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SURVEY OF NILE SYSTEM POLLUTION SOURCES

Report No. 64

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Water Policy Program

International Resources Group **Winrock International** **Nile Consultants**

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This report provides a brief overview of Egypt's water resources and the following: 1) institutional responsibilities within the GOE water quality community; 2) legal basis for water quality regulations; 3) sources of pollution; and 4) a water quality assessment of the Nile system. It is not meant as a technical report on water quality management, but as a status report, which presents available data and information collected by the study team and provides insight to where additional data resides.

Sources of pollution and water quality data have been identified. The impact of pollution sources on ambient water quality has been assessed and gaps of information with respect to water quality are noted.

In general, analysis of the water quality data indicates the following:

- The water quality of the main part of the Nile River, from Aswan to Delta barrage is good in-spite of the high organic loads discharged from some of the drains and industrial activities, indicating the continued high self-assimilation capacity of the Nile.

- Agricultural drains receive all types of wastewater and experience more severe contamination than the Nile River and canals. In Upper Egypt, four drains have been identified as major sources of pollution. These are Kom-Ombo, Berba, Khor El-Sail Aswan and Etsa drains.

- In the Delta, most of the drains receive high loads of pollution exceeding their assimilation capacity.

- Information about the quality of other components of the eco-system (sediments, phytoplankton and fish) is lacking.

- Almost no information is available about the pollution contributed from the use of animal manure, sludge and sediments which are dredged from the drains and used as fertilizers.

In general, ranking pollutants according to their severity to public health and the environment puts pathogenic microorganisms at the top. This is followed by organic compounds which biodegrade and deplete dissolved oxygen, rendering water unsuitable for many purposes. This is followed by pesticide residues and heavy metals. However, very little information is available to quantity the magnitude of the problem.

List of Abbreviations and Acronyms

APRP	Agricultural Policy Reform Program
BCM	Billion Cubic Meters
BOD	Biochemical Oxygen Demand
CAPMAS	Central Agency for Public Mobilization and Statistics
CBD	Central Business District
CEDARE	Center for Environment and Development in the Arab Region and Europe
CIDA	Canadian International Development Agency
CLEQM	Central Laboratory for Environmental Quality Management (NWRC)
COD	Chemical Oxygen Demand
DRI	Drainage Research Institute (NWRC)
EEAA	Egypt's Environmental Affairs Agency
EEIS	Egypt Environmental Information System (a CIDA project at EEAA)
EHD	Environmental Health Department (MOHP)
EIA	Environmental Impact Assessment
EIMP	Environmental Information and Monitoring Program
EMUs	Environmental Management Units
EOHC	Environmental and Occupational Health Center (MOHP)
EPADP	Egyptian Public Authority for Drainage Projects
EPIQ	Environmental Policy and Institutional Strengthening Indefinite Quantity Contract
ERC	Environmental Research Council
FAO	Food and Agriculture Organization of the United Nations
FWMP	Fayoum Water Management Project
GOE	Government of Egypt
GOFI	General Organization for Industrialization
HAD	High Aswan Dam
IIP	Irrigation Improvement Project
LCD	Liters per Capita per Day
MADWQ	Monitoring and Analysis of Drainage Water Quality
MALR	Ministry of Agriculture and Land Reclamation
MSEA	Ministry of State for Environmental Affairs
MOHP	Ministry of Health and Population
MHUNC	Ministry of Housing, Utilities and New Communications
MOI	Ministry of Industry
MWRI	Ministry of Water Resources and Irrigation (previously MPWWR)
NAWQAM	National Water Quality and Availability Management (CIDA project)
NEAP	National Environmental Action Plan
NOPWASD	National Organization for Potable Water and Sanitary Drainage (MHUNC)
NRI	Nile Research Institute, NWRC (previously known as: HADSERI)
NWRC	National Water Research Center, MWRI
NWRP	National Water Resources Plan
PPM	Parts Per Million
PRIDE	Project in Development and the Environment (USAID)
RIGW	Research Institute for Groundwater (NWRC)
SAR	Sodium Adsorption Ratio
TDS	Total Dissolved Solids
TSP	Total Suspended Particles
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
USAID	United States Agency for International Development
VOC	Volatile Organic Compounds

WHO	World Health Organization
WPAU	Water Policy Advisory Unit (MWRI)
WPRA	Water Policy Reform Activity (APRP)
WUA	Water Users Association
WWTP	Wastewater Treatment Plant

1. Introduction

1.1 Overview

The Agricultural Policy Reform Program (APRP) is a United States Agency for International Development (USAID) grant program involving several ministries. The Ministry of Agriculture and Land Reclamation (MALR) is the primary Egyptian governmental agency charged with support of agriculture production. The Ministry of Water Resources and Irrigation (MWRI) has the prime management responsibility for Egypt's water resources. The MALR, MWRI and USAID, under the umbrella of the APRP, jointly designed an agricultural and water policy package, which consists of integrated policy and institutional reforms. USAID supports the ministries' efforts through annual cash transfers based on performance in achieving identified and agreed-upon policy reform benchmarks.

Technical assistance for the water policy analysis activity is provided through a task order (Contract PCE-I-00-96-00002-00, Task Order 807) under the umbrella of the Environmental Policy and Institutional Strengthening Indefinite Quantity Contract (EPIQ) between USAID and a consortium headed by the International Resources Group (IRG) and Winrock International. Local technical assistance and administrative support is provided through a subcontract with Nile Consultants.

1.2 Purpose of the Report

The purpose of this report is to document the results of the Survey of Nile System Pollution Sources study conducted by WPAU/EPIQ. The study objective is to identify the main sources of pollution of the Nile System and to characterize those sources.

This is one of two undefined "Analytical Studies" included in the scope of work for the contract extension period 1 April – 30 September 2002. It should be noted that the scope of the present study was approved during the first week of July resulting in a very short period to complete the effort.

1.3 Background

Water Pollution is considered to be one of the most dangerous hazards affecting Egypt. Pollution in the Nile River System (main stem Nile, drains and canals) has increased in the past few decades because of increases in population; several new irrigated agriculture projects, and other activities along the Nile.

As the program to expand irrigated agriculture moves forward, the dilution capacity of the Nile River system will diminish at the same time that the growth in industrial capacity is likely to increase the volume of pollutants discharged to the Nile.

To solve the water pollution problem in Egypt, it is first necessary to understand the characteristics of the Nile River System and how pollution now, and in the future, affects the system. The present study is intended to complete the first step toward achieving that understanding.

The objective of this study is to identify and characterize of the sources of pollution discharges to the Nile River System.

The approved scope of work for this study includes accomplishment of the following tasks:

- Survey the sources of existing, recent Nile River System data (post-1995) to: 1) identify the main sources of pollution discharges to the system, 2) describe the source (i.e. name and type of source such as municipal or industrial point sources, and; if possible, diffuse agricultural sources), 3) characterize the discharges as chemical or biological, and 4) define the location of each source.
- Prepare a graphical presentation of the pollution sources, by displaying the sources on a map of suitable scale or on a schematic of the Nile System. The final format will be jointly selected by WPAU/USAID/EPIQ.

1.4 Organization of the Report

The remainder of this report is organized in six chapters as follows:

- General Water Resources Setting.
- Responsibilities for Water Quality Management.
- Description of Data Collection Effort.
- Water Quality Assessment.
- Identification of Main Problem Areas.
- Conclusions.

2. General Water Resources Setting

2.1 General

The primary thrust of this study is to identify and characterize sources that cause pollution of the various water supply resources in Egypt. In order to gain a full appreciation of the impacts of discharging pollutants to water bodies, one must have knowledge of the sources of Egypt's water supply and of the general situation with regard to wastewater generation and management. This section breifly summarizes the sources of water supply in Egypt and presents a general overview of what types of discharges are causing degradation of the water supply.

2.2 Water Resources

2.2.1 Conventional Resources

The conventional water resources in Egypt are limited to the Nile River, groundwater in the Delta, Western deserts and Sinai, rainfall and flash floods. Each resource has its limitations on use. These limitations relate to quantity, quality, location, time, and cost of development.

The Nile is the predominant source of fresh water in Egypt. Presently, it's flow rate relies on the available water stored in Lake Nasser to meet needs within Egypt's annual share of water, which is fixes at 55.5 Billion Cubic Meters (BCM) annually by an agreement signed with Sudan in 1959.

Groundwater exists in the western desert within in the Nubain sandstone aquifer that extends below the vast area of the New Valley and its sub-region East of Owaynat. This aquifer stores about 200,000 BCM of fresh water. However, this groundwater occurs at great depths and the aquifer is generally non-renewable. Therefore, the utilization of such water depends on pumping costs and its depletion rate versus the potential economic return over the long run.

Groundwater in Sinai exists mainly in three different water-bearing formations; the shallow aquifers in Northern Sinai; the valley aquifers; and the deep aquifers. The shallow aquifers in the Northern part of Sinai are composed of sand dunes that hold the seasonal rainfall, which helps in fixing these dunes. The aquifers in the coastal area are subject to salt-water intrusion. The total dissolved solids in this water range from 2,000 to 9,000 ppm.

The groundwater aquifer underlying the Nile valley and Delta is recharged by seepage losses from the Nile, the irrigation canals and drains, and deep percolation of water from irrigated lands. The total available storage of the Nile aquifer is estimated at about 500 BCM but the maximum renewable amount (the aquifer safe yield) is around 7.5 BCM. The existing rate of groundwater abstraction in the Valley and Delta regions in about 4.8 BCM/year, which is still below the potential safe yield of the aquifer.

Rainfall on the Mediterranean coastal strip decreases eastward from 200 mm/year at Alexandria to 75 mm/year at Port Said. It also declines inland to about 25 mm/year near Cairo. Rainfall occurs only in the winter season in the form of scattered showers. Therefore, it cannot be considered a dependable source of water. Nevertheless, some seasonal rain-fed agriculture is practiced in the northern coast to the west of Alexandria and in Sinai utilizing these small amounts of water. Floods occurring due to short period, high intensity storms are a source of environmental damage, especially in the Red Sea area and southern Sinai.

2.2.2 Non-Conventional Water Resources

Non-conventional water resources include agricultural drainage water, desalinisation of brackish groundwater and/or seawater, and treated municipal wastewater. Desalination is practised on a small scale at present, mainly along the Red Seacoast. Treated municipal water is presently in the research and pilot testing stage. These latter two sources are not discussed further herein. Reuse of agricultural drainage has been practiced for many years. Plans are underway to increase this source in future. Agricultural drainage reuse is considered a significant water source and therefore warrants separate discussion as follows.

2.2.2.1 Agricultural Drainage.

The agricultural drainage of the southern part of Egypt returns directly to the Nile River where it is mixed with the Nile fresh water and reused for different purposes downstream. The total amount of such indirect reuse is estimated to be about 4.07 BCM/year in 1995/96. This drainage flow comes from three sources; tail end discharges and seepage losses from canals; surface runoff from irrigated fields; and deep percolation from irrigated fields (partially required for salt leaching). The first two sources of drainage water are of relatively good quality water. The deep percolation component is more salty and even highly saline, especially in the northern part of Delta, due to seawater intrusion and upward seepage of groundwater to drains.

In addition, it is estimated that some 0.65 BCM/year of drainage water is pumped to El-Ibrahimia and Bahr Yousef canals for further reuse. Another 0.235 BCM/year of drainage water is reused in Fayoum while about 0.65 BCM/year of Fayoum drainage is disposed of in Lake Qarun

In the Delta region the amount of agricultural drainage water reuse was estimated in 1995/96 to be around 4.27 BCM in addition to about 0.3 BCM lifted to Rossetta branch from west delta drains. This constitutes the official reuse carried out by pumping stations of the Ministry of Water Resources and Irrigation (MWRI). Additional unofficial reuse done by farmers themselves, when they are short of canal water, has been estimated to be around 2.8 BCM.

The remaining drainage water is discharged to the sea and the northern lakes via drainage pump stations. The total amount of drainage water that was pumped to the sea during the year 1995/96 has been estimated to be 12.41 BCM.

Reuse of agricultural drainage water in the Delta is limited by the salt concentration of the drainage water. Moving from upstream to downstream, the level of salinity increases but in most of the valley and in the southern part of the Delta region, the salinity remains below the critical level of 1,000 ppm making it possible for reuse. However, in the northern part of Delta region, large quantities of salt seep through groundwater to the drainage water due to the sea water intrusion. The amount of seawater that seeps into the drains is estimated to be about 2.0 BCM/year. This water is pumped back to the sea and northern lakes to maintain the salt balance of the system.

2.3 Sectors Contributing to Pollution

Degradation of Water quality is a major issue in Egypt. The severity of present water quality problems in Egypt varies among different water bodies depending on: flow, use pattern, population density, extent of industrialization, availability of sanitation systems and the social and economic conditions existing in the area of the water source. Discharge of untreated or partially treated industrial and domestic wastewater, leaching of pesticides and residues of fertilizers; and navigation are often factors that affect the quality of water.

2.3.1 Industrial Wastewater

The industrial sector is an important user of natural resources and a contributor to pollution of water and soil. There are estimated to be some 24,000 industrial enterprises in Egypt, about 700 of which are major industrial facilities. The spatial distribution of industry in Egypt is influenced by the size of the employment pool, availability of services, access to transportation networks, and proximity to principlan markets. The manufacturing facilities are therefore often located within the boundaries of major cities, in areas with readily available utilities and supporting services. In general, the majority of heavy industry is concentrated in Greater Cairo and Alexandria.

Industrial demand for water in the year 2000 has been reported to be 3.6 BCM/year. By the year 2017, the industrial demand for water is expected to reach 5.5 BCM/year. Consequently, a corresponding increase in the volume of industrial wastewater is expected, (NWRP, 2002).

2.3.2 Municipal Wastewater

Based on the population studies and rates of water consumption, the total wastewater flows generated by all governorates, assuming full coverage by wastewater facilities is estimated to be 3.5 BCM/year. Approximately 1.6 BCM/year receives treatment. By the year 2017, an additional capacity of treatment plants equivalent to 1.7 BCM is targeted (National Water Resources plan, 2002). Although the capacity increase is significant, it will not be sufficient to cope with the future increase in wastewater production from municipal sources and therefore, the untreated loads that will reach water bodies are not expected to decline in the coming years, as demonstrated by the following table.

Projections of Wastewater Treatment Coverage

Year	**Population**	**People Serves**	**People Not Served**
1997	60 Million	18 Million	42 Million
2017	83 Million	39 Million	44 Million

The constituents of concern in domestic and municipal wastewater are: pathogens, parasites, nutrients, oxygen demanding compounds and suspended solids. In Greater Cairo and other cities, the sewerage systems also serve industrial and commercial activities. Therefore, instances of high levels of toxic substances in wastewater have been reported. As these toxic substances (heavy metals & organic micro-pollutants) are mainly attached to suspended material, most of it accumulates in the sludge. Improper sludge disposal and/or reuse may lead to contamination of surface and ground water.

In general, the bulk of treated and untreated domestic wastewater is discharged into agricultural drains. Total coliform bacteria reach 10^6 MPN/100 ml as recorded in some drains of Eastern Delta. It is important to mention that all drains of Upper Egypt flow back into the Nile. Moreover, it has become a national policy to maximize the reuse of drainage water by mixing it with canal water. Many irrigation canals may be contaminated with pollutants from domestic sources as a result.

2.3.3 Agricultural Drainage Water

Apart from being the largest consumer of water, agriculture is also a contributor to water pollution. Drainage water seeping from agriculture fields are considered non-point sources of pollution. These non-point sources are, however, collected and concentrated in agricultural drains and become point sources of pollution for the River Nile, the Northern Lakes, and irrigation canals in case of mixing water for reuse. Moreover, these non-point sources of pollution may also influence the groundwater quality. Major pollutants in agricultural drains are salts; nutrients (phosphorus & nitrogen); pesticide residues (from irrigated fields), pathogens (from domestic wastewater), and toxic organic and inorganic pollutions (from domestic and industrial sources).

3. Responsibilities for Water Quality Management

3.1 General

Several ministries are involved in water quality activities in Egypt for operational, research, monitoring and regulation purposes. The remainder of this chapter presents the legal basis for controlling water pollution and summarizes the responsibilities of various GOE agencies related to water quality.

Most of the information presented in this chapter was abstracted from National Water Resources Plan for Egypt Technical Report No. 5, Water Quality and Pollution Control prepared by the WL delft Hydraulic/MWRI study team.

3.2 Legislative Aspects

A legal basis for controlling water pollution exists through a number of laws and decrees. Law 48/1992 regarding the protection of the river Nile and other waterways from pollution, and Law 4/1994 on Environmental protection are the most important ones and are discussed below.

3.2.1 Law 48/1982 and Decree 8/1983

Law 48 of 1982 specifically deals with discharges to water bodies. This law prohibits discharge to the river Nile, irrigation canals, drains, lakes and groundwater without a license issued by the MWRI. Licenses can be issued as long as the effluents meet the standards of the laws. The license includes both the quantity and quality that is permitted to be discharged. Discharging without a license can result in a fine. Licenses may be withdrawn in case of failure to immediately reduce discharge, in case of pollution danger, or failure to install appropriate treatment within a period of three months.

Under the law, the Ministry of Interior has police power while the Ministry of Health and Population is the organization responsible to give binding advice on water quality standards and to monitor effluents/discharges. Law 48 does not cover ambient quality monitoring of receiving water bodies although some standards are given.

Law 48 recognises three categories of water body functions:

- Fresh water bodies for the Nile river and irrigation canals;
- Non-fresh or brackish water bodies for drains, lakes and ponds;
- Groundwater aquifers.

Ambient quality standards are given for potable resources which are intended as raw water supplies for drinking water. The implementing Decree 8 of 1983 specifies the water quality standards for the following categories:

- The Nile river and canals into which discharges are licensed (article 60);
- Treated industrial discharges to the Nile river, canals and groundwater;

  - Upstream the Delta barrages discharging more than 100 m^3/day (article 61);
  - Downstream the Delta barrages discharging more than 100 m^3/day (article 61);
  - Upstream the Delta barrages discharging less than 100 m^3/day (article 62);
  - Downstream the Delta barrages discharging less than 100 m^3/day (article 62);

- Drain waters to be mixed with the Nile river or canal waters (article 65);
- Treated industrial and sanitary waste discharges to drains, lakes and ponds (article 66);
- The drains, lakes and ponds into which discharges are licensed (article 68);

Discharge of treated sanitary effluents to the Nile River and canals is not allowed at all (article 63) and any discharge of sanitary waste into other water bodies should be chlorinated (article 67). The water quality standards are generally based on the drinking water standards and are not linked to all other functions a water body may have. The use of agrochemicals for weed control is also regulated in the law.

3.2.2 Law 4/1994

Through Law 4 of 1994 the EEAA is the authority responsible for preparing legislation and decrees to protect the environment in Egypt. The agency also has the responsibility for setting standards and for carrying out compliance monitoring. It should participate in the preparation and implementation of the national programme for environmental monitoring and utilisation of data (including water quality). The agency is also charged with establishing an “Environmental Protection Fund” which would include water quality monitoring.

With respect to the pollution of the water environment, the law states that all provisions of Law 48/1982 are not affected and further, Law 4 only covers coastal and seawater aspects. Nevertheless a number of issues are unclear:

- The MWRI remains the responsible authority for water quality and water pollution issues, although the definition of “discharge” in Law 4 specifically includes discharges to the Nile River the waterways. EEAA is responsible for coordinating the pollution monitoring networks.
- In Law 4 it is stated that all facilities discharging to surface water are required to obtain a license and maintain a register indicating the impact of the establishment’s activity on the environment. The register should include data on emissions, efficiency and outflow from treatment units and periodic measurements. EEAA will inspect the facilities yearly and

follow-up any non-compliance. This provision is confusing or creating duplication because Law 48/1982 also includes certain standards for effluents with MOHP as compliance monitoring organization and only MOHP laboratory results are considered to be official.

- Both laws create funds where fines are collected and which are used to fund monitoring and other activities.

3.3 Definition of Responsibilities

3.3.1 Minister of Water Resources and Irrigation (MWRI)

The MWRI is formulating the national water policy to face the problem of water scarcity and water quality deterioration. The overall policy's objective is to utilise the available conventional and non-conventional water resources to meet the socio-economic and environmental needs of the country. Under law No. 12 of 1984, MWRI retains the overall responsibility for the management of all water resources, including available surface water resources of the Nile system, irrigation water, drainage water and groundwater.

The MWRI is the central institution for water quality management. The main instrument for water quality management is Law 48. The MWRI is responsible to provide suitable water to all users but emphasis is put on irrigation. It has been given authority to issue licenses for domestic and industrial discharges. The responsibility to monitor compliance to these licenses through the analyses of discharges has been delegated to MOHP.

The National Water Research Centre (NWRC) supports the MWRI in its management. Within the NWRC, three institutes are focusing on the Nile, the irrigation and drainage canals and groundwater (NRI, DRI, RIGW). NWRC maintains a national water quality monitoring network and contracts portions of the monitoring activity to these institutes. NWRC also operates a database where all MWRI water quality data is consolidated. NWRC also operates a modern, well equipped water quality laboratory.

3.3.2 Egyptian Environmental Affairs Agency (EEAA)

The central organization for environmental protection is the EEAA. This agency has an advisory task to the Prime Minister and has prepared the National Environmental Action Plan of Egypt 2002/17 (2002). The Minister of State for Environment heads the agency. According to Law 4, it has the enforcing authority with respect to environmental pollution except for fresh water resources. Through Law 48, the MWRI remains the enforcing authority for inland waterways.

The EEAA is establishing an Egyptian environmental information system (EEIS) to give shape to its role as coordinator of environmental monitoring. Moreover, staff is being prepared to enforce environmental impact assessment (EIA). Major industries have been visited in view of their non-compliance with respect to wastewater treatment. Compliance Action Plans (CAP's) are being agreed upon to obtain a grace period for compliance. Additionally EEAA is monitoring waste from Nile ships and is responsible for coastal water monitoring. In cooperation with the MWRI, an action plan was implemented to reduce industrial pollution of the Nile.

3.3.3 Ministry of Health and Population (MOHP)

The MOHP is the main organization charged with safeguarding drinking water quality and is responsible for public health in general. Within the framework of Law 48/1982, this Ministry is involved in standard setting and compliance monitoring of wastewater discharges. The Environmental Health Department (EHD) is responsible for monitoring with respect to potable water resources (Nile River and canals). The MOHP samples and analyses all intakes and treated outflows of drinking water treatment plants. Also water from drinking water production wells is monitored. In case of non-compliance of drinking water quality, especially with respect to bacterial contamination, MOHP takes action.

Within the framework of Law 48 MOHP samples and analyses drain waters to be mixed with irrigation waters, industrial and domestic wastewater treatment plant effluents and wastes discharged from river vessels. In case of non-compliance of discharges, the MWRI generally takes action upon notification from the MOHP.

3.3.4 Ministry of Housing, Utilities and New Communities (MHUNC)

Within the Ministry of Housing, Utilities and New Communities, the National Organization for Potable Water and Sanitary Drainage (NOPWASD) has the responsibility for planning, design and construction of municipal drinking water purification plants, distribution systems, sewage collection systems, and municipal wastewater treatment plants. Once the facilities have been installed, NOPWASD organizes training and then transfers the responsibilities for operation and maintenance to the regional or local authorities.

3.3.5 Ministry of Agriculture and Land Reclamation (MALR)

MALR develops policies related to cropping patterns and farm production. Moreover they are in charge of water distribution at field level and reclamation of new agricultural land. With respect to water quality management issues, their policies on the use and subsidy reduction of fertilisers and pesticides is important. In addition, MALR is responsible for fisheries and fish farms (aquaculture).

The Soil, Water and Environment Research Institute is part of the MALR and is responsible for research on many subjects such as water and soil quality studies on pollution, bioconversion of agricultural wastes, reuse of sewage wastewater for irrigation, saline and saline-alkaline soils, fertiliser and pesticide use and effects.

3.3.6 Ministry of Industry (MOI)

The government has owned the majority of industries in Egypt for many decades. Within the MOI, the General Organization for Industrialisation (GOFI) manages the publicly owned facilities. The present government is in the process of privatisation of industries. At this moment GOFI still manages approximately 300 industrial facilities. MOI maintains a register of all industries in Egypt including design data related to processes used and quantities of water taken in and discharged by each facility.

3.3.7 Ministry of Higher Education and Scientific Research (MHESR)

Two of the research institutes of the Ministry of Higher Education and Scientific Research (MHESR), namely the National Research Center (NRC) and the National Institute for Oceanography and Fisheries (NIOF), collect samples for specific research projects. Both institutes have modern well-equipped water quality laboratories.

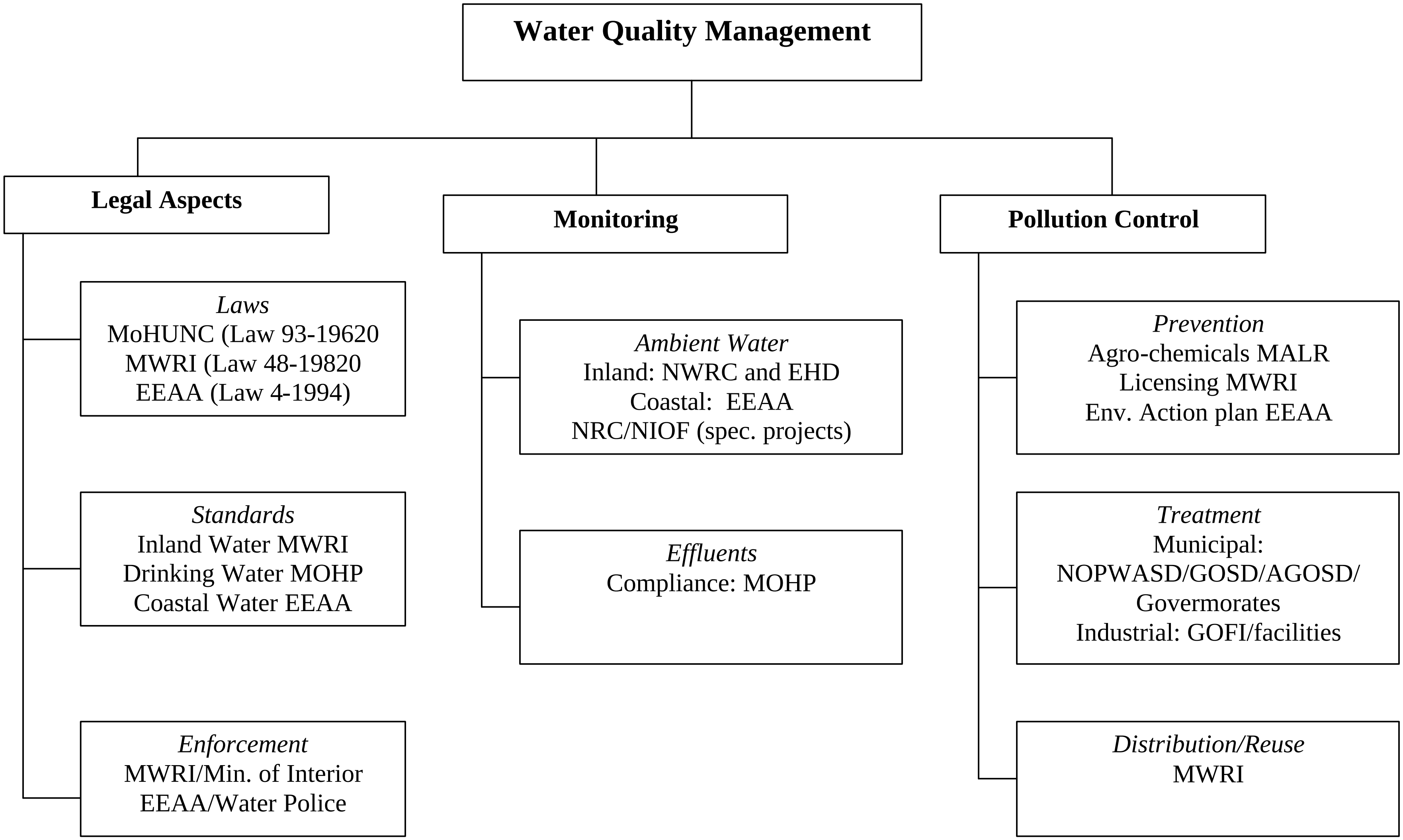
3.3.8 Ministry of Interior

The Ministry of Interior, Egypt's national police force, has for some time maintained the Inland Water Police, a special police force for enforcement of Law 48 and protection of the environment in general. The Inland Water Police provides guidance to citizens and takes enforcement actions for violations of environmental laws. Law 4/1994 provides additional authority for this environmental police force, specifying that the MOW shall form a police force specialized in environmental protection within the Ministry and in its Security Departments in the goverorates. (Article 65 of the Executive Regulations).

3.4 Summary

The institutional framework of water quality management in Egypt is summarized in Figure 3-1.

FIGURE 1: INSTITUTIONAL FRAMEWORK OF WATER MANAGEMENT IN EGYPT



SOURCE: National Water Resources Plan for Egypt, Technical Report No. 5

4. Description of Data Collection Effort

4.1 General

As mentioned previously, several ministries are charged with some level of water quality management. Therefore, data related to water quality resides with a number of GOE agencies. These agencies have historically been reluctant to share their data with other agencies, especially in electronic format. Upon initiation of this study, H.E. the Minister was requested to assist with facilitating the cooperation of government agencies, including MWRI, to provide data. He did so by sending letters to the Ministers of Environment, Industry and Transportation. He also instructed his technical office to notify all departments, authorities and institutes of MWRI to cooperate with the study team. This facilitated the data collection effort greatly and is much appreciated.

The following sections presents a brief summary description of the various agencies that were identified as being a potential source of relevant data and denotes each agency that the study team obtained data from.

4.2 Sources

4.2.1 Ministry of Water Resources and Irrigation

As might be expected, MWRI is a rich source of water quality data. The data available consists primarily of ambient water quality in waterways with a limited amount of point source monitoring. The water quality monitoring effort within MWRI has evolved over time from a relatively limited network focused on monitoring salinity to a more comprehensive network that analyses a broad spectrum of parameters. The system continues to evolve and modernize as performance is reviewed, needs change and adjustments are made.

The National Water Research Center (NWRC) within MWRI is charged with water quality monitoring for the purpose of fulfilling MWRI's responsibility to provide water of suitable quality to all users. NWRC maintains a national monitoring network, testing laboratory and database for conducting its responsibilities related to water quality management. Three institutes of NWRC play key roles in NWRCs efforts.

Several other entities within MWRI also perform water quality monitoring for specific purposes. The following describes the various water quality monitoring efforts being undertaken with MWRI.

4.2.1.1 Nile Research Institute (NRI)

NRI is responsible for protecting and developing the Nile River in a sustainable and scientific manner by means of: (i) monitoring water quality in the river channels and drainage system; (ii) assisting in the enforcement of pollution control laws related to the Nile system; (iii) evaluating and assessing the impact of new developments and interventions in water quality; and (iv) operating and maintaining a database related to water quality.

The water quality unit of NRI is responsible for monitoring water quality of Lake Nasser, the Nile River and the two Delta branches (Rosetta and Domietta). Samples of point source discharge and ambient conditions are collected and analysed by NRI. The monitoring network consists of:

43 Agricultural drain discharges to the Nile between Aswan and Delta Barrage.
43 Nile River monitoring stations.
12 Irrigation canal ambient monitoring stations in Upper Egypt.

The monitoring schedule is to sample the network twice per year, once each during high and low flow periods. The data from the February 2001 sampling survey was provided to the study team in electronic format by NWRC. Data from the 1998 and 1999 NRI surveys were obtained by the team in hard copy from other sources.

In summary, the NRI is an excellent source of data for point source discharges to the Nile River and data for ambient conditions in the Nile. The data available for the 43 drains in Upper Egypt that discharge to the Nile are useful in determining a general characterization of those drains but does not reveal anything definitive about the sources of pollutants being discharged into the drains.

Figure 4-1 (Ref. 20) presents a graphical depiction of the NRI monitoring network.

4.2.1.2 Drainage Research Institute (DRI)

The DRI has maintained a water quality-monitoring network for some 18 years. The main objective of DRIs monitoring effort is to provide MWRI with information on the availability of drainage water for reuse. Another objective is to identify changes in drain water quality caused by municipal, industrial and agricultural wastewater discharges to the drains. The DRI monitoring network includes 169 stations in the Delta and Fayoum to monitor ambient water quality, primarily in drains. The DRI monitoring network is shown on Figure 4-2 and 4-3 (Ref. 20). Sampling takes place monthly. A breakdown of the total number of sampling points is as follows:

Fayoum Area – 8 points on drains and 4 on canals
West Delta – 39 points on drains and 7 on canals
Middle Delta – 41 points on drains and 10 on canals
East Delta – 43 points on drains and 16 on canals

NWRC provided DRI data and a copy of the two-volume report titled, " Drain Pollution Sources Study for the Delta and Fayoum" (7,8). This report is a valuable source of information regarding the ambient quality of various drains. Volume II includes a schematic diagram of 19 drains including each subdrain that discharges to the drain. Water quality parameters are given for each subdrain at its point of discharge into the drain as well as ambient water quality parameters at points along the drain. Although the report was issued in 2000, the data presented is from 1998.

Figure 4-1
Nile Research Institute Water Quality Monitoring Network

Figure 4-2
Drainage Research Institute Water Quality Monitoring Network (Delta)

Figure 4-3
Drainage Research Institute Water Quality Monitoring Network (Fayoum)

4.2.1.3 Egyptian Public Authority for Drainage Projects (EPADP)

EPADP maintains a record of discharge sources to the agricultural drain network. The data is presented in a detailed format similar to the DRI format. All drains are depicted on schematic sketches, which cover an entire drain. This information was provided to the study team in hard copy on a loan basis and was used in the study.

In addition, EPADP formed an environmental and water quality management and monitoring unit in 1999. The ultimate goal for this unit is to prepare Environmental Impact Assessments for drainage projects. Through World Bank and Netherlands funding, the unit has conducted prelimary studies to assess needs and prepare implementation plans. The studies resulted in identifying 10 pilot areas in five drainage regions to commence: training, public awareness, establish an environmental database and conduct EIAs. This unit will monitor municipal and industrial sources of pollution in future and will be a good source of information in the near future.

4.2.1.4 Mechanical and Electrical Department (MED)

The MED has established an environmental unit to sample and analyse drain water quality at major pump stations. Limited testing has been conducted to date. The thrust of their testing is related to the impacts of water quality on the O&M of the pumps and associated equipment and therefore the study team did not attempt to obtain data from MED.

4.2.1.5 Research Institute of Ground Water (RIGW)

RIGW maintain a ground water monitoring network consisting of 188 sampling points. Their mandate is to monitor ground water quality and to identify sources of contamination. The scope of this study does not include groundwater and therefore RIGW was not contacted regarding data

4.2.1.6 Ground Water Sector (GWS)

The GWS is responsible to develop strategic ground water plans on the national scale. GWS works closely with RIGW and shares their database. The study team did not contact GWS regarding water quality data.

4.2.1.7 Planning Sector

The Planning Sector of MWRI is not charged with specific water quality responsibilities. However, it is presently preparing the National Water Resources Plan (NWRP) for Egypt with funding and technical assistance provided through the Egyptian-Dutch bilateral cooperation program. This project undertook a comprehensive review of the water quality situation in Egypt and established a computerized database of point source discharges to the Nile System. This database contains 311 industrial discharge points and 121domestic points. It was developed by collecting data from existing publications and from field surveys of industrial and municipal water and wastewater practices. The field survey results were published in a series of 26 reports prepared by Darwish Consulting Engineers Ltd. and covering every governorate. NWRP was extremely cooperative and provided the study team with total access to their work products.

4.2.2 Egyptian Environmental Affaires Agency (EEAA)

The EEAA has two units that monitor water quality of the Nile River.

The Environmental Quality Section is responsible to monitor ambient water quality of the Nile River. Their program commenced in 1999 and consists of sampling on an annual basis. The first years program included 18 sampling points and the network has expanded to 31 points in the 2001 program.

This unit maintains its information is a computerized database. Reports of the three monitoring surveys were provided to the study team in hard copy. When the database in electronic format was requested, the response was that Minister Abu-Zeid would have to request it specifically.

The Environmental Inspection Unit (EIU) is charged with monitoring industries that discharge wastewater to waterways. They monitor approximately 550 industries that discharge wastewater into the Nile River and agricultural drains. They verify compliance with Law 48 and the terms of their discharge license. Violators are given 90 days to rectify the problem and letters are delivered to MWRI and the Governor of the area where the violation takes place. The EIU returns to the violator after 90 days to check to see if the violation has been rectified. For non-violators, they are rechecked on a random basis. As the time of visiting this unit, it was processing 17 notifications of violations to be sent to MWRI. A comprehensive database of the 550 industries is maintained by the EIU. It presently exists in hard copy but is being computerized under the Egyptian Environmental Information System project being implemented with cooperation of Canadian International Development Agency. The computerized database is expected to be operational by the end of 2002. Obtaining a copy of the database in either format requires specific approval of the Minister of State for Environmental Affairs and therefore was not obtained.

4.2.3 Ministry of Health and Population (MOHP)

The MOHP undertakes four programs related to water quality monitoring. One of these is related to the adequacy of potable water treatment with the objective of ensuring that all such treatment plants in Egypt meet drinking water standards. This program does not have a direct bearing on this study and will not be discussed further. The remaining three programs are described below.

4.2.3.1 Nile River Program

MOHP monitors the ambient condition of the Nile to assess its suitability as a source of drinking water supply. They monitor 103 points immediately upstream and downstream of industrial and agricultural drain discharge points. Sampling is performed monthly. This data is maintained in a computerized database.

This data is presented in an annual report that is distributed to the cabinet, one copy is routinely passed to the Minister of Water Resources and Irrigation.

4.2.3.2 Industrial Discharge Program

The MOHP conducts an industrial discharge monitoring program jointly with MWRI. MWRI, thru EPADP, notifies MOHP of industrial discharge licenses as they as approved and issued. MOHP adds each new license to its monitoring database. Licensed industrial dischargers are monitored quarterly to ensure they meet the terms of Law 48 and of their license. All parameters defined in Law 48 are tested. The results of this program are included in their annual report also.

4.2.3.3 Wastewater Treatment Plant Program

The MOHP monitors the discharge from major wastewater treatment plants on a quarterly basis. The program includes 86 of the 104 operating plants throughout Egypt. The results of this program are transmitted to MWRI immediately after each quarterly survey is complete. The majority of the 86 plants are non-compliant with the requirements of Law 48.

4.2.3.4 Data Obtained

The MOHP reports and data forms are in Arabic and have all been provided to MWRI as they became available. Timing precluded, the study team from utilizing this data, however it is recommended that the latest reports be borrowed from the MWRI archives and pertinent data regarding point sources and their location be abstracted and incorporated into the study database.

4.2.4 Ministry of Housing, Utilities and New Communities (MHUNC)

The National Organization of Potable Water and Sanitary Drainage (NOPWASD) within MHUNC has the responsibility for planning, design and construction of municipal wastewater treatment plants and sewage collection systems. To date, NOPWASD has constructed 52 wastewater treatment plants with a combined capacity of 2.7 BCM/day.

NOPWASD provided data on the location and design characteristics of these plants to the study team. NOPWASD does not operate the plants they construct and therefore do not maintain a database of effluent discharges.

4.3 Data Archiving

The data collected by the study team consists of reports containing data, hard copy of data from periodic surveys and electronic copies of data. A study library was established for the reports and data obtained in hard copy. No attempt was made to convert information received in hard copy into electronic format because of:

- Limited time and resources to complete this study.
- Much of the data was old and did not include all information contained in recent data surveys and therefore is not useful for trend analysis.
- Older data related to industrial discharges is misleading because of improved treatment implemented since the data was obtained.
- Older data related to municipal wastewater treatment plants is misleading due to increased loading on plants and deteriorating O&M in some instances.

Data that was received in electronic format has been maintained in electronic form.

4.4 Problems Encountered and Gaps

4.4.1 Problems Encountered

As expected, the study team discovered that obtaining data from various governmental agencies is not an easy task and is time consuming. Within MWRI, the Ministers office notified the various entities about this study and requested them to cooperate with, and make information available to the study team. The result was good.

Regarding cooperation of other ministries, a letter request was sent from Minister Abu-Zeid to the Minister of other ministries requesting cooperation and sharing of information. This approach was successful resulting in the requested ministry providing some information on the topic of water quality and pollution. There was a time gap before receipt of the response. After reviewing the material transmitted, if the study team noted information that was know to reside at the ministry but was not delivered, a personal contact with the relevant section or department was made to request the data of interest. The response was that the information could not be released without Minister-to-Minister request for the specific item. In future, the study team must recognize that the burden is on them to define in advance the specific information/data that resides in other ministries and request Minister Abu-Zeid to request the desired items.

4.4.2 Information Gaps

The study team has collected useful data regarding point sources of pollution. However, the data generally does not include clearly defined locations of the discharge points and quantity of discharge is lacking in some cases. Also, one must keep in mind that the best data is the recent data that has been sampled during high flow regimes (abundant water year). Analysis of ambient conditions in the Nile River, and drains to some extent, gives a skewed picture of the water quality situation as a result.

4.5 Summary

Data received in electronic format was copied to the study teams' computer in order to be able to sort and display it in different arrangements. The data that is resident on the study team's computers includes:

1. NWRP database of pollution sources and ambient water quality for the Nile System.
2. NWRC pollution survey of February 2001 (primarily from NRI).

Table 4.1 presents a listing of the major industrial point source discharges to the Nile River that was abstracted from the available data. Table 4.2 is a similar listing of industrial point source discharges to drains. The actual data for these point sources is available in the study teams database and reference library.

TABLE 4.1

TABLE 4-2

5. Water Quality Assessment

5.1 General

After review of the available information and data, it became clear to the study team that the various agencies dealing with water quality monitoring and pollution control have upgraded their capabilities significantly over the past five years. The team concluded that samples taken and tested prior to about 1999 should be considered in any future studies of water quality and used for verification purposes, but should not be included as the basis for an assessment of present-day water quality conditions. Therefore, the team used the NWRC 2001 survey data to prepare a water quality assessment for the Nile. In order to assess the water quality of agricultural drains, the limited recent data was supplemented with older data out of necessity.

The canals, rayahs and drains referred to in this chapter are identified on the two maps contained in Annex A.

5.2 Nile River Aswan to Delta Barrage

5.2.1 Agricultural Drain Point Source Discharges

According to the National Water Resources plan for Egypt (NWRP), 2001, the Nile River from Aswan to Delta Barrage receives wastewater discharge from 124 point sources, of which 67 are agricultural drains and the remainder are industrial sources. Figure 5-1 shows the industrial outfall points schematically while Figure 5-2 depicts the agricultural drain outfalls.

Physico-chemical characteristics and fecal coliform counts of 42 major drains at the tail ends, before discharge into the Nile are presented in Table 5.1. The parameters that are non-compliant with Law 48 are shown shaded in the table. The data indicates that out of the 43 drains, only 10 are complying with the standards set by Law 48/1982 (Article 65) regulating the quality of drainage water which can be mixed with fresh water. This is demonstrated graphically in Figures 5-3 – 5-7 for selected parameters. The remainder of the drains exceed the consent standards in one or more of the parameters. The worst water quality is that of Khour El-Sail Aswan, Kom Ombo, Berba and Etsa drains.

In terms of organic load, it was found that the highest organic load is discharged from Kom Ombo drain (218.1 ton COD/d, 59.7 ton BOD/d). This is followed by El-Berba drain (172.7 ton COD/d; 59.7 ton BOD/d), (Table 5.2). The shaded values highlight the drains that are the worst cases by far. It is worth mentioning that these two drains contribute 76% of the total organic load (calculated as COD) discharged into the Nile by drains from Aswan to Delta Barrage. This is followed by Etsa drain which contributes about 11% of the total COD load (56.8 ton COD/d). Figure 5-8 and 5-9 depict this graphically.

Figure 5-1: Industrial Outfalls to the Nile River

Figure 5-2: Agricultural Outfalls to the Nile River

Table (5.1) Water quality of agricultural drains: Upper Egypt.

No.	Drain Name	Location (KM)	Discharge mm3/day	COD mg O_2/l	BOD mg O_2/l	DO mgO_2/l	TDS mg/l	FC MPN/100ml	Heavy Metals
	Consent Standard			**15 mg/l**	**10 mg/l**	**5 mgO_2/l**	**500 mg/l**	**5.00E+03**	**3**
1	Khour El sail Aswan	9.9	0.10	102	32.80	1.91	1190	3.25E+04	0.31
2	El Tawansa	37.3	0.01	8	1.01	6.16	710	3.50E+03	0.50
3	El Ghaba	46.6	0.19	11	1.00	7.8	570	1.85E+03	0.75
4	Abu Wanass	47.2	0.20	7	1.28	7.03	463	3.00E+03	0.39
5	Main Draw	48.9	40 l/s	17	1.48	7.34	460	3.00E+04	0.61
6	El Berba	49.1	0.15	113	42.70	3.85	414	2.25E+04	0.70
7	Com Ombo	51.0	0.14	151.6	41.50	2.25	325	2.25E+04	2.15
8	Menaha	55.0	-	4	1.52	7.86	285	7.50E+03	0.26
9	Main Ekleet	57.0	0.02	4	1.53	9.21	340	1.50E+03	2.44
10	El Raghama	64.7	0.04	10	1.55	8.56	390	1.75E+03	0.30
11	Fatera	70.5	0.78	5	2.04	7.7	564	3.50E+03	0.54
12	Khour El sail	70.8	0.17	2	1.05	9.07	500	2.00E+03	0.34
13	Selsela	73.9	50 l/s	3	1.25	6.38	380	3.20E+03	1.26
14	Radisia	99.9	0.13	16	3.06	9.02	1430	2.30E+03	0.22
15	Edfu	116.2	0.27	15	1.59	9.49	817	3.00E+03	2.37
16	Houd El Sebaia	139.5	0.05	16	1.83	6.77	495	1.75E+04	0.76
17	Hegr El Sebaia	149.1	0.05	19	2.55	7.82	670	4.50E+03	0.51
18	Mataana	187.7	0.12	39	3.15	6.45	613	1.75E+04	1.29
19	El Zeinia	236.0	NA	NA	NA	*	*	*	NA
20	Habil El Sharky	237.7	0.08	30	1.78	8.45	560	4.00E+02	1.06
21	Danfik	251.6	0.01	34	2.52	8.51	367	1.50E+03	1.05
22	Sheikia	265.3	0.06	37	1.72	7.55	662	3.75E+03	4.68
23	El Ballas	270.7	0.01	144	10.78	9.17	1395	1.50E+04	0.59
24	Qift	275.9	0.03	30	1.60	9.11	375	2.50E+03	0.39
25	Hamed	331.2	0.07	11	1.00	7.18	1015	9.00E+02	0.35
26	Magrour Hoe	340.4	0.06	21	3.24	8.2	185	1.60E+03	1.05
27	Naga Hammadie	377.8	0.21	13	2.17	8.11	375	3.30E+03	1.67
28	Mazata	392.8	0.01	10	2.19	8.37	495	2.50E+02	0.23
29	Essawia	432.7	0.07	9	2.43	6.61	200	1.50E+03	0.51
30	Souhag	444.6	0.05	9	2.81	7.42	440	8.00E+02	0.38
31	Tahta	486.4	0.01	21	2.01	7.86	980	1.40E+03	0.29
32	El Badary	525.4	0.12	6	3.27	7.25	255	9.00E+02	0.48
33	Bany Shaker	588.6	0.02	13	2.25	7.47	485	1.00E+04	0.30
34	El Rayamoun	637.4	NA	21	15.85	2.77	290	1.50E+03	0.16
35	Etsa	701.2	0.57	100	38.00	1.58	575	3.50E+04	0.19
36	Absoug	780.5	0.19	29	1.89	7.34	640	3.00E+03	0.34
37	Ahnasia	807.2	0.54	14	1.31	7.08	610	3.75E+03	0.26
38	El Saff	871.3	NA	NA	NA	*	*	*	NA
39	El Massanda	879.6	0.14	45	4.99	5.57	715	3.00E+03	0.19
40	Ghamaza El Soghra	884.5	0.06	42	2.52	6.37	235	9.50E+02	0.46
41	Ghamaza El Kobra	885.0	0.05	32	3.79	7.39	290	7.50E+02	0.28

No.	Drain Name	Location (KM)	Discharge mm3/day	COD mg O_2/l	BOD mg O_2/l	DO mgO_2/l	TDS mg/l	FC MPN/100ml	Heavy Metals
42	El Tibeen	898.1	0.02	25	15.20	3.71	840	3.25E+04	0.39
43	Khour Sail Badrashin	910.2	NA	NA	NA	*	*	*	NA

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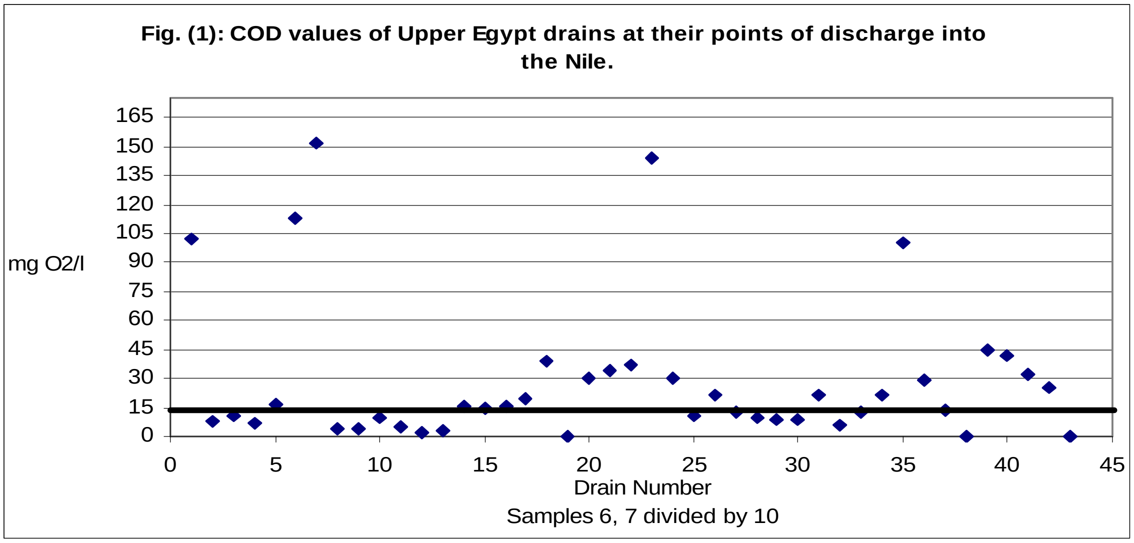
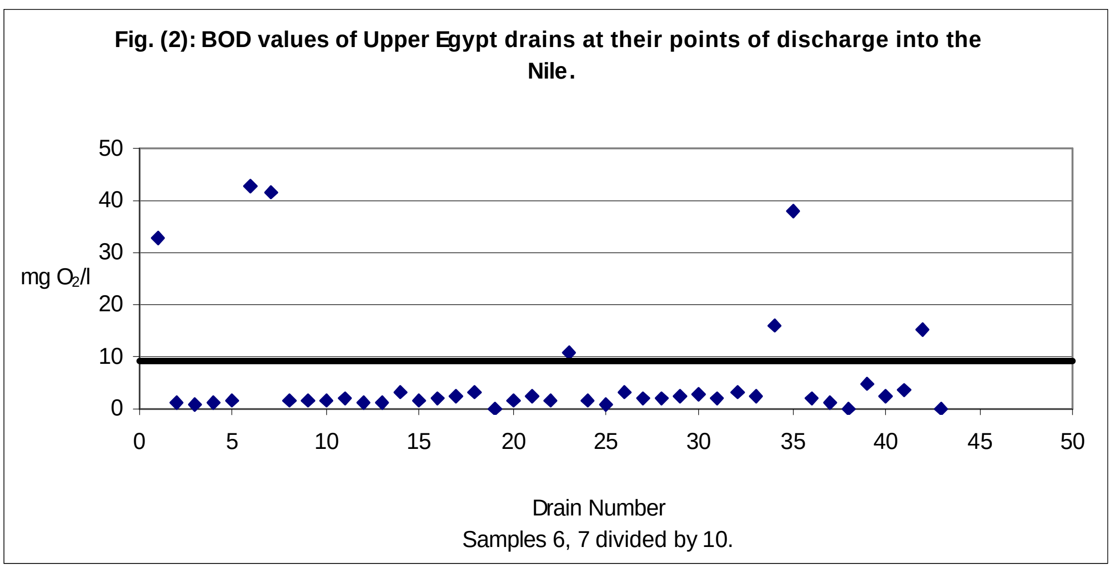




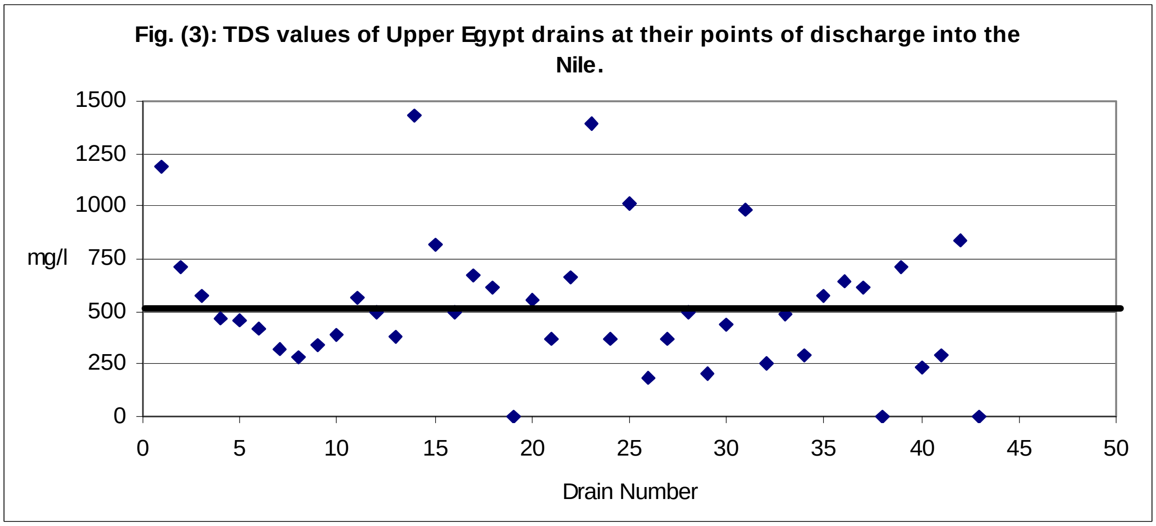


Fig. (3): TDS values of Upper Egypt drains at their points of discharge into the Nile.
mg/l
Drain Number

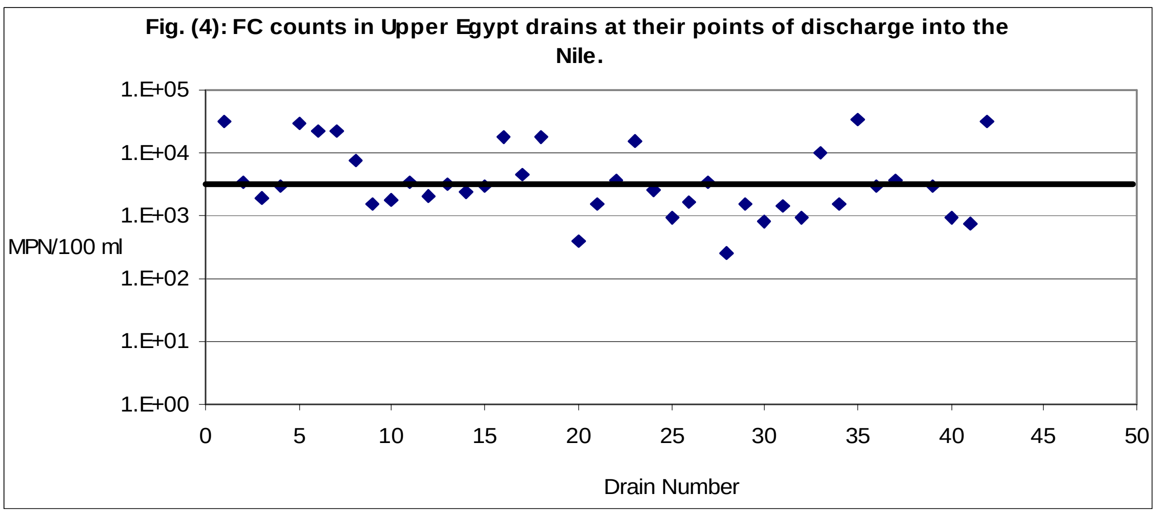


Fig. (4): FC counts in Upper Egypt drains at their points of discharge into the Nile.
MPN/100 ml
Drain Number

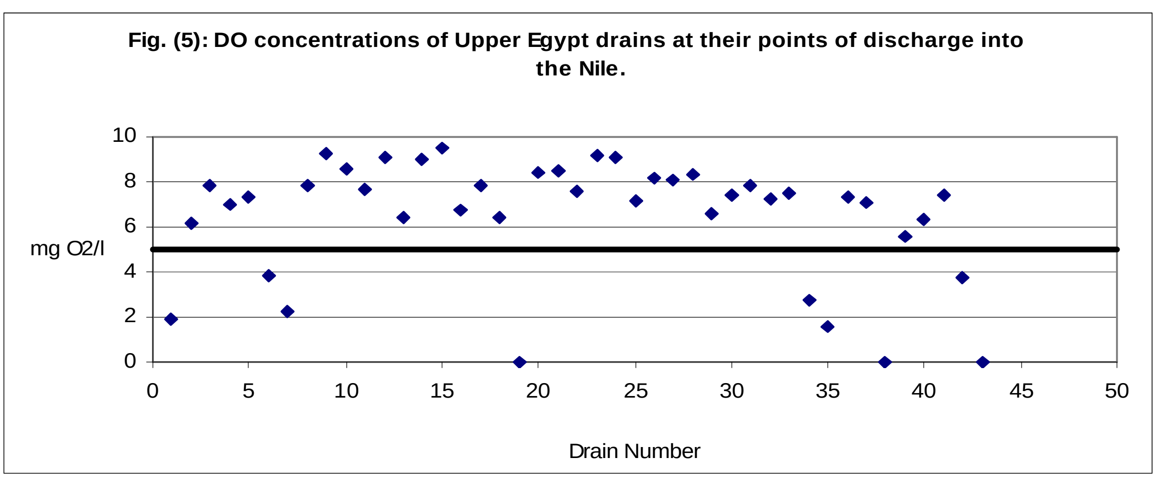


Fig. (5): DO concentrations of Upper Egypt drains at their points of discharge into the Nile.
mg O2/l
Drain Number

Table (5.2): Loads of organic and inorganic pollutants discharged into the Nile from Upper Egypt drains.

No.	Drain Name	Location (KM)	Discharge mm3/day	COD kg/day	BOD kg/day	Heavy metals kg/day
1	Khour El sail Aswan	9.9	0.098837	10.08137	3.241854	0.030333075
2	El Tawansa	37.25	0.006484	0.051872	0.006549	0.003245242
3	El Ghaba	46.55	0.194087	2.134957	0.194087	0.146341598
4	Abu Wanass	47.15	0.199061	1.393427	0.254798	0.078330504
5	Main Draw	48.85	0.003456	0.058752	0.005115	0.002106432
6	El Berba	49.1	0.15282	172.6866	65.25414	0.10720323
7	Com Ombo	51	0.143865	218.0993	59.70398	0.309122726
8	Menaha	55	NA	0	0	0
9	Main Ekleet	57	0.020166	0.080664	0.030854	0.049174791
10	El Raghama	64.65	0.044712	0.44712	0.069304	0.013346532
11	Fatera	70.45	0.779492	3.89746	1.590164	0.418197458
12	Khour El sail	70.75	0.170387	0.340774	0.178906	0.058016774
13	Selsela	73.85	0.00432	0.01296	0.0054	0.005454
14	Radisia	99.85	0.1307	2.0912	0.399942	0.02908075
15	Edfu	116.2	0.2689	4.0335	0.427551	0.63742745
16	Houd El Sebaia	139.5	0.048989	0.783824	0.08965	0.037256135
17	Hegr El Sebaia	149.1	0.049541	0.941279	0.12633	0.02524114
18	Mataana	187.7	0.122499	4.777461	0.385872	0.158207459
19	El Zeinia	236	NA	0	0	0
20	Habil El Sharky	237.7	0.079119	2.37357	0.140832	0.084222176
21	Danfik	251.55	0.008224	0.279616	0.020724	0.00865576
22	Sheikia	265.3	0.05983	2.21371	0.102908	0.279794995
23	El Ballas	270.7	0.006383	0.919152	0.068809	0.003788311
24	Qift	275.9	0.032637	0.97911	0.052219	0.012744749
25	Hamed	331.2	0.067068	0.737748	0.067068	0.023239062
26	Magrour Hoe	340.35	0.058709	1.232889	0.190217	0.061497678
27	Naga Hammadie	377.8	0.2149	2.7937	0.466333	0.35920535
28	Mazata	392.75	0.005868	0.05868	0.012851	0.001329102
29	Essawia	432.7	0.074202	0.667818	0.180311	0.037731717
30	Souhag	444.55	0.0475	0.4275	0.133475	0.01826375
31	Tahta	486.4	0.006276	0.131796	0.012615	0.001829454
32	El Badary	525.4	0.11994	0.71964	0.392204	0.05703147
33	Bany Shaker	588.6	0.019602	0.254826	0.044105	0.005968809
34	El Rayamoun	637.4	NA	0	0	0
35	Etsa	701.15	0.567976	56.7976	21.58309	0.105359548
36	Absoug	780.5	0.194386	5.637194	0.36739	0.066965977
37	Ahnasia	807.2	0.541652	7.583128	0.709564	0.138933738
38	El Saff	871.3	NA	0	0	0
39	El Massanda	879.6	0.14148	6.3666	0.705985	0.02624454
40	Ghamaza El Soghra	884.5	0.059616	2.503872	0.150232	0.027214704
41	Ghamaza El Kobra	884.95	0.048036	1.537152	0.182056	0.013618206
42	El Tibeen	898.1	0.02017	0.50425	0.306584	0.007795705
43	Khour Sail Badrashin	910.15	NA	0	0	0
sum				516.6321	157.8541	3.449520092

Fig. (6): COD loads cotributed by the agricultural drains from Aswan to delta barrage .

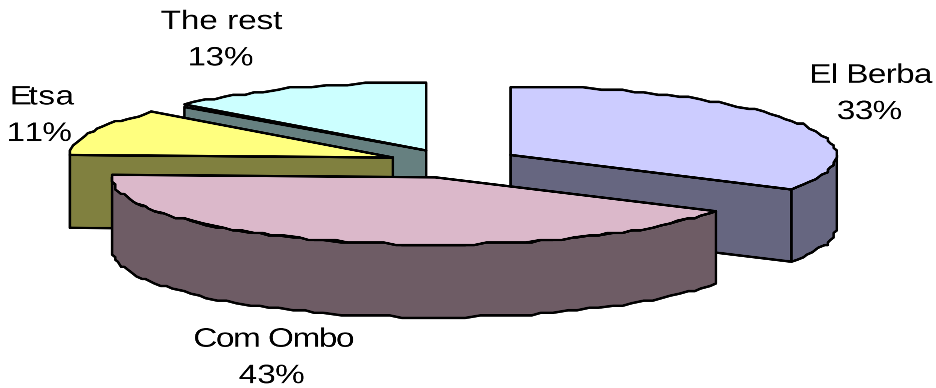
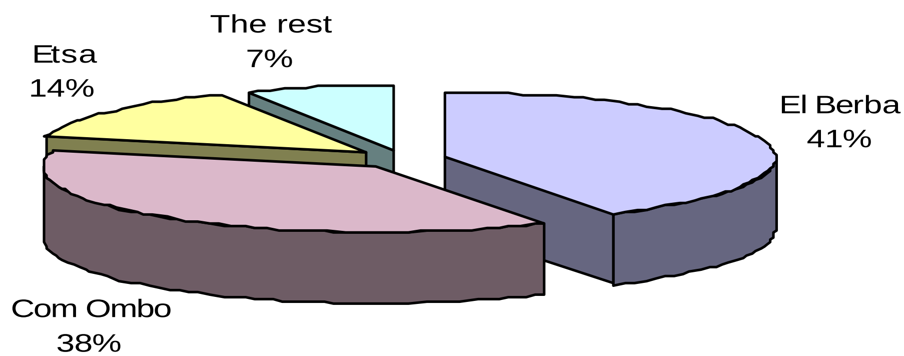


Fig. (7): BOD loads cotributed by the agricultural drains from Aswan to delta barrage ..



5.2.2 Industrial Point Source Discharges

Physico-chemical characteristics of industrial outlets for the years 1998 and 1999 are presented in Table 5.3. The shaded values in the table denote parameters that exceed standards. From the available data it can be concluded that most of these outlets are not complying with the standards given in Article No. 61 Law 48/1982 regulating discharge of industrial wastewater into the Nile River from Aswan to Delta Barrage. Due to lack of information about the quantities of wastewater discharged from these factories, it was not possible to calculate the organic loads discharged from these sources.

In general major sources of pollution from industrial activities in the Nile are sugar factories in Kom-ombo, Ques, Armant, Deshna and El-Hawamdia and the oil and Coca-Cola factories in Souhag. It should be mentioned however that it has been reported that these factories have constructed treatment plants. Recent information about the present situation was not available during the preparation of this report to assess the impact of these reported treatment facilities.

Table (5.3) Physico-chemical Characteristics of Industrial Point Sources Discharging into the Nile River (From Aswan to El-Kanater)

No.	Location from AHD (KM)	Point Source	Bank	BOD		COD		TSS		Oil & Grease		Ammonia	
				1998	1999	1998	1999	1998	1999	1998	1999	1998	1999
		Consent standard		30 mgO_2/l		40 mgO_2/l		30 mg/l		5 mg/l		NA	
1	50.000	Kom Ombo Sugar Ind.	R.B.	144	760	3072	1500	58	46	1.2	9.3	0.01	0.01
2	63.600	Ekleet power station	R.B.	1.2	4.8	2	84	28	79	1.21	2.55	0.01	0.01
3	119.600	Kaleh Power Station	L.B.	1.4	2.0	5	40	15	32	2.26	3.09	0.01	0.10
4	122.450	Edfu Paper Pulp A	L.B.	12	78	27	622	9	158	1.45	11.10	0.01	0.35
5	122.500	Edfu Paper Pulp B	L.B.	13	75	19	354	9	25	0.36	2.81	0.05	0.01
6	123.000	Edfu Sugar Ind.	L.B.	12	260		370	72	35	0.2	7.4	0.01	0.13
7	147.000	Sebaia Phosphate Ind.	R.B.							0.87			
8	204.500	Armant Sugar Ind 1	L.B.		70		161		15		9.6		0.10
9	204.505	Armant Sugar Ind 2	L.B.										
10	204.510	Armant Sugar Ind. 3	L.B.										
11	257.000	Ques Sugar Ind.	R.B.		33		59		20		3.36		0.01
12	265.400	Ginning Mill	L.B.										
13	314.000	Dishna Sugar Ind.	R.B.	74	67	178	800	32	20	0.55	8.32	0.01	0.01
14	337.500	Aluminum Ind.	L.B.										
15	343.200	Naga Hammadie Sugar A	L.B.	12	54	20	117	12	23	1	4.04	0.01	0.01
16	343.250	Naga Hammadie Sugar B	L.B.										
17	443.200	Onion Ind.	L.B.										
18	445.600	Souhag Oil Ind.	L.B.	1	75	8	260	20	61	9.4	5.87	0.01	0.14
19	445.605	Cocacola Ind.	L.B.		75	42	260	397	61	5.53	5.87	0.01	0.14
20	454.700	Seflak Ind.	R.B.		5.4	101	9	12	41	2.66	0.7	0.01	0.1

No.	Location from AHD (KM)	Point Source	Bank	BOD		COD		TSS		Oil & Grease		Ammonia	
				1998	1999	1998	1999	1998	1999	1998	1999	1998	1999
21	552.200	Mankabad Pipe 1	L.B.		1.5	5	22	13	28	-	2.04	0.7	0.15
22	552.205	Mankabad Pipe 2	L.B.										
23	552.210	Mankabad Pipe 3	L.B.										
24	904.000	Hawamdia Chemical 1	L.B.										
25	904.008	Hawamdia Chemical 2	L.B.										
26	904.300	Hawamdia Chemical 3	L.B.										
27	904.350	Hawamdia Chemical 4	R.B										
28	909.200	Helwan Power Station	R.B.										
29	911.400	Chemical Ind.	L.B.		420		5600		79		48.4		0.17
30	911.400	Hawamdia Suger Moulas	L.B.		445		6000		166		50.2		0.01
31	912.100	Hawamdia Sugar Pipe 1	L.B.	73	440	687	3850	51	285		17.6	0.16	2.51
32	912.105	Hawamdia Sugar Pipe 2	L.B.	33.5	58	591	77	190	25		2.73	0.01	0.01
33	912.115	Hawamdia Sugar Pipe 3	L.B.	2	86	4	185	76	61		3.64	0.01	0.01
34	912.120	Hawamdia Sugar Pipe 4	L.B.	71		1220		131				1.0	
35	912.125	Hawamdia Sugar Pipe 5	L.B.	23		48		48		6.44		0.01	
36	912.130	Hawamdia Sugar Pipe 6	L.B.										
37	915.000	Iron Steel Ind.	R.B.										
38	916.550	Kotsica Starch & Glucose	R.B.										
39	916.551	Kotsica Starch & Glucose	R.B										
40	939.600	El Nasser Glass Tube 1	R.B.	2		27		36		4.39		0.3	
41	939.605	El Nasser Glass Tube 2	R.B.										
42	939.610	El Nasser Glass Tube 3	R.B.										

No.	Location from AHD (KM)	Point Source	Bank	BOD		COD		TSS		Oil & Grease		Ammonia	
				1998	1999	1998	1999	1998	1999	1998	1999	1998	1999
43	939.615	El Nasser Glass Tube 4	R.B.										
44	939.620	El Nasser Glass Tube 5	R.B.										
45	947.900	Delta Cotton Kanater	R.B.	5		8		27		3.36		0.01	

L.B. = Left bank
R.B = Right bank

5.2.3 Assessment of Ambient Water Quality Status

Since the construction of the Aswan High Dam, the water quality of the Nile in Egypt, has become primarily dependent on the water quality and ecosystem characteristics of the reservoir (Lake Nasser), and less dependent on water quality fluctuations of the upper reaches of the Nile. Water released from Lake Nasser generally exhibits the same seasonal variation and the same overall characteristics from one year to another.

Downstream changes in river water quality are primarily due to a combination of land and water use as well as water management interventions such as: (a) different hydrodynamic regimes regulated by the Nile barrages, (b) agricultural return flows, and (c) domestic and industrial waste discharges including oil and wastes from passenger and river boats. These changes are more pronounced as the river flows through the densely populated urban and industrial centers of Cairo and the Delta region.

The results of the last monitoring campaign carried out by the NRI (Febr. 2001) are presented in Table 5.4. Shading of values in the table denotes non-compliance with standards. The sampling sites are identified on Figure 4-1. From the available data, the following can be concluded:

Dissolved Oxygen Concentration (DO):

In general, the oxygen situation in this reach is not alarming. Specific “hot spots” could not be detected. In all monitored sites DO concentrations were higher than 7.0 mgO_2/l, indicating the high assimilation capacity of the Nile.

Chemical Oxygen Demand (COD)

COD values showed slight, but steady increase from south to north. 21 samples out of the 35 samples were not complying with the standard value given by law 48/1982 for ambient water quality (10 mgO_2/l), (Figure 5-10).

Biochemical oxygen Demand (BOD_5)

BOD which is a measure for biodegradable organic compounds showed a random distribution but did not exceed the standard value (6 mgO_2/l) given by the law (Figure 5-11).

The relationship between COD/BOD values indicates the presence of non-biodegradable organic compounds, from industrial sources.

Total Dissolved solids (TDS)

An increase in TDS from 171 mg/l at Aswan to 240 mg/l at the Delta Barrage has been recorded. But this is within the permissible limit given by the law (Figure 5-12).

Fecal Coliforms Counts

Law 48/1982 did not specify a standard for fecal coliform (FC) counts for the ambient water quality of the Nile River. Therefore, the value given by the WHO (1989) as a guideline for use of water for unrestricted irrigation (1000/MPNml) has been taken as a guide for the evaluation of the water quality in this report.

The results of the microbiological examination indicated a great variation in the spatial distribution of the fecal coliforms counts. Great exceedances have been found around the catchment areas of Kom Ombo, El-Berba, Main Ekleet and Fatera drains. It is worth mentioning that the FC counts in the water samples taken from the specific bank side, where the drain water is pumped, are even higher. This indicates the presence of untreated human wastes in these drains. A situation which requires special attention (Figure 5-13).

Table (5.4) River Nile Water Quality.

Location	Distance from AHD	COD	BOD	TDS	FC
Consent Standard		10 mg/l	6 mg/l	500 mg/l	NA
4	5	7	1.25	171	1.6E+02
5	21	10	1	170	3.5E+02
6	53.8	15	1.45	169	6.5E+02
7	83.4	15	1	175	1.2E+03
8	110	7	1	188	4.0E+02
9	148	22	1.46	184	1.2E+03
10	168	12	1.23	183	5.0E+01
11	206.9	5	1.37	186	2.5E+03
12	222	14	1.72	189	3.0E+03
13	277	6	2.36	190	6.0E+02
14	311	9	2.86	191	1.6E+02
15	361	10	2.26	194	4.0E+02
16	397	12	1.56	197	3.5E+02
17	448	5	2	198	1.5E+02
18	489	11	1.92	202	5.0E+02
19	512	10	2.6	204	5.0E+02
20	532	9	2.34	208	7.5E+02
21	545	14	2.46	205	6.0E+02
22	587	14	2.46	200	8.0E+02
23	635	14	2.5	204	4.0E+02
24	683	27	2.19	205	6.5E+02
25	617.6	18	2.2	209	1.0E+02
26	748	16	1.86	211	8.0E+01
27	792	8	1.8	213	9.0E+01
28	815	12	1.99	216	8.0E+02
29	832	14	2.37	220	3.0E+01
30	874	17	2.47	229	3.5E+02
31	888	15	3.25	231	1.6E+02
32	902	22	2.51	248	8.0E+02
33	922	17	3.5	235	1.2E+02
34	938	15	3.31	235	1.0E+03
35	967	24	3.28	240	6.5E+02

Fig. (8): Variation in COD values of the Nile Water from Aswan to Delta Barrage.

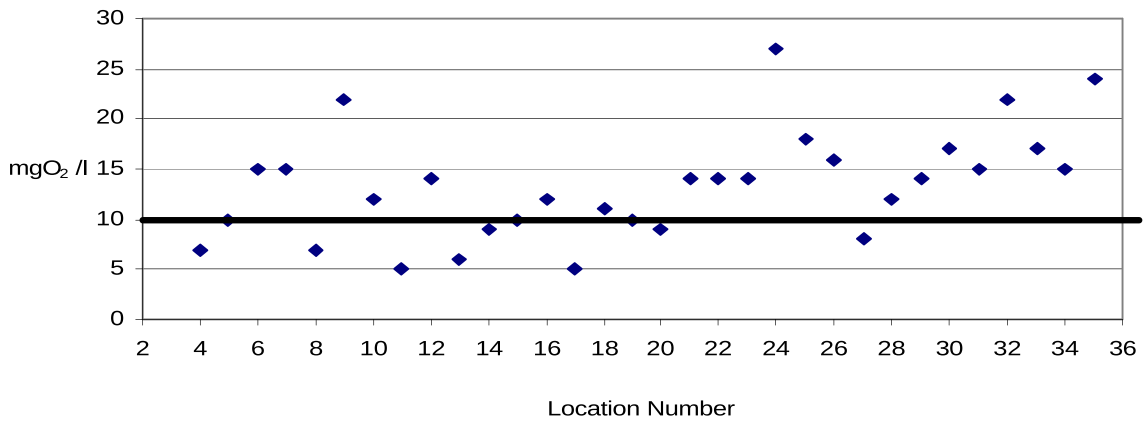


Fig. (9): Variation in BOD values of the Nile Water from Aswan to Delta Barrage.

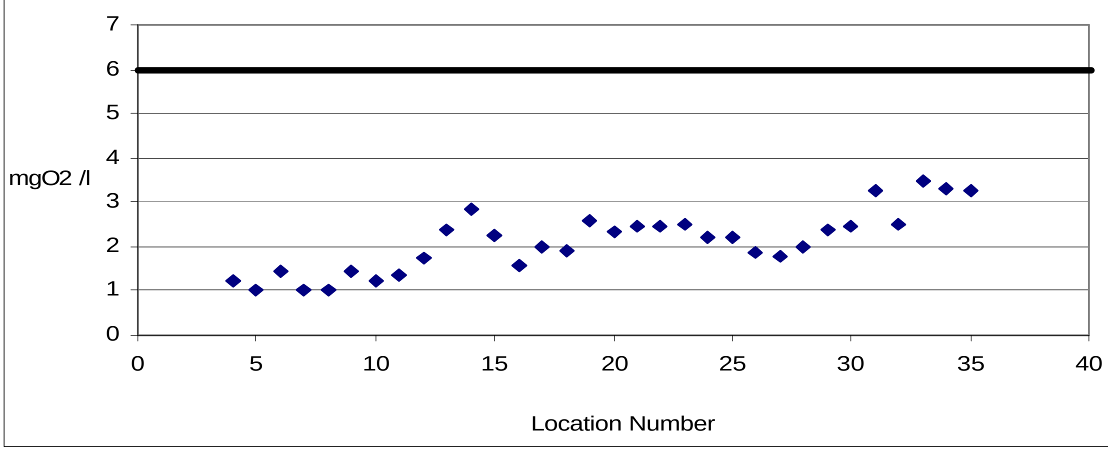


Fig. (10): Variation in TDS values of the Nile Water from Aswan to Delta Barrage.

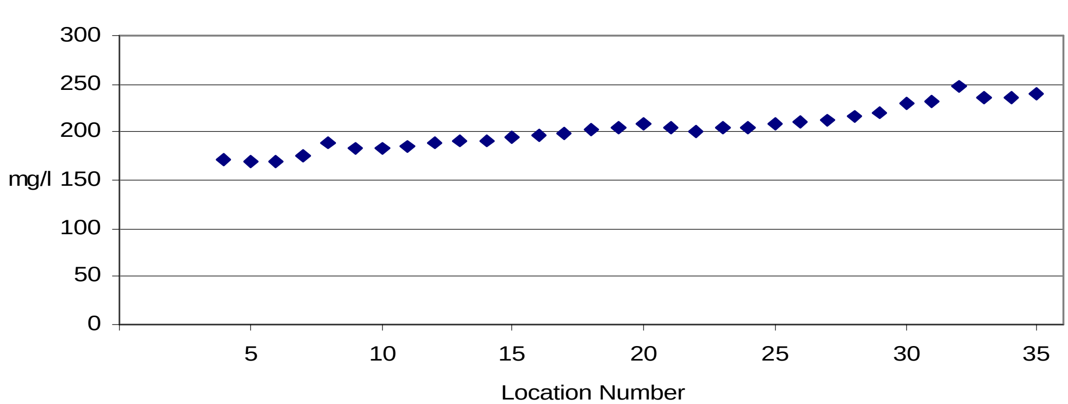
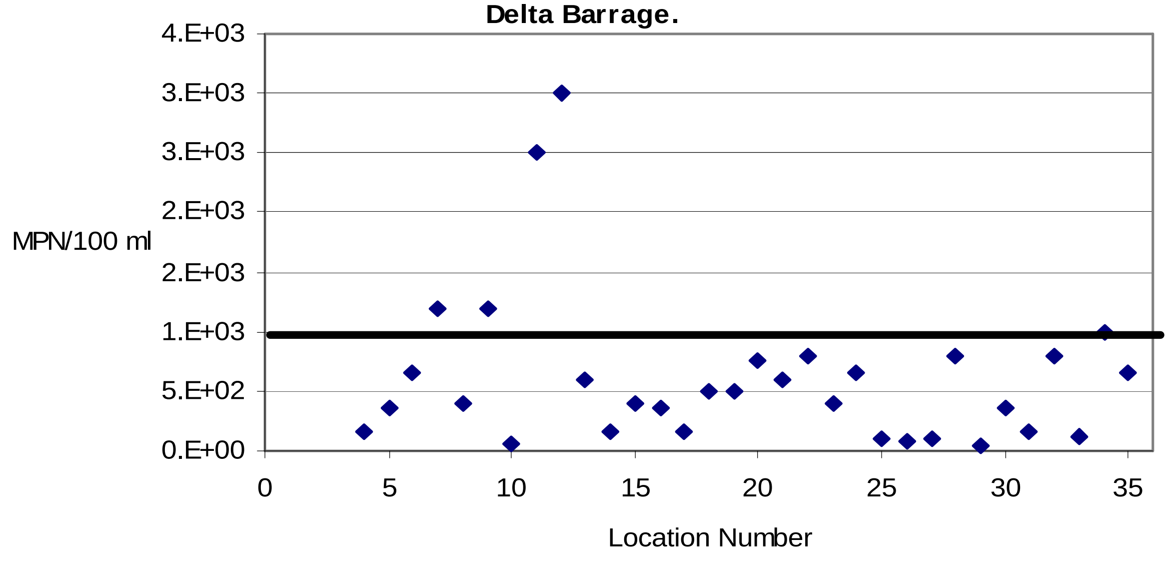


Fig. (11): Variation in FC counts of the Nile Water from Aswan to Delta Barrage.



5.3 The Damietta and Rosetta Branches

5.3.1 The Damietta branch

Damietta branch begins at the Delta Barrage and ends 220 km downstream at Faraskour dam near Damietta. Major sources of pollution to Damietta branch are Talkha fertilizers factory, High Serw 1 Drain and High Serw Power station.

Assessment of the results of the monitoring trip which was carried out during February 2001 indicates the following:

- Dissolved oxygen concentration ranged from 7.8 mgO_2/l at its southern part to 6.2 mgO2/l at the northern part.
- Nutrients concentrations (nitrogen & phosphorus) were within the permissible limits.
- The chemical oxygen demand exceeded the standard set by law 48/1982. However, the concentrations were similar to those of the Nile water from Aswan to Delta Barrage (Table 5.5 & Figure 5-14).
- BOD values comply with the consent standard, except at one location at the end of the branch (Figure 5-15).
- TDS increased from 240 mg/l up to 372 mgO_2/l, but the values are still within the permissible limits (Figure 5-16).
- FC counts exceeded the WHO Guidelines in almost all sampling sites. This is an indication of the discharge of human wastes in Damietta branch (Figure 5-17).

Table (5.5) Damietta Branch Water Quality.

Location	Distance from AHD	COD	BOD	TDS	FC
Consent Standard		10 mg/l	6 mg/l	500 mg/l	NA
36	1025	8	2.64	235	3.5E+03
37	1058	7	1.91	240	9.0E+02
38	1096	14	1.73	279	1.0E+03
39	1150	23	2.55	365	1.5E+03
40	1166	20	2.26	358	1.2E+03
41	1180	13	2.22	357	1.5E+03
42	1077	22	7.42	372	1.3E+03

Fig. (12): Variation in COD values of Damitta branch.

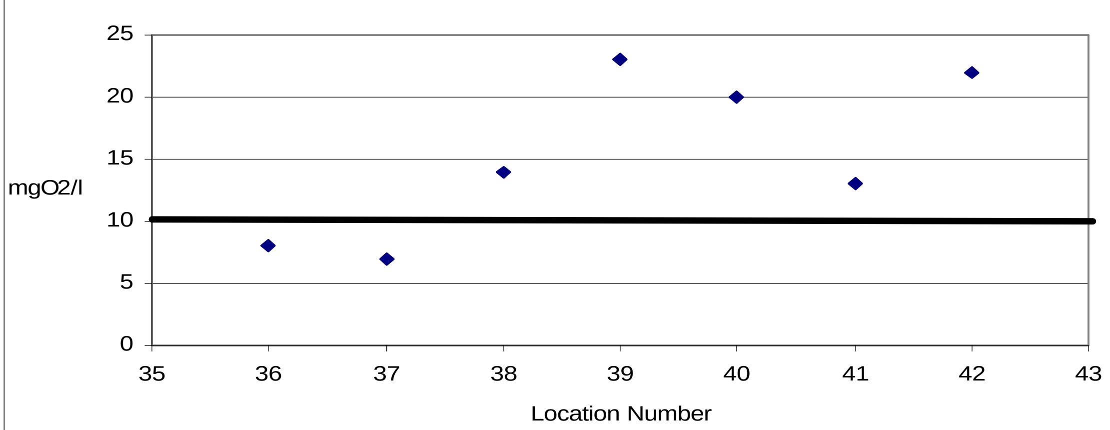
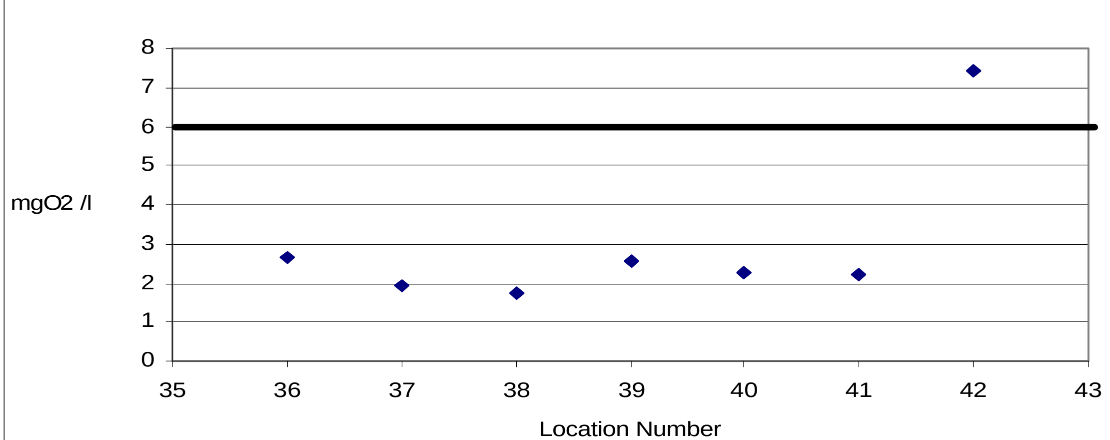
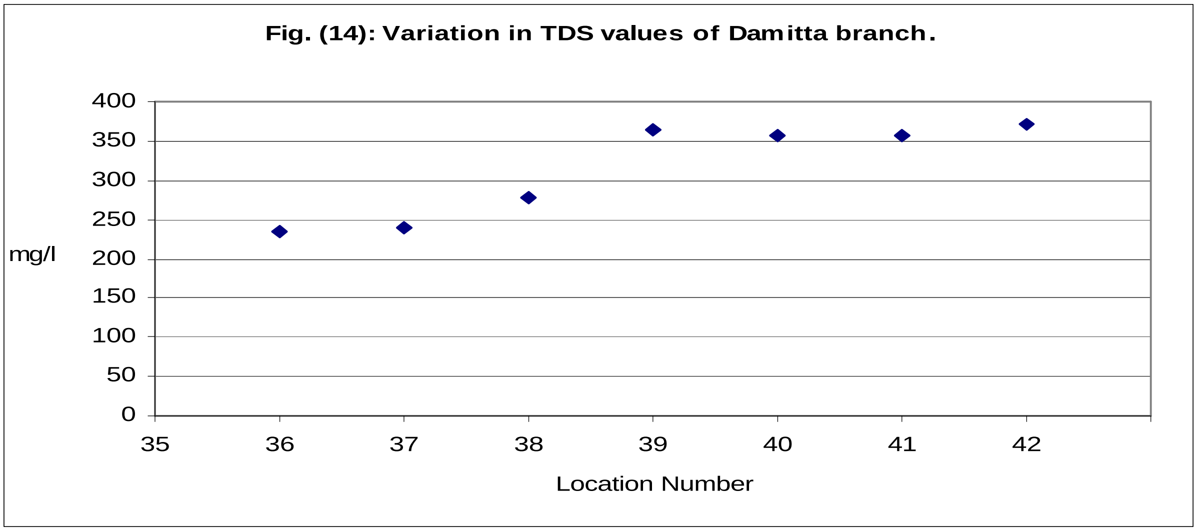
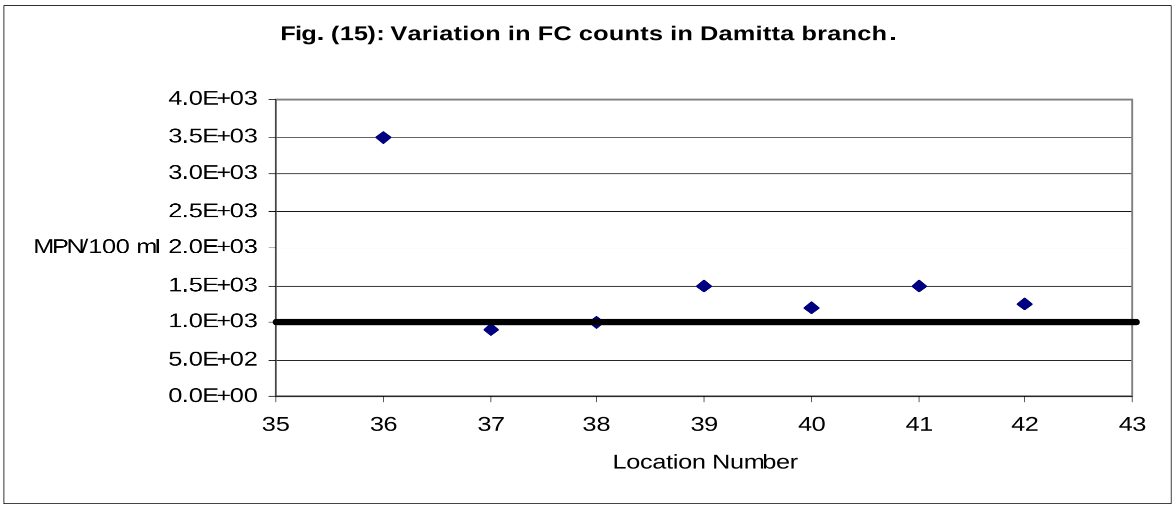


Fig. (13): Variation in BOD values of Damitta branch.







5.3.2 Rosetta Branch

Rosetta branch, starting from Delta Barrage receives relatively high concentrations of organic compounds, nutrients and oil & grease. Major sources of pollution are Rahawy drain (which receives part of Greater Cairo wastewater), Sabal drain, El-Tahrrer drain, Zawiet El-Bahr drain and Tala drain. At Kafr El-Zayat, Rosetta branch receives wastewater from Maleya and Salt and Soda companies.

Ambient water quality status of Rosetta Branch is presented in Table 5.6 & Figures 5-18 and 5-19. Dissolved oxygen concentrations, as indicated by the results of the February 2001 monitoring trip ranged from 5.1 mgO2/l at the southern part to 6.3 mgO_2/l at the northern part of the branch.

Nutrient concentrations are within the permissible limits. COD and BOD values exceeded the standards, but were similar to those recorded for Damietta branch.
TDS ranged from 240 at Delta barrage up to 415 mg/l at the end of the branch (Figure 5-20).

With regard to FC, high counts were detected at Kafr El-Zayat, after which the water complied with the WHO Guidelines (1989) for unrestricted irrigation (Figure 5-21).

Table (5.6) Rosetta Branch: Water Quality

Location	Distance from AHD	COD	BOD	TDS	FC
Consent Standard		10 mg/l	6 mg/l	500 mg/l	NA
43	1075	24	7.78	370	1.3E+03
44	1123	14	4.59	388	2.5E+02
45	1136	15	6.73	475	6.0E+02
46	1156.5	25	7.73	370	1.7E+02

Fig. (16): Variation in COD values of Rosetta branch.

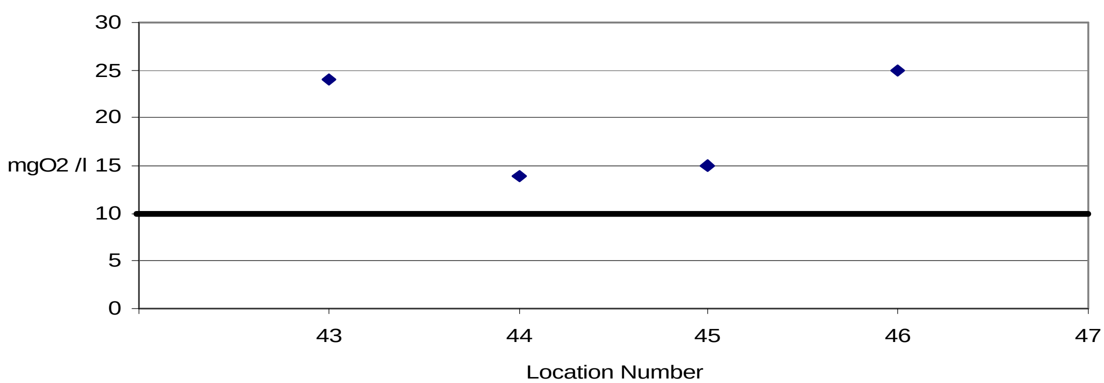


Fig. (17): Variation in BOD values of Rosetta branch.

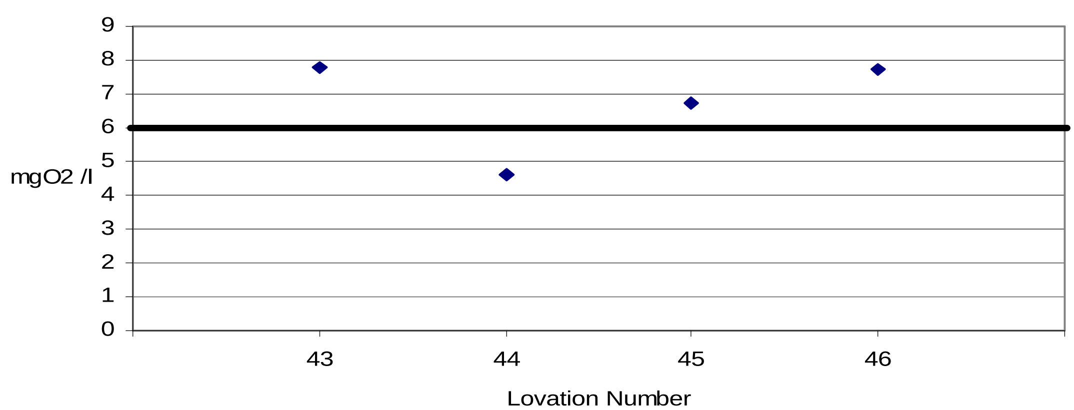


Fig. (18): Variation in TDS values in Rosetta branch .

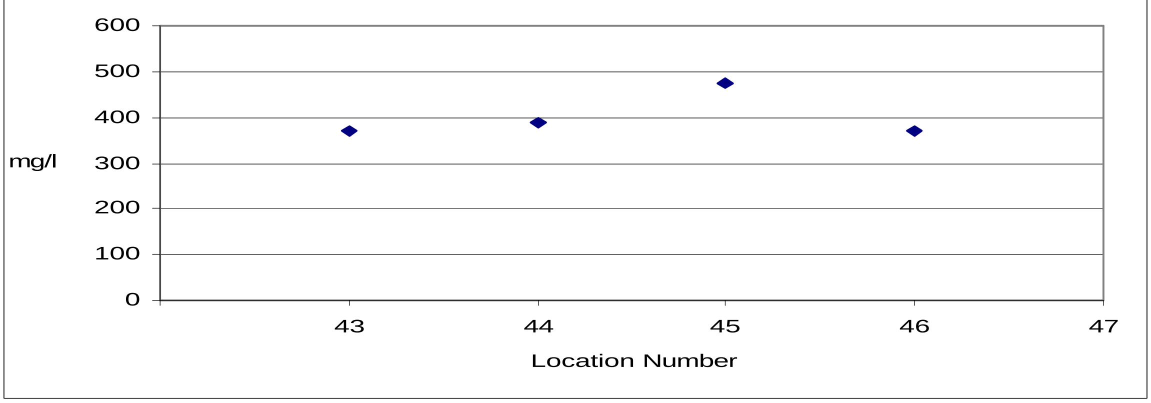
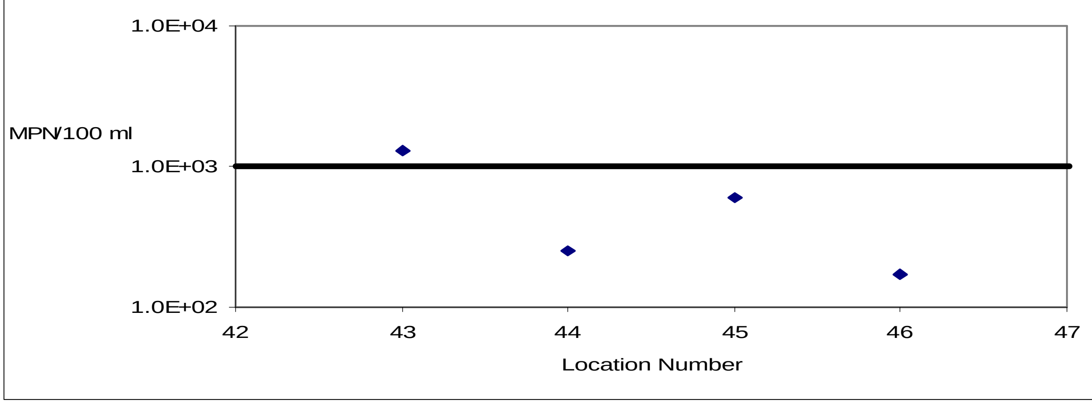


Fig. (19): Variation of FC counts in Rosetta branch .



5.4 Canals & Rayahs

Water quality monitoring campaigns conducted to date have included irrigation canals to a very limited extent. In general, canals have water quality similar to that at the point of diversion from the Nile. The flow in the canals varies with irrigation demands. Most of these canals are sources for drinking water treatment plants.

Twelve canals and rayahs have been monitored during the February 2001, campaign. Available data indicates that dissolved oxygen, BOD and total solids concentrations in all surveyed canals and Rayahs are within the permissible limits (Table 5.7). The shaded values in the table denote non-compliance with standards. With regard to COD values, only El-Lahoun and Sako complied with the standard values .

With the exception of Ibrahimia Canal and El-Beherri Rayah, fecal coliform counts in all surveyed canals exceeded the WHO Guidelines (1000 MPN/100 ml). In Monoufi and Nasery Rayahs, the fecal coliform counts were 10^4. This indicates the presence of human wastes. Heavy metals concentrations in canals and Rayahs were within the permissible limits.

Table 5.7 Results of Field Analysis for Canals and Rayahs

Canal & Rayah	DO	COD	BOD	RDS	TSS	FC
Consent standards	5	10	6	500	NA	1000*
Menoufi Rayah	5.97	16	3.02	225	29	10000
El-Beherri Rayah	7.58	14	1.74	220	6	1000
El Nasey Rayah	6.71	12	3.96	220	16	10000
Astoun Canal	7.03	11	1.82	200	8	1600
Kelabia Canal	7.57	15	1.71	205	12	1500
East Naga Hamadi Canal	6.31	25	5.78	213	9	1750
West Nagahamadi Canal	7.22	18	4.32	200	6	2500
Ibrahimia Canal (Dairot)	7.84	37	3.55	200	8	2000
Ibrahimia Canal (El-Minia)	8.12	23	3.08	200	17	650
Ibrahimia Canal (Beni-Suef)	7.38	21	2.01	230	12	1500
El-Lahoun	7.08	10	1.89	305	12	5000
Sako	6.98	10	2.68	280	40	1100

* **WHO (1989) Guidelines for Unrestricted Irrigation**

5.5 Agricultural Drains in the Delta

Delta drains are mainly used for discharge of predominantly untreated or poorly treated wastewater (domestic & industrial), and for drainage of agricultural areas. Therefore, they contain high concentrations of various pollutants such as organic matter (BOD, COD), nutrients, fecal bacteria, heavy metals and pesticides.

The drainage water is becoming more saline; on average its salinity increased from 2400 g/m3 in 1985 to 2750 g/m3 in 1995. But there are local variations. For example, in the southern part of the Nile Delta drainage water has salinity between 750 and 1000 g/m3, whereas the salinity in the middle parts of the Delta reaches about 2000 g/m3 and in the northern parts between 3500 and 6000 g/m3.

In a recent study published by DRI (2000), it has been estimated that the Delta and Fayoum drains receive about 13.5 BCM/year. Almost 90% of which is contributed from agricultural diffuse source, 6.2% from domestic point sources, 3.5% from domestic diffuse sources and the rest (3.5%) from industrial point sources (Table 5.8). It was also found that Bahr El-Baqar receives the greatest part of waste water (about 3 BCM/year). This is followed by Bahr Hados, Gharbia, Edko and El-Umoum, with an average flow of 1.75 BCM/year for each. The wastewater received by the rest of the drains is less than 0.5 BCM/year for each.

In terms of organic loads, as expressed by COD and BOD values, Bahr El-Baqar drain receives the highest load followed by Abu-Keer drain. Also, El-Gharbia Main receives significant amounts of organic pollutants.

Table 5.8 Effluent (m3/day) discharged to drains

Drain	Domestic point Sources m^3/day	Industrial Point Sources m^3/day	Domestic Diffuse source m^3/day	Agricultural Diffuse source m^3/day	Total m^3/day
Bahr El-Baqar	184000.0	64268.0	122795.0	4521678.0	6548741.0
Bahr Hados	80000.0	6135.0	207754.0	4836000.0	5129889.0
Faraskour	2490.0	0.0	13272.0	186758.0	202520.0
El-Serw El-Asfal	7710.0	0.0	18769.0	508515.0	534994.0
El-Gharbia Main	156500.0	44460.0	293315.0	3927556.0	4421831.0
Tala	179.0	300.0	45076.0	1087148.0	1134318.0
Sabal	79000.0	0.0	39925.0	1196384.0	1315309.0
No. 8	0.0	0.0	42428.0	469848.0	512276.0
Bahr Nashart	22000.0	13968.0	108915.0	968859.0	1113742.0
No. 7	12500.0	0.0	39778.0	390056.0	442334.0
No. 1	39350.0	20960.0	78329.0	1204654.0	1343293.0
No. 9	0.0	0.0	88029.0	595644.0	683673.0
Zaghloul	0.0	0.0	1838.0	122890.0	124728.0
Edko	20000.0	7470.0	57346.0	4232034.0	4316850.0
Borg Rashid	0.0	0.0	0.0	311246.0	311246.0
El-Umoum	25000.0	0.0	81890.0	5163208.9	5270098.9
Abu-Keer	0.0	22897.0	15803.0	621592.2	660292.2
El-Batts	22396.0	0.0	26213.0	1468340.8	1516949.8
El-Wadi	3000.0	0.0	13272.0	1600340.6	1616612.6
Total (m^3/day)	2311740.0	180458.0	1294747.0	33412752.5	37199697.5
Total Billion m^3/year	0.84	0.066	0.47	12.2	13.6
% Ratio	6.2%	0.5%	3.5%	89.7%	

In the following section organic loads discharged into some Delta drain from domestic (point and diffuse) and industrial sources will be presented, (DRI, 2000).

5.5.1 Bahr El-Bagar Drain

The Bahr El-Bagar drain is 106 km long and has two main branches: the 73.2 km Qalubia drain and the 66 km Belbaise drain. The total catchment area of Bahr El Bagar drain system is 760,000 feddan including 300,000 fedan for Qalubia drain, 60,000 feddan for Belbaise drain and 400,000 feddan for Bahr El-Bagar drain downstream from the intersection of the two main branches. The total discharge pumped to Lake Manzala is 1.4 bcm/year.

Bahr El-Bagar drain basin is located in a very densely populated area of the Eastern Delta passing through Qalubia, Sharkia and Ismailia Governorates. The water of Bahr El-Baqar is used unofficially for irrigation and contributes much to groundwater pollution in the Sharkia Governorate.

All sewage and industrial wastewater, treated and untreated, from the eastern zone of Greater Cairo is dumped into the Belbaise drain through the effluents of both Gabal Asfar and Berka treatment plants. The capacity of Gabal Asfar plant is 1,200,000 m^3/day, while that of the Berka treatment plant is 600,000 m^3/day.

The state of the Qalubia main drain is more serious than the Belbaise drain. Qalubia's main 14 branches (intermediates) collect treated and untreated wastewater legally and illegally from the heavily populated area of Shobra El-Khemma and its large industrial area, together with the urban communities of Qalubia and Sharkia Governorates. Bacause of the good quality of Bahr El-Bagar drain with respect to salinity (800 ppm), some mixing pump stations were constructed to cover the shortage of water in canals supplying irrigation water for legal and illegal rice. Rice covers almost 80% of Sharkia Governorate lands in summer. The main mixing pump station on the Qalubia drain is called El Wady, located at the end of the drain, before the connection to Bahr El-Bagar drain. This pump station was constructed to supply El Wady canal with 307 mcm/year. El Wady canal has a maximum freshwater discharge of 2.0 mcm/day.

Bahr Al-Baqar drain receives very high organic load from domestic (point & diffuse sources) and industrial sources (Table 5.9 & Figures 5-22 through 5-26).

Table 5. 9 Loads of Pollution received by Bahr Al-Bakar Drain

Source	**Q m3/d**	**Load (kg/d)**					
		BOD	**COD**	**SS**	**TDS**	**O&G**	**Heavy metals**
Domestic Point sources	1840000	356450	630850	327000	1363400	28200	1530
Domestic diffuse sources	122795	55257	73677	61397	96008	-	-
Industrial Point Sources	55938	28755	71108	31616	44834	5638	34
Total	**2018733**	**440462**	**775635**	**420013**	**1505242**	**33838**	**1564**

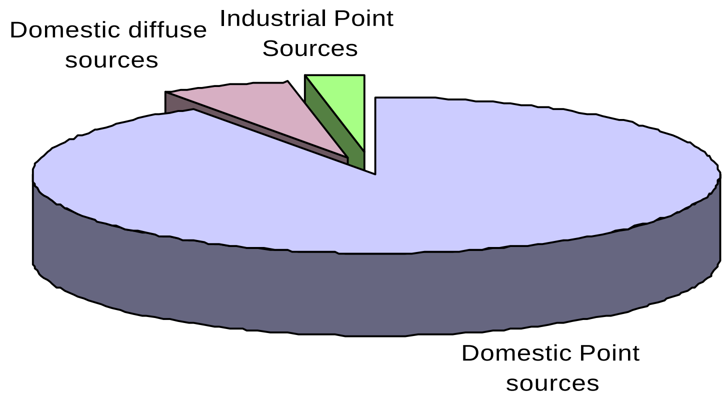


Fig. (22): Watewater discharged into Al-Bakar Drain (% Q).

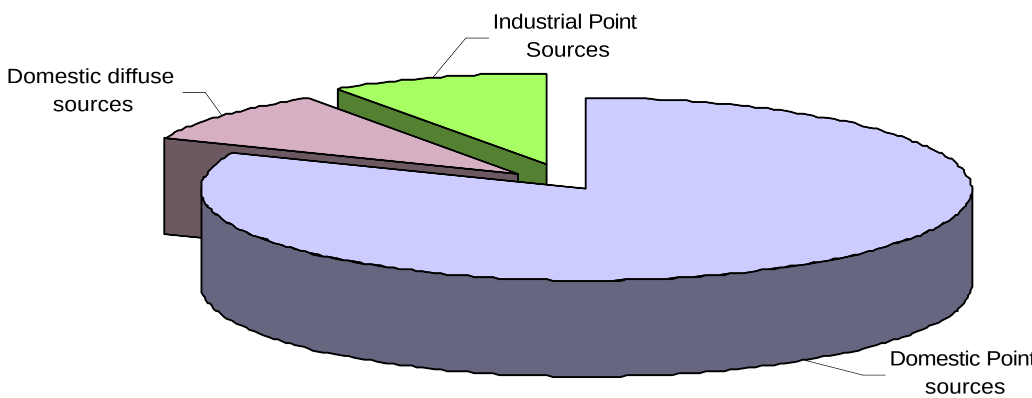


Fig. (23): COD (%) loads received by Al-Bakar Drain.

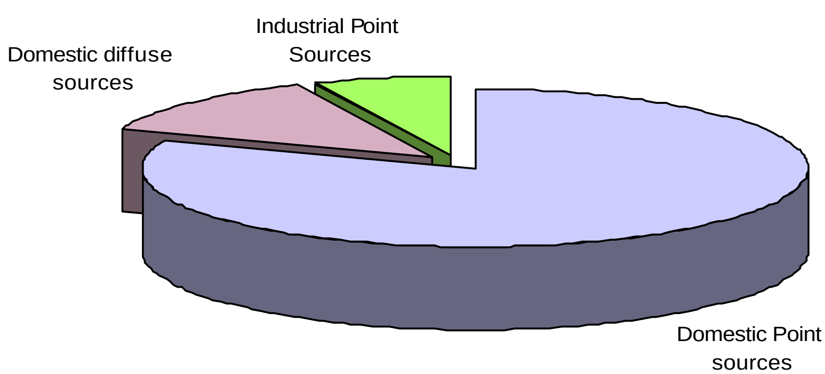


Fig. (24): BOD (%) loads received by Al-Bakar Drain.

Fig. (25): SS (%) loads received by Al-Bakar Drain.

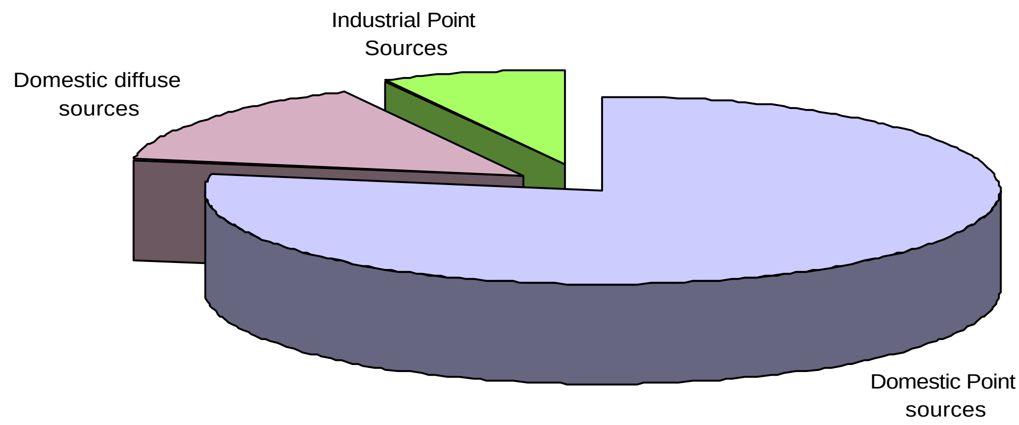
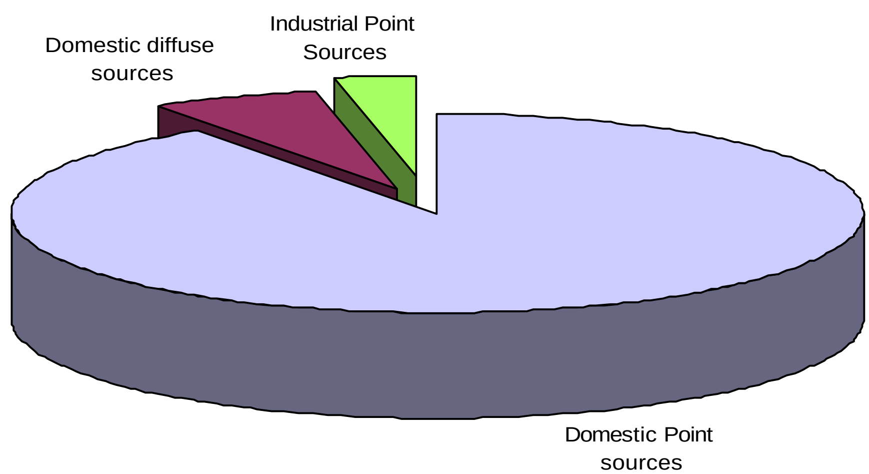


Fig. (26): TDS (%) loads received by Al-Bakar Drain.



5.5.2 El-Gharbia Drain

Gharbia drain has a catchment area estimated at 700,000 feddan and covering a heavily populated area in Gharbia and Kafr El-Sheikh Governorates. Gharbia drain has two mixing pump stations downstream from El-Segaeia. The first is El-Hamoul, which has a discharge of 1.5 million cubic meters (mcm) per day, reaching 1.8 mcm/day in summer to supply Bahr Terra canal. The second is Botteta mixing pump station, which supplies Rowaina canal with 600,000 m^3/day. Botteta mixing pump station is not operational at present due to the pollution coming from the wastewater effluent of the sugar beet factory.

The current quantity of reused drainage water from Gharbia drain is estimated to be about 1 bcm/year, which is a considerable amount of water compared to total reuse in Egypt. This is in addition to the large quantity of unofficial drainage use which puts the Gharbia drain in the highest priority list for protection from pollution.

At present, El-Gharbia drain receives very high organic loads from domestic diffuse sources, which indicates low coverage with sanitation systems in this catchment area 61.1% of the BOD load received by this drain is from domestic diffuse sources, 21.4% from domestic point sources and the rest from industrial sources (Table 5.10 and Figures 5-27 to 5-31).

Table 5.10 Loads of Pollution Received by El-Gharbia Drain

Source	Q m3/d	Load (kg/d)					
		BOD	COD	SS	TDS	O&G	Heavy metals
Domestic Point sources	156500	47516	57959	50972	214404	-	-
Domestic diffuse sources	293315	142693	213430	146049	226774	-	-
Industrial Point Sources	44460	32283	76383	26499	77546	18211	9
Total	**494275**	**222492**		**223520**	**518724**	**18211**	**9**

Fig. (27): Watewater discharged into El-Gharbia Drain (% Q).

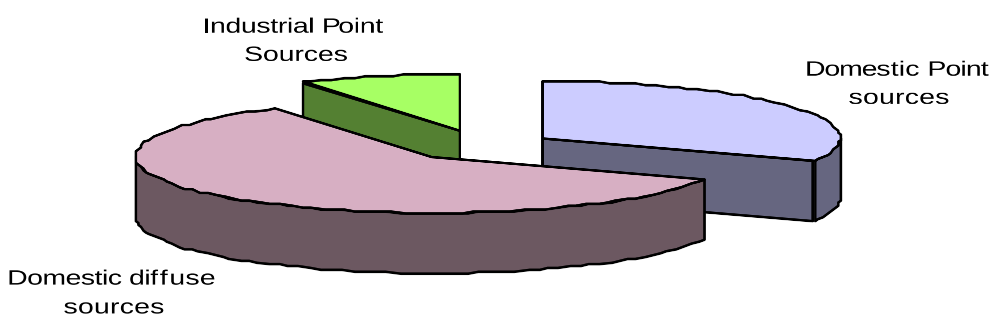


Fig. (28): BOD (%) loads received by El-Ghabia Drain.

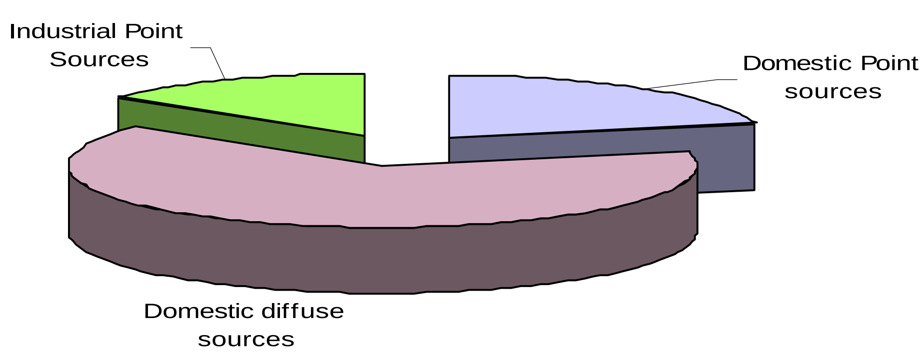


Fig. (29): SS (%) loads received by El-Ghabia Drain.

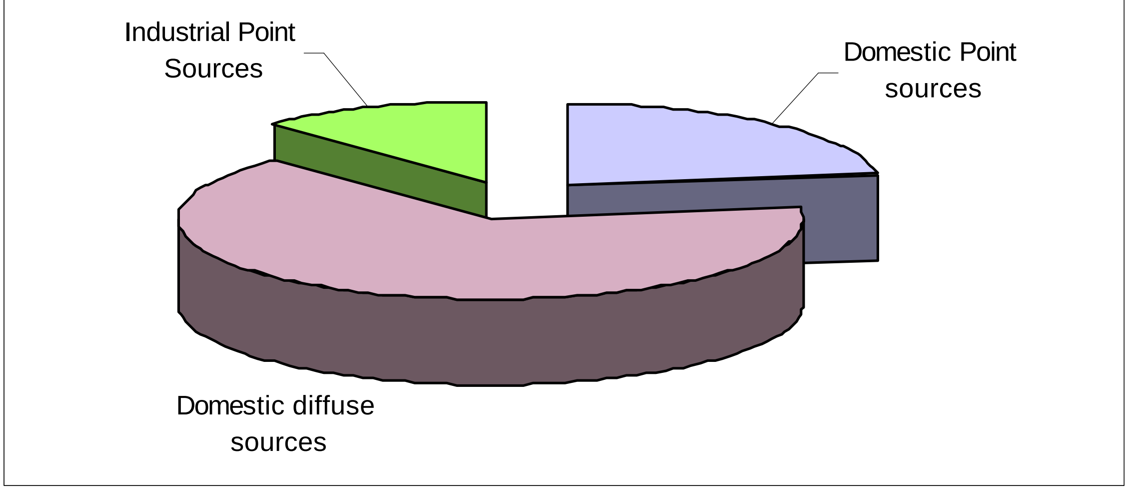


Fig. (30): TDS (%) loads received by El-Ghabia Drain.

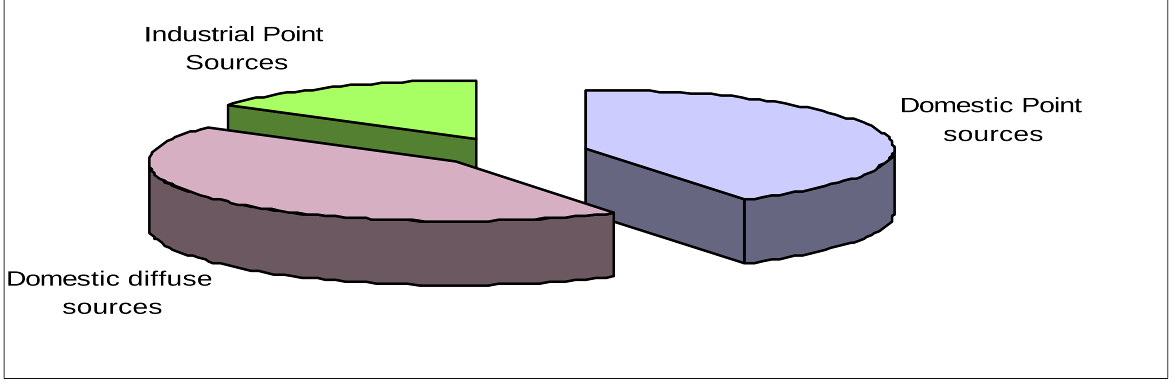
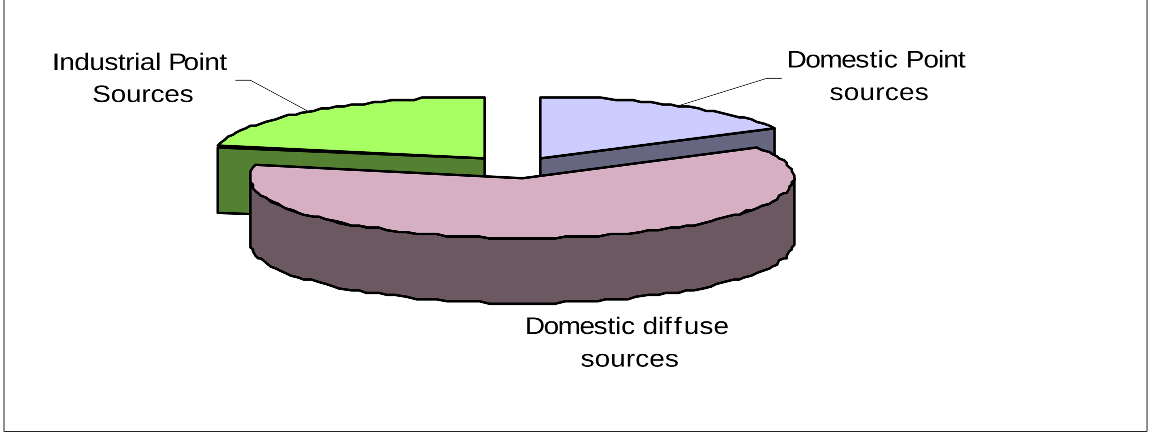


Fig. (31): COD (%) loads received by El-Ghabia Drain.



5.5.3 Edko Drain

Edko drain in Behera Governorate supplies El-Mahmoudia canal with water in order to cover the need for irrigation along the canal and for drinking water for Alexandria City. Like all drains in the Delta, Edko drain catchment area covers a highly-populated governorate in which the quality of water in the drain system (main drain and its branches) is deteriorating due to legal and illegal dumping of domestic wastewater.

Most of the organic load received by this drain is from domestic diffuse sources (90.2 %). Domestic point sources represent only 3.2% and the rest (6.7%) is contributed from industrial sources (Table 5.11 & Figures 5-32 to 5-36).

Table 5.11 Loads of Pollution Received by Edko Drain

Source	Q m3/d	Load (kg/d)				
		BOD	COD	SS	TDS	O&G
Domestic Point sources	20,000	882	1540	802	15850	-
Domestic diffuse sources	55276	24321	26145	27361	43668	-
Industrial Point Sources	7970	1872	2993	7328	5388	1195
Total	**83246**	**27075**	**30678**	**35491**	**64906**	**1195**

Fig. (32): Watewater discharged into Edko Drain (%Q).

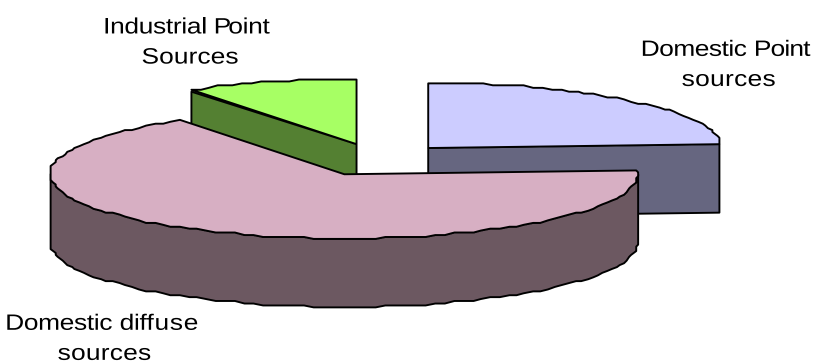


Fig. (33): BOD (%) loads received by Edko Drain.

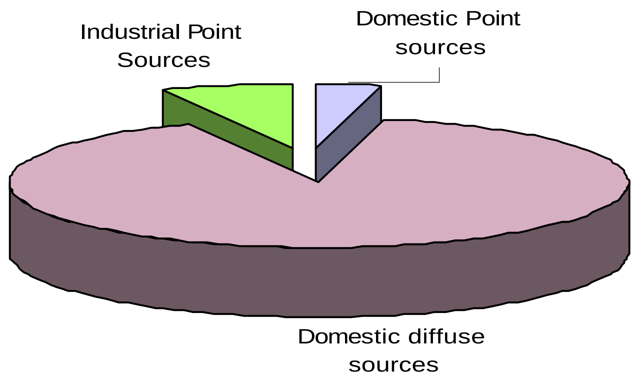


Fig. (34): COD (%) loads received by Edko Drain.

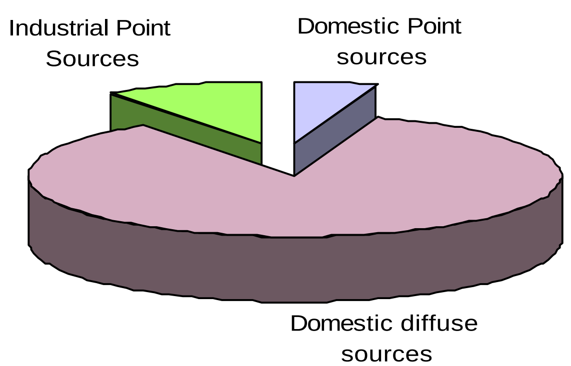


Fig. (35): TDS (%) loads received by Edko Drain.

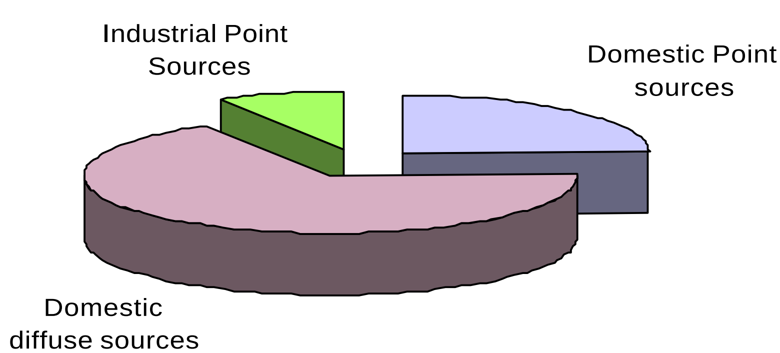
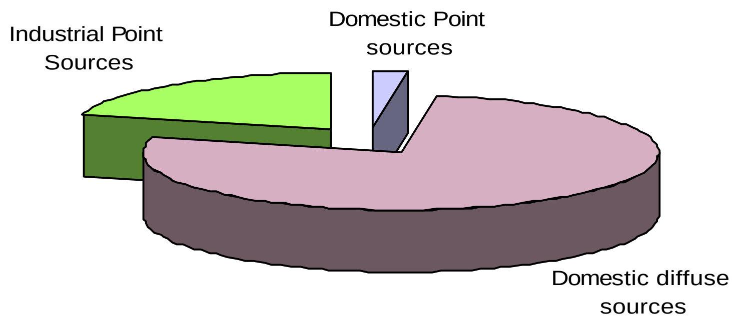


Fig. (36): SS (%) loads received by Edko Drain.



5.5.4 Mouheet Drain

El Mouheet drain in Giza is considered one of the most polluted main drains, coming second only to Bahr El-Bagar drain in the Eastern Delta. The situation of El Mouheet drain is of greater concern than Bahr El-Bagar as it dumps its water into the Nile (Rossetta Branch) via Rahawy drain while Bahr El-Bagar empties into Lake Manzala. The total length of the drain is 70.2 km from the beginning to Rahawy pump station. The main drain starts at El-Badrasheen and ends at Mansouria. It receives water from six intermediates on the right side dumping its water in Gennabiete El Mouheet El Youmna drain. Gannabiete El Mouheet El-Youmna has 11 intermediates coming from the right side and one from the left. It also receives drainage water from Gannabiete El mouheet drain El-Yousra, with its one intermediate on the left side. The whole system dumps into the Nile through Rahawy Pump Station on the Rossetta Branch. This pump is not working now since the water is flowing to the Nile by gravity, due to high water levels.

Two main treatment plants are located within the drainage basin of El mouheet drain: Abu Rawash and Zenein plants with maximum effluents of 700,000 and 400,000 m^3/day, respectively. There are limited treatment plants within the drain catchment area.

5.6 El-Salam Canal

Drainage water supplied to El-Salam canal is estimated to be 2 bcm/year. This quantity is harvested from Bahr Hadous, Lower and Upper Serw together, if needed, and Farasqour drains (Figure 5-37). This drainage water will be mixed with another 2 bcm/year freshwater drawn from Damietta Branch to reach a total discharge of 4 bcm in order to supply irrigation water to 200,000 feddan in the western Suez canal region and 440,000 feddan in the East, north of Sinai Governorate.

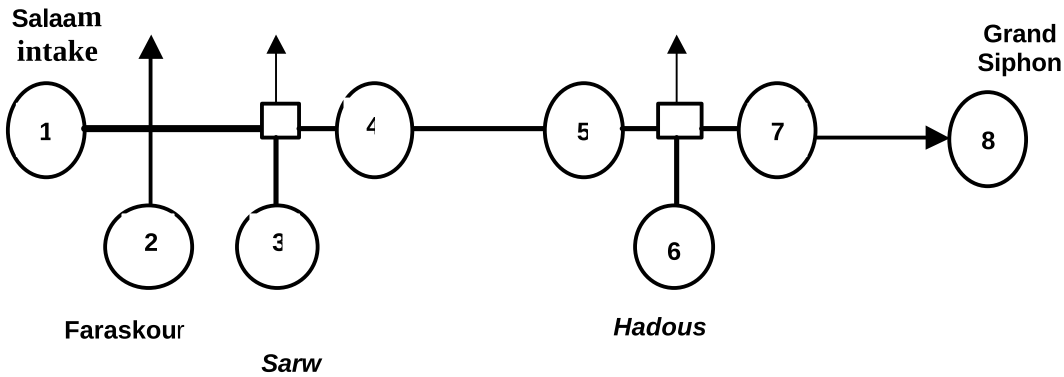


Figure 5-37
El-Salaam Canal Schematic

Since the catchment area of Bahr Hadous, Upper and Lower Serw, and faraskour drains are located in highly populated area, all drain systems within the region are susceptible to pollution from legal and illegal dumping of domestic and industrial wastewater. The current proposed mixing ratio of 1:1 between drainage and freshwater might be enough to reduce the pollution to acceptable levels.

Most of the water received by Bahr Hadous drain (94.3%) is from agricultural diffuse sources. Although the domestic diffuse sources is only 4% of the total discharge, it contributes 94.7% of the organic load received by Bahr Hadous, expressed as BOD (Table 5.12). Loads of pollution received by Faraskour and El-Serw El-Asfal drains are presented in Tables 5.13 & 5.14. No information is available about input from industrial sources.

Table 5.12 Loads of Pollution Received by Bahr Hadous Drain from Different Sources

Source	Q m3/d	Load (kg/d)			
		BOD	COD	SS	TDS
Domestic Point sources	80000	1680	3680	1600	61360
Domestic diffuse sources	207754	77459	110211	81782	179722
Industrial Point Sources	6135	1768	2606	2965	61360
Total	**293889**	**80907**	**116497**	**86347**	**302442**

Table 5.13 Loads of Pollution Received by Faraskour drain

Source	Q m3/d	Load (kg/d)			
		BOD	COD	SS	TDS
Domestic Point Sources	2490	223	377	220	1657
Domestic diffuse Sources	13272	6450	9356	4870	10484
Industrial Point Sources	NA	NA	NA	NA	NA
Total	**15762**	**6673**	**9733**	**5090**	**12141**

Table 5.14 Loads of Pollution Received by El-Serw El-Asfal Drain

Source	Q m3/d	Load (kg/d)			
		BOD	COD	SS	TDS
Domestic Point Sources	7710	897	1402	666	5203
Domestic diffuse Sources	18769	8113	11823	6751	15568
Industrial Point Sources	NA	NA	NA	NA	NA
Total	**26479**	**9010**	**13225**	**7417**	**20771**

The water quality of Faraskour, Serw and Hadous drains, at their ends before mixing with El-Salam canal is presented in Tables (5.15,5.16 & 5.17). Assessment of the available data indicates that the fecal coliform counts in the water of the three drains exceed both WHO and Egyptian standards for use of water for unrestricted irrigation, especially Hadous which gave very high fecal coliform counts (92000 MNP/100). It is worth/mentioning however, that a great reduction of the counts takes place downstream of the points of mixing along El-Salam canal, which indicates the importance of the self purification in surface water bodies. The same observation apply to physico-chemical characteristics. However, all samples showed exceedingly high intestinal helminth eggs, particularly ascaris, taenia, haokworms, and hymenolepis diminuta (Table 5.16). A situation which needs great attention and continuous monitoring.

Table 5.15 Selected Water Quality Parameters, Salaam Canal*

	Monitoring Location	TDS (ppm)	BOD (ppm)	COD (ppm)	Fecal coliform (count/100 ml)
	Along Salaam Canal				
1	Beginning	242	10.0	24.0	4,500
2	Faraskor Drain	812	150.0	256.0	170,000
3	Serw drain	1048	48.0	72.0	35,000
4	After Serw Drain	408	17.5	22.8	17,000
5	Before Hadous Drain	416	10.0	19.2	200
6	Hadus drain	1584	37.0	58.0	92,000
7	After Hadous Drain	1171	22.0	37.0	11,000
8	End	514	14.0	19.2	900

Table 5.16 Intestinal Helminth Eggs, Salaam Canal*

	Monitoring Location	Intestinal helminth eggs (cont/100 ml)								
		Ascaris	Taenia sp.	Hook worm	Hymenolepis diminuta	Hymenolepis nan	Capollaria hepatica	Schistosomia mansoni	Trichuris trichiura	Paragonimus westermani
	Along Salaam Canal									
1	Beginning	60	30	60	30	-	-	-	-	60
2	Faraskor Drain	180		144	180	30	-	-	-	60
3	Serw drain	280	180	720	198	-	30	-	-	-
4	After Serw Drain	720	360			-	-	-	180	-
5	Before Hadous Drain	180	90		180	30	-	-	-	-
6	Hadus drain	360	144	720	180	216	-	-	180	-
7	After Hadous Drain	720	360			-	-	-	180	-
8	Before grand siphon	28	72		24	24	-	-	-	-

*** Monitored by the MOHP Environ. Health Dpart. at Mar-Apr. 2000**

Table 5. 17 Fecal Coliform Bacteria and Intestinal Nematode Eggs, Salaam Canal*

	Monitoring Location	Fecal coliform Bacteria counts (counts/100 ml)	Intestinal helminth eggs (cont/100 ml)								
			Ascaris	Taenia sp.	Hook worm	Hymenolepis diminuta	Hymenolepis nan	Capollaria hepatica	Schistosomia mansoni	Trichuris trichiura	Paragonimus westermani
	Along Salaam Canal										
1	Beginning	4,500	60	30		30	-	-	-	-	60
2	Faraskor Drain	170,000	180		60	180	30	-	-	-	60
3	Serw drain	35,000	280	180	144	198	-	30	-	-	-
4	After Serw Drain	17,000	720	360	720		-	-	-	180	-
5	Before Hadous Drain	200	180	90		180	30	-	-	-	-
6	Hadus drain	92,000	360	144		180	216	-	-	180	-
7	After Hadous Drain	11,000	720	360	720		-	-	-	180	-
8	Before grand siphon	900	28	72		24	24	-	-	-	-

- **Monitored by the MOHP Environ. Health Dpart. at Mar-Apr. 2000**

It is important to mention, that the study (DRI, 2000) from which this data was abstracted did not include the ambient water quality of the drains. Therefore, it was not possible to assess the impact of discharge of wastewater effluents on the quality of the drains.

Water quality of some of the Delta drains (1999) are shown in Table 5.18.

Table 5.18: BOD, COD and E. Coli values in some drains in the Delta

	BOD Mg/1	COD Mg/1	No. coliform Bacteria/1 ml
Eastern Delta:			
El Arin Drain	62	28.8	$21 X 10^4$
Upper Screw	47	30.4	$2 1 X 10^4$
El Guinina P.S	40	79.2	$2 1 X 10^4$
El Nezam P.S.	42	172.8	$21 X 10^4$
Saflt P.S.	52	50.2	$21 X 10^4$
Hanut P.S.	60	74.0	$21 X 10^4$
Elwadi P.S	64	112.2	$21 X 10^4$
B lad El Abed P.S	46	34.0	$42 x 10^4$
Lower Serow P.S.	52	51.8	$21 X 10^4$
Bahr El Baqar Drainage P.S.	162	132.0	$42 x 10^4$
Middle Delta:			
El Gartbia Drain at El-Kashaa	84	128.0	$42 x 10^4$
East Henoufla P.S	38	82.4	$56 x 10^4$
Tira P. S after mixing	62	182.0	$21 X 10^4$
Mahnlet Roh P. S.	64	62.0	$21 X 10^4$
ZI-amoul P.S.	82	216.0	$56 x 10^4$
Talia Drain Outfoul	4	7.0	$21 X 10^4$
Lower P.S. NO.8	62	92.4	$52 x 10^4$
P.S. NO.	81	182.0	$52 x 10^4$
Hafir Shahab Z--Din-P.S	64	132.0	$21 X 10^4$
Mahlet Rob Bridge	--	31.0	$21 X 10^4$
P.S. NO.11	83	198.0	$21 X 10^4$
LwerP.S. NO.1	24	98.4	$52 x 10^4$
Upper P.S NO.1	150	225.0	$42 x 10^4$

Western Delta:			
El-Delingat P.S.	36	32.6	42 x 10^4
Etay El-Baroud P.S.	60	61.4	21 X 10^4
Edko Irrigation P.S.	32	80.0	2 1 X 10^4
Khairy P.S.	62	88.0	56 x 10^4
Shobrakhlt P.S.	48	62.4	46 x 104
El-Khandak El Gharbia P. S.	60	44.6	42 x 10^4
El-Bousely P.S.	62	82.0	42 x 10^4
Shrishra P.S.	24	116.8	56 x 10^4

6. IDENTIFICATION OF MAIN PROBLEM AREAS

Assessment of the status of water quality in Egypt indicates the following:

1. Twenty-five agencies, under seven ministries are involved in water quality monitoring programs. However most of these monitoring activities are not conducted on a regular bases. Also, there are many gaps in geographical coverage such as:

   - Monitoring the canals has only recently been included in the monitoring programs.
   - Information about water quality along the length of drains in Upper Egypt is missing.
   - The monitoring programs do not cover the sediments, the phytoplankton and fish.
   - A great deal of data is collected about conventional parameters while limited data is available about parameters such as pesticides, heavy metals and hydrocarbons.

2. There is a lack of intra- and inter-ministerial cooperation and data sharing. Many available reports related to water quality issues relied on old water quality data, which minimizes the benefit of these studies.

3. Most of the available studies assumed that the organic loads received by drains are from domestic and industrial sources while the effect of diffuse agricultural discharges from the irrigated fields has been neglected.

It should also be noted that the use of animal manure, dredged sediments from drains and sludge as fertilizers is practiced in Egypt. Leaching of part of these bio-fertilizers, which contains high concentrations of pathogens, heavy metals, organic compounds and nutrients is a major source of pollution. This is confirmed by the low water quality of the drains in spite of the high dilution factor (9:1 diffuse agricultural water to domestic wastewater). Data about this source of pollution is scarce and should be studied.

7. CONCLUSIONS

Assessment of the available data indicates the following:

1. The main Nile River ambient water quality does not exhibit high pollution levels that create health risks at present, except for some locations where the presence of Coli Bacteria indicates unsafe levels of pollution for direct use in irrigation and fisheries.

2. The major sources of pollution from Aswan to Delta Barrage are:

    - Khour El-Sail Aswan
    - El-Berba drain
    - Kom-ombo drain
    - Etsa drain
    - Sugar factories in upper Egypt and Giza
    - Oil & Soap factories in Sohag

    Although the impact of discharge of these wastes on ambient water quality of the Nile has not been significant in recent years due to the high dilution factor and the high self assimilation capacity of the Nile water, special attention should be given to mitigate pollution from these sources as their effects may become significant during low flow years.

3. Major sources of pollution of Rosetta branch is El- Rahawy drain in the southern part and industry at Kafr El-Zayat.

4. Damietta branch is receiving, and is adversely affected by industrial wastewater from Talka fertilizers factory.

5. Delta drains receive high concentrations of organic and inorganic pollutants from industrial, domestic as well as diffuse agricultural wastewater. High priority should be given to those drains receiving high loads of pollution such as: Bahr El-Baqar, Bahr Hadous, El-Garbia Main, El-Rahawy and El-Umoum drains.

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ANNEX A