No.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

MINISTRY OF PUBLIC ENTERPRISES (MOPE)
EGYPTIAN ENVIRONMENTAL AFFAIRS AGENCY (EEAA)

STUDY ON INDUSTRIAL WASTE WATER POLLUTION CONTROL IN THE ARAB REPUBLIC OF EGYPT

FINAL REPORT

DECEMBER 2000

CHIYODA-DAMES & MOORE CO., LTD.
CHIYODA CORPORATION

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Preface

In response to the request from the Government of the Arab Republic of Egypt, the Government of Japan decided to conduct the Study on Industrial Waste Water Pollution Control, and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent a study team, headed by Mr. Itsuo Nagahama of Chiyoda-Dames & Moore Co., Ltd. and organized by Chiyoda-Dames & Moore Co., Ltd. and Chiyoda Corporation, to the Arab Republic of Egypt four times from August 1999 to October 2000.

The team held discussions with the officials concerned of the Egypt Government, and conducted surveys of current pollution due to industrial waste water including field surveys at 5 factories and a technology transfer seminar. After returning to Japan, further studies and designs were made and this report was prepared.

I hope that this report will contribute to decrease of pollution due to industrial waste water and enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Egypt Government for their close cooperation extended to the team.

December 2000

Kunihiko SAITO
President
Japan International Cooperation Agency

December, 2000

Mr. Kunihiko SAITO
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Sir,

STUDY OF INDUSTRIAL WASTE WATER POLLUTION CONTROL IN THE ARAB REPUBLIC OF EGYPT

LETTER OF TRANSMITTAL

We are pleased to submit to you the final report of the captioned study, the major purposes of which are as follows:

1. With respect to five (5) factories (see **Note** below), to survey the current situation of pollution due to industrial waste water(s) and of control of the waste waters and to design the treatment facilities of waste water for each factory.
   Further, to select one (1) factory out of nominated five where the treatment facilities shall be installed as Demonstration Plant by evaluating such aspects of technology, environment and geographic conditions.
   Note: 5 factories, which were already nominated in accordance with the agreement between Egyptian and Japanese Sides, consists of 4 factories belonging to steel or metallurgy industry and of 1 factory of chemical industry.
2. To transfer the technology relating to industrial waste water treatment and management
3. To propose legislative recommendations and counter-measures to enable many industries and factories to install more treatment facilities of waste water(s) in the near future and to preserve the environment.

The most pages of this report are allocated to the description of the survey results of five (5) factories and to the design of appropriate treatment facilities for them.

The public enterprises under Ministry of Public Enterprises (MOPE) are planned to be privatized in due time and, therefore, they have been trying to fulfill the requirements of privatization. Further, factories of the private sector must treat their waste water(s) adequately from the standpoint of environmental preservation along River Nile and of desert.

We are confident that the survey results, design methods of the treatment facilities and recommendation of the legislative policy & counter-measures described in this report are very useful to Egyptian Side and that they will be able to utilize them.

We wish to express our sincere appreciation to the officials of Japan International Cooperation Agency, of Ministry of Foreign Affairs and Ministry of International Trade & Industry of Japan for their kind guidance and assistance for us to perform the study smoothly.

Also, taking this opportunity, we would like to express our cordial thanks to the officials of such Egyptian Authorities as Ministry of Public Enterprises (MOPE) and Egyptian Environmental Affairs Agency (EEAA) for their close cooperation through all the phases of our survey and study.

Itsuo Nagahama

Itsuo NAGAHAMA
JICA STUDY TEAM LEADER
Chiyoda Dames & Moore Co., Ltd.

DELTA STEEL MILL CO. (1/2)

Photo. DSM-1　Oil Trap of Wastewater Sewer

DELTA STEEL MILL CO. (2/2)

Photo. DSM-2 Sampling Point No.1

Photo. DSM-3 Flow Measuring at S-1.

EGYPTIAN FERROALLOYS CO. (1/2)

Photo EF-1 Wharf faced to the Nile River

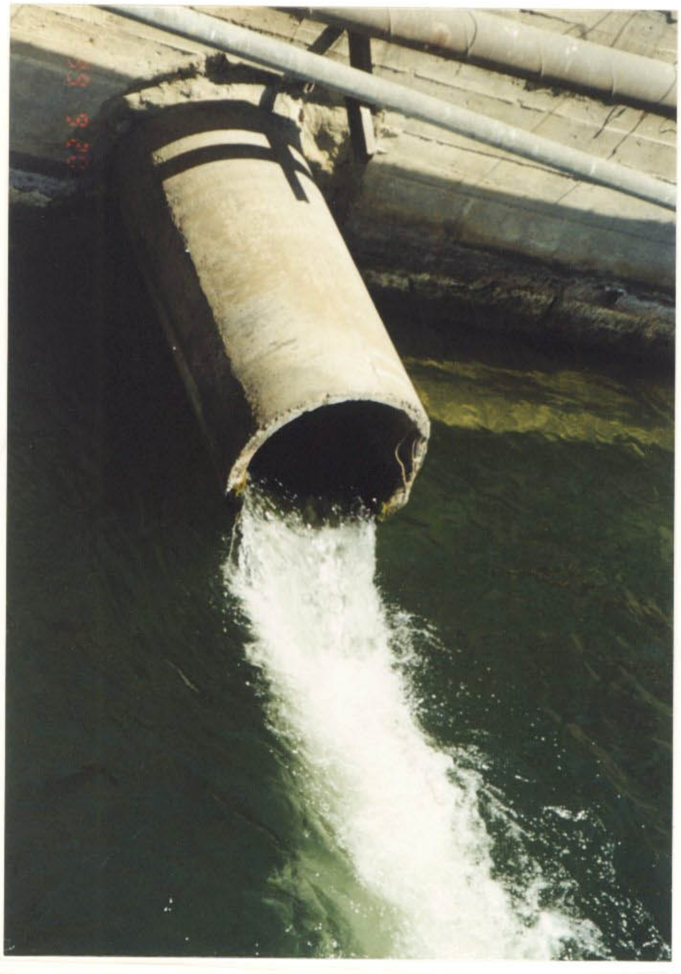


Photo EF-2 Discharge Water to the Nile River

EGYPTIAN FERROALLOYS CO. (2/2)

Photo EF-3 Sampling Work at Transeformer Yard

Photo EF-4 Crusher and Classifier of Quartz

EL NASR CO. FOR STEEL PIPES AND FITTINGS (1/2)

Photo. NSP-1 Memorial Photo. after Sampling Work
Center: Auto-sampler
Back: Mobile laboratory of TIMS

Photo. NSP-2 Pickling Plant (HCl)

Photo, NSP-3 Neutralization Plant for Pickling Wastewater

Photo. NSP-4 Oil Separator Basin for Cooling Water

MANSOURA CO. FOR RESINS AND CHEMICALS (1/2)

Photo. MRC-1 Resin Plant Constructed by SUMITOMO Japan.

Photo. MRC-2 Wastewater Sewer

MANSOURA CO. FOR RESINS AND CHEMICALS (2/2)

Photo. MRC-3 Old Type Cooling Tower

Photo. MRC-4 Non Potable Water Canal trough Industrial District

Photo. EIS-1 Pickling Plant at Cold Rolling Mill Facility

Photo. EIS-2 Rinsing Bath of Pickling Plant

Photo. EIS-3 Sampling Points
Left: Spent Sulfuric Acid Pipe
Right: Rinsing Water

Photo. EIS-4 Leakage (Acid) Water Sewer

Photo. EIS-5 Jar Test (Coagulation/Sedimentation Test) at TIMS.

Photo. EIS-6 Building for Spent Sulfuric Acid Recovery Unit

Left: By-product Ferrous Sulfate Bags

Right: Fresh Sulfuric Acid Tanks

Photo. EIS-7　W.W.T Plant Construction Site proposed by EISCO.

Photo. EIS-8 Crystalizer

ABBREVIATIONS

ARWW	Acid Rinsing Wash Water
BOD	Biochemical Oxygen Demand
CCC	Cairo Central Center
CIDA	Canadian International Development Agency
COD	Chemical Oxygen Demand
CP	Cleaner Production
DANIDA	Danish International Development Agency
DDT	Dichloro Diphenyl Trichloro Ethane
DSM	Delta Steel Mill Company
EC	Electric Conductivity
EEAA	Egyptian Environmental Affairs Agency
EEIF	Egyptian Environmental Initiative Funds
EEIS	Egyptian Environmental Information System
EF	Egyptian Ferro-Alloys Company
EIA	Environmental Impact Assessment
EIS	Egyptian Iron & Steel Company
EMOHC	Environmental Monitoring and Occupational Health Center
EMU	Environmental Management Units
EOP	End of Pipe
EPAP	Egyptian Pollution Abatement Project
FINNIDA	Finnish Ministry of Foreign Affairs
GIPAP	Governorate Industrial Pollution Abatement Plan
GOFI	General Organization for Industrialization
HCMI	Holding Company for Metallurgical Industries
ISO	International Organization for Standardization
JICA	Japan International Cooperation Agency
KFW	Kreditanstalt Fur Wiederaubau
LE	Egyptian Pound
MDCI	Management Development Center for Industry
MHU	Ministry of Housing and Utilities
MIWR	Ministry of Irrigation Water Resources
MOHP	Ministry of Health and Population
MOI	Ministry of Industry
MOPE	Ministry of Public Enterprises

MRC	Mansoura Company for Resins and Chemicals
NGO	Nongovernmental Organization
NPPP	Nile Pollution Prevention Program
NRC	Nile Research Center
NSEA	Ministry of State for Environmental Affairs
NSP	El-Nasr Steel Pipes & Fittings Company
PAAP	Pollution Abatement Action Plan
PAF	Pollution Abatement Fund
pH	Hydrogen Exponent
RBO	Regional Branch Office
SEAM	Support for Environmental Assessment and Management
SSA	Spent Sulfuric Acid
SSARU	Spent Sulfuric Acid Recovery Unit
TDS	Total Dissolved Solid
TIMS	Tabbin Institute for Metallurgical Studies
TSS	Total Suspended Solid
UK DFID	UK Department for International Development
UNEP	United Nations Environment Programme
UNEP	National Cleaner Production Center
UNIDO	United Nations Industrial Development Organization
USAID	UA Agency for International Development
WWT	Waste Water Treatment

1.0 **OUTLINE**

1.0 Outline

1.1 Background of Study

The Nile River is a lifeline for Egypt because almost all water used in Egypt is obtained from the Nile River. Based on the agreement between Egyipt and Sudan in 1959, Egypt has the right to obtain an annual minimum of 55.5 billion m3 of water volume from the Aswan High Dam. As water consumption of Egypt has been increasing, water quality of the Nile could become worse.

There is a concentration of population, industry and agriculture along the Nile River. Untreated waste water from various sources including household, industry and agriculture has been discharging into the Nile River. Water pollution problems in the upstream and mid reaches of the Nile River are not significatnt due to a relatively high water volume and natural purification capacity. However, the untreated waste water discharges at the Nile branches and delta areas where population, agriculture and industry are concentrated is considered one of the main cause of effects on environment and human health.

The Government of Egypt has implemented various abatement of water pollution in the Nile River including:

- Law No.93 of 1962 concerning Drainage of Liquid Wastes to Public Sewerage
- Law No.48 of 1982 concerning Protection of the River Nile and Waterways against Pollution
- Environmental Action Plan of 1992
- Law No.4 of 1994
- Nile River Clean Up Program of 1997
- Aids of International donors

However, water pollution of the Nile River has not been effectively improved due to lack of awreness of environmental protection, organizations, technology, experts, funds.

In light of current conditions described above, the Government of Egypt requested the Japanese Government the development study of industrial pollution control. In response to the request of the Government of Egypt, the Japan International Coioperation Agency (JICA) dispatched a project identification study team on March, 1997. The Government of Egypt officially submitted a request letter of the study on June, 1997. JICA dispatched a project confirmation study team on March and May, 1999. JICA also dispatched a preparatory study team on May, 1999 and the scope of work of full-scale study was agreed and signed between the Japanese Government and the Government on June 2, 1999. The full-scale study in accordance with the scope of work was commenced on August, 1999.

1.2 The Purposes of the Study and the Procedures

The Purposes of the Study and the Procedures are:

1) To survey the current pollution due to industrial waste water(s).

2) To design the treatment facilities for industrial waste water(s) at five (5) factories already nominated. Further, to select one (1) factory where it is judged suitable to install the treatment facilities for industrial waste water(s) as "Demonstration Plant" by considering several factors to be mentioned hereinafter.

3) Develop recommendations on policy measures for industrial waste water abatement.

4) Make technology transfer through the study

1.3 Study Area

The Phase 1 Study has been authorized to address the waste water treatment system at the following five factories, located as shown on Figure 1.3.1, vicinity maps:

1. Delta Steel Mill Company
2. Egyptian Iron & Steel Company,
3. Egyptian Ferro-Alloys Company
4. El-Nasr Steel Pipes & Fittings Company
5. Mansoura Company for Resins and Chemicals

Four (4) factories are located in Cairo or its vicinity while one is located at Aswan.

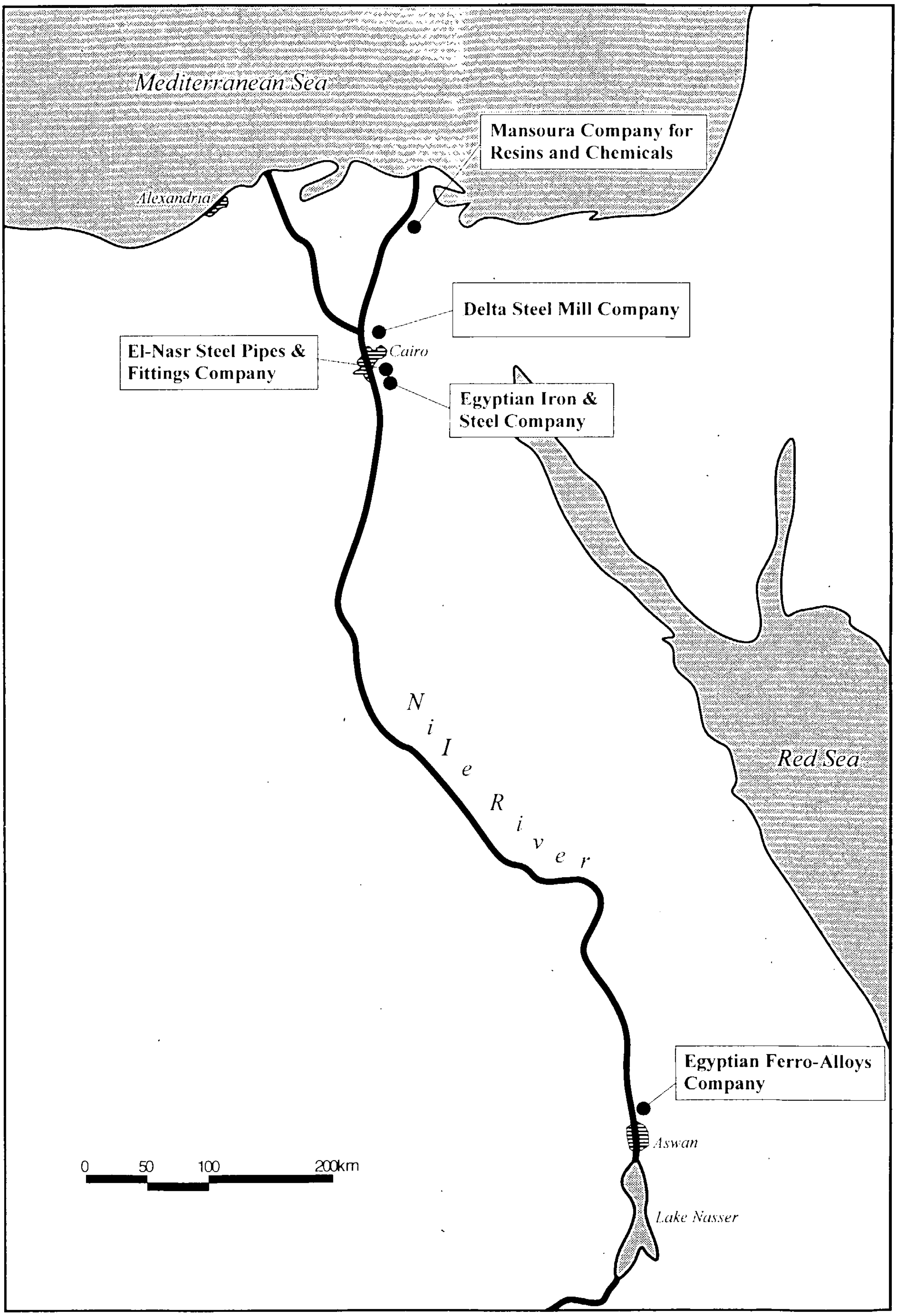


Figure 1.3.2 Study Area

1.4 Result of Study

1.3.1 Design of waste water treatment facilities

Study Team made the following design:

Conceptual Design

Conceptual design of certain waste water treatment facilities were made for 5 factory nominated. (One conceptual design for each factory: Total 3 designs)

Basic Design

Out of five (5) factories following three (3) factories were selected as representative factory:

(A) Mansoura Company for Resins and Chemicals

(B) El Nasr Company for Steel Pipes and Fittings

(C) Egyptian Iron and Steel Company (EIS)

Individual conceptual design of each factory was developed to "basic design".

Further, for EIS, another basic design was made for the new neutralizing facilities under the premises that spent sulfuric acid be never discharged to the new neutralizing facilities. Therefore, two (2) basic designs were made for EIS. (Total 4 basic designs)

1.3.2 Recommendation on Environmental Management Policy of Egypt

In reviewing the water quality control administration in Japan, especially the history of fighting with the pollution problems caused by industrial wastewater, the most suitable administration systems for water pollution control in Egypt and effective measures were discussed.

1.3.3 Technology Transfer Seminar

One seminar was held on December 6, 1999 where two topics were lectured: one was "the introduction how to treat waste water(s)" and the other one was "project execution (engineering and procurement) in

Private sector". The seminar was so successful that certain technology transfer was attained.

1.5 Work Process

The study was started on August, 1999 and performed as shown in Figure 1.5.1.

(1) Preparatory Work in Japan (August, 1999)

a. Prepare an execution Plan for the Study

b. Prepare an inception report.

(2) First Field Survey in Egypt (September, 1999 - October, 1999)

a. Submit, explain, and discuss the inception report.

b. Perform a survey of the industrial waste water conditions in the five nominated factories.

c. Complete the conceptual design of the WWTP.

d. Select the three representative factories where the conceptual design of the WWTP will be designed.

e. Collect factual data from each factory for the conceptual design of the WWTP.

f. Prepare and submit the progress report No. 1.

(3) First Office Work in Japan (October, 1999 - November, 1999)

a. Conduct the Basic Design of the three representative factories

b. Prepare and submit the interim report.

(4) Second Field Survey in Egypt (November, 1999 - December, 1999)

a. Explain the interim report

b. Select a Factory where a Demonstration Plant will be installed.

c. Cancellation of construction of Demonstration Plant

d. Conduct of the Technology Transfer Seminar

e. Prepare and submit the progress report No. 2.

(5) Second Office Work in Japan (November, 1999 - March, 2000)

a. Preparation of Concise Manual for Industrial Wastewater Treatment facilities

b. Study of Improvement plan of Spent Sulfuric Acid Recovery Unit

(6) Third Field Survey in Egypt (February, 2000 - March, 2000)

a. Basic Design for Industrial Wastewater Treatment facilities

b. Survey of the Spent Sulfuric Acid Recovery Unit

(7) Third Office Work in Japan (February, 2000 - March, 2000)

a. Basic Design for Industrial Wastewater Treatment facilities

b. Prepare and submit the interim report No. 2

(8) Fourth Office Work in Japan (May, 2000 - June, 2000)

a. Study of Proposal for the Policy of Egypt

b. Prepare and submit the Draft Final Report

(9) Fourth Field Survey in Egypt (July, 2000)

a. Explanation of the Draft Final Report

(10) Fifth Office Work in Japan (September, 2000)

a. Prepare and submit the Final Report

2.0 OUTLINE OF THE STUDY AREA

2.0 Outline of the Study Area

2.1 Location and Topography

Egypt is situated in the northeast corner of Africa and is located in the north latitude between 22 and 32 and the east longitude between 24 and 37. The country is surrounded on the north by the Mediterranean Sea, on the east by the Red Sea and Israel, on the west by Libya and on the south by Sudan. The total area of Egypt is 1,001,450 km^2 (about 2.7 times bigger than Japan). Over 95% of this area is desert and only 4% of this area is cultivated.

Topographicaly, Egypt can be divided into 4 regions as follows:

(1) The Nile Valley and the Delta

The Nile transverses Egypt from Wadi Halfa of Sudan in the south to the Mediterranean shores on the north. After leaving Cairo, the Nile forks into two big branches - the Damietta and the Rosetta.

The fertile soil belt, which consists of black alluvial soil called "Nail Silt", extends along the Nile in a band 2 to 10 km in width. The Nile basin north of Cairo, with its rich alluvial fertile soils, is called the Nile Delta. South of Cairo, the basin is referred to as the Nile Valley.

The Nile Valley and the Delta occupy 3,007km^2 and 22,000km^2, respectively and account for about 4% of the total area of the country. The total cultivated land in the Delta and the Valley is about 15,000km^2.

(2) The Western Desert

The Western Desert is located west of the Nile Valley and extends to the borders with Libya. It also extends north to the Mediterranean shores, and south to the sudanese border. This desert occupies 671,000km^2, or about two thirds of the total area of Egypt.

The Western Desert forms part of the Libyan Desert and continues westward to the Great Sahara Desert.

The main features of the Western Desert are its extremely dry climate (except for the northern coastal area), its relatively flat topography with low hills and shallow valleys, and its relatively closed water conveyance system (river, groundwater, etc.).

(3) The Eastern Desert

The Eastern Desert is located east of the Nile Valley and is surrounded on the east by the Red

Sea, Gulf of Suez and the Suez Canal. This desert occupies 225,000km^2, about one fourth the total area of Egypt.

The Eastern Desert mainly consists of mountains; thus its elevation is relatively high. Its landform is not as flat as the Western Desert. It also contains several deep wadis (dry river beds) and rolling hills.. In contrast with the closed water conveyance system in the Western Desert, almost all the rivers of the Eastern Desert discharge in either the Red Sea or the Mediterranean Sea.

(4) The Sinai Peninsula

The Sinai Peninsula is situated in the northeastern tip of Egypt. It is characterized by its hilly terrain. Its shape is similar to an inverted triangle, with its base facing the Mediterranean Sea on the north and its tip pointing to the Red Sea on the south. The peninsula lies between Gulf of Aqaba on the east and Gulf of Suez on the west and almost half of its circumference faces these two gulfs. Saini occupies 61,000km^2, about 6% of the total area of Egypt.

The southern part of the peninsula has the highest mountain range in Egypt, which consists of granite. The middle part of Saini contains may limestone hills sloping gently toward the northern large barren planes.

2.2 Population

The total population of Egypt is 62,966,000 (1996 Census) and most people inhabit either the Nile Valley or the Delta. Inhabited area constitutes 6% of the total area of the country and the rest is desert where few people inhabit scattered settlements. The population density of the total country area is about 60 people/km^2, while population density of the inhabited area is about 1,000 people/km^2.

2.3 Climatology

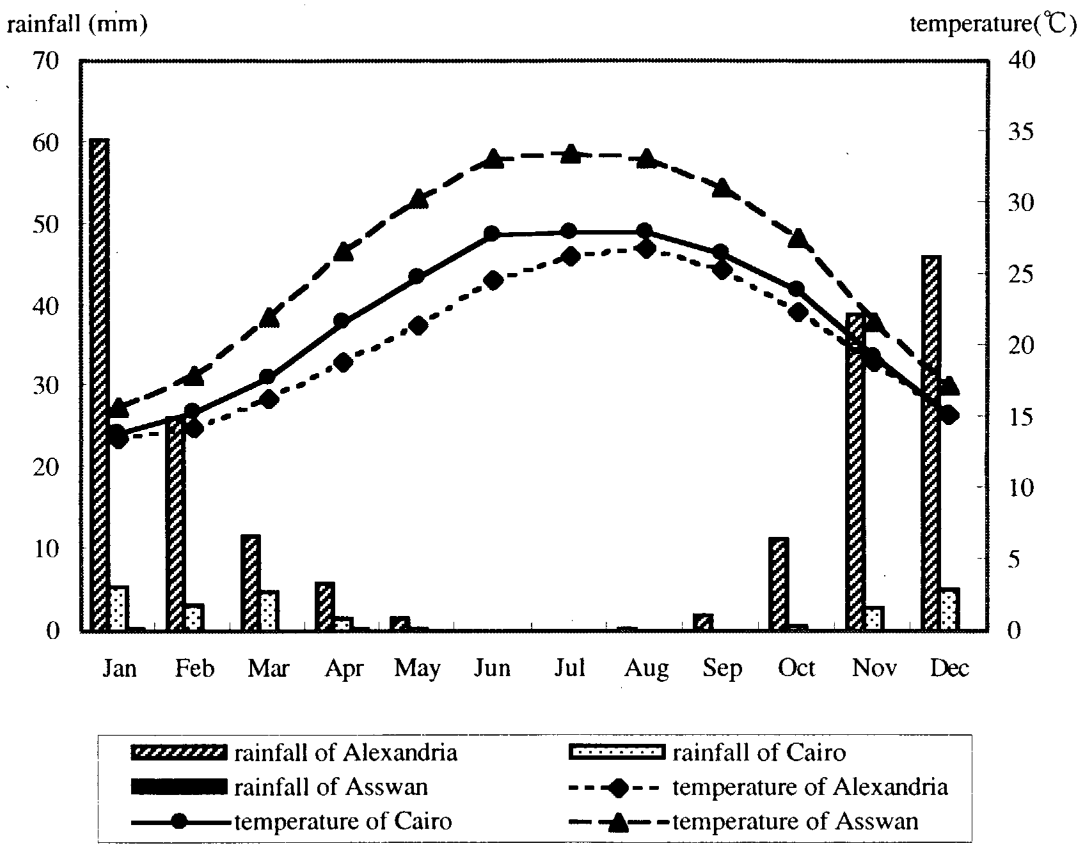
The climate of Egypt is dominated by a Mediterranean-type climate in the northern coastal area and a desert-type climate in the remainder of the country. As shown in Figure 2.1, the temperature in the southern inland area is higher than that in the northern Mediterranean coastal area.

The climate of Cairo is dry and stable throughout the year. As shown in Table 2.1, mean monthly temperature of Cairo is minimum in January (winter) at 13.9°C and maximum in July (summer) at 28.0°C. Also, the temperature varies widely between day and night. The mean daily temperature range is 10°C in winter (January and December) and16°C in summer (May and July).

In the southern inland area, the daily temperature range is wider than that in Cairo. In Asswan, temperatures may range from 41°C during the day and down to 10°C at night in July.

Rainfall in Egypt is extremely scarce, with fewer than 50 mm in most areas, with most rainfall occurring in the winter season. Even in the wettest coastal area around Alexandria, annual rainfall is only about 200 mm. Annual rainfall in Cairo and Asswan is 24 mm and 1 mm, respectively.

A characteristic phenomenon of Egypt's climate is the hot wind carrying sand from the end of February to the middle of June. This wind is caused by a low atmospheric pressure originating from the Libyan Desert and is called "Khamsin" wind.



Source: Rika nenpyo [Chronological Scientific Tables], 1999, National Astronomical Observatory of Japan.

Figure 2.1 Mean Monthly Temperature and Rainfall of Study Area

Table 2.1 Monthly Temperature and Rainfall in Cairo

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maximum Temperature (°C)	18	21	24	28	33	35	36	35	32	30	26	20
Average Temperature (°C)	13.9	15.3	17.7	21.6	24.8	27.7	28.0	27.9	26.5	23.9	19.3	15.1
Minimum Temperature (°C)	8	9	11	14	17	20	20	22	20	18	14	10
Rainfall (mm)	5.4	3.3	4.7	1.6	0.3	0.0	0.0	0.0	0.0	0.7	3.0	5.3

Source: Rika nenpyo [Chronological Scientific Tables], 1999, National Astronomical Observatory of Japan, etc.

2.4 Hydrology

Egypt largely depends on The Nile River for fresh water source with 98% of water supply extracted from the Nile. The Nile main water source is Lake Victoria situated near equator. Other water sources are the many streams that discharge rainwater from the Ethiopia Plateau.

The Nile is the longest river in the world with a total length of 6,690km.

2.5 Ecology

About 95% of the total area of Egypt is occupied by desert, and most of the vegetation can be found in either in the Nile Valley or the Delta.

In the Nile Valley or the Delta, limited natural vegetation survived the thousand of years of continuous cultivation the heavy use of fertilizers. It is reported that 4 species of amphibians and 29 species of reptiles, such as bullfrog, mud turtle, crocodile, etc., are found in the Valley and the Delta. Many migrant birds and 71 species of birds breed in the Nile Valley, while 41 species breed in the Delta. As for mammals, 21 species including rats, jackals and foxes have been identified.

Endangered species still found in Egypt include the giant tortoises in the desert facing the Mediterranean Sea, the acacia forest in the Western Desert, and the gazelles in the oases.

2.6 Industry

The Gross Domestic Product (GDP) of Egypt was 251,673 million LE (75,502 million US$) in June 1998. Agriculture contributes 15.7%, Mining contributes another 26.6%. Trade and finance make up 21.2% of GDP, while social services amount to 15.0% of GDP, and the remaining 21.5% come from various other activities.

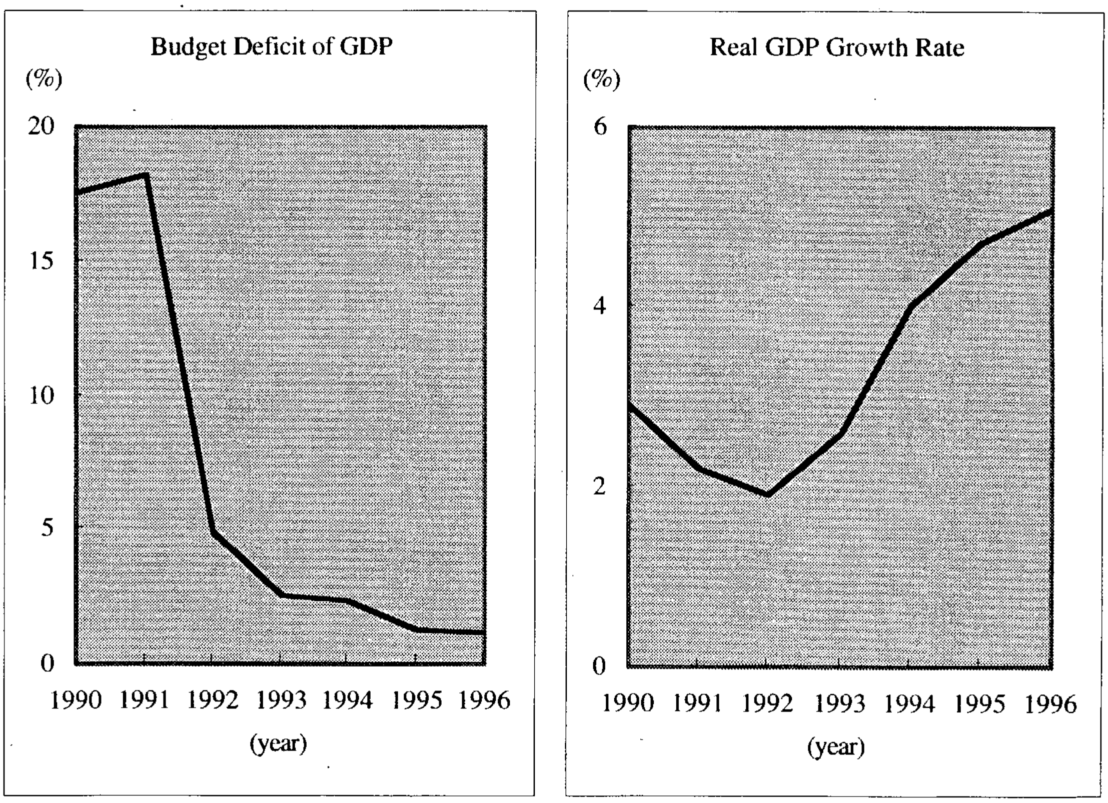
In recent years, the economy of Egypt is growing up in remarkably rapid pace. As a result, the budget deficit of GDP has been steadily declining as shown in Figure2.2.

(1) Agriculture

The completion of the construction of Asswan High Dam in 1971 made possible a year-round cultivation in The Nile area. The dam also controlled the yearly flood every year around the autumnal equinox, which caused excessive damage to the cultivated land. The main crops in Egypt are wheat, clover and broad beans in winter, cotton, rice and sugar cane in summer and corn in Nail season (late summer). Egyptian cotton with its long fiber is one of the most important exports.

(2) Mining Industry

Egypt developed its industries relatively early compared with other Arabian Countries. Industrialization have expanded in recent years and greatly diversified. The majority of industries in Egypt, however, are engaged in food processing and production of textile.



Source: the website of the Embassy of Arab Republic of Egypt (http://embassy.kcom.ne.jp/egypt/)

Figure 2.2 GDP Change of Egypt

Major natural resources of Egypt are petroleum, phosphate, manganese, tin, zinc, sulfur, natural soda, salt, and iron ore. Petroleum is produced mainly in the Eastern Desert, the Sinai Peninsula, Gulf of Suez and the Western Desert.

(3) Fisheries

Egypt's fisheries are divided into sea fisheries and inland water fisheries. Important fisheries area of sea are the Mediterranean Sea, the Red Sea, Gulf of Suez, etc., and those of inland water are northern salt lakes and Asswan High Dam. Total amount of fish caught from both sea and inland water fisheries is about 350,000 ton per year. In recent years, fish-farming became a growth industry.

(4) Tourism

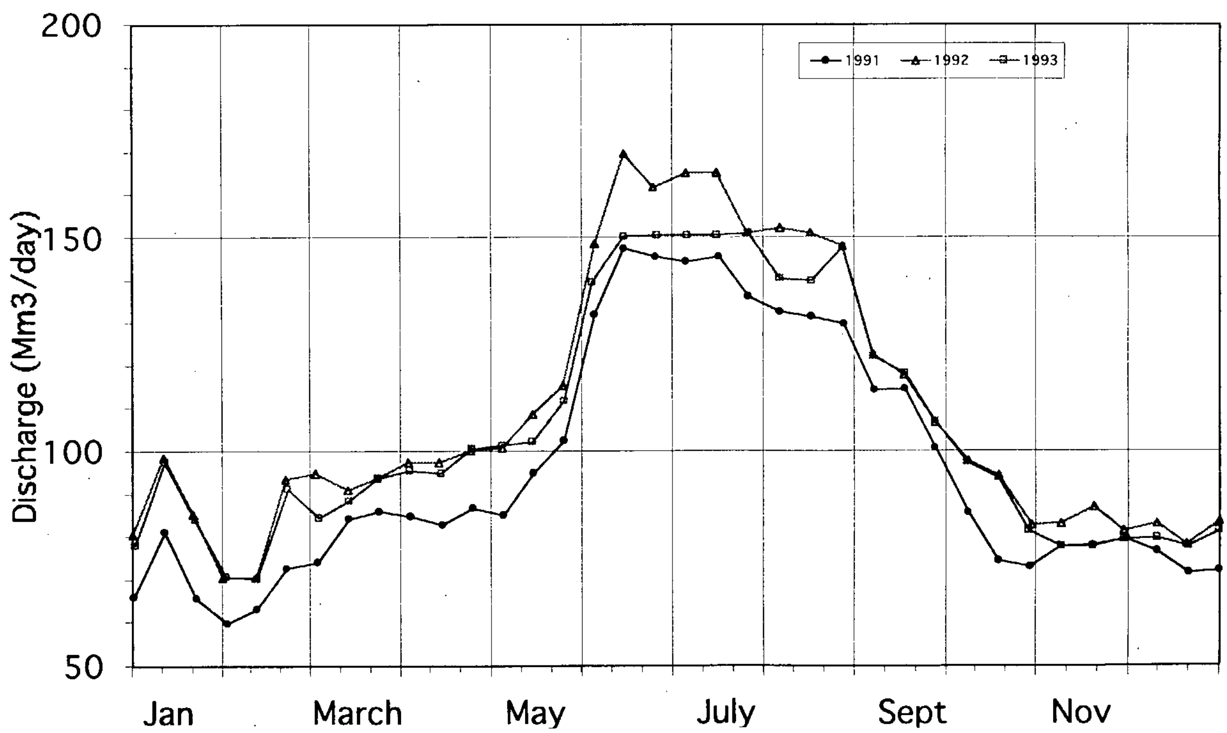
A large number of tourists visit Egypt every year to see the world-famous archeological monuments such as the Giza Pyramids and the Sphinx. The total number of tourists in 1995 was 3,133,461, of which 69,253 were from Japan (about 2.2% of total).

3.0 EXISTING WATER ENVIRONMENT OF THE NILE

3.0 Existing Water Environment of the Nile

3.1 Water Flow

The construction of the Aswan High Dam allowed a good control on the river water flow downstream of the Dam. The Nile Research Institute, a National Research Institute concerned with the water quality in the Nile, has been measuring the flow downstream of the Aswan High Dam. The reported data for 1991, 1992 and 1993 are shown in Figure 3.1. The measured daily river flow at El-Ekhsass (a measuring station downstream of the dam) has ranged from about 60 million m^3/day to 175 million m^3/day. The river flow during the months of May, June, July and August is relatively higher than the average monthly flow. It has been observed that the increase in the water flow correlates fairly well with high rainfall intensity in Sudan, which is located in the middle reach of the River Nile. It has therefore been concluded that the river flow pattern downstream of the Aswan High Dam is affected by rainfall pattern in Sudan.



Source: S. K. Ag. Hassan, M. El-Moattass, Recent Status of the River Nile Water Quality (from July 1991 to August 1993), Complied Research Paper of Nile Research Institutes as of 1995

Figure 3.1 Flow Rate at El-Ekhsass

3.2 Water Resources in Egypt

The River Nile is the most important water source in Egypt supplying approximately 98% of Egypt's fresh water needs. In 1959, an agreement was singed between the countries located along the river course to determine each country's share from the Nile water. The agreement provided Egypt with an annual release of 55.5 billion cubic meters (BCM) per year. Actual release from the Aswan High Dam has varied between 52.9 and 57.4 BCM per year. Of the 54 BCM of flow released from Aswan High Dam in 1990, approximately 14.1 BCM drained into the Mediterranean Sea. The balance was consumed by various economic sectors, as discussed below.

3.3 Water Use

The average yearly water consumption in Egypt has been estimated as shown in Table 3.1.

Table 3.1 Annual Water Use (unit: billion m^3/y)

WATER CONSUMED BY	Average Yearly Consumption During		
	1980-86	1990	2000
Industry	0.4	0.7	1.8
Urban consumption	1.8	2.4	3.1
Fresh water flow to sea (Edfina)	5.6	1.8	0.3
Drains to the sea	13.8	12.3	6.4
Balance: agriculture and evaporation	35.0	38.6	45.9

Source: Environmental Action Plan Egypt, April, 1992

As shown in the above Table, agriculture is the largest water consumer. This is due to the fact that 98% of irrigation is carried out by old, inefficient methods. Modern, water-saving irrigation techniques are only applied on 2% of the cultivated land and mostly in new reclaimed areas. Of the water consumed by irrigation, up to 50% is lost both through seepage from canals during conveyance and distribution of water, and on the farm as a result of poor, outdated irrigation practices.

Industrial water will have increased by four-and-a-half folds between 1986 and 2000. Despite this increase, the industrial sector consumes less than four percent of the average yearly flow out of Aswan High Dam. Water use in each geographical region and by each type of industry is shown on Tables 3.2 and 3.3, respectively.

An evaluation of the data summarized in the these two Tables provide the following:

I. In the year 1989, the industrial sector obtained about 90% of its total water needs from the Nile and Canals.

II. The industrial activities in the Greater Cairo region and in Alexandria consume approximately 40% of the total industrial water use.

III. The food industry is the largest water consuming industry.

Table 3.2 Industrial Water Use of Each Region (1989)

Region	Number of Factories	Water Use from Each Source (million cubic meter/year)			
		Nile	Canals	Groundwater	Total
Upper Egypt	35	184	6	22	212
Cairo	126	84	41	37	162
Nile Delta	60	105	15	27	147
Alexandria	85	36	52	22	110
Other	24	4	4	0	8
Total	330	413	118	71	639

Source: S. K. Ag. Hassan, M. El-Moattass, Recent Status of the River Nile Water Quality (from July 1991 to August 1993), Complied Research Paper of Nile Research Institutes as of 1995

Table 3.3 Industrial Water Use of Each Industry

Industry	Number of factory	Water Use (Mm^3/y)
Chemical	53	127
Food	119	296
Textile	75	114
Engineering	39	13
Mining	11	69
Metal	33	19
Total	330	639

Source: S. K. Ag. Hassan, M. El-Moattass, Recent Status of the River Nile Water Quality (from July 1991 to August 1993), Complied Research Paper of Nile Research Institutes as of 1995

The increase in population, the development of new land reclamation, and the increase in the number of industrial projects will further increase the demand for river water. It is estimated that water demand in the year 2000 by the industrial, domestic,. and agricultural consumers will be 1.8, 3.1, and 45.9 billion m^3, respectively.

The Water supply capacity of the Nile River is rather limited. Therefore, appropriate measures must be taken to utilize the river's water more efficiently and to protect the water quality from pollution.

3.4 Water Quality

3.4.1 Water quality monitoring

The following governmental institutions in Egypt have conducted water quality monitoring in the Nile:

II. Drainage Research Center (Ministry of Public Works and Water Resources)

III. Nile Research Center (Ministry of Public Works and Water Resources)

IV. Environmental Monitoring and Occupational Health Center (Ministry of Health)

Monitoring program of each Center is described below:

(1) Drainage Research Center

V. Objective of the Center

The Drainage Research Center has been conducting water monitoring in the Nile Delta under a program titled "Reuse Monitoring Program". The objective of the Program is to provide the Ministry of Public Works and Water resources with data concerning the quantity and quality of the generated drainage water in the Nile Delta.

VI. Sampling points

The center has permanent sampling locations at 140 points in the Eastern, Middle, and Western segments of the Delta. The Eastern segment is located east of the Rashid Branch of the Nile. The Western Segement is located west of the Damietta Branch of the Nile. The Middle Segment is located between these two branches.

VII. Monitoring frequency:

The center monitors its 140 sampling locations once a month.

VIII. Monitoring parameter

Samples collected from the sampling locations are tested for the following parameters:

pH, EC, Total coliform, BOD, COD, Oil & Grease, Turbidity, TSS, TVS, NO_3, NO_2, NH_4, PO_4, Cu, Fe, Mn, Zn, Pb, B, TDS, Ca, Mg, Na, K, CO_3, HCO_3, SO_4, Cl, RSC, SAR, Adj SAR

(1) Nile Research Center

IX. Objective

Nile Research Center (NRC) has been conducting Water Quality Monitoring Program for the Nile River since 1991. The objectives of the Program are:

- To serve as general reference for water quality condition on the whole river;
- To detect stream standard violations and maintain effluent standards;
- To determine the quantitative seasonal variations of the water quality and the point sources off pollution.

X. Sampling point

The NRC has established a total of 35 sampling locations along the river between the High Aswan Dam and the Mediterranean Sea as shown on Figure 3.2.

Out of the 35 locations, there are twelve located near the major barrages, the major industrial areas, and near intensive agricultural areas and large cities. The remaining 22 locations were selected at fixed, well known points along the River Nile to fill the gaps between the major points and to represent different segments along the river.

XI. Monitoring frequency

The locations are currently sampled once per year. It is planned to increase this frequency to twice per year when sufficient funds are available.

XII. Monitoring parameters

All 35 samples are tested for the following Basic parameters:

pH, Temperature, Conductivity, DO, Total alkalinity, Turbidity, Kjeldahl nitrogen, ammonia, Nitrite, Ortho-phosphorus, Total phosphorus, BOD, COD, TSS, TDS, Chlorides, Sulfates, Carbonates, Bicarbonates, E-coliform, Fecal coliform.

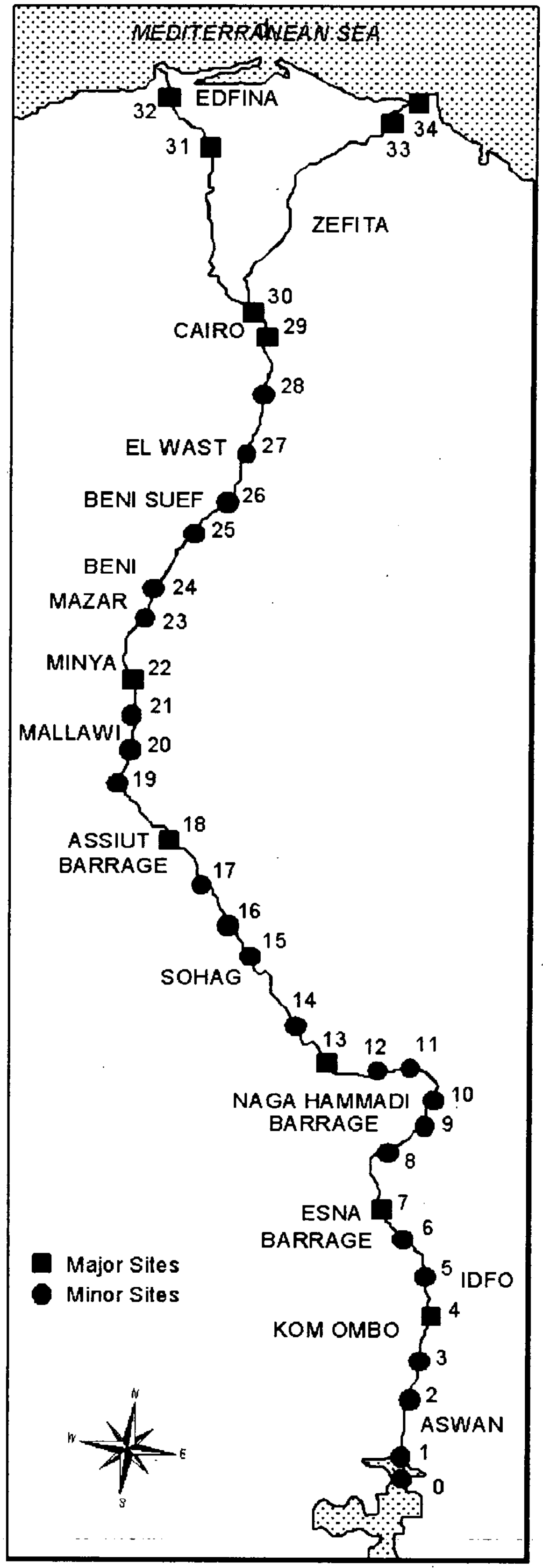


Figure 3.2 Monitoring Point

Samples collected from the agricultural drains are additionally tested for the following parameters: Ca, Mg, Na, K, Oil & Grease, Phenols, Pesticides, Surfactant, Total Copper, Total Lead, Total Zinc.

Samples collected from the Industrial Outfalls are additionally tested for the following parameters: Sulfide, Acidity, Ca, Mg, Na, K, Oil & Grease, Phenols, Surfactant, Total Lead, Total Zinc, Total Chromium, Total Arsenic, Total Mercury, Total Cadmium, Iron, Mg, Cyanide, Total Nickel.

(3) Environmental Monitoring and Occupational Health Center (EMOHC)

XII. Objective

The objective of the EMOHC is to ensure the quality of the drinking water sources.

XIII. Sampling Locations

EMOHC has established 130 sampling locations located between the High Aswan Dam and the Mediterranean Sea.

XIV. Monitoring frequency:

Once a month.

XV. Monitoring parameters

All collected samples are tested for the following parameters: pH, Temperature, Conductivity, DO, Ammonia, Nitrite, Nitrate, BOD, COD, TDS, SS, Total alkalinity, Total hardness, Major anions and cations, Oil & Grease, Phosphate, Sulfates, Total bacterial count, E-coliform. In addition, samples collected from the Greater Cairo area are tested for Pesticide and heavy metals.

3.4.2 Water Quality Data

1. Data of the Nile Research Center

The Nile Research Center performed an evaluation of the water quality along the Nile during July 1991, April 1992, December 1992 and August 1993. The results of the evaluation are shown in Figures 3.3 to 3.12.

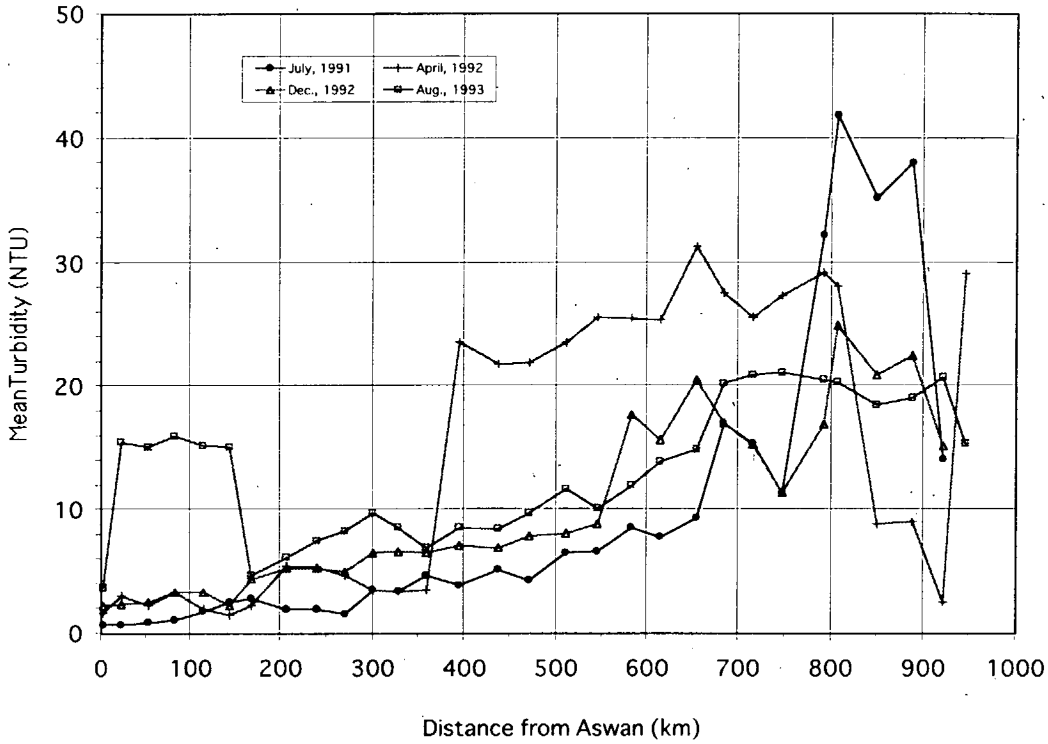


Figure 3.3 Variation of Turbidity along the River Nile

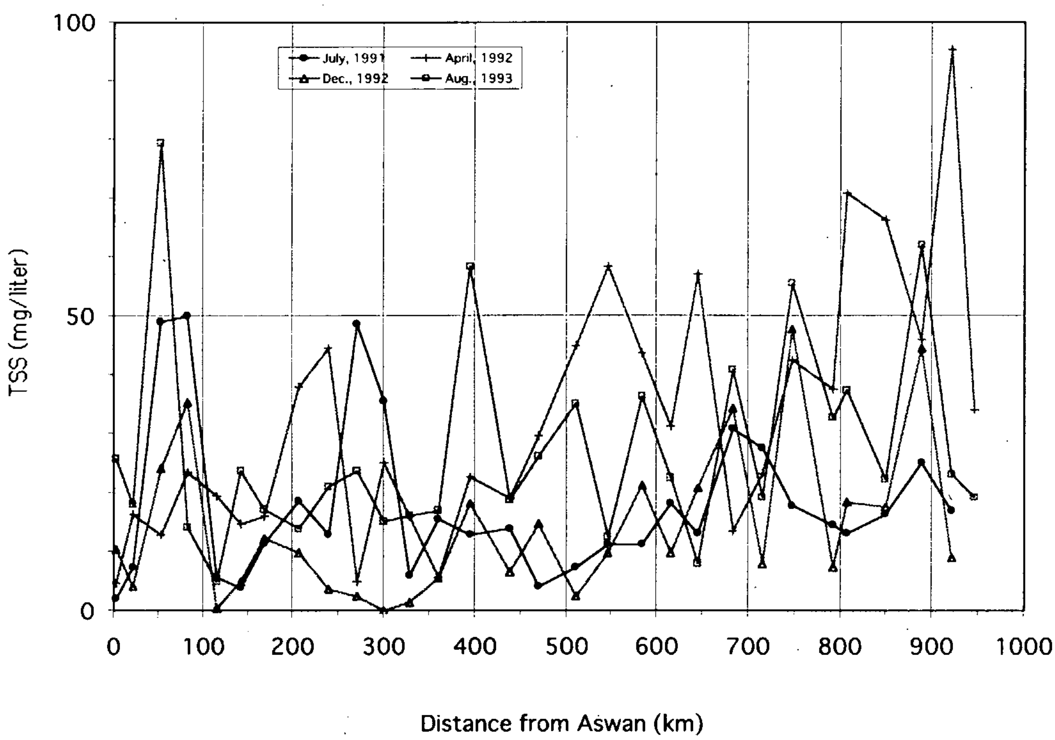


Figure 3.4 Variation of Total Solid Suspended along the River Nile

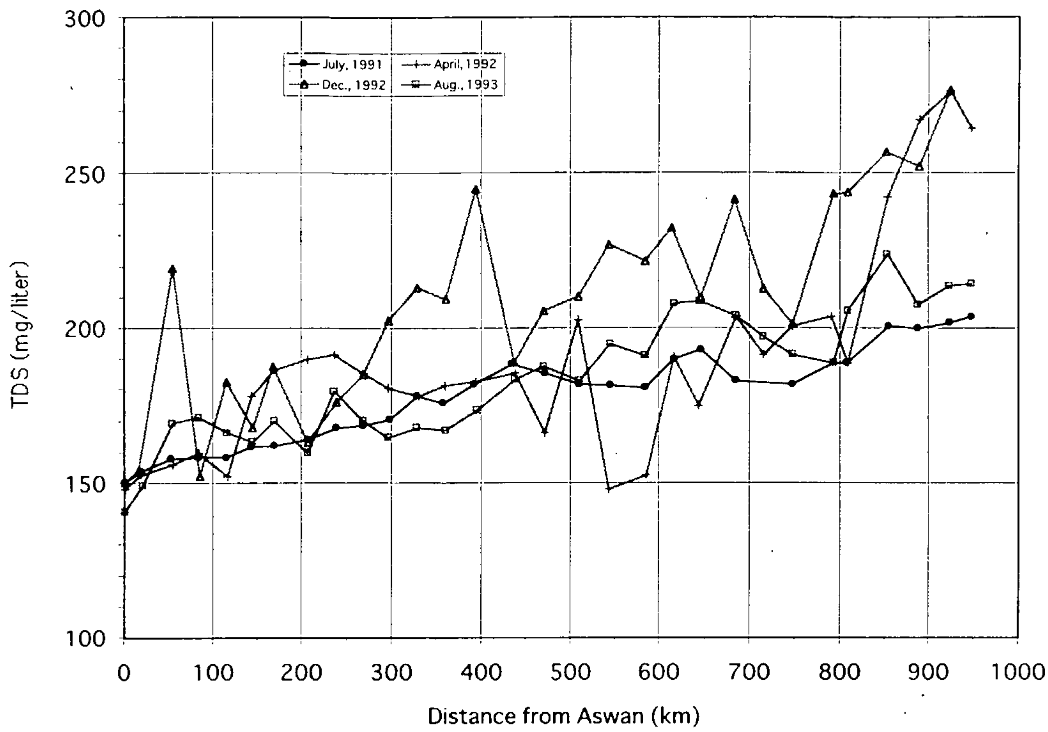


Figure 3.5 Variation of Total Dissolved Solids along the River Nile

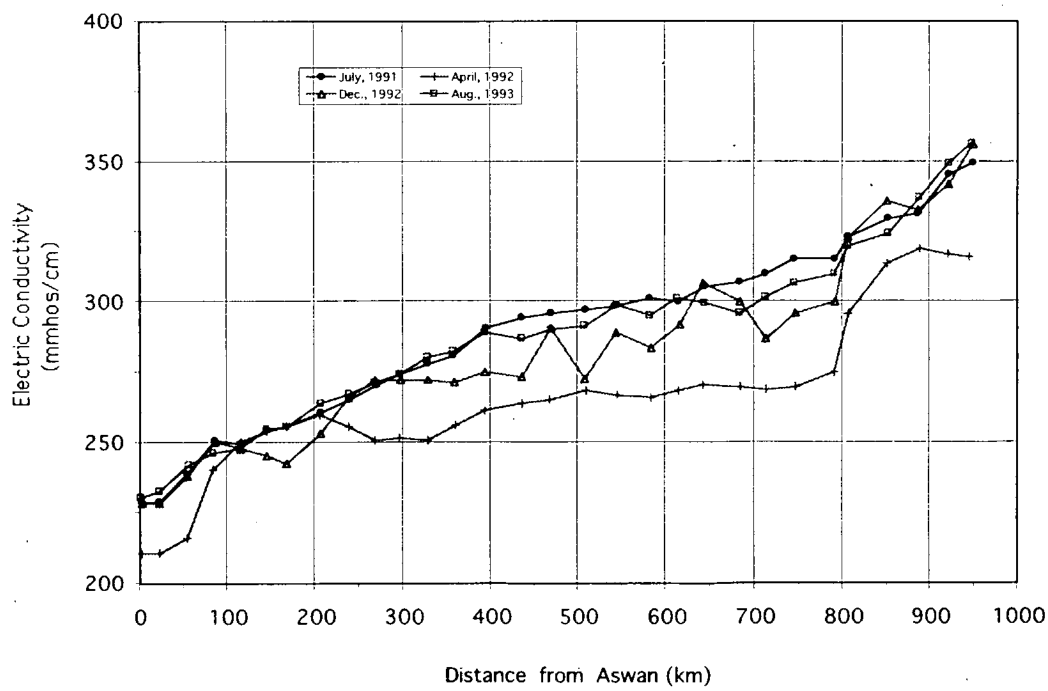


Figure 3.6 Variation of Electric Conductivity along the River Nile

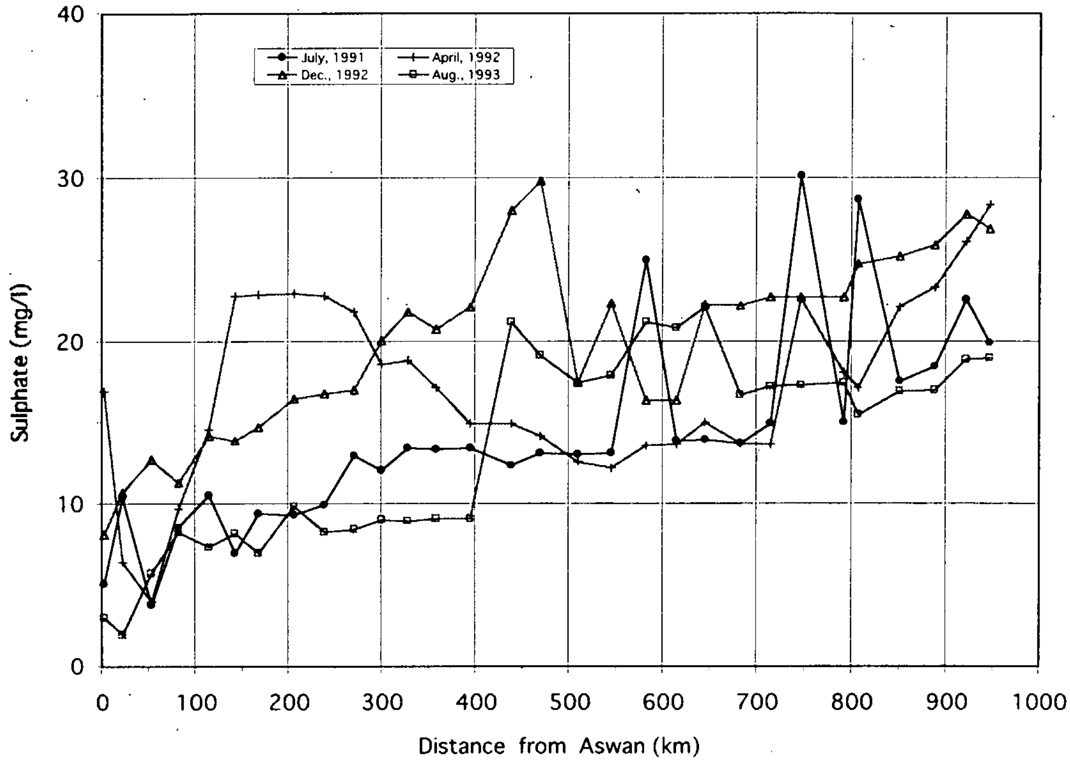


Figure 3.7 Variation of Sulfate along the River Nile

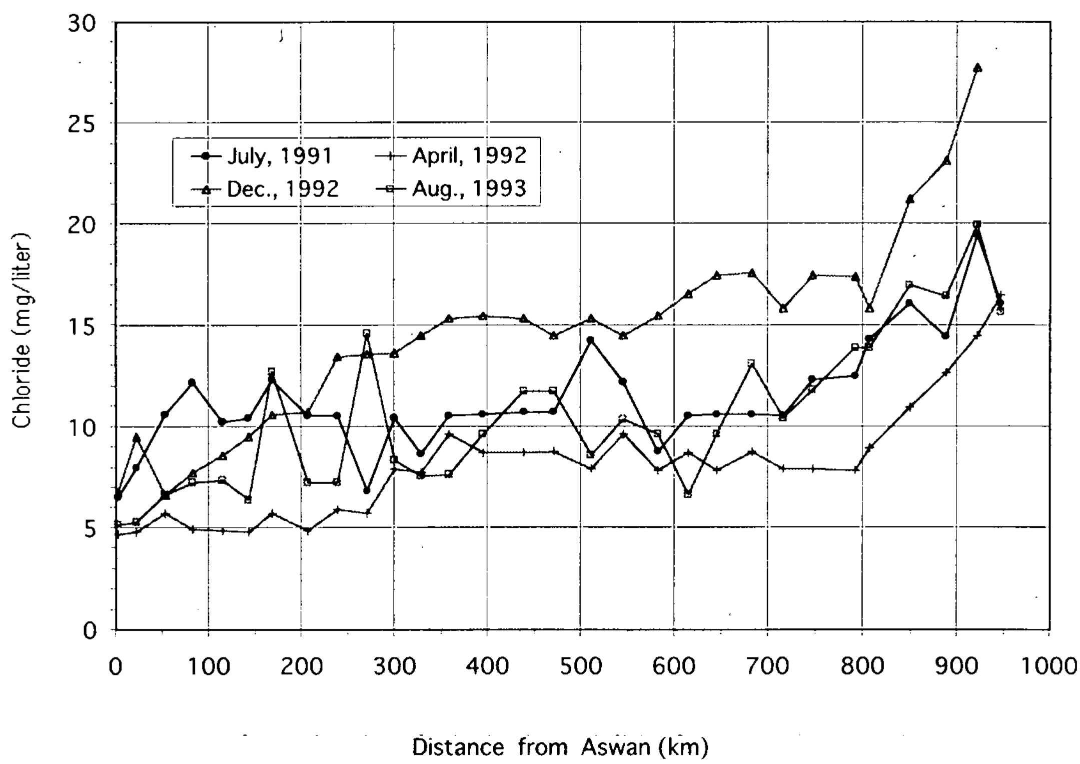


Figure 3.8 Variation of Chloride along the River Nile

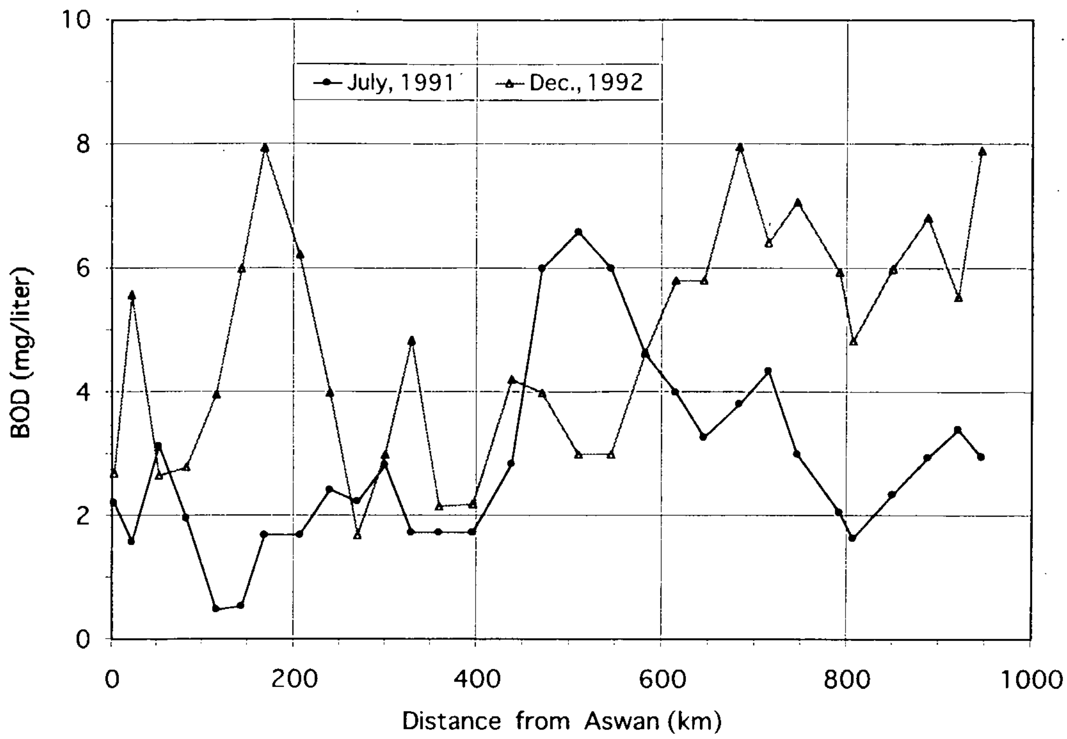


Figure 3.9 Variation of BOD along the River Nile

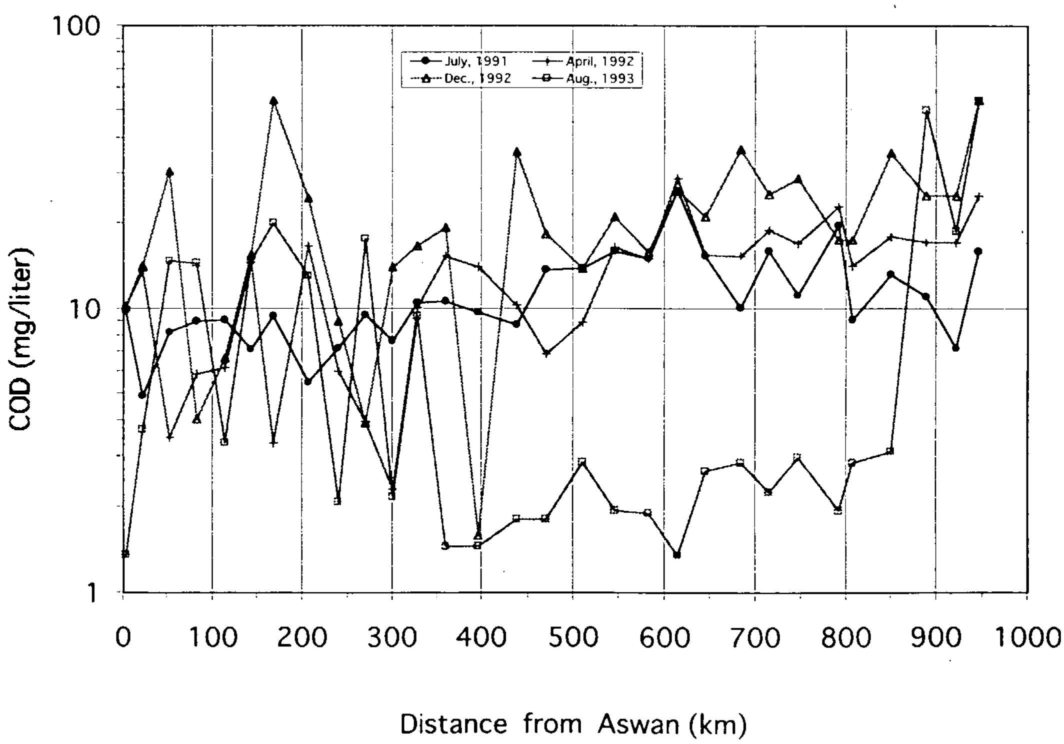


Figure 3.10 Variation of COD along the River Nile

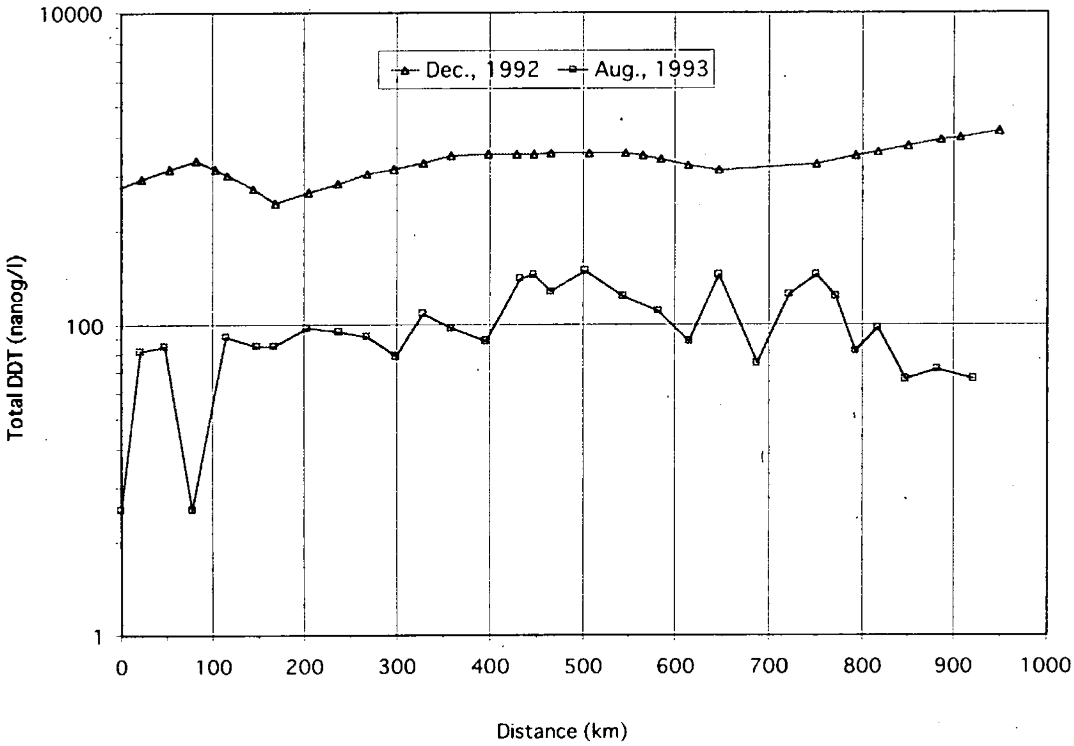


Figure 3.11 Variation of DDT along the River Nile

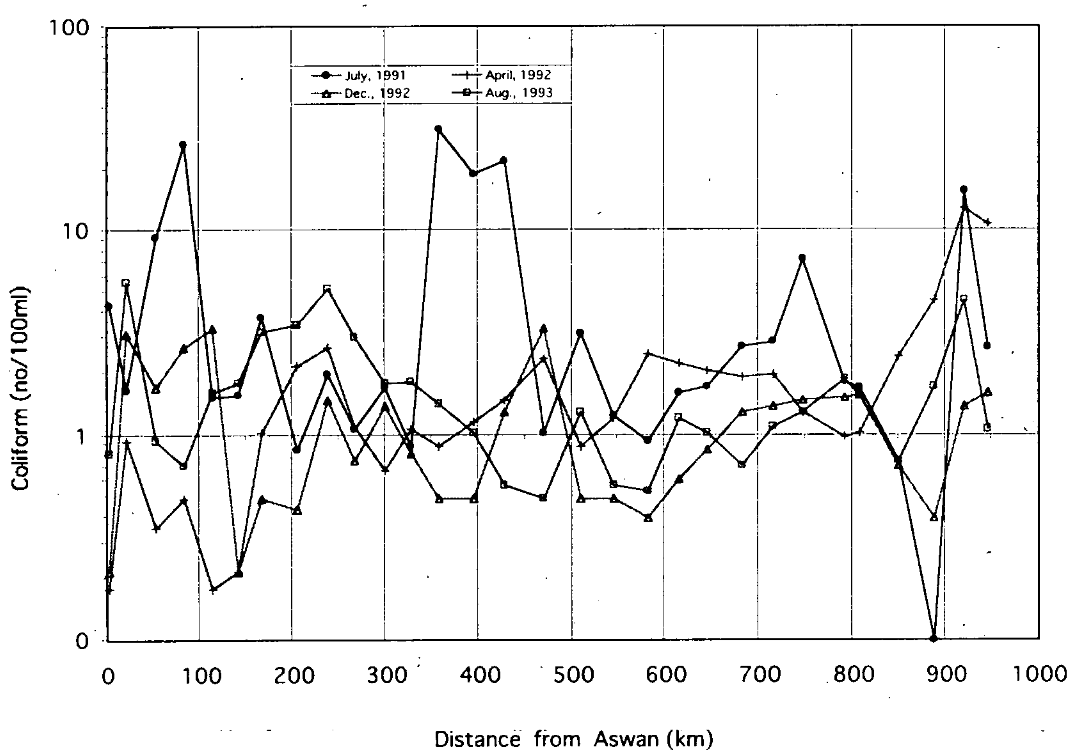


Figure 3.12 Variation of Coliforms along the River Nile

Based on the evaluation performed by the Nile Research Center, the water quality of the River Nile is discussed below. Not only background values of numerous parameters but also the gradients of the variation curves are commonly different from those of other zones, apparent on the binary graphs. Therefore, the 1000 kilometers length of the River Nile starting from Aswan City can be divided into three zones as follows:

XVII. Upstream Zone located between 0 and 300 kilometers from Aswan

XVIII. Midstream Zone located between 300 and 800 kilometers from Aswan

XIX. Downstream Zone, ranging from 800 to 1000 kilometers from Aswan

Each zone consists of flow with different directions as described below:

Upstream Zone of the Nile consists of

(i) Northward flow extending from 0 to 100 kilometers

(ii) NNW flow trending from 100 to 200kms, and

(iii) NEE-N-NW flow (200 to 240, 240 to 270, and 270 to 300 kilometers respectively).

Midstream Zone includes

(iv) SWW flow ranging from 300 to 400 kilometers

(v) NW flow extending from 400 to 600kms

(vi) Northward flow from 600 to 700kms, and

(vii) NNE flow existing between 700 and 800kms.

Downstream Zone exists

(viii) N flow from 800 to 900kms, and

(ix) NNW flow extending from 900 to 950 kilometers distance

XX. Turbidity (NTU) and Total solid suspended (TSS)

The Turbidity of the Nile gradually increases toward the downstream zone Average variation of turbidity are 2 to 10 NTU from 0 to 600 kilometers distance, 10 to 20 NTU between 600 and 800 kilometers and greater than 20 NTU of the downstream zone between 800 to 950 kilometers. It is common that fluctuations in the turbidity becomes distinct and increases in the zone located from 400 kilometers to 950 kilometers from Aswan during all periods. Turbidity contents of the upstream zone slightly increase from July 1991 to December 1992 through April 1992.

Less than 1 NTU of turbidity occurred in the 0-to-100 kilometer distance in July 1991, which is the lowest value ever recorded in this study. There are two locations where turbidity contents are twice greater than background level. The first is located in the 100-to-200 kilometer zone, and the second at 300 kilometers distance. Similarly, there are three domains, of which turbidity contents are higher than background level, in the midstream zone. Their locations are from 300 to 450 kilometers, from

450 to 600 kilometers and from 650 to 750 kilometers. Abrupt enrichment of turbidity close to 50 NTU existed between 800 and 950 kilometers in the downstream zone.

TSS (measured in unit of mg/liter) is also a parameter commonly proportionate to above-mentioned Turbidity. The fluctuation from the average TSS value is larger than that in turbidity measurements. This is true in all seasons indicating that TSS is a more sensitive parameter to the physical mechanisms experienced by the River Nile than turbidity.

TSS contents ranged from 3 to 10 mg/liter between 100 and 300 kilometers, from 4 to 14 mg/liter between 500 and 800 kilometers, and from 10 to 14 mg/liter between 800 and 950 kilometers. General variation features are followed to foregoing parameter, Turbidity. Overall, higher contents and wider ranges of TSS fluctuations along the whole length of the Nile were recorded in April 1992. Lower background level and smaller peaks belonged to the curve of December 1992. Remaining two curves are intermediary. Spatial variation on each curve is common in showing higher contents and degrees of fluctuations at the down stream zone compared to those at the upstream and mid stream zones, suggesting the continual supply of suspended solids in this zone.

XXI. Total Dissolved Solid, TDS (mg/liter)

TDS contents along the River Nile ranged from 140 to 160 mg/liter in the upstream zone, from 160 to 180 mg/liter in the midstream zone, and from 180 to 200 mg/liter in the downstream zone.

The abnormal higher contents and the wider differences of fluctuations in the third data series of December, 1992 are compatible with its lower Turbidity and TSS. Whereas, the lower TDS content of the April 1992 is consistent with its higher Turbidity and TDS at the Midstream zone. Enrichment rate of TDS in the downstream zone is apparently higher during April 1992 and December 1992. It may be concordant with higher increasing rate of chloride and electrical conductivity indicating potential sea water intrusions in those periods at these locations.

XXII. Electrical conductivity, EC

EC is directly reflected from the cations and anions dissolved in the water generally parallel to the TDS. It is 225 in the upstream zone up to 320 in the end of the midstream zone and gradually increasing at a constant rate with respect to increasing distances from the start. Relatively higher degree of enrichment is apparent in the down stream zone extending from 800 to 1,000 kilometers. There is a very high degree of correlation between EC and chloride.

XXIII. Sulfate and Chloride content (mg/liter)

Sulfate contents in the River Nile ranged from 8 to 12 mg/liters in the upstream zone, 12 to 15 mg/liters in the midstream zone, and 15 to 20 mg/liters in the downstream zone. Sulfate contents are highest in December 1992, which seem to have resulted from a lesser volume of discharge water along the Nile in December. Higher rate of sulfate enrichment in the downstream zone occurred in April 1992 and December 1992 compatible with chlorite variation in those periods.

Chloride generally follows the TDS and EC variation. It increases proportionally with distance from Asswan. Its concentration in the upstream and midstream zones ranged between 5 mg/liter and 10 mg/liter along the 800 kilometers length. Higher degree of chloride enrichment in the downstream zone may have resulted from seawater intrusion.

XXIV. Biological Oxygen Demand (BOD)

BOD levels recorded in July 1991 ranged from 0.5 to 3 mg/liter in the upstream zone, 1.8 to 7 mg/liter in the midstream zone and 1.8 to 4 mg/liter in the downstream zone. Several higher peaks above the background values include a 3 mg/liter concentration of BOD between zero and 100 kilometers and between 200 and 350 kilometers, a 7 mg/liter concentration of BOD between 500 and 750 kilometers, and 5 mg/liter concentration of BOD between 880 and 920 kilometers. BOD contents in December 1992 slightly decreased below those in July 1991 except in the downstream zone. BOD concentration in the downstream zone in December 1992 was about 6 milligram/liter, which is slightly greater than that measured in July 1991. The locations of the higher BOD concentration peaks completely coincided with peaks of COD concentrations. Their occurrences are usually confined to the locations of lower Turbidity and lower total solid suspended. BOD and COD contents are commonly depleted at places where Turbidity and TSS are obviously higher.

XXV. Chemical Oxygen Demand (COD)

Concentrations of COD along the River Nile ranged from 6 to 10 mg/liter in the upstream zone, 10 to 12 mg per liter in the midstream zone, and 10 mg/liter in the downstream zone. Some fluctuated points showing 15 to 20 mg/liter of COD were located at 600 kilometers, 720 kilometers, and 800 kilometers distance. These locations coincided with the locations of contamination and pollution that may have occurred in July 1991. As mentioned earlier, high levels of BOD were also recorded at these same locations, indicating that the same parameters control both BOD and COD concentrations.

Similar to BOD variation in December, 1992, there are several points having 20 to 50 mg/liter contents of COD appearing like distinct peaks on the variation curve of December, 1992. Respective locations are also exactly the same as those of BOD.

XXVI. Total DDT

Total DDT contents detected in April 1992 ranged from 600 to 1,200 nanogram/liter in the upstream zone, 800 to 1,300 in the midstream zone, and 1,200 to 1,800 in the downstream zone. The high DDT in the downstream zone suggests that the most extensive contamination existed the downstream zone, exactly as other parameters suggest. Total DDT contents measured in August 1993 along the whole length of the Nile were less than 200 nanogram/liter, obviously lower than those measured in April 1992.

XXVII. Coliforms

Coliforms contents recorded in July 1991 ranged from 1 to 30 numbers/100 milliliters. This is the highest level compared to those measured in other periods, which ranged from 0.1 to 3. There are four areas where coliforms were abnormally high in July 1991. They represented locations of extensive pollution. They are located between 0 and 100 kilometers, between 350 and 750 kilometers, between 600 and 800 kilometers and from 900 to the end. Coliforms of the former three areas became lower in April 1992 and December 1992. Coliforms from the downstream zone, between 900 and 950 kilometers are high in all periods indicating continuous contamination and water quality deterioration in the downstream.

(2) Data of the Drainage Research Institute

The Drainage Research Institute conducted water quality analysis of the drainage water in the Nile Delta. Average values of the monitored parameters during the period 1994/1995 are summarized in Table 3.4, and an evaluation of the data shown in the table is presented below:

XXVIII. Water of the Nile Delta is more polluted than the water of main stream of the River Nile when comparing the major pollution parameter including COD and BOD.

XXIX. Nutrients (nitrogen, phosphorus) concentration in the Nile Delta possibly caused by a runoff of fertilizer from agriculture land and untreated sanitary wastes are of relatively high levels.

Table 3.4 Annual Average of Water Quality in the Nile Delta (1994/1995)

Sampling Point		Eastern	Eastern	Middle	Middle	Western
Parameters	Unit	Delta(1)	Delta(2)	Delta(1)	Delta(2)	Delta(1)
Total Coliform	MPN/100ml	90,800	7,200	666,668,667	350,000	63,400
BOD	mg/l	68.33	43.47	44.33	46.50	35.00
COD	mg/l	92.29	64.93	118.07	143.00	256.63
OilGrease	mg/l	0.00	0.00	0.00	0.00	0.00
Turbidity	NTU	24.67	18.67	14.33	25.00	19.25
TSS	mg/l	140.00	171.67	156.67	210.00	282.50
TVS	mg/l	15.67	13.33	22.33	24.00	28.75
NO3	mg/l	3.31	3.42	2.71	1.76	1.59
NO2	mg/l	0.00	0.00	0.00	0.00	0.00
NH4	mg/l	5.09	8.27	1.57	24.65	1.10
PO4	mg/l	0.41	0.26	0.21	0.30	0.34
Cu	mg/l	0.00	0.01	0.00	0.00	0.00
Fe	mg/l	0.26	0.30	0.15	0.21	0.08
Mn	mg/l	0.08	0.00	0.00	0.00	0.10
Zn	mg/l	0.00	0.00	0.00	0.00	0.00
Pb	mg/l	0.00	0.00	0.00	0.00	0.00
B	mg/l	0.00	0.00	0.00	0.00	0.00
pH		7.50	7.70	7.47	8.70	7.57
EC	dS/m	2.76	3.98	2.03	1.72	2.06
TDS	mg/l	1761	2534	1253	800	1375
Ca	meq/l	5.07	7.44	4.64	2.31	4.65
Mg	meq/l	5.30	8.70	3.39	2.29	3.80
Na	meq/l	17.10	23.96	10.97	7.35	12.20
K	meq/l	0.42	0.37	0.26	0.26	0.26
CO3	meq/l	0.00	0.00	0.00	0.96	0.00
HCO3	meq/l	3.41	4.31	3.66	3.17	2.63
SO4	meq/l	8.11	12.60	6.04	2.83	10.56
Cl	meq/l	16.37	23.55	9.55	5.24	7.83
RSC		0.00	0.00	0.00	0.00	0.00
SAR		6.46	8.34	5.45	4.93	5.67
Adj SAR		15.34	20.68	12.06	10.46	12.08

Source: Drainage Research Center, Reuse Monitoring Program, Yearbook 1994/95, Drainage Water in the Nile Delta, Report 40

3.5 Pollution Source

As shown in Table 3.5 and Figure 3.13, along the Nile, there are 79 discharge agricultural drains, and 63 discharge points from industrial effluent, power stations and domestic wastewater. Current situation of major pollution sources are summarized as follows:

Table 3.5 List of Drains and Industrial Effluent (1)

Serial No.	Kms From Aswan	Name	Description
1	6.000	Aswan Sewerage Drain	Sewarage Drain
2	9.900	Khour El Sail Drain	Agricultural Excess Water R.B.
3	37.250	El Tawansa Drain	Agricultural Excess Water R.B.
4	42.500	El Sheikh Ibrahem Drain	Agricultural Excess Water R.B.
5	46.550	El Ghaba Drain	Agricultural Excess Water R.B.
6	47.150	Abu Wanas Drain	Agricultural Excess Water R.B.
7	48.000	El Shatb Drain	Agricultural Over Flow From Canal R.B.
8	48.850	Main Draw Drain	Agricultural Excess Water R.B.
9	49.100	El Berba Drain	Agricultural Excess Water R.B.
10	50.000	Kom Ombu Sugar Ind.	Industrial Effluent R.B.
11	51.000	Kom Ombu Drain	Agricultural Excess Water R.B.
12	53.000	Benban Drain	Agricultural Excess Water L.B.
13	55.000	Meneha Drain	Agricultural Excess Water R.B.
14	57.650	Main Ekleet Drain	Agricultural Excess Water R.B.
15	63.600	Ekleet Power Station	Power Station
16	64.650	Berak El Raghama Drain	Agricultural Excess Water R.B.
17	70.450	Fatera Drain	Agricultural Excess Water R.B.
18	70.750	Khour El Sail Drain	Mixed From Water & Ind. R.B.
19	73.850	Selesla Drain	Agricultural Excess Water R.B.
20	75.750	Kagouk Drain	Agricultural Excess Water R.B.
21	76.000	Awarta Drain	Agricultural Excess Water R.B.
22	99.850	Radisia Drain	Agricultural Excess Water R.B.
23	101.750	Hasia Drain	Agricultural Excess Water L.B.
24	109.250	Hager Drain	Agricultural Excess Water L.B.
25	116.200	Edfu Drain	Agricultural Excess Water R.B.
26	119.600	Kalh Power Station	Power Station
27	122.450	Edfu Paper Pulp A.	Industrial Effluent L.B.
28	122.500	Edfu Paper Pulp B.	Industrial Effluent L.B.
29	123.000	Edfu Sugar Ind.	Industrial Effluent L.B.
30	135.600	El Mahameed Drain	Agricultural Excess Water R.B.
31	139.500	Houd El Sabaia	Agricultural Excess Water L.B.
32	143.100	Hagz El Bahary Drain	Agricultural Excess Water R.B.
33	147.000	Seba Phosphate Drain	Industrial Effluent R.B.
34	149.100	Hagar El Sebia	Agricultural Excess Water L.B.
35	187.700	Mataana Drain	Agricultural Excess Water L.B.
36	196.700	Ghoreara Drain	Agricultural Excess Water L.B.
37	204.500	Armant Sugar Ind. 1	Industrial Effluent L.B.
38	204.505	Armant Sugar Ind. 2	Industrial Effluent L.B.
39	204.510	Armant Sugar Ind. 3	Industrial Effluent L.B.

Source: Drainage Research Center, Reuse Monitoring Program, Yearbook 1994/95, Drainage Water in the Nile Delta, Report 40

Table 3.5 List of Drains and Industrial Effluent (2)

Serial No.	Kms From Aswan	Name	Description
40	209.000	El Salamia Drain	Agricultural Excess Water R.B.
41	220.800	El Mraibia Drain	Agricultural Excess Water From Canal L.B.
42	220.850	El Rayayna Drain	Agricultural Excess Water L.B.
43	224.500	Outlet Louxor Water Treatment	Industrial Effluent
	228.600	Khour El Sail at Qena	Agricultural Excess Water
44	236.000	El Zeinia Drain	Agricultural Excess Water R.B.
45	237.700	Habail El Sharky Drain	Agricultural Excess Water R.B.
46	245.100	El Shanhoria Drain	Agricult. Excess Water From Canal R.B.
	246.850	Ques Sugar Ind.	Industrial Effluent R.B.
47	251.550	Danfik Drain	Agricultural Excess Water L.B.
48	265.300	Sheikhia (El Hagaza) Drain	Agricultural Excess Water R.B.
	265.400	Grinding Mill	Industrial Effluent R.B.
49	270.700	El Ballas Drain	Agricultural Excess Water L.B.
50	275.900	Kaft (Qift) Drain	Agricultural Excess Water R.B.
51	286.750	El Tramasa Drain	Agricultural Excess Water L.B.
52	288.600	Khour El Sail Qena W. Treat. P.	Mixed From Agr. & Ind. R.B.
53	299.750	Bahari Dandra Drain	Agricult. Excess Water From Canal R.B.
54	314.000	Deshna Sugar Ind.	Industrial Effluent R.B.
55	331.200	Hamad Drain	Agricultural Excess Water R.B.
56	333.500	Salamia Drain	Agricultural Excess Water R.B.
	337.500	Alumenium Ind.	Industrial Effluent
57	337.800	Naga Hammadi Drain	Agricultural Excess Water
58	340.350	Magrour Hoe Drain	Agricultural Excess Water L.B.
59	343.200	Naga Hammadi Sugar Ind. A.	Industrial Effluent L.B.
60	343.250	Naga Hammadi Sugar Ind. B.	Industrial Effluent L.B.
61	363.000	Abu Homar Power Station	Power Station
62	377.800	Naga Hamadi Drain	Agricultural Excess Water L.B.
63	384.000	Abu Shousha Drain	Agricult. Excess Water From Canal L.B.
64	392.750	Mazata Drain	Agricultural Excess Water R.B.
65	432.700	Essawia Drain	Agricult. Excess Water From Canal L.B.
66	443.200	Onion Ind.	Industrial Effluent L.B.
67	444.550	Souhag Drain	Agricultural Excess Water L.B.
68	445.600	Souhag Oil Ind.	Industrial Effluent L.B.
69	445.605	Cocacola Ind.	Industrial Effluent L.B.
70	454.700	Seflak Drain	Agricultural Excess Water R.B.
71	473.850	Ekheem Drain	Agricultural Excess Water R.B.
72	486.400	Raaina Drain	Agricult. Excess Water From Canal R.B.
73	486.700	Tahta Drain	Agricultural Excess Water L.B.

Source: Drainage Research Center, Reuse Monitoring Program, Yearbook 1994/95, Drainage Water in the Nile Delta, Report 40

Table 3.5 List of Drains and Industrial Effluent (3)

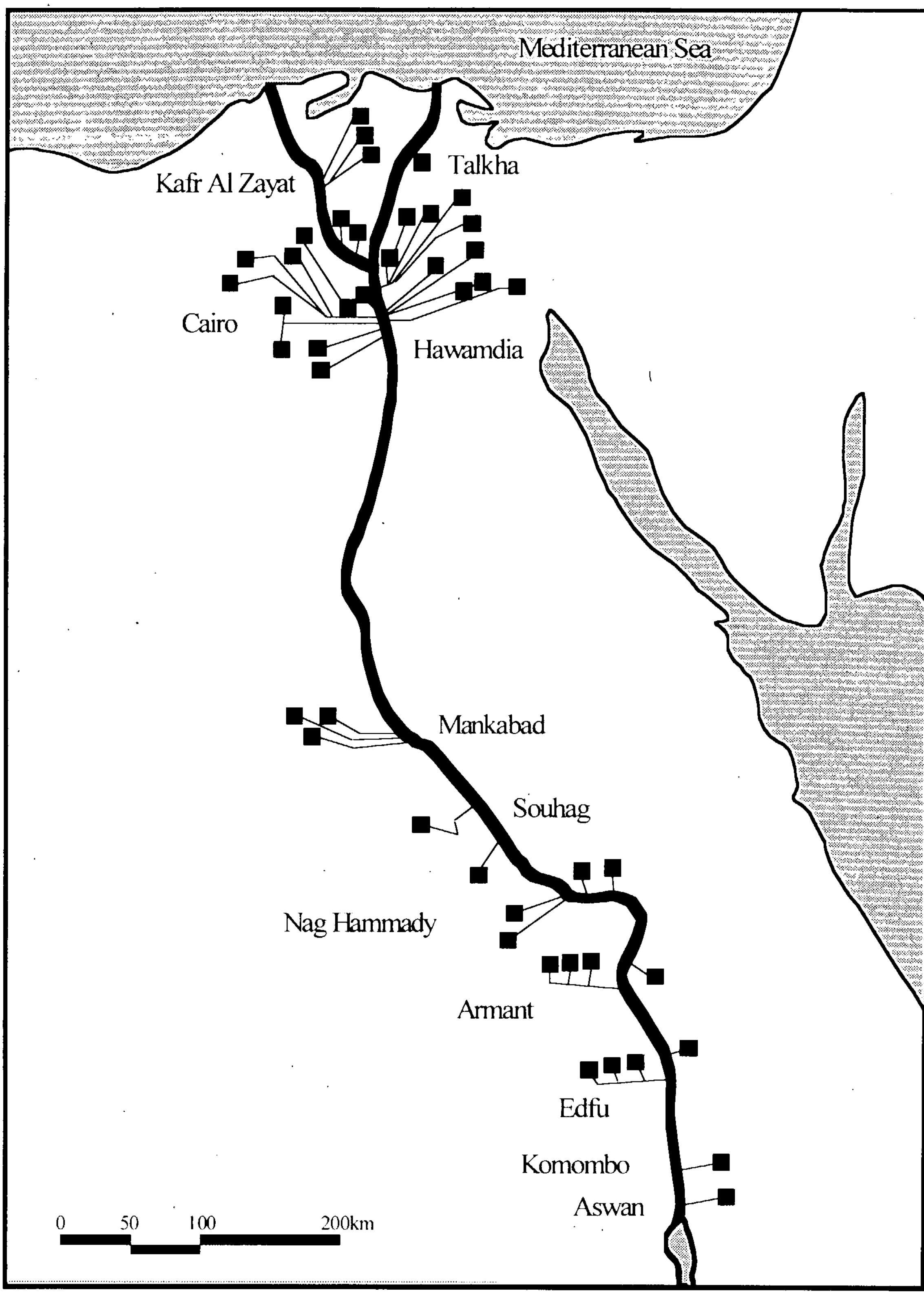
Serial No.	Kms From Aswan	Name	Description
74	520.800	Abu Teeg Drain	Agricultural Excess Water L.B.
75	525.400	El Badary Drain	Agricultural Excess Water R.B.
76	525.850	El Metmar Drain	Agricult. Excess Water From Canal R.B.
	535.400	Badary Drain	Agricultural Excess Water
77	536.000	Assuit Power Station	Power Station
78	537.000	Assuit Water Treatment Plant	Industrial Effluent
79	544.250	Marawana Drain	Agricultural Excess Water R.B.
80	550.200	El Zenar Drain	Agricultural Excess Water L.B.
81	552.200	Mankabad Pipe 1	Industrial Effluent L.B.
82	552.205	Mankabad Pipe 2	Industrial Effluent L.B.
83	552.210	Mankabad Pipe 3	Industrial Effluent L.B.
84	588.600	Bany Shaker Drain	Agricultural Excess Water L.B.
85	637.400	El Rayamoun Drain	Agricultural Excess Water L.B.
86	642.750	Abu Henis Drain	Agricultural Excess Water R.B.
87	682.000	Minia Water Treatment Plant	Industrial Effluent
88	682.500	Makoussa Drain	Agricultural Excess Water L.B.
89	701.100	Etsa Drain	Agricultural Excess Water L.B.
90	752.150	El Sheikh Zied Drain	Agricultural Excess Water L.B.
91	780.500	Ebsug Drain	Agricultural Excess Water L.B.
92	807.000	Beni Sulf Water Plant	Industrial Effluent
93	807.200	Ahnasia Drain	Agricultural Excess Water L.B.
94	808.000	El Saayda Drain	Agricultural Excess Water L.B.
95	841.000	El Zawia Drain	Agricultural Excess Water L.B.
96	848.900	Khour El Sail Atfih Drain	Agricultural Excess Water R.B.
97	865.200	El Dessamy Drain	Agricultural Excess Water R.B.
98	871.300	Kafr Gazara (El Saaf) Drain	Agricultural Excess Water R.B.
99	879.600	El Masandra Drain	Agricultural Excess Water R.B.
100	884.500	Ghamaza El Soghra Drain	Agricultural Excess Water R.B.
101	888.950	Ghamaza El Kobra Drain	Agricultural Excess Water R.B.
102	898.100	El Tibeen Drain	Mixed From Agricultural & Ind. R.B.
103	901.000	Tibeen Power Station	Power Station
104	904.000	Hawamdia Chemical 1	Industrial Effluent L.B.
105	904.080	Hawamdia Chemical 2	Industrial Effluent L.B.
106	904.300	Hawamdia Chemical 3	Industrial Effluent L.B.
107	904.350	Hawamdia Chemical 4	Industrial Effluent L.B.
108	909.200	Helwan Power Station	Power Station
109	910.150	Khour Sail El Badrashin	Mixed From Agricultural & Ind. R.B.

Source: Drainage Research Center, Reuse Monitoring Program, Yearbook 1994/95, Drainage Water in the Nile Delta, Report 40

Table 3.5 List of Drains and Industrial Effluent (4)

Serial No.	Kms From Aswan	Name	Description
110	911.400	Chemical Ind.	Industrial Effluent L.B.
111	911.900	Hawamdia Sugar Maulas	Industrial Effluent L.B.
112	912.100	Hawamdia Sugar Pipe 1	Industrial Effluent L.B.
113	912.105	Hawamdia Sugar Pipe 2	Industrial Effluent L.B.
114	912.115	Hawamdia Sugar Pipe 3	Industrial Effluent L.B.
115	912.120	Hawamdia Sugar Pipe 4	Industrial Effluent L.B.
116	912.125	Hawamdia Sugar Pipe 5	Industrial Effluent L.B.
117	912.130	Hawamdia Sugar Pipe 6	Industrial Effluent L.B.
118	912.900	Khour Sail El Masara Drain	Mixed From Agricultural & Ind. R.B.
119	916.550	Kotsica Starch & Glucose Dr.	Industrial Effluent R.B.
120	916.551	Kotsica Starch & Glucose Dr.	Industrial Effluent R.B.
121	939.600	El Nasr Glass tube 1	Industrial Effluent R.B.
122	939.605	El Nasr Glass tube 2	Industrial Effluent R.B.
123	939.610	El Nasr Glass tube 3	Industrial Effluent R.B.
124	939.615	El Nasr Glass tube 4	Industrial Effluent R.B.
125	939.620	El Nasr Glass tube 5	Industrial Effluent R.B.
126	947.000	Power Station	Power Station
127	947.900	Delta Cotton at Kanater	Industrial Effluent
R1	962.850	El Rahawy Drain	Mixed From Agricultural & Ind. R.B.
R2	1025.000	Sabal Drain	Agricultural Excess Water R.B.
R3	1039.500	El Tahreer Drain	Agricultural Excess Water L.B.
R4	1053.700	Zaweit El Bahr Drain	Agricultural Excess Water L.B.
R5	1073.400	Tala Drain	Agricultural Excess Water R.B.
R6	1074.500	Pesticides Company	Industrial Effluent R.B.
R7	1074.505	El Malaya Company	Industrial Effluent R.B.
R8	1074.510	Salt & Soda Company	Industrial Effluent R.B.
D1	1098.000	Talkha 1 Fertilizers	Industrial Effluent L.B.
D2	1098.120	Talkha 2 Fertilizers	Industrial Effluent L.B.
D3	1124.500	Batra Drain	Agricultural Excess Water R.B.
D4	1125.200	High Serw 1	Agricultural Excess Water L.B.
D5	1135.300	High Serw Power Station	Power Station R.B.
D6	1166.000	Faraskous	Industrial Effluent R.B.

Source: Drainage Research Center, Reuse Monitoring Program, Yearbook 1994/95, Drainage Water in the Nile Delta, Report 40



Source: Drainage Research Center, Reuse Monitoring Program, Yearbook 1994/95, Drainage Water in the Nile Delta, Report 40

Figure 3.13 Location of Industrial Effluent

3.5.1 Agricultural Source

Out of the 79 agricultural drains, 72 drains discharge their waters into the main river from Aswan to Cairo. Five of these drains discharge their waters into the Rosetta branch; while the remaining 2 drains discharge their waters into the Damietta branch.

3.5.2 Industrial Source

A total of 59 industrial outfalls are loacted along the main stream of the Nile. In upper Egypt, there are varieties of industries including sugar, fertilizer, paper pulp, aluminum, food production. Sugar factories, which are the main industry in upper Egypt, are located in Kom Omub, Edfu, Armant, Ques, Deshana and Naga Hammadi. In the south region of Cairo (Hawamdia, El Tibeen and Helwan), factories including iron and steel, coke and fertilizer, wood processing, sinning and weaving, sugar are located.

3.5.3 Municipal Source

There are a few direct discharges of municipal waters into the Nile. Most of the municipal wastewater is discharged to the Nile through agricultural drains.

3.6 Pollutant Loads

The National Environmental Action Plan of 1992 indicated that, in 1989, wastewater discharge from the various industries was as summarized on Tables 3.6 to 3.8.

Table 3.6 Industrial Waste water Discharge Area and Volume (1989)

Region	Number of Factory	Discharge Area and Volume(Mm3/year)				
		Nile	Canal	Sew. canal	Lakes	Total
Upper Egypt	35	192	5	2	5	204
Cairo	126	80	21	20	7	128
Nile Delta	60	27	85	13	1	126
Alexandria	85	13	7	33	35	88
Other	24	0	0	3	1	4
Total	330	312	118	71	49	550

Source: Environmental Action Plan Egypt, April, 1992

Table 3.7 Pollutant Load at Each Region (1989)

Region	Pollutant Load(ton/day)					
	BOD	COD	OIL	SS	TDS	Heavy Metals
Upper Egypt	72	37	5	68	532	0.20
Cairo	71	120	93	97	135	0.75
Nile Delta	34	42	24	86	224	0.50
Alexandria	91	186	45	40	246	0.17
Other	2	3	1	5	15	0.03
Total	270	388	168	296	1152	1.65

Source: Environmental Action Plan Egypt, April, 1992

Table 3.8 Pollutant Load from Each Industry (1989)

Industry	Pollutant Load(ton/day)					
	BOD	COD	OIL	SS	TDS	Heavy Metals
Chemical	26	178	23	33	241	0.94
Food	182	142	110	168	666	0.17
Textile	39	47	24	64	191	0.30
Engineering	5	7	2	3	13	0.03
Mining	15	14	8	24	29	0.20
Metal	3	0	1	4	11	0.01
Total	270	388	168	296	1152	1.65

Source: Environmental Action Plan Egypt, April, 1992

As shown in Table 3.6, industries in the Greater Cairo region and in Alexandria discharged about 40% of the total industrial water use and drainage. Pollutant load from food industry contributed more than 50% of the BOD load, while the heavy metal discharge originated for almost 60% from the chemical industry. However, industrial pollutant load has been reduced by implementation of industrial wastewater treatment projects for major pollution sources.

3.7 Effects Due to Industrial Waste Water

The High Aswan Dam Side Effects Research Institute conducted water sampling and analysis of 46 industrial outfalls from 1976 to 1988. Effects due to industrial wastewater were analyzed for each segment as follows:

I. Reach No.1: from High Aswan Dam to Esna Barrage (0 – 167 km)

II. Reach No.2: from Esna to Naga Hammadi Barrage (167 - 359 km)

III. Reach No.3: from Naga Hammadi to Assiut Barrage (362 - 544 km)

IV. Reach No.4: from Assiut to Delta Barrage (544 - 952 km)

V. Reach No.5: Rosetta Branch

VI. Reach No.6: Damietta Branch

The effect of each source is discussed below.

(1) Reach No.1

1) Kima Factory

The water from drains potentially affected the Nile water by high contents of organic loading and high concentrations of chemical and solids. This effect was noticeable downstream of the discharging point for about 300 m. Further downstream the river started to recover back to background concentrations.

2) Sugar factories of Kom-Ombu

The river received waste water from the factories at 50 km downstream from Aswan. This was reflected in the high concentration of organic matter and suspended solids. Both of BOD and COD concentrations decreased in the river water 200 m downstream from the outfall, while suspended solids were reduced from 180 mg/l to 150 mg/l along the same disntance.

3) Edfu paper pulp and sugar factories

The river water strongly suffered from receiving effluent of low oxygen, high organic matter, suspended solids, high concentrations of oil & grease and TDS.

4) El Sebaia Phosphate Port

Activity here increased the concentration of phosphate downstream from the port.

(2) Reach No.2

This reach received the liquid wastes of sugar factories of Armant 204.5 km from Aswan, Ques 256.6 km from Aswan, Deshna 314.0 km from Aswan and Naga Hammadi 343.2 km from Aswan.

The increase in the concentration of dissolved and suspended pollutants (such as TDS, suspended solids, and organic matter), discharged to the river water from the raw industrial effluent, strongly affected the river water quality for about 300 m before starting to recover.

Wastes from aluminum complexes at Naga Hammadi discharged at 337.5 km from Aswan and contained high concentrations of solids, and oil and grease. The water quality started to recover 200 m downstream from this source.

(3) Reach No.3

The river water of this reach received industrial effluent from the following industries:

I. Onion drying factory at Souhag (443.2 km from Aswan), and
II. Coca Cola (soft drink) industry at 445.6 km, which has a limited impact

The pollutants mainly consisted of organic matter, oil and grease and suspended matter. The river recovered easily from these pollutants 200 m downstream from the discharge points.

The waste of the Souhag edible oil, and soap company for oil extraction and hydrogenation at 444.0 km from Aswan, was considered a potentially hazardous liquid discharging into the waters of this reach since it contained high concentrations of organic matter, suspended solids, dissolved solids and oil and grease.

(4) Reach No.4
At a length of 395 km, this reach is the longest of the six reaches. Downstreatm from Assiut Barrage at 555 km the Nile received the wastes of chemical industries and fertilizers at Mankabad which had relatively high concentrations of TDS, SS and phosphates. The river water started to recover from these effects at 500 m from the discharge point.

As the river water flows north, it received potentially hazardous wastes produced from various types of industries located in the south Greater Cairo area (normally at Hawamdia, Tebeen and Helwan). Industrial effluents of iron and steel companies, coke and fertilizer industries, wood processing industries, metallurgical and light transportation industries and spinning, weaving and textile industries were discharging into El Tebeen drain and Helwan and then into the river. Laboratory analysis of these wastes indicated that they have a very low oxygen content, high BOD and COD concentrations, TDS, and oil and grease.

On the left bank at Hawamdia, most of the polluting waste was from sugar factories, distillation and extraction and chemical production industries. These wastes had a high content of organic load, and solids (both suspended and dissolved). In addition, the thermal pollution and the oil and grease resulting from discharges of cooling water of El-Tebeen and Helwan thermal power plants were also major sources of pollution in this reach. With the addition of effluent from the boats travelling on the Nile, the level of pollution increased significantly in the Greater Cairo area. The improvement of the water quality took place in the downstream direction at a much longer distance.

(5) Reach No.5 (Rosetta Branch)
With regard to the Rosetta Branch, there were two sources of pollution which potentially affected and deteriorated the water quality of this reach.

The first source is Rahawy drain which discharges its wastes in the branch a few kilometers downstream of Delta Barrage. Its waste was a mix of agricultural, domestic wastes and sanitary drainage from a large area of Greater Cairo. The impact of this source on the water quality of the branch extended for about 500 m before starting to recover due to the high content of organic loads, suspended solid and low oxygen content.

The second source is Kafr El-Zayat industrial area. The industrial waste effluents from the Malyia Company (super phosphate, sulfur compounds), oil and soap industries (salt and soda) and pesticide factories were discharged directly from the right bank of the Rosetta Branch and their effects on water quality of the branch were detectable for about 300 m downstream.

(6) Reach No.6 (Damietta Branch)
Talkha fertilizer factory was considered the main source of industrial pollution in the Damietta Branch. Its impact on the water quality of the branch was due to the high concentration of nitrogen compounds and TDS. This industrial pollution extended for about 300 m before recovery.

The characteristics of the effluent plume are affected by various factors including discharge rate, waste water quality, water depth, currents, meteorological conditions and discharge configuration. Based on the results described above, the effects of industrial effluent extended for a distance 200 m to 500 m downstream of the discharge points before the concentrations revert to ambient water quality level.

4.0 ENVIRONMENTAL ADMINISTRATION

4.0 Environmental Administration

4.1 Organization

The administrative organization for industrial waste water is Ministry of State for Environmental Affairs (MSEA), EEAA, Ministry of Industry (MOI), Ministry of Housing and Utilities (MHPU), Ministry of Irrigation Water Resources (MIWR) and Ministry of Health and Population (MOHP). The responsibilities of each administrative organization are described below.

(1) MSEA, EEAA

MSEA has a portfolio of the Cabinet. Responsibility of MSEA includes policy decisions such as environmental regulations, national plans on environmental protection and environmental project, and budget securing to implement environmental administration. At the operational level, EEAA is responsible for preparation of environmental plan, enforcement, coordination and supervision of environmental affairs. The EEAA, established by virtue of law no.4 of the year 1994, is to replace the Environmental Agency established by Presidential Decree No. 631 of the year 1982, in all its rights and obligations. EEAA's tasks are defined in Law No.4/94 as follows:

- Prepare draft laws and decrees related to the fulfillment of its objects and express its opinion on proposed legislation related to the protection of the environment.

- Prepare studies on the state of the environment, formulate the national plan with the projects included for the protection of the environment, prepare the estimated budgets for each as well as environmental maps of urban areas and areas to be developed and lay down the criteria to be observed when planning and developing new areas as well as the criteria targeted for old areas.

- Lay down the criteria and conditions which owners of projects and establishments must observe before the start of construction and during the operation of these projects.

- Draw up a comprehensive list of national institutions and organizations as well as of qualified individuals who could contribute in the preparation and execution of environmental protection programmes and could be made use of in preparing and implementing the projects and studies undertaken by the Agency.

- Conduct field follow-up of compliance with the criteria and conditions that are binding to agencies and establishments and take the procedures prescribed by law agat permissible levels of pollutants are not exceeded.

- Gather national and international information on the environmental situation and the changes affecting it on a periodical basis in cooperation with the information centres of other agencies, publish such information and evaluate and utilize it in environmental management and planning.

- Lay down the principles and procedures for assessing the environmental effects of projects.

- Prepare an environmental contingency plan in the manner stated in .

- Lay down a plan for environmental training and supervise its implementation.

- Participate in the preparation and implementation of the national programme for environmental monitoring and make use of the data provided thereby.

- Compile and publish periodic reports on the main environmental indicators.

- Prepare programmes for the environmental education of the public and assist in their implementation.

- Coordinate with other competent authorities in connection with regulating and setting safety standards for the conveyance of hazardous materials.

- Administer and supervise natural protectorates.

- Prepare the draft budgets required for the protection and promotion of the environment.

- Follow up the implementation of international and regional conventions related to the environment.

- Propose economic mechanisms to encourage different activities and procedures for the prevention of pollution.

- Implement pilot projects for the preservation of natural resources and the protection of the environment from pollution.

- Coordinate with the Ministry for International Cooperation to ensure that projects funded by donor organizations and countries are in line with environmental safety considerations.

- Participate in laying down a plan to protect the country from leakages of hazardous substances and waste causing environmental pollution.

- Participate in the preparation of an integrated national plan for the administration of coastal areas abutting on the Mediterranean Sea and the Red Sea in coordination with the authorities and ministries concerned.

- Participate with the Ministry of Education in the preparation of training programmes for the protection of the environment within the scope of the various curricula in the basic education stage.

- Prepare an annual report on the environmental situation to be submitted to the President of the Republic and the Cabinet, a copy of which shall be deposited at the People's Assembly.

EEAA is managed by a Board chaired by the MSEA. The board members are composed of A representative from each of six ministries (Ministry of Agriculture, Ministry of Public Works and Water Resources, Ministry of Transport and Communications, Ministry of Industry, Ministry of Interior and Ministry of Health), two experts in the field of environmental affairs, three representatives from non-governmental organizations, a high-ranking employee of the EEAA, the head of the Legal Opinions Department at the Council of State, three representatives from the public business sector and two representatives from universities and scientific research centres.

EEAA plays key role in industrial water pollution control. Annual budget of EEAA is LE 9.0 million. Ministerial Decree provides an organization of EEAA as shown in Figure 4-1. EEAA has a staff of 80 professionals as of 1997. This number is short of staff. In order to enforce the Law No.4 at all 26 Governates in Egypt, EEAA is expected to establish eight

Regional Branch Offices (RBO) (Suez, Assiut, Tanta, Helwan, Alexandria, Hurgada, Mansoura and Aswan) and 26 Environmental Management Units (EMU) at each Governorate. JICA is undertaking Environmental Monitoring Training Project (EMTP) to establish laboratory in each RBO and Cairo. The purposes of EMTP are RBOs and Cairo are capable of conducting ambient and point sources monitoring on water, air and monitoring on industrial solid wastes. EMTP includes dispatch of Japanese experts, provision of monitoring equipment and training of Egyptian staff. RBO has the following functions:

- Supervision of the environmental monitoring networks, collection of information at the networks and sending to EEAA
- Inspection of factory
- Follow up of implementation of Law No.4 and relevant regulations and take necessary penalties in case of violation
- Raising environmental awareness
- Coordination between community and EMU
- Implementation of EEAA's decisions concerning environmental protection and achievement of the goals in the Governorates
- Preparation of annual report of environment in the Governorates
- Strenghtening the coordination and cooperation between the EEAA and the Governorates to achieve the goals of environmental protection

Function of EMU at each Governorate performs necessary works of environmental protection in cooperation with RBO. EMU perform a factory inspection as part of EMU's function. The factory inspection is classified into two types of inspection: based on complaints received from resident people, and based on environmental policy by Minister of MSEA. EMU receives complaints from resident people and send them to EEAA. Based on the review results of the complaints, Director of EEAA issues instructions of inspection to one of the three department of Environmental Awareness & Public Awareness, Environmental Impact Assessment and Environmental Quality Department. If necessary, RBO conducts sampling and analysis.
The factory inspection based on environmental policy by Minister of MSEA is conducted at declared cities as environmental protection and environmental model cities. RBO has conducted sampling and analysis of air quality and water quality at factories located in 10th of Ramadan City, 6th October City and industrial cities. Report of analysis results is sent to the Director of EEAA.

In reality, however, RBOs and EMUs have not fully had capabilities in terms of an effective monitoring and enforcement of environmental laws. EMTP by JICA and EPAP by World Bank have been undertaking to strengthen organizational and technical capacity through developing procedures and guidelines for management of industrial pollution issues, training and providing equipment necessary for monitoring and supervision.

(2) Ministry of Industry (MOI)

As MOI has jurisdiction of most of manufacturing industry sector, MOI in an important ministry of industrial pollution control. MOI has established General Organization for Industrialization (GOFI). GOFI includes an environmental management unit which is responsible for industrial pollution. GOFI takes measures to prevent and reduce industrial pollution such as air pollution, water pollution, noise and hazardous materials. The measures include as follows:

- Based on the request from the factory, MOI conducts a factory survey and provides recommendations on industrial pollution control for the factory.
- MOI has a system to give a subsidy for a treatment facility when the factory installs a treatment facility.
- MOI performs research and development of industrial pollution prevention technology, technical assistance, industry siting plan, pollution prevention plan and studies
- MOI holds conferences, seminars and workshop for concerned enterprises to raise awareness of industrial pollution and mitigation measures.

(3) Ministry of Housing and Utilities (MHU)

MHRU is responsible for planning, designing and implementing of potable water supply and sewage treatment. MHU is the competent authority of the Law No.93 (1962) concerning drainage of liquid wastes into public sewage system. MHU issued the Ministerial Decree No. 649 (1962), the executive regulations of Law No.93. Base on the decree, MHU inspects the waste water discharge to public sewage system and issues a license of the waste water discharges.

(4) Ministry of Irrigation Water Resources (MIWR)

MIWR is responsible for volume and quality management of all water bodies including groundwater, delivery of irrigation water, land reclamation and shore protection. MIWR is the competent authority of the Law No.48 (1982) concerning protection of the River Nile and waterways against pollution. MIWR issued the Ministerial Decree No. 8 (1983), the executive regulations of Law No.48. Base on the decree, MIWR inspects the waste water discharge to the River Nile and waterways, and issues a license of the waste water discharges.

(5) Ministry of Health and Population (MOHP)

MOHP is responsible for establishing standards for drinking water, monitoring for safe drinking water, establishing standards for the Law No.93, establishing standards for the Law No.48, sampling and analysis of sanitary waste water and industrial discharges.

An organization chart of administration for industrial waste water is shown in Figure 4-2.

4.2 Legislation

(1) Law No.4

Law No.4 was enacted in 1994, which is a law of comprehensive principles for environmental protection and management. Law No.4 provides responsibility of EEAA, environmental protection fund, incentives, protection of soil pollution, protection of air pollution, protection of water pollution and penalties. Law No.4 sets effluent standards for wastewater discharges to the marine environment. Prime Minister's Decree No.338 was promulgated in 1995 to provide detailed rules in implementation of the Law No.4. It is requested to comply with Law No.4 within 5 years after issuance of Prime Minister's Decree No.338 (1995). In order to be complied with the Law No.4, it is requested to submit an Environmental Impact assessment (EIA) for new projects and a Pollution Abatement Action Plan (PAAP) for existing facilities.

PAAP is prepared three levels of national government, local government and enterprise.

- At the national level, EEAA determines the enterprises and priorities to be implemented industrial pollution abatement in coordination with relevant ministries. EEAA prepares a priority list of enterprises industrial pollution abatement.
- At the local government level, each governorate prepares a Goverorate Industrial Pollution Abatement Plan (GIPAP) in collaboration with the listed industrial enterprises, as part of a Governorate Environmental Action Plan.
- At the industrial enterprise level, based on the GIPAP, each enterprise in the priority list prepares an enterprise PAAP consistent with the GIPAP. The PAAP includes type and amount of pollutants, appropriate actions to comply with the environmental standards, implementation schedule, required costs and monitoring program.

The EMU monitors implementation of the enterprise PAAP with support from the RBO. In case of lack of progress, the Governor could suspend or revoke the operating license of the enterprise.

A copy of EIA and PAAP is sent to GOFI. GOFI provides advice to enterprise based on the review results of EIA or PAAP.

Actual examples of PAAP are described below.

The discharge of industrial waste water and gas emission in the Tenth of Ramadan City, Sixth of October and other industrial cities exceeded the standards established by the law. Iron and steel, ceramic, chemical industries and furnaces are identified as major sources of air pollutant in the new cities, and there is a lack of waste management system and wastewater treatment facilities. Tenth of Ramadan City is set up as a first priority. All factories in the city must comply with the law by the end of 1999. A compliance program for Sixth of October City follows, after which programs set up for other industrial cities.

A total of 1,350 out of a total 2,700 industrial factories with capital investment exceeding L.E. 2 million were inspected by a team representing the EEAA, the Ministry of Manpower and Ministry of Public Works & Water Resources. The inspection was completed by the end of 1998. The factories in question were notified of the results and grace period of 60 days to comply. MSEA requested to inspect 400 industrial factories during 1999.

(2) Law No.93

Law No.93 of 1962 regulates the discharge of waste water to public sewage and stipulates that licenses be obtained from the MHU prior to any discharge. According to the law, water from commercial and industrial waste water is sampled by the MHU, to check the compliance of industries and commercial establishments to the specifications and standards set by the Ministry itself. The Ministry of Housing and Utilities Decree No.643 was issued in 1962 to implement Law No.93. The decree sets the standards for wastewater discharge to public sewage.

(3) Law No.48

Law No.48 of 1982 for the protection of the River Nile against pollution, also regulates the quality of the wastewater discharged to the Nile and its waterways, and sets standards for such discharges. The administration responsible for the enforcement of Law No.48 is the MIWR. The Ministry of Housing and Utilities Decree No.8 was issued in 1983 to implement Law No.48. The decree sets the standards for wastewater discharge to the Nile and its waterways, and ambient water quality standards for two categories of non-potable water and potable water. Law No.48 stipulates that licenses be obtained from the MIWR prior to any discharge. MOHP has the obligation for the monitoring of effluent from the facilities.

Discharge limitation and ambient water quality standards set by above laws are summarized in Table 4-1 and Table 4-2 respectively.

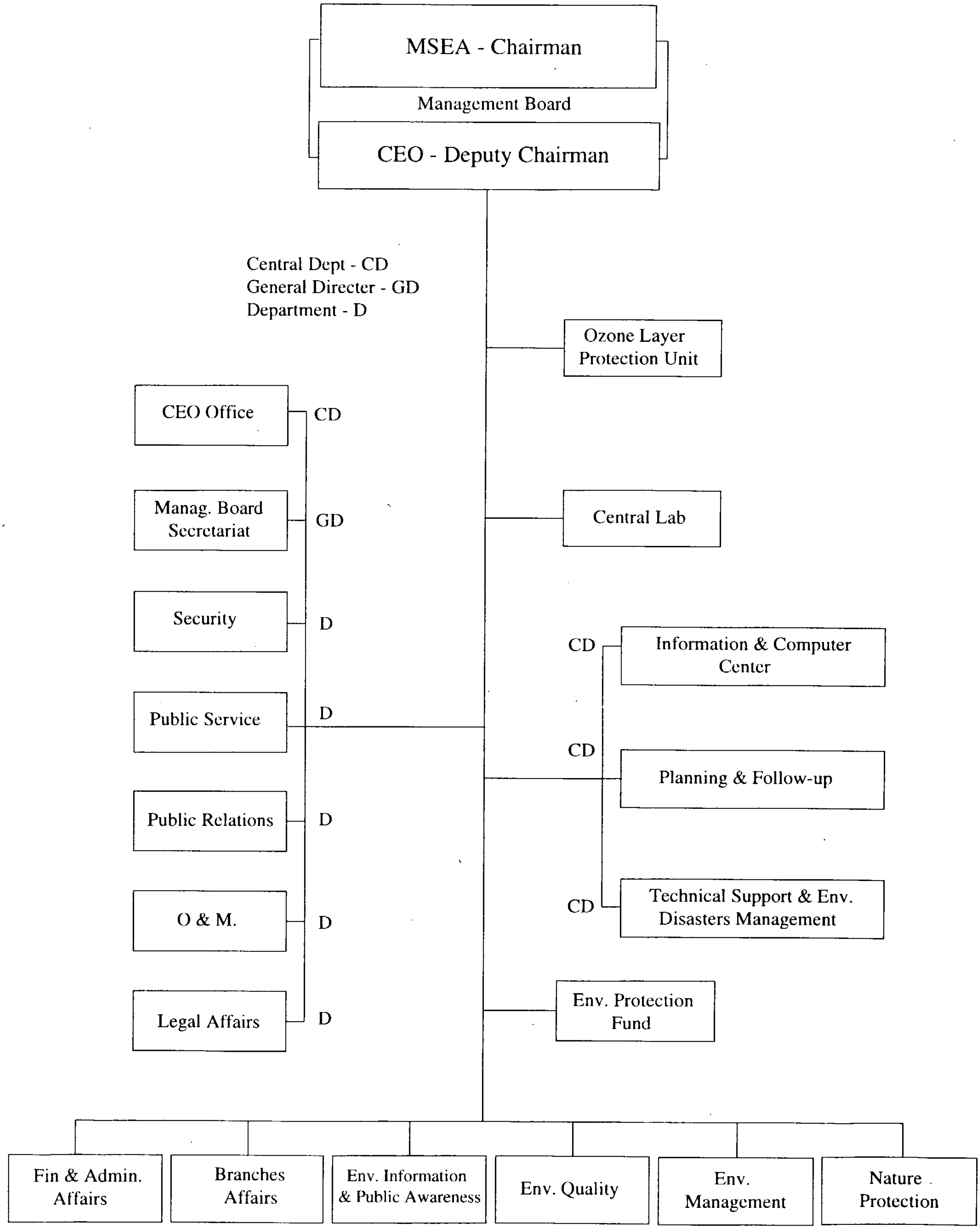


Figure 4-1 Organization Chart

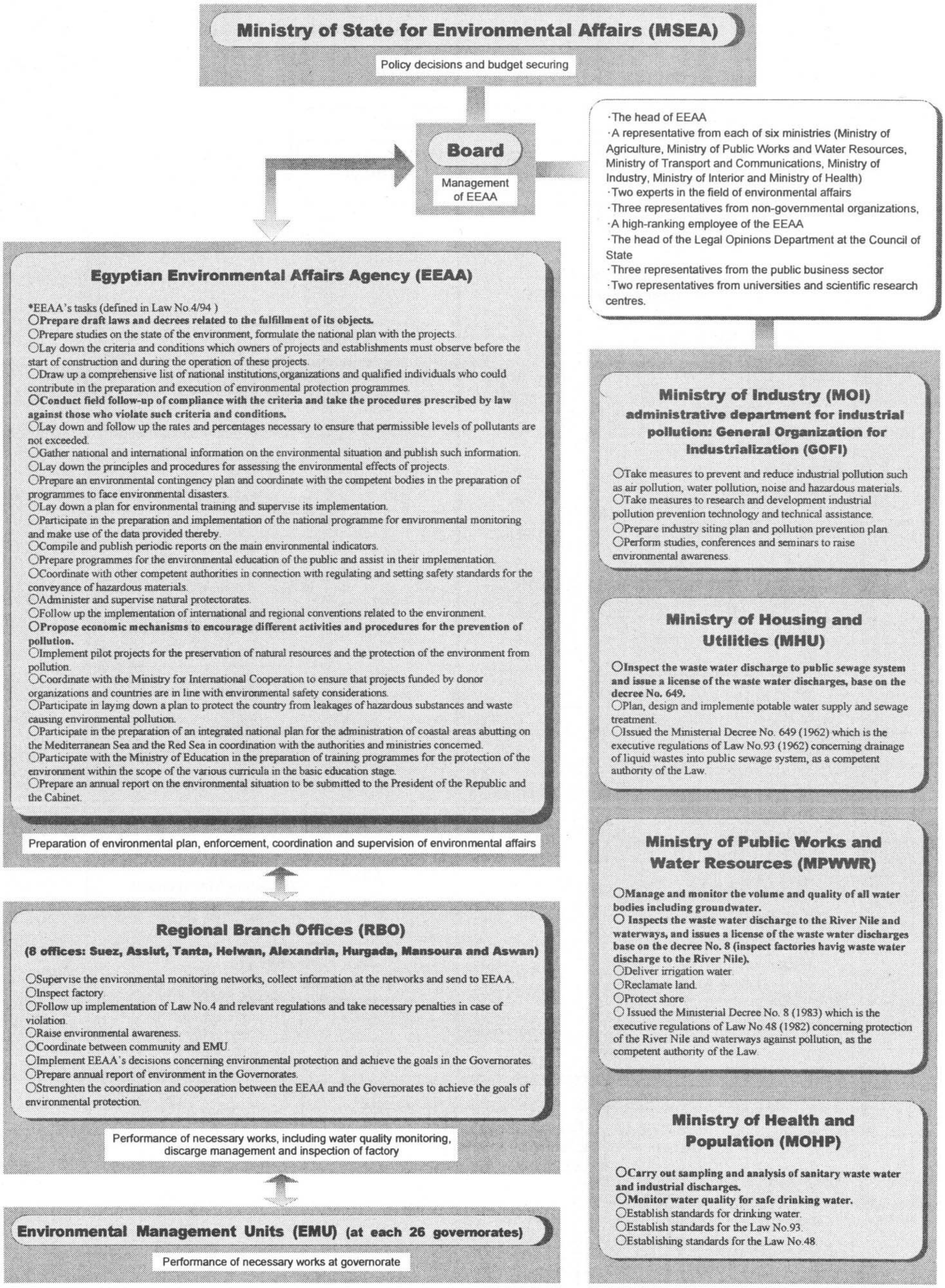


Figure 4-2 Administrative Organization Concerning Industrial Effluent

Table 4-1 Wastewater Discharge Regulation in Egypt

Parameter ppm or mg/L (unless otherwise noted)	Law 4/94: Discharge to Coastal Environment	Law 93/62: Discharge to Sewer System		Law48/82			
		as modified by Decree 9/89	as modified by Decree 44/2000	Underground Reservoir & Nile Branches /Canals	Nile (Main Stream)	Non Potable Surface Water: Municipal	Non Potable Surface Water: Industrial
BOD (5 day, 20℃)	60	<400	600	20	30	60	60
COD (Permananate)	n/a	350		10	15	40	50
COD (Dichromate)	100	<700	1100	30	40	80	100
pH (units)	6-9	6-10	6-9.5	6-9	6-9	6-9	6-9
Oil & Grease	15	<100	100	5	5	10	10
Temperature (℃)	10 C>temp of receiving body	<40	43	35	35	35	35
TSS total Suspended Solids	60	<500	800	30	30	50	60
SS Settable Solids (ml/l)	n/a	n/a	10min - 8 30min - 15	n/a	n/a	n/a	n/a
TDS Total Dissolved solids	2000	2000		800	1200	2000	2000
PO_4	5	30	25 (Total Phosphorous)	1	1	n/a	10
NH_3-N (Ammonia)	3	<100		n/a	n/a	n/a	n/a
NO_3-N (Nitrate)	40	<30	100 (Total Nitrogen)	30	30	50	40
Total Recoverable Phenol	1	<0.005	0.05	0.001	0.002	n/a	0.005
Fluoride	1	<1		0.05	0.05	n/a	0.5
Sulphide	1	<10		1	1	1	1
Chlorine	n/a	<10		1	1	n/a	n/a
Surfactants	n/a	n/a		0.05	0.05	n/a	n/a
Probable counting for colon group/100 cm^3	5000	n/a		2500	2500	5000	5000
Aluminum	3	n/a		n/a	n/a	n/a	n/a
Arsenic	0.05	n/a	2.0	0.05	0.05	n/a	n/a
Barium	2	n/a		n/a	n/a	n/a	n/a
Beryllium	n/a	<10		n/a	n/a	n/a	n/a
Cadmium	0.05	<10		0.01	0.01	n/a	n/a
Chromium	1	Total metals: <10, <50 m^3/d <5, >50 m^3/d		n/a	n/a	Total concentration for these metals should be <1 for all flow streams	
Chromium Hexavalent	n/a		0.5	0.05	0.05		
Copper	1.5		1.5	1	1		
Iron	1.5			1	1		
Lead	0.5		1.0	0.05	0.05		
Manganese	1			0.5	0.5		
Mercury	0.005	<10	0.2	0.001	0.001	n/a	n/a
Nickel	0.1	<10	1.0	0.1	0.1	n/a	n/a
Silver	0.1	<10	0.5	0.05	0.05	n/a	n/a
Zinc	5	<10		1	1	n/a	n/a
Cyanide	0.1	<0.1	0.2	n/a	n/a	n/a	0.1
Total Metals	n/a	Total metals: <10, <50 m^3/d <5, >50 m^3/d	5	1	1	1	1
Organic Compounds	0	0		0	0	0	0
Pesticides	0.2	0		0	0	0	0
Colour	None	None		None	None	None	None

n/a = not applicable

5.0 CURRENT STATUS OF INDUSTRIAL WASTER WATER POLLUTION ABATEMENT

5.0 Current Status of Industrial Waste Water Pollution Abatement

Discharges of industrial waste water into the River Nile have been one of the major sources of water pollution affecting the water quality in the River Nile because there are many industries which waste water is discharged into the Nile River. The Environmental Map of Egypt (1995) lists several prevention measures for waste water at 321 major public sector factories. The report indicated that 38 factories out of 321 treat their waste water in primary treatment plants. Six other factories had a treatment facility under construction. Other factory discharge untreated waste water directly to the Nile, canals, sewerage system and sea. In the light of present status described above, various measures for pollution control of industrial waste water have been taken. The following three examples of measures are described the following sections.

- Industrial waste water treatment project (Nile Pollution Prevention Program)
- Environmental management

5.1 Nile Pollution Prevention Program

The Ministry of State for Environmental Affairs (MSEA) decided in early 1997 to place the prevention of industrial wastewater to the Nile at the top of the environmental project. The MSEA initiated a national program to prevent direct discharge of industrial waste water into the Nile.
The Nile Pollution Prevention Program (NPPP) was officially launched in July 1997, with a firm deadline to complete all program activities by 31 December 1998.

The initial phase of NPPP, which focused on the identification of industrial sources that discharge effluents in the Nile, was completed in July 1997. Based on the identification results, a crash program involving diagnostic environmental audits was begun in order to formulate specific NPPP proposals' that were cost-effective, feasible, and relevant to the needs of the 34 targeted industries. The industries include oil and soap, fertilizer, petroleum refining, sugar refining, glass and crystal, cement, iron and steel, flour mill, beverage, starch and glocose, pulp and paper, dairy and ferrosilicon as shown in Figure5.1.

Investment Mobilization of L.E. 350 million by 34 major industries to stop the direct discharge of 100 million cubic meters/year of polluted industrial waste water into the river Nile and effective mitigation.

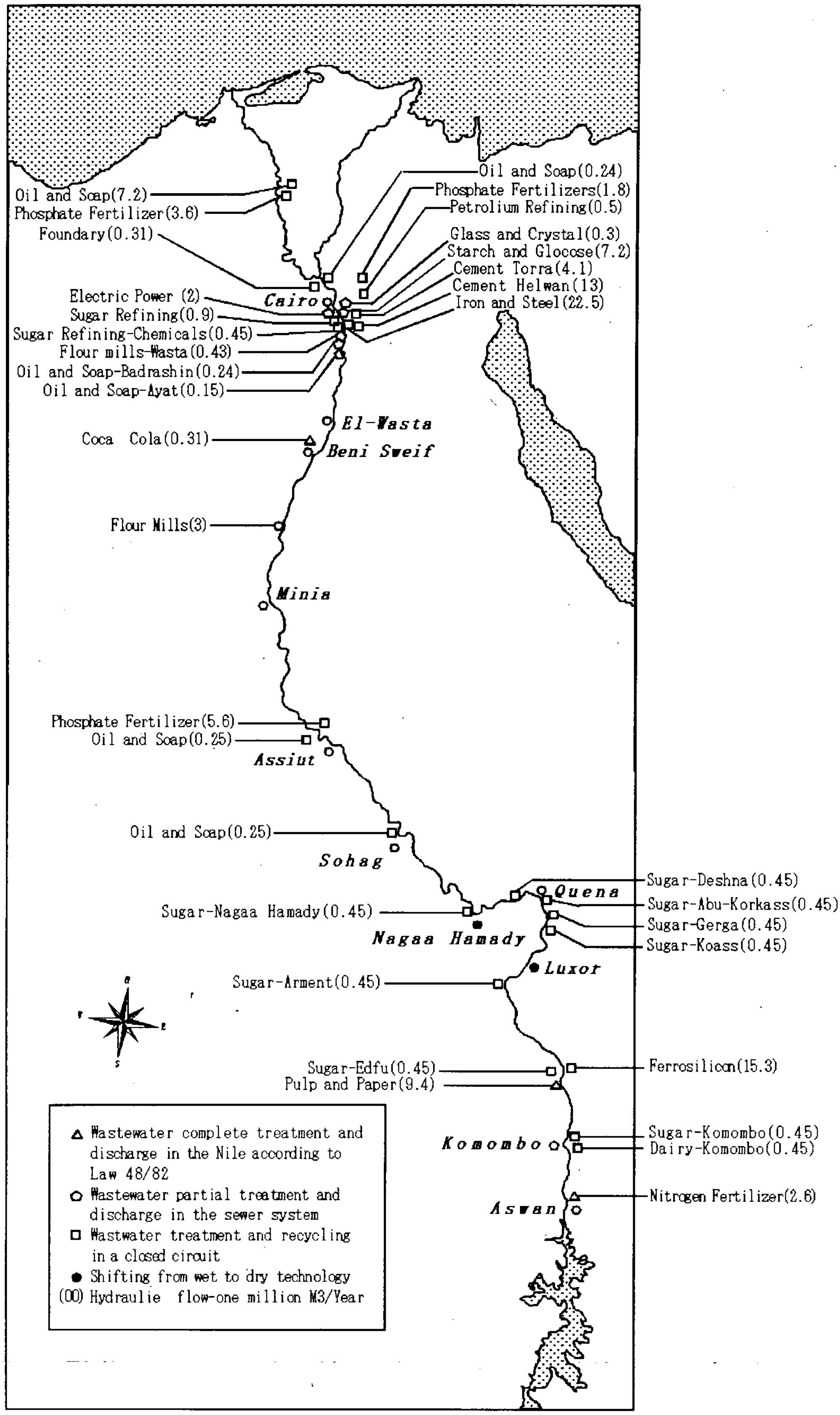


Figure 5.1 Location of the 34 Industries

The followings are selected cases of the waste water treatment by the industries

5.1.1 Pulp and paper

The Edfu Pulp and Paper Company relies on bagasse as a raw material in its manufacturing process. Bagasse is a short fiber that produces pulp similar in properties to hard wood pulp. Pulping is made by cooking with caustic soda to produce brownstock. The brownstock is washed with water to remove cooking liquids (black liquor). Process waste water is presently generated at a rate of 100 m3 /ton pulp. The BOD load is 20-40 kg/ton of pulp, while suspended solids range from 20-50 kg/ton of pulp. A secondary system which consists of chemically aided precipitation and activated sludge treatment was introduced to treat the highly polluted waste water. The treated effluent meets the requirements for discharge in the Nile River as stipulated in Law No.48.

5.1.2 Petroleum Refining

The Cairo Petroleum Refinery (CPR) implemented several measures in an effort to modify processes and introduce new CP technologies. These measures eventually led to substantial reductions in pollution levels. New technologies, such as land farming of sludges and the increased removal of oil by coalescence prior to treatment of process effluents, brought significant improvement in waste management practices at the refinery.

5.1.3 Edible Oil Refining

There are six large plants located in the Sohag, Assiut, Giza, Cairo, and Gharbia governorates in Upper Egypt and in the Delta. The plants produce shortening, margarine, salad and cooking.

All plants have installed gravity oil separators (GOS) for recovery of oil from heavily polluted process effluents. The recovered oil is reused in the production of low-grade soaps. Several facilities also introduced micro-flotation technology (dissolved air flotation [DAF]) as a complementary treatment to ensure removal of emulsified oils. Where the treated effluent is intended for discharge into the sewer system, no additional waste water treatment is required to achieve compliance with discharge regulations. In addition to DAF, in three facilities (Kafr el-Zayat, Badrashin, and Assuit), a two-stage biological treatment system was installed in order to meet the stringent requirements of discharge directly into the Nile.

5.1.4 Starch and Glucose

The Egyptian Starch and Glucose (ESG) plant in Cairo uses corn a s basic raw material. Waste water originates mainly from the steeping process in which clean, broken corn is macerated in caustic soda for dissolution of proteins, followed by the concentration process of the milk starch. The starch produced contains more than 15 percent protein. High-speed centrifuges have recently replaced milk starch separators in a two-stage separation system. This modification resulted in the production of high-grade starch with less than 1 percent protein. A new unit has been installed for protein recovery from starch wastes by multi-stage evaporation. These CP modifications reduced the waste load in addition to improving product quality and reutilizing the wasted protein as animal fodder.

To enable compliance with the NPPP timetable (by end of 1998), the company decided in November 1997 to switch its effluent discharge from the Nile to the public sewer system (effluent limits for public sewer is less stringent than the limits for the Nile). However, the partially treated waste water, which carried high loads of organic matter, would not be in compliance with the discharge limits for the public sewers. The Cairo Sanitary Drainage Organization had imposed an annual surcharge of L.E. 1 million on ESG, to cover the cost of treating their non-compliant discharge. The heavy surcharge prompted ESG management to implement a stalled project for on-site physico-chemical treatment. The commissioning of the new waste water pretreatment facility in the second half of 1998 resulted in significant reduction of waste loads, which subsequently permitted compliance with the sewer discharge regulations, and the waiver of the imposed surcharge.

5.1.5 Sugar and Yeast

The Sugar and Integrated Industries Company (SIIC) produces raw sugar from sugarcane in eight extraction plants along the Nile River course in Upper Egypt (Kom Ombo, Edfu, Arment, Nagaa Hamady, Koass, Gerga, Abu Korkass, and Deshna).

Prior to the NPPP, these plants were discharging high loads of polluted effluents into the Nile without pretreatment. This practice caused severe deterioration to the water quality of the river, particularly in the immediate vicinity of effluent discharge. On-site treatment equipment has been installed in these facilities enabling reuse of large portions of the treated effluents in irrigation and process operations, while the remaining amounts are discharged into the drainage canals or sewer systems. Discharge of waste water in the Nile has been entirely halted in all sugar extraction facilities located in Upper Egypt.

5.1.6 Nitrogen Fertilizers

The Fertilizers and Chemical Industries Company in Aswan (KIMA) produces ammonium nitrate and prilled urea. The release of extremely high concentrations of ammonia and nitrate in the process effluents to the Nile has had harmful effects on aquatic organisms and posed risks to public health.

In 1998, KIMA completed a project for the installation of six surface condensers and the upgrading of the existing waste water treatment system. The ensuing reductions in the polluting constituents have rendered the final effluent fit for discharge into the Nile, in conformity with the limitations set by Law 48/1982.

Though the facility has complied with the requirements of the NPPP, KIMA has requested permission to discharge into the new sewage treatment plant in Aswan that is scheduled to start operation by the end of the year 2000. Another alternative being contemplated is to broaden the use of the treated effluent in irrigation and landscaping.

5.2 Environmental Management at Factories

5.2.1 Environmental Audit at Food Industry

Environmental industrial auditing conducted at a fish-processing factory is reported. The environmental industrial auditing was conducted as one of the SEAM (Support for Environmental Assesment and Management) project components by UK Department for International Development. The main objectives of the audit are :

- Search for opportunities of environmentally damaging activities
- Identification of environmentally damaging activities
- Compliance with legislation
- Reduction in resource utilization
- better working conditions and image

Water related issues identified by the audit are as follows:
It is estimated that 30-40 m3 of water are consumed per ton of fish processed. This is an enormous quantity and leads to a large hydraulic flow to pick up contamination. High organic load exists in the industrial waste water and also high values of oil and grease in the oil plant waste water. No public sewer system exists and both sanitary and industrial waste water are discharged into the Nile.

5.2.2 ISO 9000 and ISO 14000

Awareness of international standard ISO 9000 series for Quality Management System (QMS) and ISO 14000 series for Environmental Management System (EMS) have not substantially spreaded in Egypt. According to information of Management Development Center for Industry (MDCI) which is a management training center under MOPE, about 350 factories have been certificated for ISO 9001 while about 30 factories have been certificated for ISO 14001. The certificated companies of ISO 14001 are included pharmaceutical, cement, carbon black and food industries which number of employee is 3,000-4,000. In Egypt, there are 2,700 industrial factories with capital investment exceeding L.E. 2 million. The number of factories with ISO 14001 certification is only 1%.

5.3 Summary

Based on the above case studies, current status and requirements of industrial waste water abatement are considered as follows:

The waste water treatment plant installed in the 34 factories contributed to reduce pollution loads of waste water from major industries to the Nile River. Even in factories that installed waste water treatment plant, improper operation and maintenance of waste water treatment plant cause water pollution of the Nile River. Proper operation and maintenance of the waste water treatment plant are required to assure continuous compliance of the effluent with standards. Regular monitoring is also required to check compliance level of the waste water with standards.

There are a total of industrial 26,300 factories in Egypt including public sector industry of 321 and private sector industry of 26,000. The 321 factories of public sector include 72 of textile, 62 of food, 36 of oil&soap, 36 of chemical, 35 of engineering, 17 of mining, 15 of metal, 12 of refractory, 11 of sugar, 11 of pulp&paper, 5 of wood, 4 of electrical, 3 of fertilizer and 2 of tannery (Environmental Map of Egypt, EEAA 1995). As the example of industrial area and fish-processing factory described above, insufficient waste water quality analysis in industrial area and environmental audit at fish-processing industry indicated that compliance rate with laws was low, most factory discharge untreated waste water into the Nile river or sewers. The JICA Study Team recognized similar situations for waste water treatment of capacity, operation and maintenance at five factories, where, untreated or insufficiently treated industrial waste water are discharged from factories because waste water treatment plant has not been installed or even if waste water treatment plant is installed, the plant does not work satisfactory due to insufficient treatment capacity, operation and maintenance of the plant. In the light of current status of waste water treatment described above, industrial waste water treatment is required for many factories.

Industrial waste water characteristics including quality, quantity and fluctuation vary widely among type of industries. It is important to apply appropriate technology of industrial waste water treatment that is adequate to the characteristics of industrial waste water. However, existing data on quality and quantity discharged from various type and size of factories are insufficient and uncertain to evaluate pollution loads and an appropriate industrial waste water treatment system. Required data and information for an appropriate industrial waste water treatment plan include raw water source and consumption, waste water source, waste water quality, waste water quantity, fluctuation and discharge point.

In addition of waste water treatment plan, feasible waste water management at production sites is required to reduce waste water discharge and to improve waste water quality. It involves the judicious use of resources through source reduction (recycling within a process, material substitution, process modification), reuse of input materials and reduced water consumption.

Not many factories have been established an environmental management system when compared with the number of ISO 14001 certificated factory and a total number of industrial factories. There are 2,700 industrial factories with capital investment exceeding L.E. 2 million. However, the statistic indicates that the number of factories with ISO 14001 out of 2,700 factories is only 1%. Environmental management of factories has not been fully established. The Egyptian government has issued policy directives to promote environmental management systems by ISO 14001 certification. However, factories have not fully implemented nor understood the importance of the environmental management system. Awareness, education and training for management and employees are required to spread environmental management in factories.

6.0 PRESENT STATUS OF INDUSTRIAL WASTE TREATMENT AND DESPOSAL

6.0 Present Status of Industrial Waste Treatment and Disposal

This chapter describes the present status of industrial waste management in Egypt.

6.1 Policy, Regulations and Guideline by Governmental Authorities against Industrial Wastes

Prime Ministerial Decree No. 338 of 1995, the Executive Regulations of the Law No.4 on Environment provide rules for permitting, collecting, storing, transporting, treating, handling, disposing and monitoring of hazardous materials and wastes. A special license is required to use and handle hazardous materials and wastes. Ministry of Industry issues a license of dangerous industrial materials and wastes. To obtain the license, an application must be submitted including:

- Full description of materials and waste
- Method of collection
- Means of transportation
- Methods of storage
- Method of disposal
- Record keeping
- Covenants not to mix hazardous materials or waste with other non-hazardous materials

The applicant must demonstrate a safety system including:
- Trained supervisor in charge of the handling and transport
- Necessary means for safe handling and transport
- Emergency plan

The treatment facility for hazardous materials or waste must not be located within three kilometers from the nearest residential or urban areas. The treatment site must also satisfy the following conditions:
- Site must have an adequate capacity to handle the estimated quantity of hazardous materials or waste treated
- Site must be completely enclosed
- Site must have adequate access and evacuation route
- Site must have adequate water supply
- Site must have a proper occupational health protection plan
- Site must have sufficient communication means
- Site must have adequate and safe storage areas
- Site must have an adequate incineration capacity
- Site must have dedicated marking equipment
- Site must have a dedicated, properly-constructed area for waste burial

6.2 Methods & Measures to Treat or Dispose of Industrial Wastes

The 1992 Environmental Action Plan estimated that the volume of industrial hazardous wastes generated in Egypt was approximately 50,000 tons per year. Another study estimated that industrial wastes generated in the Greater Cairo Area alone are 77,000 tons per year (solid waste is 32,000 tons per year, remainder is mostly sludge).

In many cases, an off-site disposal is presently done without consideration of the nature of the waste and without due identification and segregation of suspected hazardous wastes. One or more of the following venues are pursued:

- Sale by auction or through specific contractors without knowing what the waste final destination will be and without responsibility to the waste generator.
- Disposal under contract with a contractor or the municipality whereby the wastes are transported and disposed of by the contractor or the municipality. In most cases, these wastes will find their way to the public dumps – or even illegally dumped in vacant lots or public places. Some of the pharmaceutical companies take precautionary measures by ensuring by themselves a relatively safe fate of wastes by burning and covering in a public dump in the presence of authorized representatives. Most of the open dumps are viable grounds for scavengers who may handle hazardous wastes like empty containers and packages.
- Illegal dumping in vacant spaces

Current condition of industrial solid waste disposal in Helwan Area, which is one of the industrial areas in Egypt, is reported as follows:

The main industrial solid wastes in the Helwan area include:
- Steel and non-ferrous scrap, which are recycled
- Slag, most of which is reused
- Lining from furnaces, which is disposed of
- Sludge resulting from gas and waste water treatment, which is disposed of
- By-pass dust of cement plants which is disposed of
- Tar sludge, which is disposed of
- Asbestos dust, which is very hazardous
- Steel turning and chips, which are impregnated with oil and hard to recycle

Solid wastes generated at Helwan Area are disposed to 18 open dumping sites shown in Figure 7.1.

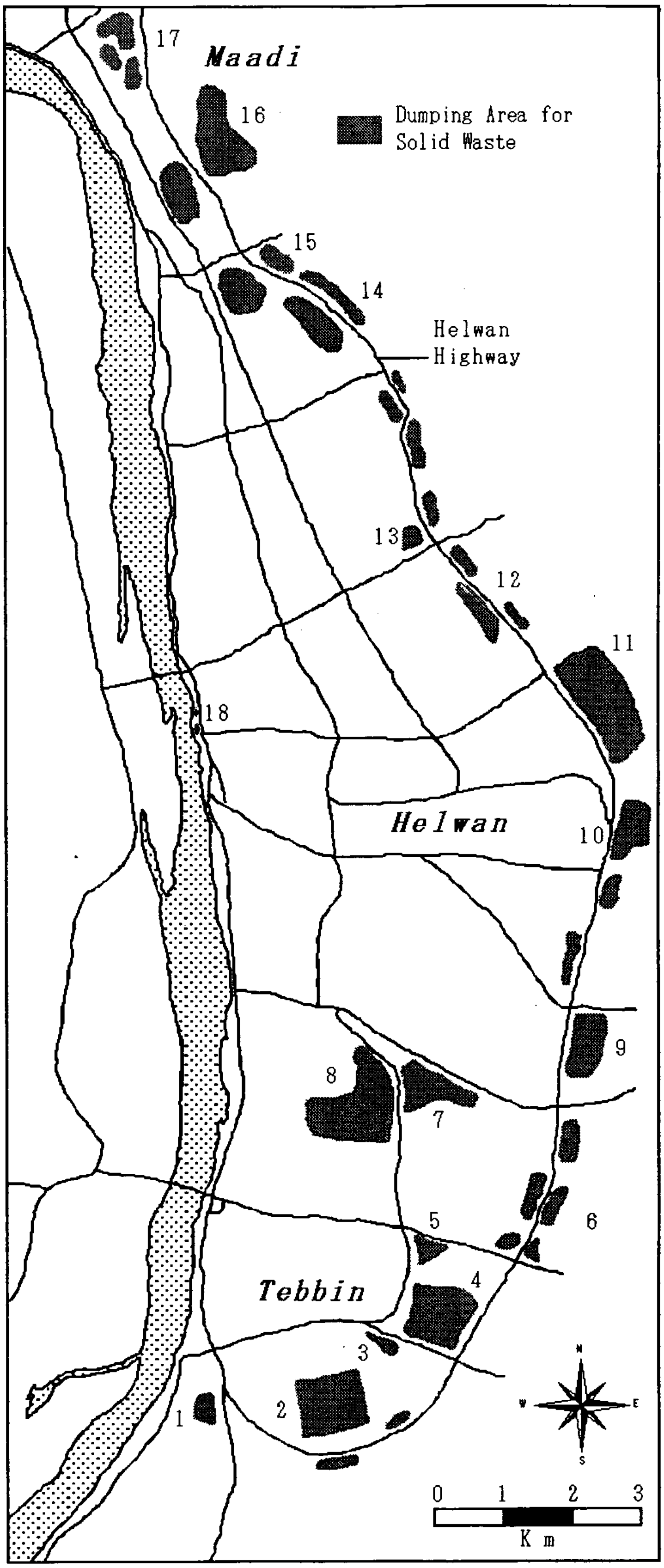


Figure 6.1 Solid Waste Dumping Areas for Solid Waste in Helwan Industrial Area

JICA Study Team visited the Dumping Site No.4 on September 14, 1999 to observe the current situation of industrial waste management in Egypt. The situation at this site was as follows:

- The dumping site has no boundaries or demarcations.
- A 12-inch pipe carries the slurry from the factory to the dumping site. The pipe discharges in an irregularly shaped natural depression, about 200 meters in dimension. The depth of the depression is about 10 meters.
- Trucks were dumping waste materials around the site in an uncontrolled manner.
- No supervisors were present at the time of site visit.
- Scrapers were used to spread the materials after dumping.
- The bolts connecting the 12-inch diameter pipe to the sleepers were sheared off along a portion of the pipe alignment, possibly due to the earthquake that struck the area in 1994. The pipe along this portion of the alignment was off its support by about 50 to 100 cm.

Judging from the observation results at Helwan Industrial Area and other information collected in this study, it is concluded that there is a significant gap between regulations for industrial waste management and state-of-practice at the waste dumping site.