Although the national policy allowed for the decentralized setting of environmental qualities and standards to reflect the different environmental, social and economic context of each region, it simultaneously placed high technical demand on the local environmental agencies. The middle level administrators in the field offices were concerned about their ability to determine the appropriate environmental standards because of the general lack of technical competency.
- The national policy that requires field regulators to take into consideration the economic capacity to comply with environmental regulations - such as investing in pollution prevention and paying emission charges - restricted the regulators' abilities to impose uniform standard across the region. They were required not to impose overly restrictive standards on one hand and yet to enforce stringent environmental regulations on the other. Caught in this dilemma, the regulators were compelled to treat every pollution incident as an unique case. There was thus no standard operation guideline that can be adopted. Equity and integrity of the regulatory system also became questionable. This problems was further compounded by the general lack of interdepartmental and inter-district/county coordination in that there was insufficient standard operating guidelines for individual field office to work in consistent manners.
- There were serious misgivings regarding the legitimacy of environmental protection among the field regulators. About a quarter of the interviewed regulators felt that the government should

not be responsible for environmental protection, and about 70 percent of them were strongly against increasing government expenditure in environmental management at the expense of spending on other services such as housing and price subsidies. Priority of economic development over environmental protection has resulted in this skepticism about the role of environmental protection in China.

- There was an incongruence among the officials in the field offices in the perception of the importance of public environmental awareness. While upper and middle management in the field offices felt that low public awareness was not the cause of ineffective implementation, the low-level field regulators believed that low public awareness was the root cause of the problem. The fact that field regulators routinely and directly interact with the industry and the public, their views on the cause of problems might be more accurate. There was a suspicion that while the middle and upper officials' concerns about lack of financial and technical support were justified, they might have missed the most fundamental cause of implementation difficulties, i.e. the low public environmental awareness.
- The ability of management and field regulators to police, monitor, levy pollution charges, and to amend emission standards has given them power to exercise discretion to their advantage. This power to extract political rent [Ref 16] provided the EPO a means to secure financial independence in order to fund its own growth. Assuming existing institutional setting persists, continuous economic expansion and the corresponding increase in industrial activity would result in more pollution but ironically more financial income for the EPO. Because China's current environmental goals are subservient to its national economic objectives, bureaucrats in the EPO would do best by ensuring institutional growth and compromising on environmental management rather than pursuing stringent regulations that would constraint expansion of economic activities.

4.7 KEY MESSAGES

Although the Chinese government has exhibited growing awareness of environmental problems confronting the country, the evolution of environmental policies, just like other policies in China, is still very much subjected to the influence of factional politics within the highest echelon of the Chinese Communist Party. In this regard, environmental policies process in China can be approximated by the Bureaucratic Politics Model [Ref 15]. Under this model, government's policy decisions are essentially the outcomes of "compromise, coalition, competition and confusion" among the different agents or groups of agents within the governance structure. Policy decisions may thus not be the most appropriate "solution to a problem", but results of "political bargaining"

among the key players, notwithstanding that the Chinese government has began addressing environmental problems through environmental legislation and programs since early 1970s.

China, in its continuous efforts to rationalize and institutionalize the legal and policy framework for environmental protection, has promulgated basic environmental laws and a series of regulations addressing specific aspects of pollution controls and protection in China in the past two decades. These efforts were attempts to isolate the influence of and depart from factional politics that dominates policy process in China. The creation and promotion of NEPA to the ministry level, and the increased involvement in environmental programs also signifies a growing commitment of the central government in environmental management. Nevertheless, the existing policy framework and regulatory agencies still operate within the larger context of other mineral and resource ministries, state-owned enterprises, and above all, national economic planning that only began to address environmental concerns until very recently. Environmental policies and objectives are frequently compromised. Although recent embarkation on the Agenda 21 program will undoubtedly introduce new thrusts on environmental management in China, this program was apparently positioned more as a means to attract more foreign technical and financial assistance than an integrated approach to address problems at the national level. In short, it seems that Chinese government is attempting to address environmental problems with two approaches: from the macro-level by providing a 'working version' of national regulatory and policy regime and from the micro-level by promoting grassroots projects that address specific problems. It will still be some time before environmental management becomes an integral part of national economic development and is coordinated at all levels of implementation.

As the implementation and enforcement of environmental policies in Guangzhou and other cities have shown, environmental management still fall short of successful execution at the grassroots levels. The general low level of environmental awareness among the Chinese population, the misgivings and lack of technical capabilities of 'street-level' regulators weaken the abilities to carry out environmental regulations effectively. Experience at municipal levels also supports the argument that environmental objectives are subservient to economic goals, resulting in compromised environmental standards and sometimes non-enforcement. The abilities of Guangzhou's environmental protection agency to levy 'pollution-charges' on industries has created distorted incentives for environmental protection. Industrial pollution sources were regulated because of the ability to generate revenue - which was used to expand the bureaucracy of the agency - while residential sources and smaller industries with fewer financial resources were not regulated and pollution prevention for these sources neglected. The large amount of untreated residential wastewater was a result of institutional inefficiencies at the municipal levels: The

municipal government has no proper incentives and financial support to provide for wastewater treatment of residential wastewater, and the policy regime does not define the role of and provide the means for local environmental protection agency to regulate residential wastewater.

Environmental regulations in China take the command-and-control approach in stipulating measures such as control of "three wastes", observation of "three simultaneous actions", and levying of emission charges. The incomplete shift to a market economy, continued subsidy or price cap on services, and the lack of well a functioning taxation systems prevent the use of market-based instruments in regulating pollution activities. Not only will China not be able to realize improved economic efficiency associated with market-based instrument, but consumers of environmental services are not involved, through their responses to price changes in the market, in influencing decisions on what and how much environmental protection is necessary. These are some basic issues that any infrastructure privatization plan must addresses.

In summary, although the progress of environmental management in China is encouraging, there are still many aspects requiring improvements in current policy regime and institutional set up.

CHAPTER 5
INTERNATIONAL PRIVATIZATION EXPERIENCE

In Chapter 3, the environmental justifications of technological options to managing urban sewage treatment were established. Chapter 4 identified the inadequacies of existing policy and regulatory institutions in managing urban sewage in Guangzhou. Non-public sector involvement in providing the necessary sewage treatment infrastructure might thus offer a possible solution to the problem of water pollution in Guangzhou. It is in this context that this chapter attempts to study privatization experience of countries in the world and in China. Important lessons will be derived. The chapter will begin with a review of the economic and political objectives of privatization as a policy choice in providing infrastructure in the developing countries. 4 mini country studies - the United Kingdom (England and Wales), the United State, France, and Mexico - will provide international examples for learning about privatization in practice. In each case, the economic and political context of privatization, issues with implementation and policy framework for privatization will be briefy discussed. China's experience with infrastructure privatization will be reviewed to identify some of the problems and uncertainties.

5.1 THEORETICAL AND PRACTICAL CONSIDERATIONS OF PRIVATIZATION

5.1.1 Definition

The term 'privatization' has been used very broadly to describe the involvement of the private sector, or the market, in activities that were once solely performed by the pubic sector. In a more definitive manner, privatization can be defined as the transfer from the public to the private sector of the ownership and/or control of productive assets, their allocation and pricing, and the residual profits flow generated by them [Ref 1 pp. 6]. Another way to define privatization is to only emphasize the change in the supply of the service from the public sector to the private sector, irrespective of the source of its financing. Privatization is thus a continuum of activities that involve the private sector in various nature and to varying extent. Section 5.1.5 provides a description of the various form of private sector participation in infrastructure. Privatization in the developing countries has been viewed as an instrument both for short-term stabilization through expenditure reduction and medium term supply-side improvements by promoting more efficient resource allocations and management. In the context of sewage treatment infrastructure, privatization could therefore be seen as an enabling element of technological solutions to environmental problems, in lieu of adequate public involvement in water pollution control.

5.1.2 Economic Objectives of Privatization

Demands for infrastructure services in the developing countries have been rising rapidly in the past few decades due to population growth and economic development. However, many infrastructure in these countries are plagued by problems such as inadequacies, insufficient maintenance, misallocation of investment, unresponsiveness to users and technical inefficiencies. The major causes of these poor performance include [Ref 3, pp. 6-7]:

- Lack of Financial Resources

  Providing infrastructure services has been the traditional responsibilities of the government in many countries. However, rapidly increasing demand - usually faster than economic growth - has outstripped the financial ability of these governments to fund infrastructure development continuously. Many a time the borrowing capacities of these governments are limited because of indebtedness, poor fiscal management and political instability. The rising opportunity cost of donor funding has also made multilateral financing more scarce. All told, there is an increasing shortage of financial resources from traditional sources.

- Lack of Competition and Autonomy

  Because infrastructure has typically been operated by public monopolies or equivalencies in highly protected markets, there has been general lack of competition to ensure that providers operate at efficient levels. Government subsidizes to the operators of these services have also created "soft budget constraints" that lead to wastage and inefficiencies. Because agencies providing the services are owned by the government they are also influenced by political objectives that are not based on sound economic rationale. Many of the providers are either employers of last resort and/or are required to deliver services at below total costs of production. The lack of competition and management autonomy has not only resulted in economic inefficiency but also created further drain on public financial resources.

- Lack of User Involvement

  Studies conducted by the World Bank have indicated that, contrary to common beliefs, residents in developing countries have indicated a willingness to pay for access to and improvements in basic infrastructure. However, they are not well positioned for their demands to be felt by the providers. There is a general lack of channels for reflecting their needs and involving them in the planning and decision making processes. Furthermore, the economically optimal level of demand is unknown because improper pricing policies, typically below cost, have results in excessive demand and wastage.

Improper incentive schemes faced by the service providers and poor alignment of supply with demand have resulted in the economic inefficiencies highlighted above. The primary economic objective of privatization, provided that competition is ensured and regulatory measures is

appropriate and properly enforced, is thus the correction of the causes of inefficiencies. Four potential economic benefits are [Ref 2, pp. 66-68]:

- Improved Efficiency

  The most important economic outcome of privatization is improved efficiencies in overall resource allocation. These efficiency gains can come from access to more efficient technologies, cost-effective construction and operation, effective management, proper pricing, and lower-cost of financing etc. - conditions that are made possible by the existence of competition in the market. Freed from the burden of providing infrastructure, government can now channel scare financial and managerial resources to address more pressing needs such as poverty alleviation, basic healthcare provisions, and rudimentary education services.

- Reduced Government Risk

  To the extent that commercial risks associated with the various aspect of privatization - the ownership, the management-operation, and the financing - are taken up by the private sector, the risks borne by the government will be reduced. Government risks are typically not removed entirely because government guarantees are indispensable features of almost all types of privatization programs.

- Additionality

  Additionality is defined as the net increase in financial resources available to the domestic economy as a result of private investment. In order to be additional, the privatization of an infrastructure project must increase the base of total financial resources, which may come from both domestic savings and foreign capital inflows. The degree of additionality is dependent on the structure of the project financing, i.e. the sources (foreign or domestic) and the type (debt or equity) of financing. The net impact on additionality due to privatization of infrastructure privatization is uncertain, although foreign sources of project financing - in BOT projects or bonds - are typically additional. This is however, subjected to the caveat that foreign lenders (commercial banks, export credit guarantee agencies, and international aid agencies) might not be willing to offer loans when a perceived credit ceiling is reached. Projects drawing on private domestic equity, on the other hand, are typically nonadditional unless capital outflows are captured or more domestic savings are induced with a corresponding increase in domestic interest rate. Increase in domestic financial resources for infrastructure projects might also take place at the expense of other non-infrastructure sector as a result of resource reallocation.

- Positive Externalities

  Less tangible positive externalities can also result due to privatization. Privatization is often perceived as a change in economic policies and regulatory regime for the better, i.e. less interventionists and acceptance of free market approach. Government's commitment to privatization, especially openness to foreign participation, will improve international

perceptions of the investment climate in the country, paving the way for greater foreign investment in future. Local capital market can be established and invigorated. Privatization of infrastructure will also demonstrate that efficient operations can be achieved through commercial terms to public entities in other sectors, promoting efficient practices among them.

Thus privatization not only provides alternative sources of finance, but also more efficient resource allocation and operations of provisions when managed with commercial principles, provided that competition in the market is ensured.

5.1.3 Political Objectives of Privatization

Privatization of infrastructure involves redefining the scope of public-private responsibilities in providing the services and the share of claims to potential benefits from the provisions. It is inherently a political process, and thus political objectives play an important role in shaping and influencing the process and form of privatization. Different approaches of redistributing property rights or ownership of infrastructure will have different impacts on the political stakeholders in the country, resulting in redistribution of political influence. In effect, political objectives ultimately determine the design of transactions, usually not without trade-off between economic objectives [Ref 1, pp. 52-59; Ref 5, Chapter 1].

Privatization of state assets has been used as an policy instrument by incumbent governments to increase political support from the parties that have participated and perceived to have benefited from the transactions. These parties can be the general public, special-interest groups, or inhabitants of a particular geographic region depending on the form of private sector involvement. For example, the public issue of infrastructure bonds or equities, if well received by the public, will be the most suitable means of generating political support from the masses. Very often however, privatization involves the redistribution of economic rent of the infrastructure to favored groups - ethnic, business, regional, religious etc. - in order to build constituencies among these groups for the politicians in government. In some cases, cronyism prevails. Business organizations that are closely associated with the politicians in the government become key beneficiaries of privatization transactions, gaining economic benefit by participating as the contractors of infrastructure projects.

In some instances, privatization have also been used as a signal of the central government's commitment in economic policy reform in order to improve the reputation and credibility of the government both domestically and internationally. Notwithstanding the difficulties of honoring these claims, the government concerned will ideally be able to attract more foreign assistance and

investment in the future. Under such constraints, the government concerned will be tempted to ensure that the first privatization programs are politically successful, even at the expense of economic efficiency. Thus when restricted access to the benefits of privatization is present, economic objectives are sometimes compromised when they contradict political objectives.

5.1.4 Classifications of Infrastructure Provision

Privatization involves partial and/or total market participation in three aspects: the ownership, management-operation, and financing of the assets and activities. The nature and degree of private involvement and the role of competitive markets necessarily vary with how much the particular infrastructure approximate a public or private goods. Two criteria, *excludability* and *subtractability*, are used to classify the nature of infrastructure [Ref 2, pp. 51]. Excludability refers to the degree to which individual user of goods of services can be excluded if the user does not meet conditions set by the suppliers. It entails the availability of cost-effective monitoring and cost allocation systems in which consumption of individual user can be monitored and charged accordingly. Subtractability refers to the extent to which the consumption of goods and services by one user will reduce the availability of the same service to other users without raising production costs. These two variable provide a means to classify the nature of infrastructure services: *public goods* are those with both low excludability and subtractability whereas *private goods* are those with both high excludability and subtractability. *Toll goods* and *common-property goods* are the intermediates of these two extremes. Ideally, under the appropriate economic structure and regulatory regime, the importance of a competitive market in ensuring efficiency and the ease of total privatization is the highest in the private goods category. Figure 5.1 indicates the classification and examples of the four different types of goods and services. The two criteria, excludability and subtractability, for a particular infrastructure are by no means perfectly circumscribed. For examples, cost effective monitoring of electricity consumption might be feasible in well established housing regions but not in squatter settlement while non-subtractability of a highway will be diminished once a thresholds of usage is reached and congestion set in. Wastewater treatment facility falls into the category of public goods.

5.1.5 Alternatives of Private Sector or Market Involvement

Depending on the type of infrastructure as described in the previous section, the nature and extent of involving the private sector (or the market) in introducing competition into the ownership, management-operation, and financing of provisions differ. The World Bank has outlined four broad arrangements in which market or private sector participation in infrastructure is possible [Ref 3 pp. 55-64]. They are competition from substitutes, competition *in* the markets, competition *for* the markets, and the privatization of monopolies. In the second option, multiple providers compete

Figure 5.1 Classification of Infrastructure Provisions

Subtractability	Excludability: Low	Excludability: High
Low	Public Goods • Urban roads • Local rural roads • Waterways • Highways • Wastewater treatment	Toll Goods • Toll highway • Telecommunications • Ports • Airports • Urban water systems • Power transmission and distribution
High	Common-Property Goods • Irrigation systems • Rural water systems • Thermal and hydropower generation • Storm drainage	Private Goods • Road transport • Urban Transport • Rail transport • Water storage • On-farm irrigation

Source: Reference 2, Table 5.1, page 52

directly in the same market while government regulations ensure fair competition. For infrastructure sectors in which direct competition among rival providers is not possible, the third option ensures efficiency by introducing competition through contractual arrangements such leases and concessions. There is competition for providing the market when the contract for a particular service is opened for bidding (either for the first time or renewal), although there is no competition in the market during the term of contract. Several approaches in which the four broad forms of private sector involvement can be achieved are discussed as follows [Ref 2, Chapter 6; Ref 3, pp. 60-63]. From the experience of privatization of water utility and sewage treatment provisions in the developing countries (Table 5.1), it is observed that concession - a variation in the competition for the market - is the most common for large scale urban projects whereas community self-help arrangement is common in small scale rural projects.

- Service and Management Contract

  This is perhaps the simplest form of private sector involvement in infrastructure. Typically, private companies are hired for limited periods to provide specific services or to manage the public assets for fixed-fees while all the financial risks were shouldered by the government. The process might begin with total or partial buy-out of public employees before the services are outsourced from the private sector. Competitive bidding from potential service providers ensure economic efficiency and the price of contract can be based upon service parameter such as volume of water delivered, quantity of wastewater collected and treated etc.

- Lease

  Under the lease contract, private contractors pay for the rights to operate the public infrastructure and provide the services. While the related capital investment is borne by the

Table 5.1 Examples of Private Sector Involvement in Water-Sewage Infrastructure

Country	Concession	Community Self Help	Infrastructure Bonds	BOT
Cote d'Ivoire	O			
Madagascar	O			
Bangladesh		O		
China	O			
Hong Kong	O			
Macau	O			
Malaysia	O		I	
Philippines		O		
Jordan			O	
Morocco	O			
Pakistan			O	
Argentina		O		
Brazil			O	
Bolivia		O		
Chile	O	O		P
Colombia			O	P

O:Operational I: Initiated P: Planed
Source: Reference 2, Annex 6.1, page 74-75

government, the private contractors bear the commercial risks during the period of contract, typically 6 to 10 years in duration. The private contractors are compensated by the profit from selling the services. This type of arrangement is most suitable for infrastructure projects in which the responsibility of management-operation can be separated from the ownership. Water and sewage systems in France have been operated under leasing arrangement for several decades and this model was recently implemented in Guinea. Lease contracts have been used to operate port facilities of many Asian countries including China, Hong Kong, Japan, Malaysia, the Philippines, and Thailand.

- Concession

Concessions contain all the features of leases but give the private contractor additional responsibilities of investing in the maintenance, replacement and/or expansion of existing facilities. These arrangements are an older version of BOT (see following discussion). Private sector investment in concession contracts are typically incremental because the large capital expenditure is borne by the government. This makes concession contracts, when compared to BOT projects, simpler and financially less risky thus more attractive to private investors. For many years, concessions have been the most common form of private sector participation in water and sewage infrastructure in the developing countries (Table 5.1). It is also adopted for railways, telecommunications, and urban transport systems. This form of private participation has thus been well practiced, and countries' experience with regulations is well documented. Nevertheless, since it requires the infrastructure to be already in existence when private sectors are involved, it is not applicable to new projects in which major capital investment is required.

In these situations, BOT becomes an alternative. As the private entities involved in both lease and concession arrangements are not owners of the infrastructure assets, they may not have the incentive to maintain the facilities, especially when the possibilities of contract renewal are highly uncertain. Under such circumstances, the private entities will be tempted to depreciate the assets rapidly for short term gains while not investing enough in maintenance. These problems can be avoided by clearly defining in the contract, the responsibilities of the private contractors in maintaining the capital stock. Compliance must also be monitored and enforced.

- Community/Self-Help

  Community/self-help arrangements are most common for local, small-scale infrastructure including mini-hydropower generation, rural water supply and sanitation, distribution channels for irrigation, and maintenance of local drainage system etc. These arrangements either compliment or supplement the services and financial resources provided by provincial or central governments. Both labor and financial resources are involved in these projects though labor contributions often reduce the financial cost of the projects. In successful community/self-help projects, users must be involved in the planning, budget allocation, and decision making processes. They must also ensure equitable sharing of costs and benefits of the provisions as well as that proper technical resources are made available. The Orangi Pilot Project in Karachi's squatter settlement has been frequently cited as a innovative example of how local community was successfully organized to provide underground sewerage system to more than 600,000 poor people in the region at a total cost of less than $50 per household [Ref 4, pp. 109, Box 5.6]. Other form of self-help arrangements include the involvement of rural cooperatives and private enterprises in providing infrastructure for their own utilization.

- Build-Operate-Transfer (BOT)

  Typically, BOT projects are stand-alone, government-licensed contracts that involve industrial consortiums led by international construction companies. BOT projects are generally conceived for new infrastructure projects that require heavy capital investment in which the financial burden and risks of the projects are transferred to private entities. Consortiums are responsible for the financing, construction, management and operation of infrastructure for a duration typically ranging from 15 to 25 years, a period in which the government will play the role of a regulatory agency. Ownership of the particular asset will be transferred to the government when the BOT contract expires. During the contract period, operators of BOT projects are expected to generate enough revenues to cover capital and operating costs and to earn an acceptable return on investment, usually 15 to 20 percent. BOT contracts usually begin with \ bidding by competing consortiums, followed by rounds of negotiations with the central or provincial government. In the negotiations, details of the contract - such as pricing, government guarantees etc. - are hashed out. BOT contracts are thus highly specific, with the

parties involved - creditors, sponsoring government, project companies, equipment manufacturers etc. - sharing different degree of risks in different projects. BOT arrangements are most common in power generation and land transportation projects in developing countries largely because governments do not have the financial abilities to keep up with rapidly increasing demand in these sectors. Hybrids of BOT arrangements had also proliferated in the 1980s. These variations of BOT include BOO (build-own-operate) with no final transfer, BOOT (build-own-operate-transfer) with 'T' for transfer and training, BROT (build-rent-operate-transfer), and ROT (refurbish-operate-transfer).

- Infrastructure Bonds

  Infrastructure bonds offer a means in which financial resources in the private sector can be mobilized for project development. Instead of local municipal governments, public utilities in many Asian and Latin American countries often issue government-backed bonds to raise capital because municipal bonds are typically not creditworthy and other forms of public financing exist. Increasingly, infrastructure bonds are also issued by BOT-type projects in the developing countries. In economies where local demand for bonds are weak, innovative ways to issue bonds have been developed. Some of these methods include the issuance of bonds denominated in foreign currencies (in Pakistan) to attract local buyers and the issuance of bond in international markets (Malaysia and Indonesia). In some countries, the purchase of bonds is made compulsory, albeit in indirect ways. In Brazil for example, users of electricity were required to pay a surcharge each month for the services and in turn were compensated by long-terms bonds of the utility. In Taegu, South Korea, all motorcyclists intending to have their vehicles registered were required to purchase bonds that financed road construction.

5.1.6 Role of the Domestic Capital Market in Privatization

The absence of a domestic capital market or the existence of a weak one greatly limits the options government can adopt when privatizing infrastructure. The primary arrangement under this situation is the contracting out of services and management or the outright sales of ownership to the private sector, typically to consortia consisting of domestic and international firms. The capacity of the domestic capital market will determine the number and size of privatization projects that can be absorbed. In the presence of a well established and regulated capital market, privatization of infrastructure can take the form of municipal bond or stock issuance. Some important roles of well functioning capital markets include [Ref 1, pp. 85-87]:

- Resource Mobilization

  A capital market helps to mobilize domestic resources in several aspects. Firstly, it provides the channels in which aggregate demand of a large number of small investors could be pooled together to address financial needs of a few large privatization projects, thus largely reducing

the search costs of these transactions. Closely related to this is that minimum size of investment in financial assets by individual actors is reduced, thus removing the barrier to fixed capital formation in the economy. Spreading the ownership of privatized infrastructure facilities over a large number of smaller owners also increases the number of beneficiaries of future income from the facilities thus promoting better welfare distribution within the country. In the absence of a capital market, the objective of broadening economic participation by the populace cannot be attained. A sound domestic capital market will also encourage foreign participation in the project because it provides a market through which foreign equity stakes can be liquidated in future. Government will also enjoy greater flexibility in designing privatization deals in that government can avoid 'lumpy' privatization, moves thus smoothing out revenues.

- Ensuring Performance and Efficiency

  Tradability of stocks and bonds of privatized infrastructure facilitates in the secondary market will ensure that efficiency gains through privatization can be extracted and maintained. Trading of stocks and bonds provides a mechanism through which efficiency gains can be locked in and a means to evaluate of the net worth of the facilities. Furthermore, stock and bond price movements reflect market perceptions of the performance of enterprises operating the facilities. Capital markets can thus provide the appropriate incentives and monitoring mechanisms for continued efficient performance after privatization.

- Ensuring Transparency

  A well functioning capital market can influence the effective and proper management of privatization programs. Generally, companies engaging in public share issuances are required by law to ensure transparency, consistency and clarity in reporting performance and financial standings. Full dissemination of project information, project valuation by professional firms, public declaration of liabilities etc. are also required for any privatization projects. Governments, in facilitating privatization programs, are impelled to specify clearly future policies towards firms and the sector at large. Although this might not always be the case, since it is possible to privatize state assets in poorly regulated capital markets, improperly exploiting the capital market cannot be repeated indefinitely without adverse impact on the credibility of the government in managing privatization program.

5.1.7 Major Constraints and Challenges to Privatization in Developing Countries

Infrastructure privatization has not developed rapidly in many developing countries in the past decade. Many countries are still at the initial stage of privatizing infrastructure. Of those countries which progress has been more rapid, transactions have not been without difficulties. A recent study commissioned by the World Bank has identified several constraints to the privatization of infrastructure in the developing countries [Ref 6, Chapter V]:

- Differences in expectations and perceptions of risks

  One of the key technical bottlenecks that leads to frustrations and unduly long periods of contract negotiation is the incongruence in the perception of project risks, how the risks should be borne, how much return is desirable. On one hand, private participants typically expect high risk premiums, especially when project contracts have long duration. In addition, government guarantees are often demanded. Weak financial positions of the consumers of services - such as public utilities or low income residential users - are also major concerns of private investors. On the other hand, governments usually require that private participants assume uncertainties of long term demand and policy changes. Private companies are sometimes expected to conform to technical and managerial rules set by the governments. These differences in initial expectations about project risks and other technical details often delay negotiations, especially during the first few privatization attempts.

- Lack of government commitment and complexity of decision-making process

  Other critical constraints to the progress in privatization in developing countries is an unclear central government commitment and the complexity of the decision-making process. In many developing countries, privatization has been seen as a primarily means to alleviate the financial burden on the government, and private sector involvement is perceived as supplementary to existing public sector provisions. There is thus a general lack of commitment in broader sector policy and regulatory reform to promote privatization and ensure efficiency through competition. Without consistent commitment from the central government and clear delineation of authority, privatization efforts are often slowed down by endless negotiations and confusion within the bureaucracy.

- Lack of well-defined sector policies, legal and regulatory framework

  The lack of consistent and stable sector policies, and credible and transparent regulatory framework have created uncertainties and risks for private investors and have become a major bottleneck in attracting substantial private sector participation. In many countries, the rules for the first few projects have to be spelled out in great details because of the absence of sound sector wide policy and a legal framework. A great deal of resources are expended in lengthy negotiations. This approach will not be sustainable in the long run because a equitable policy and legal foundation is needed for all future projects.

  Pricing of services is another policy issue that need to be addressed. In many developing countries, public services have traditionally been subsidized by the government. However, privatization projects are financially viable only if the total cost of providing the service, including a reasonable rate of return for the investor, is reflected in the price. Slow progress in price reform of infrastructure services, notwithstanding the political difficulties, will hinder progress in privatization.

- Ill-practices in managing project risks

  Government guarantees expected by private participants, especially in the first few projects countries are embarking on, usually resulted in the governments assuming both commercial and sovereign risks of projects. This approach of allocating risk is unsustainable in the long run. Beside narrowing differences in the perception of risks, the World Bank has also recommended that the party which is able to mitigate risks at the least cost should be managing the risks. This means unbundling risk management, with the government assuming sovereign risk only when necessary. To speed up the bidding process, government should also clarify the risk management and mitigation responsibilities up front.

- Problems with initial privatization projects

  The first wave of privatization projects in most developing countries were typically handled on a case-by-case basis, often with protracted negotiations and involved unsolicited offers made by private companies. Because most of these projects did not involved open competition, there were no alternatives to the offers. This lack of transparency sometimes led to challenges by the public of the integrity of the projects. Reversal of government commitments often occurred, and the parties involved were compelled to re-negotiate new contractual agreements. High transaction costs are thus common with initial projects.

- Difficulties with project financing

  Two related difficulties associated with project financing, a critical enabling element of infrastructure privatization, are the under-developed or untapped domestic capital market of the host countries, and the lack of long-term financing mechanisms. The fact that most infrastructure project generate revenues and that substantial project costs (except in power and telecommunications sectors) are incurred in domestic currencies means that domestic capital has to be tapped to finance these projects in the long run. Foreign investment cannot be sustained continuously, especially in face of rising competition for international financing in developing countries all over the world. A large proportion of infrastructure investment in the world is financed by domestic savings through financial instruments such as bonds, convertible securities, etc. that provide long term debt financing. Except in Malaysia and Thailand where the domestic markets are becoming important sources of financing through these instruments, domestic capital market in most countries in the Asia-Pacific region are still incapable of supplying their own long term financial needs. On the other hand, the transaction cost (bid preparation, cost of raising finance etc.) of project-by-project financing approach - typical when the developing countries are engaging in the first few privatization projects - is relatively high compared to the amount of financing that is generated in the smaller scale projects. Economies of scale in financing and pooling of risks can only be achieved when funds from multiple international investors are pooled into a singly managed source. This is only likely in

countries where a significant number of private projects are expected, again making the initial phase of privatization more difficult for developing countries.

5.1.8 Privatization as a Challenge to Public Policy [Ref 13, 16-18]

Private participation in infrastructure services offers attractive options yet risky strategies and structure to provide for public needs. On one hand, there are convincing examples that privatization can promote efficiency, improve service quality, and reduce public indebtedness if the process is well conceived and managed. On the other hand, privatization can pose threats to political values and result in loss of jobs, loss of public accountability, fraud, mismanagement, favoritism, and corruption in various forms. The values of the private market and the public sector are also inherently different in practice. The fundamental value of the private market is profit maximization. Profit is in part driven by efficiency that is imposed by competition in the market, which is characterized by non-cooperation and lack of sharing of competitive information such as secrets and business processes. The public sector, however, is primarily based on principles of public accountability and representation of the majority. Public accountability is achieved partly by transparency in policy and openness in decision making processes, sharply contrasting with the approach of the private sector. The challenge to public policy makers is that of maximizing net benefits of privatization, minimizing risks, while striking a balance between achieving economic efficiency and political accountability. Policy makers thus need to be able to define, identify, assess and be ready to resolve possible conflicts and tensions inherent in privatization programs. Not only must the policy framework for privatization addresses the nature of services as described in section 5.1.4, it must also be designed to the context of local politic and economic realities.

5.2 PRIVATIZATION OF WATER SERVICES IN UNITED KINGDOM

5.2.1 Overview of Privatization in UK

The privatization campaign in the United Kingdom that began in 1979 has been seen as a primary example of "adversary politics" between the Labor party and the Conservative party. While the Labor party has always supported the ideology of expanding the state's economic realm through nationalization, the Conservative party had been opposing it. The privatization campaign initiated by Margaret Thatcher's government in 1979 marked a watershed in the Conservative Party's opposition to nationalization. Privatization of state services and enterprises was a key theme in the policy agenda during Margaret Thatcher's three consecutive terms as the prime minister of the United Kingdom [Ref 5 Chapter 1, pp. 13-17].

Through privatization, the British government hoped to intensify competition in the British economy, promote efficiency in managing enterprises, resolve the problems with managing nationalized enterprises, and raise additional revenue from the sales of public assets. On the other hand, there were also political objectives underlying the British privatization campaign. From the start, it was motivated by the belief that the size of the government was overblown, a public sentiment that was common in developed countries. Privatization was thus seen as an instrument to prune excess 'fat' in the government. The ideology of "property-owning democracy" or "people's capital market", achievable through expanding the number of property owners and shareholders, was also actively being articulated by Thatcher's government. The public was educated that not only would this policy enhance their assets ownership and thus economic standing, it would also promote greater independence and individualism [Ref 5, pp. 13-14]. From the electoral politics standpoint, the sales of public assets not only attained the effect of "vote-buying", it has contributed to further electoral victory by reducing the needs to raise taxes in order to fund the government [Ref 5, pp. 31].

During her first term in the office (1979-83), Thatcher's Conservative government executed the first wave of privatization program very cautiously by focusing primarily on the privatization of the public housing, a policy that received large spread popularity and support. The tenants of public housing - about a third of the population in 1979 - were delighted to be able to purchase their houses and apartments from the government at a significant discount. The sale of public housing was accompanied by partial stock market floatation of state companies. A total of some £9.5 billion was raised from the sales of public housing and another £3 billion from the sales of state enterprises during the period from 1979-84 [Ref 5, pp. 45-46, Table 4.1]. In her second term in office, (1984-88), Thatcher's government took on the privatization campaign with full force. In this period, the privatization through stock market floatation of assets of state enterprises such as British Telecom (50%), Enterprise Oil (100%), British Gas (97%), British Airways (100%), and Rolls Royce (100%) was the main focus. The total revenue generated through these sales was estimated to be about £18 billion, almost six times that of public enterprise sales in the period of 1979-1983. It was against this backdrop of success in privatizing state enterprises that the British government began to undertake the more difficult task of privatizing state-run natural monopolies such as the water industry. Under the Water Act of 1989, the 10 water authorities providing water supply and sewage services in England and Wales were privatized. New regulatory regimes and institutions were also set up simultaneously to regulate these 10 water utilities and the existing 29 statutory water companies (SWCs). The water industries in the Scotland and Northern Ireland were, however, not affected [Ref 7].

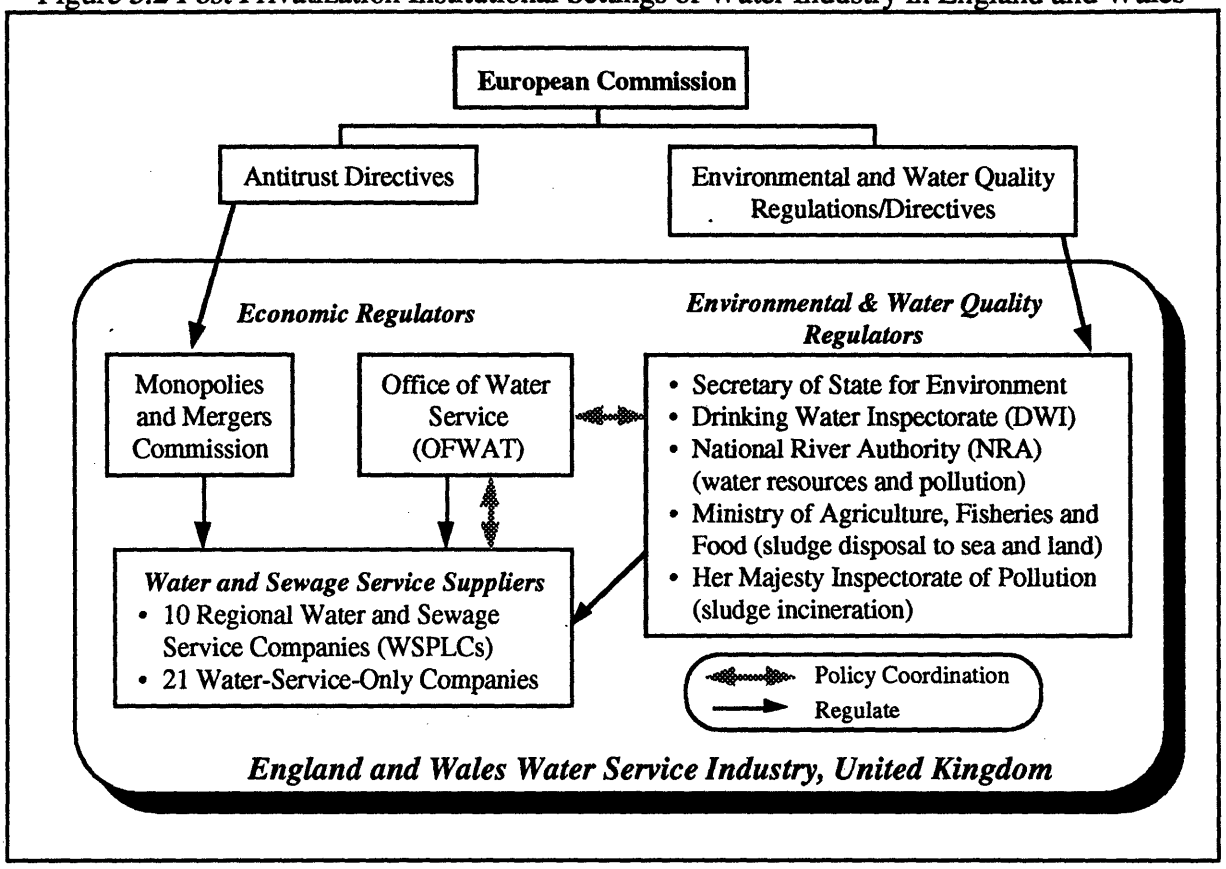
5.2.2 Brief history of water services in England and Wales

In the late 1960s, the water industry in England and Wales consisted of municipal water utilities, local agencies responsible for water resource management and pollution control, and a few dozen privately-owned water supply monopolies [Ref 7]. These water supply monopolies, also known as SWCs, were formed between the seventeenth and nineteenth centuries. There were a total of 29 SWCs each operating under its own Parliamentary Acts and Orders, as well as under general legislation. These SWCs raised their capital through the stock exchange and were subjected to financial government regulations such as limits on dividends, on transfer to reserves, and on carry forward on revenue accounts. The Water Act of 1973 initiated major changes in the water industry in England and Wales. Under this Act, entities other than the 29 SWCs were consolidated into 10 regional public bodies known as regional water authorities (RWAs). Financed by the British government, these state owned entities were responsible for providing water services to about 75 percent of the population as well as all sewage services in England and Wales. Because these entities were government owned, they were in effect, both 'the poacher and the gamekeeper', performing the tasks of operation and regulation at the same time [Ref 8]. The 1989, under the new Water Act, these 10 entities were transformed into water service private limited companies (WSPLCs) and their stocks floated in the stock exchange. At the same time, dividend control on the 29 privately run SWCs was also lifted to convert them into full-fledge private limited companies. After a series of consolidation, 21 of these water-service-only companies remained by 1994.

5.2.3 New Regulatory and Industrial Landscape

In the post-1989 regulatory regime, there are three distinct groups of actors in the water industry: the suppliers, the economic regulators, and the environment and quality regulators. Figure 5.2 illustrates the current institutional structure of the water industry in England and Wales, detailing the individual players in each group. Three new regulatory agencies, the Drinking Water Inspectorate (DWI), the National Rivers Authority (NRA), and the Office of the Water Services (OFWAT) were established. The basic feature of this set-up is the separation of responsibilities - operation, economic regulation, and environmental control - with the central role of policy coordination residing within the OFWAT. Because of its importance, the function of OFWAT is discussed in greater length in the next subsection. The environment and water quality control regulators set standards for drinking water and regulate the disposal of waste-water and sewage discharging into rivers and the sea. The economic regulators control the pricing of services, monitor service quality, promote competition, and represent the consumers. The 10 privatized regional WSPLCs were given license - which could be revoked in the event of inadequate performance - by OFWAT to provide water and sewage services for 25 years. The water industry

Figure 5.2 Post Privatization Institutional Settings of Water Industry in England and Wales



in the United Kingdom is also subjected to European Union regulations on water and the environment and merger practices. Major EU regulations that directly affect the water industry include the Urban Waste Water Treatment (UWWT) Directive, the Drinking Water (DW) Directive, and the Bathing Water (BW) Directive.

5.2.4 Major Reasons for Privatizing the RWAs

The following reasons were given for the privatization of the 10 RWAs and the simultaneous establishment of a regulatory regime that complemented this move in England and Wales:

- The newly formed WSPLCs were freed from government intervention in its routine operation and were thus less prone to political influence from the ruling party.
- Before privatization, drinking water and wastewater discharge in many parts of the United Kingdom did not meet the standards laid down by the EU Commission. It was estimated that to meet the UWWT and DW Directives, £10 billion and £3.7 billion would be needed, respectively, as capital investment [Ref 10]. Privatization is thus seen as a way for the WSPLCs to have access to private capital markets, reducing the financial burden on the British government.

- The ability of the financial market to channel funds to the more efficient WSPLCs will help to discipline these water companies in improving performance. Furthermore, in December 1994, the removal of 15 percent limit on equity ownership of the WSPLCs opened these companies to threats of corporate take-over.
- With the separation of environmental quality control from the operation of water services, water quality management and environmental protection could be addressed in a more systematic and strategic manner.
- The privatized WSPLCs would be better positioned to address business opportunities abroad, primarily in areas of water consultancy. These companies would also be able to attract higher quality professionals from other sectors in the economy to manage and operate the activities.
- Wider employee ownership of companies' shares would provide additional incentives and motivations to the employees for better work performance.

In effect, greater financial flexibility and operational efficiency were the two primary objectives the privatization program hoped to achieve.

5.2.5 Central Role of Office of Water Supply (OFWAT)

OFWAT is perhaps the most important among the three new regulatory agencies created as a result of the 1989 Water Act. Reporting directly to the Prime Minister, OFWAT's major tasks is economic in nature. The head of OFWAT, the director general, is neither accountable to the parliament nor the ministries, except for the financial matters of its department. The major functions of OFWAT are in the areas of price control, regulating service standards, consumer representation, and promoting competition in the industry. On one hand, OFWAT has to ensure that water companies are able to finance their operations and growth through adequate price adjustments. On the other hand, it has to ensure that customers are protected from these natural monopolies in a market that is not perfectly competitive. It also seeks to achieve a balance between economic issues and environmental regulations that will impact the performance of the industry. The major tasks of OFWAT are as follow:

- Price Determination and Control

  The primary function of OFWAT is to ensure that annual price increase in water services is kept within the guidelines established by the secretaries of state. Specifically, annual price increase is restricted to the retail price index plus an additional K factor ($RPI + K$). The annual K values may be positive or negative, and were calculated for the first time for each of the WSPLCs in August 1989 and the water-service-only companies in February 1990. These company-specific sets of K values are applicable for a period of ten years, subjected to revision every five years. The K values reflect the capital investments required to meet the water quality

standards demanded by the EU and UK legislation and reasonable returns on capital for the companies. Current *K* factors are positive and on average, real prices of water and sewage services have been increasing at five percent annually for the past few years.

Central to the determination of *K* factors is the Asset Management Plan (AMP, now known as the strategic business plan) of the water companies. Prior to the determination of the *K* factors, all the water companies - the WSPLCs and the water-service-only companies - were required to submit a ten-year business plan detailing an assessment of their existing physical assets, the investment required for capacity addition and maintenance in order to meet regulatory standards, and the cost of capital. These values, together with assumptions on annual efficiency gain, were programmed into a computer model in which the *K* factors were calculated. OFWAT is involved periodically, through consultation with the financial markets, engineering firms, and end-users, in the verification and revisions of the inputs submitted by the water companies to ensure that the companies will not simply fix annual cost increases without a full economic justifications. Thus, while the water industry is regulated on a price basis, the companies will need to provide the mandated level of services within the cost limits implied by the *K* factor [Ref 9, 10, 11].

Another aspect associated with pricing is that of price discrimination by the water companies among the different type of end-users. Because many water companies in England and Wales still charge consumers on a fixed-fee basis rather than on a volume basis, price does not reflect total cost of services and thus cross subsidy among different consumer groups exists. OFWAT hopes that the pricing approach based on *K* factors will correct this distortion, resulting in a more diverse tariff structure for different consumer groups [Ref 9].

- Competition Promotion

There are two primary means in which OFWAT can promote competition in the water industry. First, it acts as a surrogate for the market by conducting routine comparative analyses of the costs and performance of all the water companies and using the results to set the *K* values and service standards for the companies during the review cycle. The information on comparative performances of the companies is regularly made available to the public, including customers and investors, thus creating incentives for the water companies to operate efficiently.

OFWAT can also create competitions in the industry by granting new licenses to entrants to areas already served by the water companies. The scope of this process, also known as inset appointment, was further enlarged in the 1992 Competition Act, which grants licenses to users that consume more than 250 million liter a year intending to become self-suppliers.

OFWAT is also considering a new policy that will increase the intensity of competition by allowing companies to supply water to customers via a competitor's network. This practice, known as the 'common-carriage' approach, has been implemented in the telecommunications,

gas, and electric utilities in UK. OFWAT sometimes, when requested by the secretary of state, participates in the investigation of merger activities among the water-service-only companies although this is primarily the task of the Monopolies and Merger Commission.

- Quality Control

  Beside monitoring the performance and efficiency of the water companies, OFWAT also ensures that the water industry conforms to established service standards. Seven quality indicators were used to assess the services offered and companies have to submit annual report on their performance specified by these indicators. These indicators are pressure, interruption of supplies, flooding from sewers, water resources, hose pipe bans, response to written complaints, and response to billing queries. These standards are also incorporated into the calculation of the *K* factors. Companies need to meet targets set for the first three indicators while the remaining four have to be monitored. OFWAT and the companies are involved in setting and the periodic review of these standards. There is also a service guarantee scheme under which the companies have to pay a daily penalty of £5 to £10 per incident to the customers for failing to keep up with agreed deliveries or failing to restore interrupted services within a specific period of time [Ref 11].

- Customer Representation

  OFWAT has also established 10 regional customer service committees (CRCs) to investigate customer complaints and involve the public in policy dialogue. Each of the ten WSPLCs is assigned to one CRC. These CRCs organize public discussions with staff members of the companies regarding customer concerns and unpopular company policies or investment. The chairpersons of the CRCs meet regularly with OFWAT's director general to report on matters and concerns affecting customers in their regions.

- Balancing Environmental Needs

  As an economic regulator, OFWAT is not involved directly in the setting of environmental standards and water quality. Instead, it plays an important role in balancing both the environmental and economic aspects of water services by ensuring that environmental requirements, reflected in increased expenditure by the water industry, will not cause excessive price increase of water services. Although companies can appeal to adjust their *K* factors any time to take into account new environmental investment, OFWAT believes that the five-year review cycle offers the best opportunity for adjustment because it provides the least disruption to the tariff structure in the medium term. OFWAT has thus advocated that changes in environmental regulations and standards should be made in conjunction with the five-year *K* factor review cycle to avoid undesirable discontinuity in the prices. OFWAT also impresses upon both the water industry and the environmental regulators the importance of economically efficient and cost-effective approach to addressing water quality problems. By providing the

necessary information, OFWAT also strongly encourages that environmental regulators perform in depth cost-benefit-analyses for proposed environmental regulations [Ref 8 and 11].

5.2.6 Key Outcome of Water Service Privatization in England and Wales

It is perhaps not inappropriate to say that the British government is still grappling with the problems of privatizing the water service industry in England and Wales some six years after the Water Act of 1989. There are also positive impacts on the water industry. Some of the key problems and benefits are as follow:

- With the simultaneous establishment of a regulatory regime during the privatization exercise, the responsibility of operation was separated from regulation with respect to the newly created WSPLCs. There are now different agencies to deal with various aspects of the water industry, with the central role of policy coordination and economic regulation undertaken by OFWAT. Although the new regulatory regime has created higher transparency and clearer delineation of responsibilities, it also resulted in more bureaucracy and higher administrative costs. The approval of business plans and thus *K* factors, for example, requires extensive engineering and economic studies by both the companies and OFWAT. Also, it might well be said that OFWAT has too much responsibilities to many with, especially the difficult job of meeting environmental regulations and controlling costs. Regulating the water companies by prices rather than rate-of-return criteria can put them at disadvantage in the stock market where investors are more attracted to companies that promise higher and more faster returns.
- The pricing of water services is one of the major issues in the privatized water industry in England and Wales. The most controversial aspect of the new pricing policy under the *K* factor approach is the perception that real prices have been rising too rapidly in the post-privatization era. Under investment in the past two decades has resulted in the industry carrying with it a £28 billion modernization program as it was being privatized. All this capital investment is paid for by the consumers [Ref 10]. New environmental qualities and water standards imposed by the EU Directives are also imposing new investment requirements on the industry, thus putting upward pressures on prices. Affordability of water services is becoming a problem in England and Wales, especially for lower income households. The number of customers disconnected from service for not paying overdue bills have been increasing, especially in regions where expenditure on water services accounts for about 6-7% of gross household income [Ref 8]. Existing household tariff structures need to be reformed to correct price distortions that have also contributed to the problem of price increases. Price distortions are primarily due to the low installation of water meters in the industry. In 1991-92 period, about 60% (lowest 45%, highest 83%) of household water consumption in England and Wales was not measured, compared to less than 10% in the non-household sector [Ref 8, Table 1].

The non-metered households ended up paying higher fixed charges with no incentive to conserve water and no means to reduce water bills even if they use less water.

- The privatization program has also opened the water industry in UK, particularly the water-service-only companies, to international investors. Till date, several leading French water companies including Suar, Lyonnaise des Eaux, and Compagnie Général des Eaux have participated in the ownership of several water-service-only companies. The involvement of international water companies is perceived to have improved overall performance of the water industry in terms of more efficient operation, and expanded financial, technical and management capabilities. Competition within the UK water industry has also risen [Ref 7].
- The new industrial environment has also necessitated more active involvement of the consumers in the planning and pricing process. Other than the official channels of consumers participation via the CSCs, water companies have also conducted extensive public surveys to determine customer preferences and their willingness to pay for improved services. The results of the surveys are used as one of the key input to establish the appropriate level of investment in the business plan, thus impacting the values of *K* factors in the pricing formula. In short, consumers now have more influence over the quality and prices of water services [Ref 7].

5.3 Privatization of Wastewater Treatment in the United States

5.3.1 Brief Overview of US Wastewater Industry

By late 1980s, there were about 15,500 publicly owned and 12 public-private-equity-ownership wastewater treatment works (WTWs) in the US [Ref 13, pp. 40-41, Ref 14], serving some 76 percent of the population. The total capacity of these treatment facilities was about 29,000 MGD. The wastewater industry had seen the largest increase in the number of WTWs and total treatment capacity between 1976 and 1980, corresponding to the period of the highest federal funding for WTWs construction. Private sector participation in WTWs, primarily in the form of contract management and operations, began in the early 1970s and by 1994, there are about 350 mid-sized (1 to 5 MGD) and 40 large-sized (10 MGD) WTWs under contract operations, and 1,000 smaller plants under some form of contract management. Another 6 WTWs have been financed, designed and built by the private sector. Some industry sources expected that the various forms of privatization in WTWs, which have been increasing historically at an annual rate of 15 to 20 percent, will grow from the current 5 percent share to some 35 percent in all US WTWs [Ref 14].

5.3.2 Forms of Private Sector Involvement

Several forms of private sector participation exist in the US WTWs industry. Full privatization either involves the outright sales of publicly owned WTWs or the private design, financing,

construction, ownership and operation of new WTW. The most frequent forms of private sector involvement in US. is the contracting-out of part or all of the activities of WTWs. A public entity, typically the state or municipal government, owns the facility and oversees the services contracted out to private companies. In contract operations, some or all part of operations are contracted out while public utilities are overall accountable for the management of wastewater treatment. In the operation, maintenance and management (OM&M) approach, municipalities retain ownership of the facilities while the private firms assume responsibilities for operating the WTWs, guaranteeing deliveries, and ensuring regulatory compliance. The contract may also include the design, financing and construction of new WTWs or part of the facilities. The contract operation and/or management approach is well received and supported by the US. Environmental Protection Agency (EPA) and the International City Management Association (ICMA) [Ref 14,15].

Private sector involvement in WTWs service in the US. is dominated by contract operations. Full privatization is still limited due to high costs in private financing relative to public financing. It is further complicated by the extensive risks and possible liabilities associated with the various environmental regulations private firms need to face once ownership of WTWs are assumed. Although the issuance of Presidential Executive Order 1992 on privatization (discussed in next section) has reduced the burden of repayment of federal grants during sales of public assets, many financial and regulatory uncertainties still prevail, preventing the move to full privatization.

Private sector participation in the form of public-private joint ownership has also been adopted in several new WTWs in the late 1980s. This form of ownership involves the financing of project through debt and equity, using either tax-exempt or taxable debt and private equity. Such financing arrangements were employed by 12 wastewater plants across the US. The Mount Vernon, Illinois Wastewater Treatment Plant provided a innovative illustration. In February 1986, after ten years of failing to conform with state and federal wastewater effluent standards at its wastewater plant, the City of Mount Vernon was put on restricted status by the EPA. All new commercial and industrial connections to the wastewater plant were banned until corrections were made, seriously affecting the city's ability to attract new business investment into the region. In order to implement the estimated $9 million upgrading project swiftly before new commercial development stalled completely, the city's Mayor entered into an agreement with Environmental Management Corporation (EMC) of St. Louis to form a public-private joint venture for the project. The decision to enter into a private-public joint venture was deemed superior for several reasons: There was a high level of public support, and complete privatization would not be attractive in the post-1986 tax reform era (see discussion in next section). Furthermore, because no federal funds or state grants was involved, the potential legal and financial risks of combining federal and private

funds in the same project were removed. EMC would help to finance, design, build and operate a 5 MGD expansion of the existing tertiary treatment plant under a 20 year contract while the formal ownership of the facility would remain with the city. The city had also secured a gaurantee from EMC that the plant would meet effluent standards for 20 years. The city would make a monthly payment to EMC for the service contract. The final financing structure of the project, worth $6.64 million in total, was as follows: $240,000 from EMC, $180,000 from interest on city's construction funds, and $6.22 million from industrial development bonds (IDBs) issued by the city. These IDBs were allocated from the state-pools of tax-exempt bonds by the Illinois Development Finance Authority because Mt. Vernon did not have enough IDB bond capacity under the 1987 cap. In essence, the city raised capital through bonds issuance and in turn loaned it to EMC for construction. The financing of the deal was made possible by a letter of credit issued by a Japanese Bank. In the event of a default, the city pledges both revenue from a sales tax increase and the full faith and credit of the city. The city council had also agreed to enact an 'ad valorem' property tax to raise additional revenue if necessary. This arrangement turned out to be a successful endeavor: the fixed-priced expansion project was completed three years sooner and at $3 million less than the alternative of relying solely on federal and or state grants [Ref 13, pp. 149-150, Ref 16].

5.3.3 Policy Evolution and Impacts on Privatization

That no definitive privatization policy - except the 1992 Executive Order on Privatization - was endorsed by the US. government, evolution in infrastructure privatization has been an opportunistic consequence of changes in national policies [Ref 13, Chapter 2]. Changes in national policies affected the methods in which WTW projects were financed, constructed and managed: The private sector has been quick in responding to policy shifts and in designing the appropriate type and extent of involvement. Two related developments are central to the national policy context: New Federalism and tax laws changes [Ref 14, pp. 43-46]. Table 5.2 summarizes the major policy events since 1948.

Several periods, each with distinct policy objectives, can be observed in the development of national policy relevant to wastewater treatment in the US.. 1948 marked the beginning of direct involvement of the federal government in the control of water pollution. Subsequent years until 1972 saw a gradual increase in federal commitments to fund the development of wastewater treatment plants in the US. During this period, the state and municipal governments and private industries (for on-site operations) were primarily responsible for wastewater treatment. The Federal Water Pollution Control Act Amendments of 1972 - known as the Clean Water Act -

Table 5.2 Policy Evolution and Implications for Wastewater Treatment Privatization in US

Policy Events	Policy Intention	Financial Implications
1948 First Water Pollution Control Act (WPCA)	First federal program to provide financial assistance to state and municipal governments to construct WTWs	Total loans $22.5 million annually for five years, limited to $250,000 or a third of total cost; grants for planning and design work
1956 Amendments to WPCA; again in 1961,1965	Increase total federal assistance to wastewater facilities	Total loans of $50 million annually for ten years, limited to $250,000
1966 Clean Water Restoration Act	- ditto -	Authorized grants of $3.5 billion for 1967-71; removed limit on loans and increase grant share to 40%.
1972 Amendments to WPCA (The Clean Water Act CWA)	Provide greater federal funding and a larger federal share of total project costs, based on the premise that WTW construction was a state and local responsibility Stricter discharge standards to be met in late 1970s	Total grants of $18 billion for FY 1973-75; federal grants account for 75% of planning, design and construction
1977 Amendments to CWA	More federal assistance made available; further strengthen role of state in management and implementation of water programs	Authorized grants of $5 billion annually for five years
1981 Amendments to CWA	Reduction of federal role in funding and management of national wastewater treatment policy	Authorized grants reduced to $2.4 billion annually ; federal share lowered to 55%; planning and design grants eliminated
1981 Economic Recovery Tax Act 1982 Tax Equity and Fiscal Responsibility Act	Provide tax incentives for private investors to enter capital-intensive public work sector	10% investment tax credit; tax exempt municipal bonds; accelerated depreciation schedule over five years
1986 Tax Reform Act	Raise capital cost of private financed projects, reduce availability of tax-exempt bonds	Eliminate the 10% investment tax credit, and accelerated depreciation accounting method
1987 Water Quality Act	Transfer financial responsibility to state governments: • federal government contribute in 80-20 ratio to establish state revolving loans in FY 1989-93 • federal government terminate all funding at FY 1994	$1.2 billion annually for FY 1989-90, then at decreasing amounts to $600 million by FY 1994.
1992 Presidential Executive Order on Infrastructure Privatization	Revitalize stalling privatization moves by state and municipal governments	Allow municipalities to sell WTWs constructed using federal funds to reimburse federal governments only the 'undepreciated portion' of grant

initiated a decade of heightened federal support for WTW construction with the initial intention of enabling local authorities to meet rapidly rising needs to comply with effluent standards by 1977. Large amount of federal funds were granted for the WTW construction in the next few years and by 1977, it had become the second largest federal domestic public works program. The emergence and proliferation of OM&M contracts in the late 1970s was partly a consequence of the high level of federal financial support which had prompted hundreds of cities and towns to build new, sophisticated WTWs. Private sector firms began to offer the technical capabilities needed to operate and manage these new facilities. However, concerns that state and local governments were

increasingly looking to federal grants as the major, if not single, source of funding for WTW construction began to surface amid increasing federal grants into 1980.

1981 was the turning point in the history of funding for WTW construction, initiating a move towards greater state and local responsibilities in financing WTWs. This decrease in federal dominance has been seen as a direct outcome of the shift in metapolicy - policy about how policy is to be made - towards a "New Federalism" that advocates that state and local governments should assume more responsibility of providing public services. Tax laws changes in 1981 and 1982 that accompanied the New Federalism movement created the possibility of privatization as an option to fund WTW development amid a declining federal support. The opportunity of using privatization to supplement traditional bond financing was quickly perceived and promoted by private firms in engineering, accounting and banking sectors. By early 1986, 2 privatized WTWs were already in operation and increasing numbers of cities were actively considering the privatization option.

The 1986 Tax Reform Act, however, caused a dramatic halt in the burgeoning privatization movement. The financial attractiveness of private financing in WTW projects ensured in the Tax Laws of 1981 and 1982 were immediately removed. Interests in privatization were revived with the issuance of 1992 Executive Order on infrastructure privatization, which formally promoted the concept of reimbursing only the 'undepreciated portion' of federal grants during the sales of public assets, including WTWs. In effect, this order has removed an important barrier to full privatization. The privatization of WTWs which emerged in the early 1980s has since undergone major changes as a result of a shifting, and at times, chaotic framework of national policies.

5.3.4 Privatization Decisions: Some Practical Considerations

During the 1981-87 period in which local authorities were exploring financial options to replace the declining federal grants to address wastewater treatment needs, 25 US authorities were formally considering the privatization options. This subsection summaries the main findings from two surveys of the 25 municipalities, identifying the constraints encountered and factors that had led to their final decisions on privatization [Ref 14, pp. 50-53].

All 25 local governments were confronted with the need to build new or additional treatment capacity, and privatizing the projects was one of the options considered. This option faced several barriers. Because privatization was a response to policy changes rather than a direct result of public policies, local governments faced additional problems beyond those usually related to public policy development and implementation. Four specific problems were encountered in the decision making process:

- Conflicting values and perceptions of the role of the private sector in providing services that were traditionally responsibilities of the public sector had to be resolved;
- Privatization within the existing regulations and institutional framework - the roles EPA, state environmental agencies, the municipal governments etc. - introduced new complications;
- Privatization was an innovative approach to financing infrastructure projects and was subjected to uncertainties in terms of tax laws and environmental regulations and so the local governments faced a complex burden of persuading the community about the economic viability of the option;
- There was a general lack of policy guidance from the national and state regulatory agencies and industry wide information relevant to the US.. The absence of precedents or experience with privatization in WTW increased uncertainties concerning project viability.

For those municipalities that decided to privatize, important factors were: economics, time, need for clean water, and unavailability of grants. The inability of the municipalities to deal with a complex set of economic, technical, legal, and political problems was also important in their decisions. On the other hand, economic uncertainties, risk, difficulties in dealing with private providers, and legal and political issues were identified as major impediments to those municipalities that decided not to adopt privatization. The "loss of control", uncertainties with future tax law, and political problems with buy-back ('de-privatization') provisions were other reasons for not privatizing. These findings indicate that privatization decisions emerged from an interplay of multiple factors and were discretionary in nature in the absence of an national privatization framework. The surveys further indicate that the final decision to privatize or not to privatize was, in large part, a function of the personnel involved and the institutional decision-making processes. The presence of a leading individual in the local government organization was common to those municipalities that opted for privatization.

5.4 PRIVATIZATION IN FRENCH AND MEXICO

5.4.1 The French Model [Ref 9]

Private sector participation in the water-sewage service industry has been long promoted in France, beginning in the nineteenth century. There are currently some 12,000 independent utilities operating in 36,000 municipalities or communes under different contractual arrangements with the local governments. Private water companies now supply about three-quarters and 40 percent of the French population with water and sewage services respectively. Typically, the infrastructure - the networks of underground pipes, treatment facilities, reservoirs - is owned by the municipal governments which enter into long term franchise agreements with private companies through a

wide variety of contractual arrangements. This mode of private participation is believed to promote a competitive market because it allows the municipalities to have a wide range of management and operation alternatives and access to numerous water service providers. Bidding for franchise contracts by private companies ensures competition and thus reduces the need to regulate pricing in the industry, unlike the case of UK. Franchise contracts also promote cost-efficient practices in the management and operation of the facilities as, in theory, the lowest bidder who can deliver the required quality of service will be awarded the project.

Three generic contractual arrangements are commonly used by French municipalities:

- In the concession arrangement, the private firm is involved in all aspects of the water services including the financing, construction, operation of the infrastructure, and the billing of services. A typical concession project will last between 25 and 30 years, and the contractor is expected to recover all costs and make reasonable return over the project lifetime.
- In an *affermage* (lease) contract, the municipal government finances and builds the infrastructure while the operation and management are contracted out to private companies, usually for a period of less than 12 years. Fees collected by the private contractors include the cost of operation and the profit to the contractors. A municipal surcharge is also imposed on users to recover the cost of capital investment.
- In the management and service mode, one or several specific aspects of management and operation are contracted out to the private sector while the municipal government retain the functions of fee collection. A contract of this nature typically lasts less than 10 years.

Under the first two contractual arrangements, the price of water services, including a price increase formula to take into account of changes in price of input factors, is fixed by the private contractors. Periodic reviews of price and procedure for claims by the contractor on incidental expenditure are usually included in the franchise agreement.

The water service in Paris city is outsourced via am affermage contract. In 1985, two contracts, one for the Left Bank and the other for the Right Bank of Seine River, were awarded to two separate companies. The contracts also included a major overhaul and replacement of the city's water-distribution system. The two contractors buy water from the municipal government and retail it to the consumers. The city government retains the task of water treatment and storage.

5.4.2 The Mexico City Experience

The Mexican Constitution states that municipal governments are responsible for providing urban water and sewage systems and services. This has led to a highly fragmented and inefficient water

industry in Mexico because the municipal water services have not been able to benefit from the economies of scale brought about by large water infrastructure. Furthermore, the price of water services has traditionally been suppressed by municipalities for fear of adverse political opposition to price increases. Municipal water services are thus generally weak in financial standing and lack the technical and managerial capabilities to operate the water facilities. As a result, inadequate water provisions are widespread. According a population census conducted in 1990, only sixty-one percent of the sixteen million households have access to wastewater drainage systems and less than fifteen percent of the wastewater is treated before disposal, causing heavy pollution in most internal waterways. A new water law was passed in December 1992 by the Congress to open the water service industry to the private sector. This law calls for the establishment of water rights that can be traded in the open market. Basin authorities that consolidate activities of the municipal water utilities were also created to promote a less fragmented water industry. A new tax on untreated discharge into the waterways was also introduced to finance development of sewage treatment facilities [Ref 12].

Water problems in the Mexico City illustrate the situation that the Mexican water industry is facing. Mexico City, with a population of about 16 million, lies in a closed valley at an elevation of 2,200 meters above sea level. It was an island city at the time of the Spanish occupation. Today, the lake has effectively disappeared after centuries of water exploitation and land reclamation. Currently, the heavy rainfall Mexico City experiences throughout the year has to be drained completely or the city may risk becoming a lake again. However, the city suffers from acute water shortage because the aquifer under the city can no longer sustain its high water consumption rate - at an average of 360 liter per day per capita compared with 200 liter per day per capita in most European cities - and water import from outside the region is too costly to be politically viable. On one hand, the rain water is not captured because of lack of storage facilities within the region. On the other hand, ill-managed tariff structure and deteriorating water networks resulted in large water wastage - more than thirty percent water loss is estimated in the network. Water services are charged on a fixed-fee basis that does not varies with the level of consumption. Furthermore, no water meters are installed to measure water consumption, although recent price reform has called for billing of services on volumetric basis [Ref 12]. The situation is that of a "low-equilibrium-trap": Under-priced services and revenue loss due to severe leakage in deteriorating system leading to weak financial position of the municipal water services - The Federal District government of Mexico City currently runs an annual cash deficit of some $400 million. Poor financial situation results in under-investment in maintaining and expanding the water service infrastructure.

The Federal District government of Mexico City began to adopt a new plan to combat the city's water service problems in late 1980s. The new strategy calls for the implementation of universal consumption-based billing and the improvement of water distribution infrastructure. The private sector was invited to participate in this new plan. However, because private ownership of the water infrastructure is deemed politically unfeasible, privatization can only be implemented to a limited extent. As a result, the management contract approach was adopted while the city government retain the ownership of the infrastructure and the responsibilities in dealing with the politics of pricing water services. The management contract was structured into three phases to gradually overcome the abject conditions of existing systems and to give the city government opportunity to learn-by-doing. In the first stage, the contractor would undertake the installation of water meters and the registration of water consumers in order to establish the complete consumer database. The second phase involved billing and fee collection from the consumers according to the amount of consumption. In these two phases, the contractor would be paid for specific tasks accomplished. In final stage, the private company would buy water from the city government and sells it the end-users. It would also be in charge of managing and maintaining the water infrastructure. The arrangement thus approaches that of the affermage (lease) contract of France except that the municipal government controls the retail price that the private company can charge for water consumption [Ref 12]. In March 1992, management contracts for water service in four city zones within Mexico City were awarded to four industrial consortia each comprising French, British, and Mexican companies.

The acute problems of water shortage and expected price increase had also led to involvement in smaller scale water treatment project from industrial water users [Ref 4, pp. 102, Box 5.2]. In 1989, a group of companies in the Vallejo area of Mexico City established an innovative source alternative to water supplied by the municipal government. The industry groups realized that adequately treated sewage could provide a cost-effective and reliable substitute to clean water for industrial purposes and at the same time improving the environmental quality by treating wastewater. A private company, Aguas Industriales de Vallejo (AIV), was formed with 26 companies contributing a total equity worth of $900,000. AIV took over and rehabilitated an old wastewater treatment plant from the municipal government under a 10 year concession contract. This contract allows AIV to withdraw up to 200 liters of wastewater per second from the municipal sewer network. The plant now produces about 60 liters per second to the shareholders and 30 liters per second to the government as payment for the concession. Treated water is sold to shareholder companies at a price 25% lower than that charged by the municipal government (at $0.95 per cubic meter in 1992). AIV has planned to double the capacity by 1997 at an estimated cost of $1.5 million.

5.5 INFRASTRUCTURE PRIVATIZATION IN CHINA

5.5.1 China's Infrastructure Needs

Rapid economic growth since the onset of economic reform in the late 1970s has created tremendous demand for all forms of infrastructure services in China. China well understood that in order to sustain its economic development, the capacity and conditions of existing infrastructure have to be expanded and upgraded. The World Bank estimated that China has invested an increasing amount in its infrastructure since 1990 (Table 5.3). A total investment of about US$ 700 billion, or about 7.4% of its GDP, is further needed to meet demand in the period of 1995-2004 under World Bank's base case scenario [Ref 6]. Investment in water and sanitation alone will account for about US$ 10 billion annually. Realizing that it cannot meet this massive investment on its own, the Chinese government began to open the infrastructure sector to foreign private participation in the past few years. However, it is questionable that if World Bank's projection can be met, especially when policy uncertainties in China have halted progress in foreign private sector involvement.

Table 5.3 Infrastructure Investment in China (World Bank)

	Actual and Required Infrastructure Investment in million US$				
	1990	1991	1992	1995-2004 (base case)	% GDP
Power	7,667	7,710	9,732	200,000	2.0%
Telecommunications	1,161	1,463	2,634	141,000	1.4%
Transport	5,820	7,655	10,100	302,000	3.0%
Water & Sanitation	1,382	1,599	2,171	101,000	1.0%
Total	16,030	18,427	24,637	744,000	7.4%
% of GDP	4.1%	4.5%	5.1%	7.4%	

Reference 6, Annex, Table 2 and 3, pp. 23-25.

5.5.2 Concept of Privatization in China

The motivation and concept of privatization in China were distinctively different from that in Eastern Europe or South America [Ref 25]. Privatization in China first began in the state-owned-enterprise sector in the late 1980s as a primary means to tap into the rich capital reserve of Chinese population. In Chinese government's eyes, private citizens in China, with a total savings of US$ 310 billion by end of 1992, are collectively too rich. Private control of such large financial resources has also been seen as a potential political threat to the government. Through privatization, the Chinese government hopes to absorb these resources into the enterprises for productive investment. In order to reconcile this approach with the Marxist principle that demands state ownership of production facilities in the enterprises, the Chinese government adopted a 'limited privatization' approach in that it retains a controlling stake of between 51% to 80% of the enterprises listed in the two stock exchanges in Shanghai and Shenzhen. Under such

arrangements, no state assets have been sold per se, instead, private capital has been brought under state control. In the infrastructure sector, similar principles of privatization apply. The Chinese government has a clearly stated policy that, except for BOT arrangement, prohibits foreign private investors from the exclusive ownership and control of crucial infrastructure services that have major impacts on the livelihood of the population. For example, a thirty percent ceiling is placed on foreign equity ownership of power companies whether the foreign investor is buying into an existing facility or forming a joint venture to develop new ones [Ref 19].

Privatization - or more precisely private sector involvement - in China is thus primarily a move to gain access to private financial resources, both domestic and foreign, for its massive investment needs. Access to foreign technology and managerial expertise is more a 'by-product' of this process. The central government and the respective ministries - such as the rail and power - are in general, very reluctant to relinquish total control of infrastructure facilities to the private sector. Although a good number of BOT projects are well underway, the Chinese government began to exercise more caution and restraint in awarding new BOT projects in late 1994.

5.5.3 Privatization Approach

The Chinese has attempted several approaches to 'privatizing' its infrastructure sector with different degree of success:

- Central Government, Municipalities and Ministry Bonds

  Shortfalls between state budget and actual financial allocation to the various ministries involved in infrastructure sector prompted the ministries to seek funding beyond the traditional resources. The Railways Ministry, most adversely affected by insufficient central funding, resorted to domestic bond issues to meet its investment needs. For the first time in the PRC history, the Railway Ministry issued RMB 2 billion worth of domestic bonds in August 1992. Provincial governments have also taken liberty to raise funds through bond issues in international capital markets. For instance, the provincial government of Guangdong raised a total of US$ 343 million of infrastructure related bonds in the financial markets of Hong Kong, Tokyo, and London between 1986 and 1992. At the same time, the ministries and provincial governments have also advocated joint-development and management of infrastructure projects [Ref 26].
- Fund Raising in Overseas Stock Exchanges

  The Chinese government has also experimented, albeit being mildly successful, with raising funds for state enterprises in international stock markets. Two power companies, Huaneng Power International and Shandong Huaneng Power, were listed in the New York Stock Exchange in mid 1994. The intention was to consolidate regional smaller power plants to form

new companies and sell a minority stake of these companies to generate cash for expansion programs. This approach, if well received, would be used for other infrastructure enterprises to raise badly needed capital in future. However, the outcome of this first attempt by the Chinese government was disappointing. Even after last-minute cuts in issue prices, the market still found the shares too expensive. The initial public offerings were undersubscribed. Huaneng Power for instance, raised US$ 243 million less than expected. Shares of these two companies have been trading below their offer prices, with Shandong Huaneng trading at $11 (issue price of $14 at price earning ratio of 12.4 times 1995 earnings) and Huaneng Power at $15 (issue price $20 at price earning ratio of 13.9 times 1995 earnings) [Ref 20], reflecting weak markets perception about the likely performance of the two companies.

- Foreign Joint Ventures and BOT

  This category represents more extensive private involvement in infrastructure in China. Formation of equity or cooperative joint ventures with Chinese enterprises or local governments were encouraged by the infrastructure ministries. The most 'complete' form of private sector participation in China is the BOT approach. Till date some ten key infrastructure projects under BOT arrangement were being implemented [Ref 17], the most frequently cited one being the US$ 2.3 billion Shajiao B and C power plants in Guangdong province, undertaken by famous Hong Kong developer Gordon Wu's Hopewell Holdings.

5.5.4 Regulatory Regime of Privatization and Major Problems

Traditionally, the Chinese government has had absolute control over the construction, financing, operation and management of all infrastructure sectors. Foreign investors were generally barred from participation in these activities. A policy shift took place in the early 1990s when China began experimenting with opening its infrastructure sectors to foreign investment. However, there is currently no national-level legislation to regulate and guide private investment in the infrastructure sector. All joint ventures and BOT projects were reviewed on a case by case basis, often subject to discretion of the officials involved at various stages of the approval process. To address this policy inadequacy, the State Planning Commission, hoping to promote and expand the adoption of BOT through clearer policy guidelines, began drafting a legal framework to regulate BOT projects in early 1995 [Ref 23]. The evolution of privatization policy and regulations again reflected the 'learning-by-doing', 'experimentalism' approach of policy making in modern China. The existing regulatory framework is at best fragmented, attempting to address specific aspects of private infrastructure projects in an incomplete manner:

- Institutional Setting and Project Application Process

  As noted, direct foreign private sector participation in China's infrastructure project has taken the form of BOTs and joint ventures with state enterprises. These entities are governed by a

multiple levels of, sometime overlapping and conflicting, authorities. The state enterprises providing infrastructure services falls under the jurisdictions of the various ministries: Ministry of Electricity for electricity generation, transmission and distribution; Ministry of Communications for roads, airports, ports, and docks; Railways Ministry for rail transportation; Ministry of Post and Telecommunications for telephone network and exchange. The State Administration for Exchange Control (SAEC) on the other hand, regulates and approves the associated foreign borrowings. The State Council, through the State Planning Commission, is the supreme authority in governing infrastructure privatization in China. Application for projects that involve foreign investors - joint ventures or BOT - begins with the submission of proposal to the relevant ministry. If accepted, the proposal is submitted to the State Council for further review. Preliminary approval may be granted. A formal feasibility study, environmental impact assessment, and if relevant, joint venture contracts, are all submitted to the central government - the State Council and/or State Planning Commission - for another round of review. Negotiation of BOT projects typically take place at all the levels - the local government, the ministry, and the central government. The whole application process is thus very time consuming and can take as long as three years, especially when clearly defined policies and regulatory guidelines are nonexistent [Ref 17, 21]. In theory, foreign investment in infrastructure projects - such as small scale power plants - under US$ 30 million are subjected to very little central control. However, it has been observed that the central government has become increasingly involved in these small scale power projects [Ref 18]. This lack of a systematic, transparent and definitive policy and legal framework is the primary impediment to privatization in China. Lengthy proposal approval process, high degree and often haphazard central interventions, and cancellation of projects due to policy shifts are characteristics of the absent of consistent regulations. Inefficiency results because of too much bureaucracy and too many actors involved in a typical application process. There is also a lack of policy coordination between privatization and other macroeconomics policies: price control and subsidies makes it extremely difficult to correctly price infrastructure services; uncertainty with tax regulations increase project risks; macroeconomics policy of stabilizing inflation slows the progress of privatization in major cities etc.

- Control over 'Rate of Return' (ROR)

  The uneasiness with foreign investors extracting too much profit out of investments in China has prompted the Chinese government resorting to restricting projects' ROR - the maximum annual profit permitted as a percentage of total investment. The current ROR ceiling is between 12% to 15%. However, most foreign companies feel that this range is too low to justify the risks associated with investment in China. Chinese authority in effect dictates projects' ROR by its control over prices of fuel, raw materials, other input, and the price of service the project

can charge over the contract duration. ROR for individual project is negotiated on a case-by-case basis. The Chinese government claims that foreign investors are not penalized by the cap on ROR because preferential tax treatment and cost saving options the investors can pursue will still ensure reasonable returns [Ref 19]. This deliberate restriction on ROR has disgruntled international investors, some of which began to lose interests in China.

- Control over Government Guarantees

  In the initial years of foreign private participation in China's infrastructure sector, SAEC permitted certain institutions to issues foreign exchange guarantees to foreign investors. This is allowed under the Administrative Measures on the Issue of Foreign Exchange Guarantees to Foreign Parties by Domestic Institutions approved by the People's Bank of China and promulgated by the SAEC in 1991 [Ref 21]. The Chinese guarantor, typically a local government, pledges its foreign currency reserve against the investor's foreign currency obligations in the event that the investor could not meet them. In practice however, such guarantees were seldom granted in the past, and the central government ceased awarding guarantees to foreign loans in late 1994 [Ref 17]. Instead, some foreign investors have requested and accepted assurances from local authorities that they will be able to exchange sufficient foreign currencies at official swap centers to make payments to international creditors and stockholders. However, these promises by local government are not generally not favored by international bankers because they are not honored by the SAEC.

- Control over Foreign Borrowings

  The central government maintains tight control of financial transactions that involve foreign exchange and borrowings as a means to regulating its foreign indebtedness and controlling its foreign exchange reserves. Foreign borrowing plans of enterprises and projects - other than BOT - must be incorporated into overall borrowing programs of the relevant ministries prior to submission to the SAEC and the State Council for approval. The central government also exercises tight control over domestic money supply and exchange rates. Current rulings prohibit foreign banks - including its Chinese branches - to make loans denominated in RMB to enterprises and projects [Ref 21].

- Problems with Pricng of Services

  Infrastructure services, like other amenities, have been heavily subsidized by the Chinese government. In the short run, pricing of services based on total cost approach would undoubtedly increase the cost of living and risk further inflation in an economy that is already overheated. Pricing the services to reflect total economic cost, including a reasonable return for foreign investors, is certainly a tough call on the part of the local and central government. That many institutions and enterprises closely associated with the government or the CCP do not always pay for services such as electricity and water further compounded the difficulties of

pricing. Furthermore, it is not uncommon that projects do not have the flexibility of adjusting the price to reflect rising construction and operating costs due to rapid inflation in the country. All these issues associated with pricing add to financial risks of the projects [Ref 20, 26]. Furthermore, no clear sector-wide pricing policy for services such as power exists. Power rates are reviewed annually by local administrations, subjected to government interventions at all levels. The pricing policy has no regard for the two power companies that are listed in the New York Exchange, adversely affecting investors' perception of the two companies.

- Monopolies of Infrastructure Ministries

  The infrastructure ministries are structured as huge state monopolies based on the Soviet models. While maintaining control over vital services to the economy, they are resistant to the new concepts of ownership, operation and management that privatization calls for. In order to realize long term benefits of privatization due to efficiency gain, sector wide industrial reform and promotion of competition are imperative. However, these policies are difficult to implement under strong influence of the infrastructure monopolies. For example, the Railway Ministry officials refused to accept the proposition that it can be incorporated into a joint stock companies, and the Ministry of Post and Telecommunications is unwilling to give up its exclusive franchise to operate the country's telephone network [Ref 26].

- Competition among Sectors

  The infrastructure sector will continue to face challenges in obtaining sufficient financial resource to meet its colossal investment needs. Not only that infrastructure development has to compete with other sectors such as the publicly listed SOEs, there are also intense competitions within the sector among the different services. Under such scarce resources, only the more critical need that are imperative to economic development - services such as power and transportation - would be given priority at the expense of 'less important' services such as sanitation services. Regionally, competitions for private sector resources are also intense. The World Bank estimated that East Asian countries[2] will need a total of US$ 1,509 billion of infrastructure investment in the period of 1995-2005 [Ref 6, Table 3, Annex, pp. 25], of which China will take up about 51%. Availability of international financial resources will not be unlimited, and policies and political uncertainties in the China will further constraint the flow of international capital into the country. The apparent alternative to this constraints is to rely on domestic capital market, which however, is still under developed at the moment.

In view of the broad range of uncertainties and risks related to infrastructure projects in China, foreign private investors are actively seeking various innovative arrangements to minimized project

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2 Include China, India, Indonesia, Korea, Malaysia, Philippines, Thailand, Cambodia, Fiji., Kiribati, Loa PDR, Mongolia, Myanmar, Solomon Islands, Tonga, Vanuatu, Vietnam and Western Samoa.

risks. In the case of power projects, some investors were able to secure 'off-take' contracts in which local utilities - often the project partner - agreed to buy substantial portions if not all of the electricity generated at predetermined prices. This is an effective contract arrangement in shielding against undue uncertainties. Some power projects had succeeded in obtaining commitment from local authorities to subsidize the difference when fuel price exceeds a certain level. Another approach to reduce overall project risks involve the use of 'land grants': Foreign investor were given land rights to develop and operate facilities on land in the vicinity of the projects in order to broaden the revenue base and thus making the project more attractive financially.

5.6 KEY LESSONS LEARNED

Various forms of privatizing infrastructure, have been used primarily to gain access to the financial resources of the private sector. Efficiency gains, however, are not natural benefits that come with private sector participation. Broad sector and policy reforms that promote market competitions are needed to realize efficiency in construction, operation and management of infrastructure services. Political objectives are also determining factors in the form, nature, and progress of privatization. The international cases have shown that private sector participation, when well-conceived, coordinated with economic policies, and effectively executed, can be a viable policy option to provide for environmental protection infrastructure such as sewage treatment systems. Depending on the state of existing sewage systems, domestic market structure/conditions and regulatory framework, contract operation-maintenance-and-management (OM&M), concessions, or lease arrangements are the most widely adopted form of privatization of sewage treatment works.

UK experience in England and Wales has demonstrated the importance of policy coordination in privatizing wastewater treatment, which was part of a well planned and implemented national privatization program. The establishment of an economic regulatory agency with clearly defined responsibility and authority - the OFWAT - is instrumental to the success of privatization of water services in England Wales. OFWAT's pivotal roles in balancing the various objectives and constraints ensure that concerns of all players - the environmental regulators, the water companies, and the consumers - are taken into account in the economic regulation process. Another important lessons is that relevant authorities have to anticipate and be prepared to deal with increases in service price after privatization. In the absence of a national privatization framework, private sector involvement in the wastewater treatment industry in US took place as a result of private sector response to changes in federal funding policies and environmental regulations. The private sector played an active and leading role in providing creative solutions to the operation and management of municipal wastewater treatment works. In some instances, as exemplified by the municipality

of Mt. Vernon, creative financing arrangements by local governments are critical to privatization efforts. The US experience also reinforced the importance of consistent regulations in promoting privatization: The abrupt change in tax regulations in 1986 almost halted burgeoning private interests in water treatment works immediately. Nevertheless, US experience has indicated that importance of a technologically and financially vibrant and resourceful private sector in privatization cannot be over emphasized. Historical involvement of France's private sector in water and wastewater provisions and example Mexico City's further illustrated that privatization, with the various arrangements, can be tailored to meet specific needs and situations.

Infrastructure privatization experience in China again illustrates the potent influence of factional politics and the spirit of experimentalism characteristic of all Chinese policies. Privatization has been seen by the Chinese government as a mechanism that serves the sole purpose of tapping into domestic and to larger extent, foreign financial resources. The Chinese government, though in rather desperate demand for infrastructure investment, is still grappling with the need to ensure a reasonable return demanded by foreign investors. The Chinese government's mistrusts of foreign investors in BOT and joint ventures projects have ironically made concession and lease more acceptable forms of privatization to them. Nevertheless, the lack of consistent policy framework and coordination will continue to discourage growth in foreign involvement in China's infrastructure sector.

To sum up, international experience has demonstrated that various forms of private sector involvement, when well implemented, can provide effective solutions in meeting wastewater treatment needs in both developed and developing countries. The roles of foreign private sectors are especially important in providing financial and technical alternatives to developing countries when domestic private sector cannot adequately address the needs on its own. A transparent, stable, and well defined regulatory regime is imperative to successful privatization. Appropriate pricing of services to reflect total cost and ensure a reasonable return on investment for private investors remains one of the most difficult aspect of privatizing infrastructure services.

CHAPTER 6:
POLICY IMPLICATIONS

The central question posed by this thesis is whether privatization is an effective policy option to address water pollution due to untreated urban wastewater in China's coastal cities. Identifying the necessary policy and regulatory regime that would promote the privatization of wastewater treatment facilities becomes a natural extension to the central question. Based on the studies and analyses presented in earlier chapters, this chapter outlines a number of broad policy implications for privatizing wastewater treatment in Guangzhou city.

6.1 PRIVATIZATION AS A FEASIBLE POLICY OPTION

Decades of political and economic activities that paid no regard to the environment have resulted in the multitude of environmental problems confronting modern China. Although the Chinese government has begun to address these problems, environmental objectives remain subservient to economic development. The wealthy and economically vibrant coastal 'opened' cities and Special Economic Zones suffer from an array of environmental problems as a result of rapid urbanization and industrialization. In Guangzhou city, a substantial amount of residential wastewater is not treated before being discharged into tributaries of the Pearl River, thereby posing serious health and environmental threats to the city's 6 million population who rely heavily on the Pearl River for drinking and industrial water.

Although well-established technologies for treating residential sewage exist, current environmental policy and government commitment remain inadequate to provide the necessary sewage treatment infrastructure. Experience in other countries has demonstrated that by mobilizing resources - financial, technological, and managerial - from the private sector, privatization is a policy option that could enable technological solutions to address water pollution due to untreated urban sewage. The wealth of the coastal cities, including Guangzhou, offers potential financial resources to address urban environmental problems.

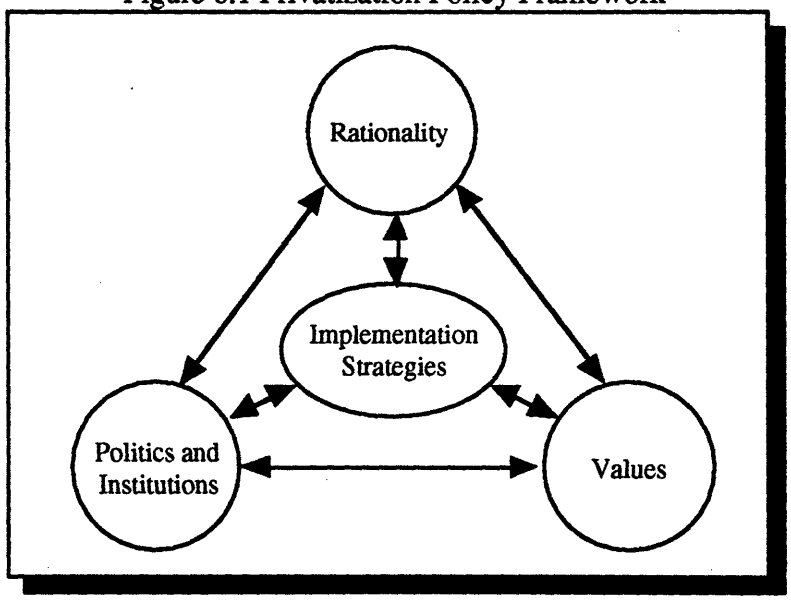
However, not all forms of private sector participation are applicable to providing sewage treatment infrastructure in China. International experience has demonstrated that small-scale (on the order of tens of million US dollars) lease and concession contracts, in which the state or municipal governments retain ownership of the infrastructure, are the most promising. Ironically, China's initial attempts with 'mega' BOT (Build-Own-Transfer) infrastructure projects provided a strong argument that small-scale, lease and/or concession contracts might be a better way to pursue

privatization from the start. In the long run, provided that clearly defined and enforceable policies are in place, the involvement of the private sector and the employment of market principles will ensure sufficient and efficient technological solutions to wastewater problems in China's coastal cities.

6.2 POLICY FORMULATION FRAMEWORK

Given the deficiencies of environmental policy and the absence of a national privatization plan in China, three complementary categories of issues need to be identified and addressed in order to ensure the success of privatizing sewage treatment infrastructure in Guangzhou. These factors form integral parts of the privatization strategy, which must provide rational solutions that are implementable in the political and social context of China. By reconciling differences in the *value* system and promoting the appropriate values, the importance of privatization and the environment in China's long-term economic development could be inculcated. The recognition and implementation of *rational solutions*, both economic and technological, will ensure that the application of limited financial resources is optimal and sustainable in the long run. *Institutional transition* towards a decentralized decision-making and effective regulatory regime must take into account political realities in China. Preparation in these three categories of issues will set the stage for an effective implementation strategy. '*Rational incrementalism*' will be the key theme of the implementation strategy that seeks to attain gradual privatization, promote the mobilization of domestic resources, increase environmental awareness of the populace, and enhance the technical capability of environmental agencies. The following sections will discuss the policy implications in greater detail. Figure 6.1 summaries the policy formulation framework.

Figure 6.1 Privatization Policy Framework



6.3 Implications for Value Systems in China

Environmental planning and protection and private sector participation in infrastructure services will become ever more important in China's economic development. Although the Chinese government has attempted to manage environmental problems and privatize infrastructure services, current efforts are still incomplete and plagued with inconsistencies. On one hand, national environmental policies are not carried out with due diligence in coastal cities such as Guangzhou. On the other hand, the Chinese government's unease with foreign investment has constrained the move towards infrastructure privatization. The Chinese government needs to reconcile these apparent contradictions and develop consistent and realistic expectations regarding environmental management and infrastructure privatization. In essence, the Chinese government should learn from and build on its past experience with these two policy endeavors. The promotion of appropriate values are fundamental to the overall development of environmental management and infrastructure privatization in China.

- Environmental Objectives and Economic Development

  Because environmental objectives have been subservient to economic development, enforcement of environmental policies has been lax, if not neglected, at the grassroots level. Lack of commitment by central and local governments in environmental infrastructure has also led to insufficient investment in treatment facilities for urban sewage. On the other hand, two decades of development and rationalization in environmental policies have seen more coordinated and heightened efforts to addressing these problems. Beyond the promulgation and enactment of laws and policies, however, the Chinese government needs to further its commitment to treating environmental management as an integral part of economic development. Barriers to the effective implementation and enforcement of environmental policies at the grassroots level must also be identified and overcome. The potential environmental, health and aesthetic benefits that can be brought about by improved water quality in the Pearl River provides strong justification for investing in environmental infrastructure, i.e. sewage treatment facilities in Guangzhou.

- Political Ideology and Ownership Issues of Privatization

  The Chinese government's insecurity with foreign private control of major infrastructure facilities has slowed the progress of infrastructure privatization. From the perspective of the China's central government, state sovereignty and the authority of the CCP are threatened or compromised on two counts: First, temporary foreign ownership of strategic infrastructure such as huge power plants and ports through BOT arrangements, will 'weaken' the 'absolute' power of the CCP; secondly, that the Chinese government would have to yield to demands by foreign investors for high rates of return represents a compromise by the CCP of the Chinese

people's 'dignity'. These differences in ideological values need to be reconciled before a consistent, long-run privatization plan can be formulated in China.

- 'Incrementalism' and 'Experimentalism'

  An abrupt deviation from the communist ideology threatens the stability of the CCP and thus considered to be politically unacceptable. China's central government has thus adopted an incremental approach in experimenting with western economic concepts and policy methodologies. This approach, although not without shortcomings, has provided a number of benefits to China. Through gradual adaptation of western principles to suit local contexts, apparent conflicts inherent in different ideologies have been resolved and overcome. On the whole, the Chinese government has exhibited a gradual transition towards a more rational and systematic approach of managing its economic development and other aspects of social improvements. This spirit of 'rational incrementalism' should be further promoted in the privatization of environmental infrastructure.

- Envisioning and Sector Plan

  A sectoral 'vision' for the treatment of urban sewage needs to be developed and communicated, detailing tentative objectives of where (locations), how much (capacity), what (treatment options), and when (implementation schedule and priority) urban wastewater treatment facilities should be constructed and how these activities could be financed. This sectoral vision must incorporate realistic assessments of (i) the interrelationship of economic development, urban wastewater and its environmental impacts; and (ii) the availability of funding, by identifying the private resources that can be tapped and the reasonable rates of return necessary to attract both domestic and foreign financial resources. This sectoral plan must be complemented by a consistent environmental regulatory framework and general guidelines of the role the private sector can play as the plan evolves. This commitment to pursue reform in a definite direction, albeit without implementation details, will at least convey more certainty and stability to prospective private investors. To successfully develop a sectoral vision for the privatization of sewage treatment infrastructure, the highest echelon of the CCP leadership must be convinced that pollution due to untreated wastewater must be checked and that small-scale privatization offers an attractive, feasible options to address this problem.

6.4 THE RATIONAL APPROACH

While the assessment of China's political value system provides an appreciation for the context in which an effective implementation strategy must take place, rational planning and decision-making will ensure that limited financial resources can be utilized in an efficient and sustainable manner. Two aspects, technological and economic, are essential for consideration.

6.4.1 Technological Rationality

A brief assessment of wastewater treatment technology indicates that a variety of options exist for the removal of organic materials in residential wastewater. Engineering decisions, supported by well-founded scientific research and analysis, are key to the cost-effective implementation of technology options in addressing untreated wastewater in Guangzhou. The main questions that need to be answered in order to implement technological solutions are the type, location, capacity, performance characteristics, and timing of construction of treatment facilities. Two important considerations are as follows:

- Integrated Approach to Planning

  An integrated approach that attempts to understand the various parameters and their interrelationship associated with problems of urban wastewater should be adopted in order to determine the optimal approach of implementation. These parameters include economic and population growth, urban housing development, water consumption patterns, the cost of fresh water treatment, geographic distribution of wastewater, regional environmental and health impacts, existing sewer networks in the cities, possibilities of reclamation and reuse of wastewater. This approach will ensure prioritized problem-solving under the constraint of limited financial resources. Research and analysis into these parameters will provide the scientific foundation for well-informed decision making.

- Dynamic Strategic Planning Approach

  A flexible approach that allows for stagewise implementation, instead of an extensive, rigid, and expensive treatment master plan, should be adopted. Continuous performance monitoring and research on environmental and health impacts of wastewater after treatment has begun will provide better information for further decisions. This approach should be coordinated with the implementation of privatization policy, so that the first few treatment projects can provide the basis of learning for future development.

In short, the planning and implementation of technological solutions for treating wastewater in Guangzhou is based on a Dynamic Strategic Planning (DSP) Model [Ref 1, Chapter 16], an approach highly appropriate when confronted with tight budget constraints, and technological and policy uncertainties. Integrated planning will also ensure that the most cost-effective solutions are executed. One likely implementation strategy may be as follows: conduct scientific research on environmental and health impacts of wastewater, establish priority locations and treatment levels, build chemically-enhanced-primary-treatment plants in priority locations, continue to monitor performance and environmental conditions, decide on further action - such as building secondary treatment plants on existing ones and/or new primary treatment plants in new locations - after sufficient scientific information is gathered and analyzed.

6.4.2 Economic Rationality

Providing for infrastructure services, whether by public, private, or public-private entities, involves the utilization of scarce economic resources in the communities. As far as possible, the levels of services should reflect an efficient utilization of resources, and the services should be priced to reflect the opportunity cost of providing the services. Economic analyses of wastewater treatment projects should incorporate these considerations in order to fully understand the trade-offs involved in making engineering decisions. That economic objectives are fundamental to privatization provides still further justification for adequate economic analysis and appropriate pricing. Two economic issues are considered here: the concept of economically optimal level of wastewater treatment [Ref 2, Chapter 4] and the pricing of services:

- Optimal Level of Treatment

  An integrated and dynamic approach to the engineering decision process will allow identification and implementation of the most cost-effective technological solutions to treat wastewater. To ensure economically efficient implementation, the total benefits of wastewater treatment, expressed in monetary terms, also need to be assessed. Theoretically, an economically optimal solution exists when the marginal cost of wastewater treatment equals the marginal benefit of treatment [Ref 2, Chapter 4] and neither too little nor too much treatment will be performed by the community. It should be noted that this optimal level will change over time due to changes in human activities, environmental awareness, availability of water resources, and regenerative capacity of the environment etc.

  To assess the potential benefits of wastewater treatment, an economic valuation has to be conducted at the same time as the scientific research is being carried out. The 'use value' components of total benefits include potential irrigation value of clean river water, potential savings of fresh water treatment cost, fisheries loss prevented, potential savings on medical expenses and time lost due to health problems, improved aesthetic value of clean river water and the aquatic environment, increased recreational value from rivers, etc. Other more difficult and controversial nonuse values associated with wastewater treatment such as option value and existence values can also be expressed in monetary terms [Ref 2, Chapter 9]. Several methods are available for the valuation of benefits associated with wastewater treatment. These include the productivity loss method, the hedonic pricing method (that assesses changes in property values due to changes in river water conditions), travel cost method, and the contingent valuation method [Ref 2, Chapter 10]. It should be noted that these valuation methods can sometimes only provide indicative estimation of economic benefits and decision-making based on the outcomes of such studies often requires a judgment call on the part of the policy makers.

- Pricing of Services

  Three issues related to pricing are considered here. First, appropriate pricing of infrastructure services is essential to ensure that capital, operation, maintenance, debt service, and administrative costs are recovered. Inadequate and deteriorating conditions of infrastructure services in many developing countries are symptoms of a 'low-level-equilibrium-trap' as a result of insufficient pricing. The user charge approach to cost recovery is an appropriate means to finance wastewater treatment facilities [Ref 3, pp. 15].

  Second, although studies have indicated that consumers in many developing countries have expressed sufficient willingness to pay for improved infrastructure services, it is difficult to assess a fee on wastewater treatment. Potential benefits of treating wastewater typically do not have an immediate, direct impact on consumers, unlike that of sewer networks that help to get sewage 'out-of-sight'. The difficulty of metering wastewater also makes pricing wastewater treatment difficult. Instead, sewage treatment and disposal charges are typically bundled with water bills to the domestic consumers. Such an arrangement is justified, as the level of water consumption is often a good proxy for the quantity of wastewater generated [Ref 4, pp. 70]. The user-pays principle should thus be adopted in pricing sewage services, albeit indirectly, to sustain treatment operations and to communicate the right incentives to users [Ref 4, pp. 16].

  Third, an additional refinement could be made to the pricing of sewage services. Marginal cost pricing that reflects the incremental costs of providing an additional quantity of service could be practiced. The components of marginal cost include marginal environmental cost, marginal operation and capital costs, and marginal resource depletion cost [Ref 4. pp. 12].

The relatively wealthier consumers of Guangzhou city provide a strong justification for appropriate pricing of wastewater treatment services. In addition, regulatory reform must complement these economic considerations to ensure success in privatization of sewage treatment.

6.5 Political and Institutional Implications

Institutional and regulatory reforms are necessary to complement the promotion of appropriate values and the employment of rational principles in planning and executing the privatization of the sewage treatment infrastructure. Institutional development in two interrelated policy areas, environmental planning and privatization, are necessary. Although China has made considerable progress in rationalizing its environmental laws and regulations and in incorporating environmental planning into economic development, enforcement still falls short of being effective at the grassroots level. China's early attempts at infrastructure privatization have proven to be acrimonious both for itself and for foreign investors because of the lack of consistent and

transparent policies and heavy-handed intervention by the central government. Several principles must be considered in formulating the appropriate policy regime and institutional setup:

- Gradual Decentralization

  Gradual decentralization has to take place in both the management of infrastructure services and approval of privatization projects. Implications for the latter are discussed below. Decentralized infrastructure management ensures that local government and utilities have more authority and flexibility to implement technological solutions according to variations in local economic and environmental conditions. In other words, greater autonomy can promote better responsiveness and sensitivity to local needs, and the benefits of technological and economic methods outlined above can be maximized when tailored to meet local demand. In many aspects, economic development in the coastal cities and the enforcement of environmental policies in China is already evolving along this direction out of necessity (Section 4.6). However, as discussed above, decentralization of infrastructure management should take place in the context of existing political ideology, power structure and institutional arrangement (with respect to the various ministries, regulatory agencies, and governance structure). Decentralization should thus occur gradually, in pace with the overall reform in China's political and economic system.

- Strengthening Implementation of Environmental Law and Policy

  To ensure that decentralized, autonomous utilities carried out their tasks of providing adequate treatment services, the implementation of national environmental policies has to be strengthened. The central government should retain the responsibility of providing basic environmental policies guidelines - including the pricing of wastewater and water services - and develop a legislative framework for enforcement. Specifically, the central role of national environmental planning and the legislative and enforcement authority of NEPA should be strengthened. The authority and responsibilities of local EPOs, which are currently part of municipal and provincial governments, should be redefined. The EPOs should report directly to NEPA. This will empower them to better enforce environmental policies and standards. A national standard for wastewater effluent discharges into inland water sources and coastal waters should be established and a timeframe for achieving this standard drafted according to local conditions, similar to what is practiced in the US and the European Union. NEPA, through the EPOs, will ensure the enforcement of this compliance schedule. This will then ensure that local governments address the problems of untreated residential wastewater, either through increased funding levels or other sources of financing such as privatization.

- Separating of Regulation and Service Providers

  Under the current institutional setting, municipal governments are both responsible for enforcing environmental regulations (through the local Environmental Protection Office, EPO)

and providing water and wastewater treatment services. There is no incentive for municipal governments to address environmental problems due to water pollution because they are both the "gamekeeper and the poacher" [Ref 5, pp. 110]. As experience in England and Wales has illustrated, the establishment of an independent regulator can be an efficient means to balance the different needs of all of the players. The regulator and the water utilities must be separated. The independent EPO will perform the necessary scientific research to establish a timeframe for complying with the national wastewater discharge standards. This will give local water utilities more definite objectives under which to operate. Private entities that will participate in wastewater treatment will be regulated by this independent agency. This institutional arrangement will, in addition, provide the foundation for further, more complete form of privatization of the wastewater services industry in the long run.

- Ensuring Transparency, Consistency, and Stability in Privatization

  The key impediment to progress in private sector participation in China's infrastructure sector is the lack of a consistent privatization policy and project approval process. Other issues such as foreign exchange restrictions, control on returns earned by foreign investor, inappropriate service pricing, and under-developed domestic capital markets have also slowed domestic and international private sector participation. Privatization policies and strategies should thus be primarily focused on reducing or eliminating these uncertainties. In the short run, more integrated planning and policy coordination is also necessary at the national level because of concerns over possible conflicts between privatization and macroeconomics objectives such as inflation stabilization, foreign exchange regulation, and tax reform. For instance, the State Planning Commission might clearly spell out the total allocation of large scale privatization projects for each year, after careful consideration of the demand and possible economic costs and benefits of implementation. This policy framework must then be effectively communicated to foreign investors who will remain instrumental to the initial phase of infrastructure privatization in China.

6.6 IMPLEMENTATION STRATEGY

Four broad complementary aspects of implementation strategy must be coordinated to ensure success in the privatization of sewage treatment infrastructure in Guangzhou, China.

- Incremental Privatization

  First, the Chinese spirit of 'experimentalism' and 'incrementalism' encourages *gradually* increasing private sector involvement in wastewater treatment and the infrastructure sector as a whole. As discussed, problems with the first few attempts at privatization are closely associated with the size of the projects and the control foreign entities have had over strategic

infrastructure. Small concession projects in wastewater treatment, on the order of tens of million US dollars, are ideal alternatives for the initial rounds of privatization.

Second, respecting the need for tight central control over privatization projects, a high-level special committee for approving privatization projects would be set up. Applications for all projects, regardless of project size, type, and location, should be filed directly with this committee. The key purpose of this special committee would be to centralize all project applications and approval, removing the need to involve multiple levels of officials and agencies. This will ensure consistency, reduce political uncertainty, provide a channel for macro-policy coordination, and speed up the application process. All negotiations should also take place between the private entities and this special committee. However, consistent with the decentralization theme, this special committee should be a transitional one set up to deal with the initial phase of infrastructure privatization in China. Eventually, when all related policies and regulations are well in place and the central government is comfortable with the decentralized approach of management, application for privatization should be handled at the provincial or the municipal level, according to the size and nature of the project.

Guangzhou city should take the lead in the privatization of sewage treatment facilities. To begin with, one or two pilot concession projects can be implemented under existing water utilities in Guangzhou. Initially, the city government might need to pledge its tax revenues against the financial uncertainties of the projects. Prices of water service to residential consumers should be adjusted gradually until user charges can finance the construction and operation of wastewater treatment. The government pledge can then be removed. Guangzhou's government might also consider financing the wastewater treatment plants by municipal debt. The pilot concession projects will provide a good 'training ground' for learning about all the aspects of privatization and the management of concession contracts. Local engineering firms should also be involved, for example, through joint venture with foreign water companies, to learn to construct, operate and manage wastewater facilities under commercial conditions. When the Guangzhou and central governments are well acquainted and at ease with the first wave of concession contracts, this arrangement can be duplicated in other regions within Guangzhou city and China.

- Mobilizing Domestic Resources

  In conjunction with the participation of foreign companies in concession projects for wastewater treatment, the involvement of local enterprises should be promoted. This can be achieved via the formation of local and foreign joint ventures, with foreign investors acting as catalysts for privatization. Because local partners will share the profits from these projects, the Chinese government's concerns of foreign investors earning too high a return on investment will be reduced. Cooperation with foreign partners will also provide a good learning

experience for local companies. This learning experience is critical to China because in the long run, with the expansion of privatization, the investment, technological, and managerial needs must be sustained by local resources.

- Enhancing Communication and Educating the Populace

  NEPA and the local environment protection agencies need to promote public education in order to raise environmental awareness within the Chinese population, especially at the coastal cities, where the wealthy population and adverse environmental conditions will ensure greater potential of success of the education campaign. This campaign can serve as important 'substitute' to environmental activist groups that are nonexistent in China. Increased environmental awareness will render treatment of wastewater and other methods of addressing urban pollution problems more acceptable to the consumers, who will eventually be more willing to pay for the protection of the environment.

- Increasing Technical Support and Training

  NEPA and its local offices should continue to be responsible for coordinating and funding R&D in wastewater treatment technologies and for establishing nation wide technical training programs and operations guidelines for personnel in local environmental agencies. Greatly strengthened training programs, to be conducted in local EPOs by NEPA trainers, would increase the technical competency and standards of the field regulators. NEPA should also collect, compile, maintain, and make available national environmental information for policy planning and monitoring of implementation strategies.

In summary, in order to ensure the successful implementation of privatizing sewage treatment infrastructure to address wastewater problems in Guangzhou, the Chinese government must further strengthen its commitment to environmental management and enforcement and reconcile value differences between political ideology and privatization needs. The regulatory and institutional transition towards a system based on economic and technical rationality must at the same time address political realities in China. The privatization of environmental infrastructure in China should follow an incremental approach and should evolve concurrently with development in environmental regulations and economic policies.

CHAPTER 7
CONCLUSION

The central question posed by this thesis is whether privatization, as a policy option, can facilitate the implementation of technological solutions to treating wastewater in China's coastal cities.

The thesis began with a brief overview of economic development and its impacts on the environment in modern China. It was pointed out that the economically vibrant coastal cities continue to experience some of the most severe urban environmental problems confronting China, water pollution due to untreated wastewater being one of them. It was argued that China should systematically address environmental problems in these coastal cities because the wealth of these cities is a potential financial resource for resolving urban environmental problems. A brief review of wastewater treatment technology indicated that treatment plants of varying cost-performance characteristics exist for treating residential wastewater that is high in organic content. The heavy reliance of Guangzhou city on the polluted Pearl River for drinking and industrial water provides a strong justification for technological solutions to treating residential wastewater.

Although the Chinese government has begun to address China's environmental problems, the current regulatory regime and government commitment remain inadequate to providing the necessary sewage treatment infrastructure. Experience in other countries has demonstrated that mobilizing resources - financial, technological, and managerial - from the private sector, i.e. privatization, is a policy option that could enable technological solutions to address problems of untreated wastewater. International experience has further demonstrated that small-scale leases and concession contracts are the most appropriate form for privatizing sewage treatment in Guangzhou.

Three complementary categories of considerations - value system, rationality, and institutional and political structure - need to be identified and addressed in order to ensure the success of privatizing sewage treatment infrastructure in China. '*Rational incrementalism*' will be the key theme of the implementation strategy that seeks to attain gradual privatization, promote the mobilization of domestic resources, increase environmental awareness of the populace, and enhance the technical capability of environmental agencies.

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CHAPTER 6

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APPENDIX

1. COST-PERFORMANCE DATA FOR TREATMENT PLANTS (size 20 MGD; BOD_5 Removal)

Table A1.1 Treatment Plant Process Description

Plant Type	Treatment Description
1	Primary Treatment
2a	Primary Treatment, Low-dose Chemical
2b	Primary Treatment, High-dose Chemical
3	Primary Treatment with Biological Secondary Treatment
4	Chemical Primary Treatment + Biological Secondary Treatment
5	4 + Nutrient Removal
6	4 + Nutrient Removal + Filtration
7	4 + Nutrient Removal + High Lime + Filtration
8	4 + Nutrient Removal + Filtration + GAC
9	4 + Nutrient Removal + High Lime + Filtration + GAC
10	4 + Nutrient Removal + High Lime + Filtration + GAC + Reverse Osmosis

GAC: Granular Activated Carbon Adsorption

Table A1.2 Capital Cost of Plant

	BOD_5 Content (mg/liter)			Capital Cost			(A)	(B)
Plant Type	Ineffluent	Effluent	BOD Removal	Low[1] ($/MG)	High[1] ($/MG)	Total[2] (M$)	ln (% BOD remaining)	ln (Total Cost)
1	202	139	31.2%	245	310	19.889	-0.374	2.9902
2a	168	80	52.4%	320	400	25.802	-0.742	3.2504
2b	146	33	77.4%	400	400	28.669	-1.487	3.3558
3	203	16	92.1%	610	720	47.661	-2.541	3.8641
4	174	9	94.8%	750	870	58.054	-2.962	4.0614
5	250	15	94.0%	750	870	58.054	-2.813	4.0614
6	250	5	98.0%	890	1140	72.746	-3.912	4.287
7	250	3	98.8%	1300	1700	107.51	-4.423	4.6776
8	250	3	98.8%	1150	1450	93.173	-4.423	4.5345
9	250	2	99.2%	1500	1800	118.26	-4.828	4.7729
10	250	1	99.6%	7000	2500	340.44	-5.521	5.8302

[1]Annual capital cost per million gallon

[2]Total capital cost = (annual capital cost per million gallon) x (20 MGD) x 365 days/year x (uniform series present worth factor)

$$\text{Uniform series present worth factor} = \frac{(1+i)^n - 1}{i(1+i)^n} = 9.818; \text{ for } i = 8\% \text{ and } n = 20 \text{ years}$$

Linear regression on column (A) and (B) yields:

$$\ln(\text{Total capital cost for 20 MGD plant}) = 2.7434 - 0.456 \ln(\%\ \text{BOD remaining in effluent})$$

$$r^2 = 0.9218$$

Table A1.3 Total Annual Cost[1]

	BOD_5 Content (mg/liter)			Total Annual Cost ($/MG)			(C)	(D)
Plant Type	Ineffluent	Effluent	BOD Removal	Low	High	Average	ln (% BOD remaining)	ln (Ave Cost)
1	202	139	31.2%	450	550	500	-0.374	6.2146
2a	168	80	52.4%	550	680	615	-0.742	6.4216
2b	146	33	77.4%	650	750	700	-1.487	6.5511
3	203	16	92.1%	930	1130	1030	-2.541	6.9373
4	174	9	94.8%	1050	1150	1100	-2.962	7.0031
5	250	15	94.0%	1250	1450	1350	-2.813	7.2079
6	250	5	98.0%	1450	1800	1625	-3.912	7.3933
7	250	3	98.8%	2400	3000	2700	-4.423	7.901
8	250	3	98.8%	2000	2400	2200	-4.423	7.6962
9	250	2	99.2%	2900	3500	3200	-4.828	8.0709
10	250	1	99.6%	4500	5500	5000	-5.521	8.5172

[1]Total annual cost = annualized capital cost + annual operation and maintenance cost

Linear regression on column (C) and (D) yields:

ln (Total annual cost for 20 MGD plant) = 5.9665 - 0.42 ln (% BOD remaining in effluent)

$r^2 = 0.9597$

Source: National Research Council, Managing Wastewater in Coastal Urban Area, National Academy Press, 1993; Page 324 - 332.

2. MAJOR ENVIRONMENTAL AND RESOURCE MANAGEMENT LAWS AND REGULATIONS IN CHINA

Year	Events, Laws and Regulation Promulgated and/or Implemented
1949	• Founding of the People's Republic of China
1953	• Directive on Mass Afforestation, Cultivation of Forests, and Protection of Forests
1956	• First appearance of regulations to control industrial pollution
1962	• Industrial pollution standards
1963	• Articles on Forestry Conservation
1970	• UN Conference in Stockholm
1973	• National Environmental Protection Agency established • Environmental planning included in the National Plan • 'Three Wastes' campaign
1974	• Trial Standards on Discharge of Industrial 'Three Wastes' • Temporary Regulations on the Prevention of Pollution in Coastal Water
1977	• Regulations on Controlling the Industrial 'Three Wastes' and Developing Comprehensive Utilization
1978	• Regulations on 'Three Simultaneous Points'
1979	• Provisional Water Quality Standards for Fisheries and Marine Resource Propagation Protection • Forestry Law provisionally accepted • Environmental Protection Law of the People's Republic of China (for trial implementation)
1980	• Noise and Sanitary Standards for Industrial Enterprises • Law on Area-wide Total Pollutant Land Control
1981	• China signed Convention on International Trade in Endangered Species of Wild Fauna and Flora • Provisional Regulations on Management of Underground Water Resources in Beijing • SC's Decision on Strengthening Environmental Protection Work in the Period of National Economic Adjustment • Procedure regarding the Management of Environmental Protection in Capital Construction Projects • SC's Decisions on Some Problems regarding Forestry Conservation and Forestry Development • SC Emergency Circular of Prohibiting the Encroachment on to Arable Land by Rural Housing Construction • Regulations for Environmental Management in the Metallurgy Industry
1982	• Grassland Management Act • Marine Environmental Protection Law • Provisional Measures for the Assessment of Effluent Charges • Environmental Standards for Air Pollution • Regulation for Requisition and Use of Urban and Rural Land • Stipulation for the Use of safe Agricultural Chemicals • Regulation for Animal and Plant Quarantine • Regulations on Soil Conservation Work • Environmental Noise Standards in Urban Districts • Air Environmental Quality Standards
1983	• Some Regulations on Prevention of Industrial Pollution on Coordination with Technological Improvement • SC Circular on the Stringent Protection of Endangered Wildlife • Regulations on National Environmental Surveillance and Monitoring Management • Regulations on Marine Environmental Protection from Oil Exploration and Exploitation • Regulations on the Prevention of Marine Pollution from Vessels • Food and Sanitary Law (for trial implementation)

SC: State Council

Year	Events, Laws and Regulation Promulgated and/or Implemented
1985	• Grassland Law • Regulations on the Control of Marine Dumping • Regulations on for the Administration of Forest and Wildlife Conservation Areas • Provisional Regulations on Issues Concerning the Multiple Use of Resources
1986	• Seventh Five-Year Plan began, environmental protection first given a full chapter in the national five-year plan • Provisional Regulations for Environmental Management in Foreign Economic Development Zones • Marine Resources Law • Land Management Law • Fisheries Law
1987	• Regulations on Environmental Protection Design for Construction Projects • Methods for Management of Urban Radioactive Wastes • SC Emergency Notice on Strict Prohibition of Disorderly and Indiscriminate Use of Wildlife • Law on Prevention and Control of Air Pollution
1988	• National Environmental Protection Agency given departmental status and put directly under the SC • Water Law • Regulations on Environmental Management to Prevent Pollution from Ship Wreck • Wildlife Conservation Law • Regulations Regarding Prevention of Pollution from the Paper Industry
1989	• Environmental Protection Law implemented • Regulations on Noise Pollution • Environmental Assessment Fee Standard (for trial implementation)
1990	• Regulations on Environmental Management to Prevent Land Source Pollutants from Polluting the Seas • Regulations on Environmental Management to Prevent Coastal Construction Projects from Polluting the Seas • Radiation Environmental Management Law
1992	• UN Conference on Environmental Development in Rio de Janeiro
1993	• Environmental Protection Commission in National People's Congress

SC: State Council

Source: Richard Louis Edmonds, Patterns of Chin's Lost Harmony: A Survey of the Country's Environmental Degradation and Protection, Routledge, 1994, Appendix A, Page 267 - 277.

3. EFFLUENT FEE STRUCTURE FROM PROVISIONAL MEASURES FOR THE ASSESSMENT OF EMISSION CHARGES (INDUSTRIAL WASTES) ISSUED BY THE STATE COUNCIL IN FEBRUARY 1982 (TRANSLATED).

Table A3.1 Effluent Charges for Gaseous Emission

Pollutants	Charges in RMB per kg above emission standard	Charges in RMB per 10 cubic meter for concentration above emission standard
• sulfur dioxide • carbon disulfide • hydrogen sulfide • fluorides • oxides of nitrogen • hydrogen fluorides • carbon monoxide	0.04	
• sulfuric acid vapor • lead • mercury		0.03 - 0.10
Particulate • glass fiber, mines, alumina powder • coal dust from power plants, cement powder • other particulate	0.10 0.02 0.04	

	Charges for effluent quality relative to emission standard (RMB per ton of fuel consumed)			
	< 4 times	4.1 - 6 times	6.1 - 9 times	> 9 time
Emissions from industrial furnaces and heating plant	3	4	5	6

Table A3.2 Effluent Charges for Wastewater

	Charges for effluent quality relative to emission standards (RMB per ton of wastewater discharge)				
Pollutants	< 5 times	5 - 10 times	10 - 20 times	20 - 50 times	> 50 times
• mercury • chromium • cadmium • arsenic • lead • other inorganic	0.15 - 0.20	0.20 - 0.30	0.30 - 0.45	0.45 - 0.90	0.90 - 2.00
• sulfides • petroleum compounds • volatile phenol • chlorides • organic phosphates • copper • zinc • fluorides • cyanide • ammonia compounds	0.10 - 0.15	0.15 - 0.20	0.20 - 0.35	0.35 - 0.60	0.60 - 1.00
• suspended particulate • COD • BOD • pH value	0.04 - 0.06	0.06 - 0.10	0.10 - 0.15	0.15 - 0.20	0.20 - 0.30
• Pathogens			0.08 for all		