PRIDE

Project in Development and the Environment

Egypt Water Quality Management Action Plan: Phase II

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July 1992

AID Contract Number:
ANE-0178-Q-00-1047-00
AID Project Number:
398-0365

Submitted to:
USAID/Egypt and the
Government of Egypt

Submitted by:
PRIDE
Sponsored by:
USAID/NE/DR/ENR
Operated by:
Chemonics International
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Egypt Water Quality Management Action Plan: Phase II

PRIDE Technical Report #5

PRIDE Delivery Order #2

July 1992

TABLE OF CONTENTS

Page

LIST OF ACRONYMS i

EXECUTIVE SUMMARY iii

I. INTRODUCTION I-1

A. Purpose of Project I-1
B. General Water Quality Problems of the Nile System I-2
B1. Pathogens/Parasites I-2
B2. Heavy Metals I-4
B3. Pesticides I-4
B4. Salinity I-5
B5. Other Water Quality Concerns I-6

C. Ranking of Pollutants I-7
D. Sources of Water Quality Problems I-9
D1. Sanitary Discharges I-9
D2. Treated Sanitary Wastes I-10
D3. Untreated Sanitary Wastes I-11
D4. Industrial Discharges I-12
D5. Agricultural Drainage I-14
D6. Salt Water Intrusion I-15

II. INSTITUTIONAL FRAMEWORK II-1

A. Laws and Decrees Controlling Water Quality II-1
A1. Law 48/1982 (and Ministerial Decree [Irrigation] 8/1983) II-1
A2. Presidential Decree 93/1962 (and Ministerial Decrees 649/1962 and 9/1989) II-3
A3. Less Significant Laws II-3

B. Responsibilities of Institutions Affecting Water Quality II-3
B1. Ministry of Public Works and Water Resources II-4
B2. Egyptian Environmental Affairs Agency II-5
B3. Ministry of Health II-6
B4. Ministry of Housing, Reconstruction, and New Communities, National Organization for Potable Water and Sanitary Drainage . . II-7
B5. Ministry of Industry, General Organization for Industry; Other Ministries II-7

TABLE OF CONTENTS
(continued)

Page

C. Conclusion II-8

III. WATER QUALITY MANAGEMENT AND MONITORING PROGRAMS III-1

A. Distribution of Water Quality Problems III-1
A1. Systemwide Water Quality Problems III-1
A2. Localized Problems III-2
A2a. Nile Delta. III-2
A2b. Northern Lakes III-3
A2c. Rosetta Branch III-4
A2d. Groundwater III-4

B. Evaluation of Current and Proposed Environmental Actions III-5
B1. Pathogens and Parasites III-5
B2. Pesticides III-6
B3. Heavy Metals III-6
B4. Salinity III-6

C. Evaluation of the Water Quality Management Process III-7
C1. Management of the Process of Water Quality Management III-7
C1a. Setting Objectives III-8
C1b. Developing Action Plans III-8
C1c. Overseeing Action Plan Implementation III-8
C1d. Monitoring Progress III-8
C1e. Revising Objectives or Action Plans III-9
C2. Data Management III-9
C3. Enforcement III-10

D. Evaluation of Water Quality Monitoring Programs III-11
E. Evaluation of Institutional Framework of Water Quality Management . . III-15
E1. Legislation III-17
E1a. Over Strict Provisions III-17
E1b. Waterway Standards III-18
E1c. Penalty Provisions III-19

TABLE OF CONTENTS
(continued)

Page

IV. ALTERNATIVES IV-1

A. Alternatives Related to Specific Pollutant Problems IV-1
B. Alternatives Related to Water Quality Management Process IV-8
C. Alternatives Related to Water Quality Monitoring IV-12
D. Alternatives Related to Institutional Aspects IV-14
E. Alternatives Related to Legislative Aspects of Water Quality Management IV-19

V. RECOMMENDATIONS V-1

A. Actions Required for Specific Pollutant Problems V-1
A1. Pathogens and Parasites V-1
A2. Pesticides V-3
A3. Heavy Metals V-5
A4. Salinity V-6

B. Actions Required for Developing Management Programs V-9
C. Actions Required to Revise Monitoring Programs V-10
D. Required Modifications to Law 48/1982 and Decree 8/1983 . . . . . V-12

ANNEX A SUMMARY OF PRESIDENTIAL DECREE 93/1962 AND MINISTERIAL DECREE 649/1962 . . . . . A-1
ANNEX B SUMMARY OF LAW 48/1982 AND DECREE 8/1983 . . . . . B-1
ANNEX C ARTICLE-BY-ARTICLE ANALYSIS OF LAW 48/1982 AND DECREE 8/1983 . . . . . C-1
ANNEX D COMPARISON OF EGYPTIAN STANDARDS WITH EACH OTHER AND U.S. AND WHO STANDARDS D-1
ANNEX E INFORMATION FOR INDUSTRIAL DATABASE E-1
ANNEX F INFORMATION FOR SEWAGE TREATMENT PLANT DATABASE F-1

PREFACE

The U.S. Agency for International Development (AID) commissioned this water management action plan in response to a request from the Government of Egypt through its Ministry of Public Works and Water Resources (MPPWR). This activity, Phase II of a two-phased assignment, is based on the results of the Phase I water quality impact assessment. Both phases are funded by the AID Mission in Egypt, through the Project in Development and the Environment (PRIDE), and by the MPPWR's Water Research Center (WRC). PRIDE is a centrally funded project that provides technical assistance in environmental and natural resource management to AID's Near East (NE) Bureau, missions, and host-country institutions.

PRIDE is being implemented by a consortium led by Chemonics International and including RCG/Hagler, Bailly, Inc.; Science Applications International Corporation (SAIC); Capital Systems Group, Inc.; Industrial Economics, Inc.; Environomics, Inc.; Resource Management International (RMI), Inc.; and Lincoln University.

Robert A. Kelly served as the team leader/water management planning specialist for this activity. Dr. Kelly is currently a senior project manager with the Environmental and Health Sciences Group of SAIC, Falls Church, Virginia. He has 20 years of experience in the analysis, assessment, and management of water pollution problems including nonpoint source controls, water quality criteria development, biological monitoring, toxicity testing, and the effects of toxic and nonconventional pollutants. James L. Welsh, who was team leader for Phase I of this assignment, served as the water quality specialist for Phase II. Mr. Welsh, an engineer with over 40 years of experience in water resource planning and water quality evaluation, is a senior consultant with RMI/Bookman-Edmonston Engineering, Inc., Sacramento, California.

Dr. Kelly and Mr. Welsh arrived in Egypt to begin the eight-week Phase II assignment on May 3, 1992. They were assisted by Rifaat Abdel Wahab, water pollution control specialist, in the collection and assessment of water quality data. The team worked closely with Dr. Mahmoud Abu Zeid, director of the Water Research Center, and other WRC staff including Dr. Fatma Attia, Dr. Shaden Abdel-Gawad, and Eng. Amal El-Sherbini.

PRIDE appreciates the continuous and active support and participation of Dr. Abu Zeid and his staff. The PRIDE team would also like to express its appreciation to the following individuals at USAID/Egypt: Glenn Rutanen-Whaley, mission environmental officer; Richard Rhoda, director of the Office of the Environment; Flynn Fuller, agricultural development officer, Office of Water and Irrigation, Directorate of Agriculture; Clem Webber, director, Office of Irrigation and Land Development; and Chris Crowley, associate mission director for program development and support.

LIST OF ACRONYMS

ASRT	Academy of Scientific Research and Technology
bcm/yr	Billion cubic meters per year
BOD	Biochemical oxygen demand
CEA	Central Environmental Agency
DO	Dissolved Oxygen
EEAA	Egyptian Environmental Affairs Agency
EHD	Environmental Health Department
EOHC	Environmental and Occupational Health Center
GOE	Government of Egypt
GOFI	General Organization for Industry
IMS	Irrigation Management Systems (USAID-funded project)
LE	Egyptian pound (currency)
MA	Ministry of Agriculture
mcm	Million cubic meters
mg/l	Milligrams per liter
MH	Ministry of Health
MHRANC	Ministry of Housing, Reconstruction, and New Communities
MI	Ministry of Interior
MPN	Most probable number
MPWWR	Ministry of Public Works and Water Resources
ng/l	nanograms per liter
NOPWASD	National Organization for Potable Water and Sanitary Drainage
NRI	Nile Research Institute
ppm	Parts per million
PRIDE	Project in Development and the Environment
RNPD	River Nile Protection and Development project
TDS	Total dissolved solids
TOC	Total organic carbon
TSS	Total suspended solids
USEPA	U.S. Environmental Protection Agency
USFDA	U.S. Food and Drug Administration
WHO	World Health Organization
WRC	Water Research Center

EXECUTIVE SUMMARY

The purpose of this project is to assess the water quality of the Nile River and to develop a water quality management program. The project involves a review of existing data on the quality of the Nile River, canals, and drains, followed by an evaluation of the current monitoring and management programs as described by reports and interviews with major involved parties.

In general, although considerable data have been collected over the last two decades, few summaries are available in a form that could be used to assess overall water quality. Data on the conventional pollution parameters (total suspended solids, dissolved oxygen, pH, temperature, conductivity, and nutrients) are available for the Nile proper, but are limited for canals and drains. Information on heavy metals and pesticides, two major types of toxic pollutants in the Nile system, is very sparse. Nevertheless, sufficient data are available to identify the major pollution problems of the Nile River and to ascertain management actions that could alleviate these problems.

The human health impacts of raw sewage contamination, pesticides, and heavy metals and salinity are considered the major water quality problems. The Nile River and its canals and drains are heavily contaminated by human waste, as demonstrated by consistently high fecal coliform levels throughout. With few exceptions, these highly contaminated waterways routinely serve as water sources for irrigation, drinking, bathing, and washing of dishes and clothes. The proximity of discharges to locations of water use results in continuing reinfection of water users with pathogens and parasites, a pattern that must be broken through appropriate control measures.

Pesticide application controls pests in most agricultural areas in Egypt but may contaminate water or food products such as fish. However, there are few data with which to reasonably judge the extent of such contamination. The large number of pesticides used (as many as 100) discourages maintenance of an active inventory. Government subsidies for pesticides and limited data on some more commonly used products suggest that Egypt needs a more controlled and controllable application program.

A number of industrial facilities are discharging heavy metals, particularly in Cairo, west and south and Alexandria in general. Some discharge directly to the Nile River or the northern lakes, but most discharge to drains or sewers. Discharges to waters that are subsequently fished or used for fish farming must be controlled to protect the valuable fishery resources in the Nile. According to limited data, metal concentrations in fish already occasionally exceed acceptable levels for human consumption, and will soon do so more frequently because of increased pollution. Similarly, water-contaminated with metals and used for irrigation and reuse of sludge for agricultural purposes jeopardizes the health of the people or animals that eat the irrigated crops.

Finally, the Nile River's salinity increases as it flows north, primarily because of its use in irrigation. By the time it reaches the northern lakes, it is too saline to be used for most purposes, including domestic and industrial water supply and irrigation. Judicious management might better control the salinity increase but only if water use is evaluated by crops grown, and the amount of water used for irrigation, industrial processes, and domestic purposes is carefully controlled.

Institutional Responsibilities

A number of government ministries have responsibility for water quality issues in Egypt. Law 48/1982 gave the Ministry of Public Works and Water Resources (formerly the Ministry of Irrigation) overall responsibility for issuing licenses and enforcing license conditions for treated industrial and sanitary discharges. However, it was not given the tools that it needed to ensure that all affected parties took appropriate actions. The Ministry of Housing, Reconstruction, and New Communities, for example, is responsible for building new sewers and sewage treatment facilities throughout Egypt, but its decisions are not guided by Nile water quality nor the need for no-cost/low-cost (non-treatment) disposal methods for rural communities. Similarly, the Ministry of Agriculture has been implementing a pesticide subsidy program. Only recently has the Government of Egypt agreed to reduce or eliminate these subsidies over the near term. Apparently no programs encourage farmers to limit their use of pesticides (except for those that are banned such as DDT). The Ministry of Industry, through the General Organization for Industry, is responsible for cleaning up the discharges of government-owned industrial facilities. Although metal-discharging facilities have been identified for additional pollution control, priority is apparently not given to the facilities causing the most environmental damage, a critical consideration when funding limitations constrain effective action.

No organization has clear responsibility for managing Nile River water quality, although currently proposed legislation would give the Egyptian Environmental Affairs Agency (EEAA) overall responsibility for coordinating environmental programs. Since the legislation has not yet been passed, EEAA's exact role is not clear. It is obviously necessary for all ministries with responsibilities in pollution control (Public Works and Water Resources; Industry; Housing, Reconstruction, and New Communities; Health; Interior; Agriculture) and EEAA to work closely together to build a common understanding of problems, issues, and the state of the environment so each can develop programs and actions that address the most egregious situations for the benefit of all. To the extent work is coordinated, progress will be made in minimizing the serious human health impacts of water-borne diseases, heavy metals, and pesticides. If data are available to concerned parties, they can debate and determine the significance of problems. If the ministries choose not to work together or not to share data that help define environmental priorities, major health problems will develop within the next 10 years and will rapidly worsen.

To improve Egypt's water quality program, emphasis is required in three areas: management of the process of water quality management; data management; and enforcement. The management of the process of water quality management requires that a specific agency or ministry be assigned responsibility for the following tasks:

- Setting objectives
- Developing action plans
- Overseeing plan implementation
- Evaluating progress toward objectives
- Revising objectives or action plans as warranted

Data management must be improved to enable the water quality program managers to quickly identify problems and develop effective solutions. Major emphasis is required in these areas:

- Ensuring widespread sharing of data and information
- Maintaining data in a meaningful format
- Standardizing data storage and retrieval procedures

Inadequate enforcement of water quality standards is jeopardizing the water quality program. Improved enforcement will require three major actions:

- Improvement of licensing and penalty mechanisms
- Full compliance with standards by all municipal and industrial dischargers
- Increased privatization to rationalize the licensing and penalty mechanisms

An effective water quality monitoring program requires timely decisions in these areas:

- Determining quality assurance/quality control standards and procedures
- Determining whether water quality is improving (trend analysis)
- Determining where water quality most needs improvement (problem analysis)
- Determining whether discharges comply with license conditions (or standards)
- Locating discharges that are not licensed or that violate license conditions
- Identifying the nature and extent of specific pollution problems
- Confirming whether a suspected problem exists

These decisions require information derived from trend analysis, "hot spot" identification, compliance monitoring, unknown source identification, nature and extent assessment, and problem confirmation.

Egypt is fortunate to have an extensive institutional framework for water quality management. However, substantial institutional reforms are needed because no one agency has final responsibility for water quality management. Once the lead agency on water quality management is determined, a major effort will have to be made to increase the supply of environmental scientists and revise Law 48 to rationalize water quality standards and enforcement mechanisms, consistent with sustained national development.

Because no single agency has exclusive authority for a comprehensive water quality program, this report analyzes the pros and cons of 52 alternative courses of action related to 20 problems in the areas of pollution, water quality management, water quality monitoring,

water management institutions, and legislative aspects of water quality management. This approach is proposed to allow the Government of Egypt to systematically address the key water quality management problems across all public and private interest groups and establish a new institutional and legislative foundation that integrates water quality into the national environmental strategy. This approach also offers a prototype planning process for all other pollution problems outside the water sector. Recommendations on water quality management cover these areas: specific pollution problems, management programs, monitoring programs, and legislative reform.

Recommendations

Four Major Water Pollution Problems

- Pathogen and parasite problems require identification of acceptable practices to dispose of human wastes, development and implementation of education programs, identification of areas that need priority attention and treatment facilities for priority action.

- Pesticide problems require improvement of the understanding of pesticide use, toxicity, and recommended dosages, and implementation of an extensive monitoring program to determine priority interventions.

- Heavy metal problems require improvement of the understanding of sources of heavy metal discharges and determination of the concentrations of heavy metals in sediments and fish.

- Salinity problems require development of a water management framework to identify ways to reduce salinity and increase usable water supply; continuing evaluation of salinity control projects; assessment of minimum Delta outflow to achieve optimum salt balance in the system; and identification, review and evaluation of specific measures that offer promise for increasing the usable water supply to the Nile system.

Management Programs. Actions are required to develop managerial capacity to improve water quality. Management programs are needed to streamline the management process and management organization and develop a data management system to provide decisionmakers with standardized, relevant, and timely water quality information.

Monitoring Programs. Actions are required to revise current monitoring programs. Priority areas of concern are determination of industry compliance with industrial discharge standards; monitoring long-term water quality trends; monitoring groundwater supplies; and developing and implementing monitoring quality assurance/quality control standards. These must be in place before serious sampling and analysis begins.

Legislative Reform. Specific modifications to Law 48/1982 and Decree 8/1983 are required to bring technical and administrative congruence to enforcement of water quality standards.[1]

[1] Specific recommendations on new language are presented in an article-by-article analysis of the law and decree in Annex C.

SECTION I
INTRODUCTION

Egypt's existence depends on the Nile River, the largest renewable source of fresh water in north Africa. It serves as almost the exclusive source of water for agricultural, industrial, and domestic use in this arid land, and as a major fishery along its entire length. With the rapid increase in population and industrialization over the last 30 years, use of the river, without concern for its quality, has altered its character so much that its waters are no longer necessarily of adequate quality for human consumption. In places, mere physical contact with river water poses severe risks of parasitism or other disease. Fish cultivated in Nile River waters could be laced with toxic heavy metals and pesticides, but few researchers have evaluated the human health risks posed by these potentially high chemical burdens. High pesticide contents could also be affecting the suitability of agricultural crops for human consumption, but few data are available that allow critical evaluation of possible contamination of Egypt's food supply.

In short, the Nile River is rapidly approaching a point where its joint use for irrigation, domestic, and industrial water supply; drainage of agricultural, sanitary, and industrial wastes; and fish production will be seriously threatened. These activities cannot continue as they have over recent years without substantial and devastating human health impacts: increased incidence of parasitism, water-borne disease, cancer from organic contaminants, and disease from consumption of fish contaminated with heavy metals. These threats occur at a time when Egypt needs its human resource potential more than ever to cope with increasing population pressures and the need for further industrial growth and agricultural productivity.

Now is the time for careful planning and action. Focusing resources on major environmental concerns, and carrying through on programs that are required to improve water quality, or at least prevent further degradation, is one of the few ways Egypt can continue to meet its role in the Mediterranean and the Arab world without being diverted by widespread, serious health concerns.

A. PURPOSE OF PROJECT

The Water Research Center of the Ministry of Public Works and Water Resources requested this project of the U.S. Agency for International Development. It was intended to evaluate available data, determine the most significant water quality problems in Egypt, and recommend a program to address them. The original request was made prior to the initiation of a similar effort (but relating to all aspects of the environment) by the World Bank. The World Bank effort was completed about halfway through this project.

The World Bank project resulted in the *Egyptian Environmental Action Plan*, a document that identified the major pollution problems in all media and recommended general

actions to overcome them. The document was a major source of information for this project. This project reanalyzed the problems and took the solutions one step further by developing an immediate action plan focused on specific targets, outlining the major structure of a water quality management program, and developing a water quality monitoring and survey program.

B. GENERAL WATER QUALITY PROBLEMS OF THE NILE SYSTEM

In designing a water quality management program, it is necessary to consider what the program seeks to achieve and which water quality problems will be targeted for control. Figure 1 gives a general orientation to the Nile River in Egypt. In the following paragraphs, the major items of concern are presented in roughly priority order.

B1. Pathogens/Parasites

The incidence of water-borne diseases is greatest in rural areas where there are no sewers to collect and subsequently treat and disinfect human waste, and contact with untreated water through bathing, washing, and cooking is increasingly commonplace. As population grows denser in rural areas, the rates of infection are likely to rise rapidly. Opportunities for contamination of water supplies and contact with material of sewage origin increase dramatically with increases in population density, lack of safe water supplies, ineffective sewage collection and disposal, and direct disposal of wastes in drains, canals, and groundwater. The prevalence of water-borne diseases intensifies the concentration of infectious agents in the wastes and the consequent contamination of water sources.

In rural areas, human wastes are often discharged from houses to open ditches, which carry them from villages to major drains. Sometimes the wastes are disposed of indiscriminately in the ground or leaching pits. The pit effluent may be in hydraulic contact with or infiltrate to shallow groundwater or drains. When the solid material from the pits is emptied, the contents are frequently dumped into the nearest drain or canal which is probably used for bathing, washing, and drinking. Hand pumps frequently deliver shallow groundwater that has been contaminated by human wastes as community drinking water.

Some villages have been provided with piped domestic water supplies but lack sewage collection or treatment systems. The outcome is that these villages are chronically flooded with sewage effluent.

Fecal coliform bacteria are widely used to indicate the presence of human contamination. While they are not normally pathogenic to humans, they occur mostly in the intestines of warm-blooded animals and so can be used as surrogate measures for the presence of human pathogens and parasites. The test for fecal coliforms is relatively simple and produces accurate results, while tests for specific pathogens may be difficult and time-consuming. Samples of surface waters from the Nile system almost always show high levels of fecal coliforms (averaging fecal coliform mpn of 1,500-2,000 per 100 ml), which strongly indicate human waste contamination. Even if specific pathogen tests are negative, the presence of human waste cannot always be ruled out.

Figure 1. Map of Egypt

3'

B2. Heavy Metals

The metallic elements typically referred to as heavy metals all behave similarly in the environment and in low concentrations are usually toxic to aquatic life and to humans. The most problematic elements include mercury, lead, cadmium, chromium, nickel, copper, and zinc. Sometimes iron and manganese are also on this list, but their toxicity is considerably lower than that of the first group, so they do not have priority in this discussion.

The toxicity is not the major reason for concern about heavy metals. Once discharged to waterways, they attach readily to sediment particles on the bottoms of drains and lakes. Once in the sediments, they are taken up by bottom-dwelling organisms, which in turn are eaten by fish. At each stage they are concentrated; in fish they can be concentrated to extremely high levels that cause illness in people who eat them. Ingestion of sufficient levels can even cause death.

Two diseases caused by heavy metals have been discussed in scientific literature: Minimata Disease, caused by mercury, and Itai-Itai, caused by cadmium. Both received their names from situations that developed in Japan after local populations consumed fish contaminated with mercury or cadmium. In both cases, contamination was so severe that several people died and many more were severely incapacitated for life.

Heavy metals are often used in industrial processes, primarily electroplating and other metal finishing, but also in tanning (chromium), chloralkalai production (mercury), and other chemical manufacturing. In modern manufacturing facilities, particularly those designed in the last 10 years, special care is taken to control the amount of metal lost from the plant, because the metals, which are the raw materials required to produce final products, are expensive. The production processes are often designed to conserve as much metal as is economically possible.

On the other hand, plants that were built more than 10 years ago probably were designed with little concern for waste recovery. High concentrations of metals in waste streams and high volumes of wastewater discharge lead to a daily discharge of several kilograms of metals into drains or the Nile. Unfortunately, these high discharge levels are costly to production, cause long-term, serious environmental damage, and could be recovered at relatively low cost with some creative engineering.

B3. Pesticides

Pesticides are chemical compounds specifically designed to kill or prevent the growth of living things. Some chemicals have been carefully tested, are harmful to only related species of plants or animals, and have few lasting effects on humans in case of accidental contact. Other chemicals have been less thoroughly screened, and because they are designed to destroy or inhibit life, may have long-term effects on humans.

Pesticides are considered an essential element of modern agricultural management. Since 1960, an estimated 620,000 tons of about 200 types of pesticides have been used in Egypt. Several of the more than 100 pesticides in use are Oxychlor for cotton, Malathion for a wide variety of crops, Temek for fruits, and Lanite for vegetables.

The types of pesticides used have changed during the last 25 years from organochlorines to organophosphates. The use of various organochlorine pesticides, such as DDT, has been banned since the late 1960s in Egypt. These pesticides behaved like heavy metals in the environment, attaching readily to sediments, and accumulating in fish, birds, and other animals, thus threatening human life as well as wildlife. DDT in particular did not readily break down in the environment and remains a contaminant even though it has been banned for many years. More recent pesticides, less persistent than DDT but just as toxic, also accumulate in the environment, especially in surface and groundwater, where they remain a threat to the environment.

Too little is known about the impacts of pesticides on human and animal health. The extent toxicological research on the currently approved list of pesticides is inadequate. However, the majority of pesticides are known carcinogens (causing cancer) in mammals. Thus, long-term exposure to most pesticides increases human death rates and generally shortens the life spans of chronically exposed individuals.

In Egypt there is strong evidence that pesticide application is uncontrolled. Inadequate design of pesticide programs, application by untrained personnel, and lack of effective monitoring pose a threat to humans and to the environment.

B4. Salinity

Salinity is a measure of the salt content of water. All natural waters contain some salts, acquired by exposure to the atmosphere, soil, rocks, and pollutants. At relatively low concentrations (e.g., less than 200 parts per million [ppm]), salinity is not detrimental for most water uses, and in fact may be desirable. As salinity increases, however, the utility of water for fresh water uses decreases.

In hot, arid climates, water evaporation is extensive. When water evaporates, it leaves behind the dissolved salts it contained, so the remaining solution becomes more concentrated. Evaporation from the surface of the High Aswan Dam reservoir consumes an estimated 10 bcm per year, which increases salinity by about 10 percent.

Plants take up water, but also selectively take up some of the chemicals dissolved in it, particularly nutrients and trace elements required for growth. At the same time however, much of the water taken up by plants is lost through evapotranspiration, evaporation from the plant surfaces. Evapotranspiration concentrates the chemicals dissolved in the water remaining in the plant, and since the plant selectively takes up only a small part of the chemicals dissolved in the soil water, the water remaining in the soil becomes much more concentrated. Subsurface drainage water from an irrigated field is generally more concentrated than the water flowing onto it.

There are sources of salts other than the water itself. Some soils contain large quantities of salt because of previous inundation followed by evaporation. As these soils are brought under cultivation and irrigation, salts are leached from the soil and carried off in the drainage water. Bringing large areas of these soils under cultivation at one time can greatly increase the salinity of drainage waters.

Each type of plant has an individual tolerance to salinity and to trace elements in the water. As the salt concentrations of applied water approach the tolerance levels of a specific plant type, more water must be used to leach the excess salts from the soil, and plant yields may be reduced. Soil types also become critical to adequate plant growth and yield. Less water may percolate through tight soils than is needed to reduce salt concentrations to usable levels causing salt buildup and yield reductions or even crop failure.

Many crops, cotton for example, can tolerate salinity up to about 1,000 ppm without yield impairment. Others, such as some vegetable and fruit crops are limited to about 700 ppm or less, even in sandy soils. Some crops, such as citrus, may also be limited by tolerance to trace elements, such as boron which is sometimes found in drainage water.

Salinity is also of concern for domestic and industrial use. Drinking water should be less than 500 ppm TDS, although concentrations of up to 1,000 ppm can be used with few undesirable effects on health. (Taste may be affected, however.) Hardness, one measure of salinity, increases the amounts of soap and detergents required, causes soap scum, and forms mineral deposits on plumbing. Domestic use also increases the salinity of sewage by concentration and by the addition of chemicals in cleaning compounds, cooking and other water uses.

Industrial requirements vary with the process. For most uses, salinity up to 1,000 ppm is acceptable as a raw water source since the industry can easily treat it to meet specific requirements. Industry may contribute salinity to the wastewater by concentration or addition of chemicals during manufacturing. Examples are concentrated boiler blowdown from heat exchange processes or salinity from fertilizer production.

In Egypt, however, salinity is increased mainly by evaporation from Aswan and water distribution, and use and reuse for irrigation. Since such a large volume of Nile water is used for irrigation, the rate of salinity increase from Aswan to the Mediterranean Sea is of great concern.

B5. Other Water Quality Concerns

Other pollutants that are discharged in municipal and industrial wastes include nutrients, suspended solids, and oil and grease. These categories of pollutants are nonconservative, unlike dissolved solids which remain indefinitely in the water column unless chemical changes occur. Nonconservative constituents decline in concentration after discharge. For example, suspended solids settle out of the water column, and oil and grease are oxidized by bacteria and other organisms but may remain in the water for some time in

reduced concentrations. Oil and grease are often toxic to aquatic life and may inhibit the transfer of oxygen when floating on the surface.

Nitrogen and phosphorus, two plant nutrients that are major components of sanitary wastes, are frequently applied to crops as fertilizer. In waterways they encourage plant growth and the development of algal blooms or expanses of aquatic macrophytes. Although high concentrations of a form of nitrogen (nitrate) can cause "blue baby" disease in infants, the circumstances are relatively rare. Otherwise, nutrients appear to be more of a nuisance than a real threat, at least in Egypt.

When discharged in large amounts, suspended solids can form large deposits on the river bed, covering bottom biota and otherwise altering the habitat available for aquatic plants and animals, particularly fish. Suspended solids also create turbidity.

Turbidity is a special measurement used to describe the amount of suspended materials in water. Turbidity renders water opaque, restricting light penetration and aquatic growth. High biochemical oxygen demand (BOD) is a measure of pollution associated with organic waste in water.

Nontoxic organic material is oxidized by aerobic bacteria, consuming oxygen in the process. If oxygen in the water is depleted by this oxidation, the aerobic bacteria are replaced by anaerobic bacteria, continuing the decay process. However, the oxygen deficit results in destruction of many beneficial organisms including fish. Anaerobic conditions in a stream or lake create an environmental wasteland which will not support a desirable aquatic population and which often cause disagreeable odors. Anaerobic conditions render the water unusable for most beneficial purposes. Since oxygen in the water is replenished from the air, an aerobic condition can be restored if existing organic matter is eliminated, and more organic matter is not added.

Oil and grease form unsightly slicks and scum on the water surface that are usually toxic to aquatic life. Oil and grease occur in discharges from ships, industrial waste, and occasionally, raw sewage. Their presence can prevent the transfer of oxygen from the air to the water, a major source of oxygen for animals that live in water, and sometimes they directly kill organisms.

C. RANKING OF POLLUTANTS

The pollutants presented above have the most damaging long-term effects, but a defensible ranking of pollutants requires the comparison of different characteristics by answering questions such as these:

- How dangerous are the pollutants to the ecosystem, particularly for human health?
- Are harmful levels of the pollutants widespread or localized in the environment?
- Do the pollutants easily decompose to compounds or materials that have little adverse effect?
- Do pollutants accumulate in fish or other foods?

- Are current trends likely to increase or decrease human exposure and the risk of harm?

By responding to these questions, pollutants in Egypt[1] were ranked in order of concern as follows:

- Pathogens and parasites
- Pesticides
- Heavy metals
- Salinity

The reasons for these rankings are explained below.

Pathogens and parasites received the highest priority because they are uniformly dangerous to humans (there is a high incidence of water-borne disease in Egypt); they are widespread at harmful levels in the environment; and even though they are easily removed/ destroyed, they are likely to dramatically increase with rapid population growth. While rural areas are particularly susceptible to water-borne parasites and pathogens, they will become increasingly important in large cities as well. With higher concentrations of organisms in water, water will become increasingly difficult to treat to safe levels as a source of drinking water.

Pesticides were ranked second because of their widespread overuse in Egypt, their toxicity to humans, their persistence, and their tendency to accumulate in fish and other foods. Although human toxicological data is scant, herbicides and pesticides are designed to retard growth or destroy life, so extended exposure must pose some relative danger to humans. The World Health Organization (WHO) reports that millions are suffering from acute pesticide exposure worldwide, but there are no specific figures for Egypt. Thankfully, the pesticides being used today are less toxic to humans and less persistent than pesticides that were used even a decade ago, but unless actions are taken to control use, higher and higher doses to control pests will result in greater and greater health problems in humans.

Heavy metals were ranked third. Although initially second, they were ranked below pesticides primarily because their discharge to the environment is reasonably isolated,[2] and they rapidly settle to the bottom of the waterway in which they are discharged.[3] Each metal concentrates in sludge, which is redistributed on agricultural land as soil amender. They are no more or less toxic than pesticides, but are primarily discharged at a few places into long drains that probably have high concentrations in their sediments, but low concentrations in

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[1] Depending on waste treatment practices and the relative distribution of industry, pollutants probably have different rankings in other countries.

[2] With the exception of lead, Hg, Cd, As, Ni, Cu, Zn, and Cr.

[3] Mercury and cadmium can be made soluble by bacterial action and thus are also exceptions to this rule.

their water when they discharge to the Nile or the northern lakes. Heavy metals are a significant problem in the few areas where there are direct discharges to the River Nile or to lakes, but probably not on a nationwide basis.

Salinity, a unique pollutant, is ranked last. Salinity causes hypertension if the drinking water consistently contains more than 1,500 mg/l TDS. It also causes arteriosclerosis. Another major effect is to reduce the suitability and consequently, the amount of water available for irrigation. Because irrigation is by far the major water use in Egypt, increased salinity can significantly reduce crop yields, or the quantity of usable water. In some areas in the northern Delta, salinity now poses a threat to irrigation. There is sufficient Nile River supply now to meet freshwater needs, but as more land comes under irrigation, salinity will affect the availability of water in the northern Delta and the quality of water available for reuse.

D. SOURCES OF WATER QUALITY PROBLEMS

The pollutants that have adverse effects on the human use of water come from a variety of sources, the nature of which often determines whether they cause extensive problems or only a small impact. The general sources of pollutants and the location of specific sources in Egypt are discussed below.

D1. Sanitary Discharges

Sanitary wastes are usually interpreted as the liquid wastes from households. They contain human wastes (feces and urine) and sullage (grey water from bathing, washing, cleaning and cooking). Sanitary wastes have higher concentrations of organic material in Egypt than in many developed countries because of lower water use. They contain higher levels of pathogens and parasites because of the higher incidence of infectious diseases. The make-up of sanitary wastes differs from area to area, however, and it is a mistake to assume that the problems caused by sanitary discharges from large cities resemble those caused by those in rural areas. This is discussed below.

Large cities in Egypt (i.e., more than 100,000 people) usually have sewer systems to collect sanitary wastes. The wastes are conveyed to a point of discharge and may be treated. In many Egyptian cities service does not extend to newly built areas, or sewers are overloaded or broken, causing discharge to streets or infiltration to groundwater. Untreated industrial wastes are often deposited in sewer systems, particularly in larger cities.

In rural areas most villages lack sewage systems and the wastes are deposited in leaching pits or on the ground. Where there are local sewer systems, the wastes often go into the nearest drain or through agricultural areas.

About 3.7 billion cubic meters (bcm) of domestic water are used each year and 2.2 bcm/yr of sanitary wastes are discharged to the Nile system. About 85 percent of the waste receives little or no treatment. Per capita sanitary wastewater production averages about 100

liters per capita/day. In the larger cities, production is up to 200 liters per capita/day, but is often less than 50 liters per capita/day in smaller villages with individual water supplies.

D2. Treated Sanitary Wastes

Treated sanitary wastes, particularly those meeting the standards specified in Executive Decree 8/1983, have little long-term impact on receiving waters. Pathogens and parasites are generally controlled, organic matter (BOD) is readily degraded, and other chemicals are partly removed, such as heavy metals and toxic organic compounds that may have been discharged to sewers.

Treatment plants that are operating at less than full capacity, overloaded, or bypassed usually discharge high levels of BOD and TSS, but more important, high levels of pathogenic organisms and parasites as well as toxic chemicals like heavy metals. Thus, a sewage treatment plant and its apparent operation do not guarantee that the effluent is acceptable or safe. Only if the plant is well maintained and operated does it guarantee sufficiently clean wastewater. Adequate budgets for maintenance and operation and well- trained operators contribute significantly to the performance of sewage treatment plants, minimizing the possibility of adverse impacts from discharges.

An estimated 43 cities in the Nile Valley and 17 in the Nile Delta have populations of 50,000 to 1 million or more, excluding Cairo, Alexandria, and Port Said. Most of these cities reportedly have sewer systems, and 36 reportedly have primary or secondary treatment plants existing or under construction. The total capacity of these plants, ranging in size from 0.5 to 120,000 cubic meters per day, is about 1,200 mcm/day. Many are reported to be not operating, bypassing sewage, or operating poorly because of overloading, inadequate maintenance, or lack of trained operating personnel, although the reports are conflicting. In the Nile Valley, discharge is primarily to drains and ultimately to the River Nile. In the Delta, plants discharge to drains and directly or indirectly to the northern lakes.

Cairo has six secondary treatment plants with a design capacity of 3.88 mcm/day operating or under construction. Currently three secondary treatment plants are operating and three primary plants are being upgraded to secondary treatment with completion scheduled by 1996. Because of plant overloads and other operational problems, raw and partially treated wastes are discharged. These plants, when completed, will accept industrial wastes. Discharge totalling about one bcm/yr is to Mohit Drain, to drains leading to the River Nile, to Bahr El Baqar, and for irrigation.

Primary treated and bypassed waste from Port Said is currently discharged to Lake Manzala. A secondary treatment plant with a capacity of 190 mcm/day is under construction. Alexandria sewage, estimated to total about 650 mcm/day is discharged to Lake Maryut after mechanical treatment.

A few smaller cities and towns have sewage collection and treatment facilities. About 40 treatment plants, primarily extended aeration facilities with design capacities of 500 to

2,500 m^3/day, are reported to serve cities and towns with combined populations of 50,000 or less. Discharge is reported to be to drains.

By the year 2000, when the total population is expected to reach 70 million with the urban population projected at 39 million or 56 per cent of the total, secondary sewage treatment is expected to be operating in major cities, including Cairo. Some 116 treatment plants for cities and towns are projected for construction by the National Organization for Potable Water and Sanitary Drainage (NOPWASD), although financing is not certain. With the increase in capability in operation and management of treatment facilities, more plants are expected to produce effluent meeting secondary standards, including BOD removal and disinfection, although some primary treated water and discharges from inoperative or poorly operating plants will continue to reach the Nile.

Even with this ambitious program, neither sewer nor treatment plant construction is expected to keep pace with continued population growth and further immigration to cities, resulting in more exposure to sewage and continued degradation of the waterways.

D3. Untreated Sanitary Wastes

Untreated sanitary waste is the single greatest source of human contact with pathogens and parasites in Egypt. Pooling of untreated sewage in village streets; the bypass of existing sewage treatment plants; the low performance of the few plants now operating; the dumping of night soil into the river, canals, and drains; and the contamination of groundwater with leachate from cesspits and poorly designed or installed septic systems all contribute to high levels of human exposure to sanitary wastes. Rural residents who daily bathe, wash, or prepare food with canal or drainage water are particularly at risk. The rural population has one of the highest infant mortality rates in the world (a death rate of 68 per 1,000 births in 1989).

Untreated sanitary waste is the source of other pollutants. In major cities where there is little or no treatment of sewage, high concentrations of industrial waste may be discharged with sanitary wastes. Small discharges of untreated wastes into drains that are not used for any other purpose for many kilometers are probably acceptable. When drains receive untreated wastes from cities the size of Cairo, however, even the 170+ km Bahr el Baqar drain poses significant threats to people residing nearby.

However, the major problem of inadequate waste treatment is in the rural areas. Egypt's rural residents live in an estimated 4,300 villages with populations ranging up to 50,000. The majority of these are in the Nile Valley and Delta. Many lack access to sewer systems and most lack community treatment facilities. The population depends on onsite disposal using a leaching pit adjacent to the house or on direct discharge of raw sewage to the ground or to drains and canals using buckets. The contents of the pits are commonly dumped into nearby drains or canals. Presently an estimated 0.3 bcm/yr of high strength raw sewage and pit sludge infiltrates to shallow groundwater and discharges to drains or canals or directly to the Nile. A program to develop viable village waste treatment facilities has been underway through NOPWASD since the early 1980s with USAID sponsorship, but

the problems, exacerbated by a rapidly expanding population, appear to be outpacing the construction of new facilities.

D4. Industrial Discharges

Industrial discharges contribute a wide variety of pollutants, of which heavy metals and toxic organic compounds generate the most concern. The industries responsible for these discharges are generally in the heavy engineering, electroplating, and chemical categories. The chemical industries of particular concern are the pesticide manufacturers, petroleum refiners, metal smelting, and plastics and rubber manufacturers. Industries discharge large amounts of other pollutants as well, including TSS and nutrients.

Depending on their location, industries discharge directly to the Nile River, northern lakes, drains, or sewers. Because the Nile and the lakes are large bodies of water, they generally can handle pollutants such as oil and grease, and TSS, except in excess. Discharges to Lake Maryut contribute more pollutants than the lake can handle, so it is severely polluted. Toxic pollutants like heavy metals and pesticides, however, pose the greatest threats when discharged to these waters because fish concentrate the metals discharged and when eaten, can cause human health problems.

Many industries discharge to drains, which serve as treatment systems for nonconservative pollutants and dilute conservative constituents. The Nile Valley has fewer industrial plants, and the dilution effect of the Nile is large, so discharges and drains there pose less of an immediate threat. The Delta's drainage system is more complex, with the drains largely separated from the fresh water supply. Here discharge is to the lakes, and the Mediterranean Sea; the drainage is reused for irrigation after mixing; or in a few cases, the drains discharge to the Nile branches.

Industrial discharges to sewers are generally considered to be the safest, because the wastes are normally treated at a wastewater treatment plant prior to discharge to natural waterways. However, if the industries discharge to sewers served by inoperative sewage treatment plants, then no benefit is obtained. However, industrial discharges can cause "upsets" in the treatment process at functioning sewage treatment plants, also causing discharge of untreated wastes. So discharges to sewers do not always cause less contamination of the River Nile, the northern lakes, or the Mediterranean, and management of these discharges is also critical to prevent environmental damage.

Egypt has about 20,000 industrial facilities, only 700 of which are major facilities. Many of the latter are publicly owned, with 330 managed by the Ministry of Industry, and 120 by other ministries. Many publicly owned facilities remove water from the River Nile and discharge liquid wastes back into the river or drains that enter the river. In major cities, most industries discharge to sewers, and the treated wastewater is returned to the Nile. In western Cairo, a major industrial center, the treated wastewater is discharged to Bahr el Baqar Drain, which ultimately enters Lake Manzala.

12

Presently, the total industrial use of water is about 4.6 bcm/yr, of which 2.9 bcm/yr is cooling water returned directly to the source with little consumptive use or quality change, except as salts build up. About 1.5 bcm/yr is used as process water, some of which may also be used for cooling. About 0.2 bcm/yr is consumed, lost in the manufacturing process or contained in the product, leaving 1.3 bcm/yr of generally untreated wastewater discharged to surface waters. The metal industries are reported to discharge 50 percent of the industrial wastewater. Textile and dyeing industries discharge some 30 percent of the wastewater, while soap and oil contribute 5 percent.

The Nile Valley above Cairo has about 125 major industrial plants, 30 discharging to the Nile, 60 to canals and drains, the remainder to sewers or land. These represent about 18 percent of the industries and reportedly contribute about 15 percent of the metals and 25 percent of the BOD. There are a number of food processing plants, including sugar, edible oils, and flour processing, and fruit and vegetable canning, as well as metal, pipe manufacturing and chemical manufacturing facilities.

Greater Cairo, including the major industrial areas of Helwan, Imbaba, and Shoubra El Kheima, and a number of diffuse factories, support an estimated 250 industrial plants, producing a wide variety of products. Categories include engineering products; ferrous and nonferrous metals for auto production; engine manufacturing; aluminum and glass; inorganic and organic chemicals; pharmaceuticals; textiles and spun goods; food industries; cement plants; and assembly plants; and a myriad of activities such as printing and dyeing. An estimated 52 tanning plants are located in Ein Sierra. Most of these discharge to sewers or drains. A few reportedly discharge to the Nile. While Greater Cairo has only 35 percent of the plants, they discharge about 40 percent of the heavy metals (about 0.75 tons per day). Heavy metals such as chromium result particularly from leather tanning, while chemical plants, textiles (dyeing), metals, and others such as printing also contribute appreciable amounts of additional metals such as Pb, Hg, Zn, Cu, Cr, Ni, As, Sb, etc.

The Delta, excluding Alexandria, has some 150 industries, including many food processing as well as fertilizer and pesticide, oil and soap, starch and yeast, plastics, and pulp and paper facilities. These industries contribute about 25 percent of the heavy metals, discharging mostly to drains, but also to the Nile branches near Kafr El Zayyat and Talkha.

Alexandria is a major heavy industrial center with some 175 industries, about 25 percent of the total in Egypt, including paper, metals, chemicals, plastics, pharmaceuticals, petroleum products, food processing, oils, and soap. These plants reportedly contribute some 20 percent of the wastewater, and a high percentage than 10 percent of the heavy metals. Almost all the waste reaches Lake Maryut, which is highly polluted. The industries discharge to drains leading directly to Lake Maryut, and to the Alexandria sewer system which discharges untreated sewage to Lake Maryut.

Despite a strongly worded law requiring treatment of all industrial wastes entering the Nile, its canals, drains, and groundwater (Law 48/1982), most industries have not yet installed wastewater treatment equipment. Recent estimates for public industries managed by the Ministry of Industry suggest that the average concentration of metals in chemical

13

industrial discharges is about 1 mg/l, the standard specified in Decree 8/1983. Since the chemical plant category includes many plants that do not discharge heavy metals, this high average indicates a large number of heavy metal dischargers are discharging significantly more concentrated wastes than allowed. This, combined with the fact that more than 74 percent of the metals, 72 percent of the BOD, and 75 percent of the suspended solids are discharged from Cairo north, means industrial facilities probably substantially affect the quality of the Nile, canals, and drains in the Delta.

D5. Agricultural Drainage

Agricultural drainage is typically believed to be wastewater, subject to municipal and sanitary waste input, and thus not suitable for reuse. This, however, is not the case. While municipal and industrial waste degrades drain water quality, and salinity becomes an issue, particularly in the lower reaches of the Delta, agricultural drainage and waste flows constitute an important, substantial portion of Egypt's water resources.

About 30,000 km of irrigation canals and 17,500 km of agricultural drains serve the estimated 7.2 million acres of irrigated land. Presently, about 28 bcm/yr of agricultural drain water, groundwater, and industrial and sanitary wastes reach the drains or are discharged to the Nile. About 19 bcm/yr is agricultural drainage.

In the Nile Valley 72 drains discharge into the Nile by gravity, or in the lower reaches, into Bahr Youssef or Rosetta Branch. There is limited information available about these drains, although in the Nile Valley about 10 bcm/yr of drainage and waste augment Nile flows and are available for reuse.

Salinity of the drainage water in the Nile Valley commonly exceeds diversion salinity of 160 to 240 ppm by from 50 to 1,000 parts per million (ppm). Increase in salinity is caused by concentration from consumptive use, soil leaching, groundwater inflow, evaporation, and municipal and industrial waste. The total salinity of 160 to 180 ppm at Aswan increases to about 230 ppm at Cairo, depending on the time of year and river stage. While the salinity increase from Aswan to Cairo remains well within acceptable limits, the higher salinity will increasingly limit reuse in the Delta.

In the Delta, drainage from 22 catchment areas flows by gravity or is pumped to drains and discharged to the northern lakes, the Mediterranean Sea, or is pumped by 21 existing reuse stations to canals, mixed with fresh water, and reused for irrigation. Here an estimated 18 bcm/yr of agricultural, sanitary and industrial wastes is discharged, mostly to drains, although some reaches the Rosetta and Damietta Branches. In contrast with the Nile Valley, drainage in the Delta mostly remains separate from the water supply unless drainage water is deliberately mixed with fresh water for reuse.

Throughout the Nile Delta, groundwater levels are controlled by the drains and by tile drainage where installed. Consequently, the drain flows are a mixture of applied irrigation water, water leached through the root zone and groundwater reaching the drains by lateral

and upward movement. In the northern part of the Delta, the groundwater is saline, resulting in high salinity drainage water.

Drainage water is becoming steadily more saline. In 1984 reused drainage water had a salinity of 867 ppm. By 1990 the reused fraction had a salinity of 1,167 ppm. The 12.8 bcm/yr of unused drainage water reached an average salinity of 3,005 ppm. An increasing trend is also seen in the salinity of the unused drainage water.

Besides agricultural drainage, the drains receive untreated sanitary wastes from many of the estimated 4,300 villages in the Nile Valley and Delta by direct discharge from collection systems or houses and as contaminated groundwater. In many urban and rural areas solid waste, including garbage and material of sewage and industrial waste origin, is dumped directly into canals, ditches, and the Nile River. Limited bacteriological tests consistently show fecal coliform counts of about 1,500 MPN/100 ml or more in drains.

Persistent organochlorine compounds, banned in the late 1960s, are still detected in the Nile branches and Delta drains. Concentrations ranging up to 460 nanograms per liter (ng/l) of DDT compounds were found in 1991 at the Delta Barrage while in 1979, analyses show DDT compounds ranging from 8 to 190 ng/l with the lower value in the river and the higher values in Hadous Drain and Kafr El Ziat.

Otherwise, little work has been done on drain water quality except for salinity. Simple tests such as BOD, COD and some micro-biological examinations have been done to check water pollution. BOD levels of 5 to 30 mg/l are commonly found, with values up to 100 mg/l in the more polluted drains. High fecal coliform levels are almost always found with values up to 10^4 MPN/100 ml.

Industrial and sanitary waste discharges to the Delta drains contribute nutrients, organic material, heavy metals, and other toxicants. Nutrients contribute to eutrophication of Nile, canal, and drain water. Phosphorus levels in drains range from 0.05 to 0.5 mg/l as PO_4 with nitrogen levels of 0.8 to about 10 mg/l as NO_3. Concentrations appear to have significantly increased since 1977. Values within these ranges increase primary productivity and cause significant algal and hydrophyte growth.

Organophosphorus pesticides are increasingly being used, although data on their concentration in receiving waters is sparse. In 1979 concentrations of organophosphorus pesticides of 8 ng/l to 28 ng/l were found in the River Nile. In Bahr Hadous Drain, also in 1979, concentrations ranging from 8 to 80 ng/l were detected. Although less persistent than organochlorine pesticides in the environment, their presence indicates a need for increased application control to minimize threats to aquatic life.

D6. Salt Water Intrusion

Within the northern Delta, seawater has intruded on shallow near-surface groundwater in historic times. This water is under a positive head. It seeps into drains and the northern lakes, increasing salinity and rendering some drain water unusable for irrigation, even when

15

mixed with canal water. The source is uncontrollable and no effective corrective measures are available. The groundwater levels must be kept below the root zone by tile or surface drainage to maintain irrigated agriculture here. As more water is used upstream, maintenance of an effective salt balance will become more difficult with lower lake, canal, and drain levels.

SECTION II
INSTITUTIONAL FRAMEWORK

Water quality management in Egypt has been relatively well defined by various laws and decrees over the years. Despite this definition, the management process has not been successful in substantially reducing pollution, even though progress is being made on several fronts. The effectiveness of the management process is directly related to the ministries that play roles in management and to their relationships with each other as defined by the laws.

This chapter presents an overview of the major laws and decrees that specify the procedures and process of water quality management, and explain the roles of various institutions in that process.

A. LAWS AND DECREES CONTROLLING WATER QUALITY

Two laws and three decrees allocate responsibilities for a variety of functions necessary to implement Egypt's water quality management program. These responsibilities and functions are apparently well understood by the ministries to which they are assigned, but implementation appears to be half-hearted in all but one of them. The legal framework appears to be basically sound, although both significant and minor changes could make it more rational and further clarify roles.

The first law, enacted in 1962, concerned the construction of sewers and the attachment of buildings to sewers, including industrial facilities. Since then, other laws have been enacted which directly address the discharge of wastes to waterways. These laws generally prohibit the use of waterways for the disposal of solid waste and the discharge of untreated wastes from industries or from river vessels of any kind, and set up mechanisms to implement and oversee various activities.

A1. Law 48/1982 (and Ministerial Decree [Irrigation] 8/1983)

The most significant law is Presidential Decree 48/1982 (see article-by-article summary in Annex B), which is broadly based on the U.S. Clean Water Act. This law prohibits discharges to the River Nile, canals, drains, and groundwaters without a license issued by the Ministry of Public Works and Water Resources (MPWWR, formerly the Ministry of Irrigation). It requires licenses to be issued to factories, sanitary sewage treatment plants, and river boats upon application as long as the effluents meet certain standards (discussed below), and other conditions. Discharging without a license or discharging in amounts or concentrations that exceed license limits is punishable by fine, jail sentence, or both. The fine must range between LE 500 and LE 2,000 and the jail sentence is limited to one year. For a second violation, the penalties are doubled. Two English translations of the law imply that the penalties can be doubled only once but are not completely clear on this point.

17

Other provisions of the Act state that licenses may be withdrawn under several conditions, including failure to immediately reduce a discharge presenting an immediate danger of pollution or failure to install treatment yielding appropriate effluent quality within three months. The law generally gives MPWWR administrative and police authority over implementation; the Ministry of Interiors Water Police also have police powers, and the Ministry of Health has a standard-setting and discharge-monitoring role.

Water quality standards are specified in the implementing decree for Law 48 (Decree 8/1983) for the following categories:

- The Nile River
- Treated industrial discharges to the Nile River and canals
  - Discharges greater than 1,000 m^3/day above and below the Delta barrages
  - Discharges less than 1,000 m^3/day above and below the Delta barrages
- Treated industrial and sanitary waste discharges to drains, lakes, and ponds
- Treated discharges from river vessels to the Nile River and canals
- Drain waters to be mixed with the Nile River or canals.

Notice that there are no standards for discharges from sanitary sewage treatment plants (sanitary drainage) to the River Nile or canals, only to drains, lakes, and ponds.[1] This is unusual, because both raw and treated sanitary waste is discharged to the Nile, and the lack of standards implies that this discharge is inconsequential. Discharge of both treated and untreated sanitary sewage to the Nile River and canals is one of the top three pollution problems in Egypt, so the lack of standards is unacceptable.

Water quality standards in the decree are generally based on drinking water standards. Discharge standards and international drinking water standards do not differ much except with regard to fecal coliforms. However, a coliform level of 5,000 MPN/100 ml is a very lax standard for the Nile River, which allows continued high contamination from treated and untreated sanitary wastes. In the United States, waterways with coliforms above 500 MPN/100 ml are deemed unsafe for human contact (through bathing, swimming, etc.). These standards are presented in a table in Annex D.

Other matters covered under the executive decree include a brief outline of the requirements for sampling and analysis of effluents, the general requirements for license applications and licenses, and special provisions for powered and unpowered river vessels. In almost all provisions, the law and decree refer to *treated* waste discharges in relation to actions required of MPWWR or the Ministry of Health (MH). This implies that to discharge untreated wastes is contrary to the law, but there is never an explicit prohibition against discharging untreated wastes (as long as they are licensed). Given the standards, it would be difficult to meet licensing requirements without some form of treatment, however.

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[1]There is considerable ambiguity on this point. The English translations state that these standards apply to brackish water, but the definition of brackish water in the decree includes drains, lakes, and ponds. Only fresh waters (the River Nile and canals) have no standards for domestic waste discharges.

18

The law is fairly inclusive in coverage, with standards meeting most situations. If it were enforced, Egypt would have substantially fewer pollution problems except for untreated sanitary sewage. Untreated sanitary sewage discharges are widespread. Raw sewage is discharged into the Nile, canals, and drains without discrimination—discharges that are not illegal. This situation seems to favor the continued discharge of raw sewage and to inhibit the development of sewage treatment plants which runs counter to the law's overall intent.

A2. Presidential Decree 93/1962 (and Ministerial Decrees 649/1962 and 9/1989)

Presidential Decree 93/1962 concerns the construction of sewers and sewage treatment facilities and the allowed discharges of residential, commercial, and manufacturing facilities to the sewer. Although originally intended to control discharges to surface waters, Law 48/1982 removed this function from the decree. Ministerial Decree 9/1989 revised the standards set out in this decree. The revised standards cover discharges to sewers for a number of classes of industries, and the land application of treated sewage on clay and sandy soils. Annex A summarizes the provisions of these decrees.

The significance of these decrees is that they specify generally less stringent standards for industrial facilities that discharge to sewers because of the additional treatment that would occur prior to discharge. Since most major sewage treatment plants have not yet been constructed or are operating at less than peak efficiency, reduced standards seem inappropriate. However, the standards are not a significant problem because the law is not enforced. A comparison of all standards is found in Annex D.

A3. Less Significant Laws

Law 38/1967 prohibits bathing and washing of utensils, clothes, vegetables, and other objects in waterways except at places specified for those purposes. Fines of LE 1 to 5 can be imposed. This law is obviously not enforced, as dish and clothes washing is common in canals and cleaner drains.

Ministerial Decree 380/1982 requires the General Organization for Industry (GOFI) and industrial sector companies to operate and maintain pollution control equipment to meet environmental standards. GOFI has enforcement authority through its licensing of all industrial facilities, and can deny licenses when adequate pollution control is not included. This law is not enforced.

Other decrees modifying the original laws or decrees are discussed in the sections on the original laws and decrees.

B. RESPONSIBILITIES OF INSTITUTIONS AFFECTING WATER QUALITY

The institutions involved with water quality management in Egypt are generally line-management ministries with responsibilities in areas that are related to, but not necessarily coincident with, environmental protection. For example, MPWWR, an outgrowth of the Ministry of Irrigation, sees itself primarily as a provider of water to various users, not as a

water quality manager. Similarly, GOFI is primarily concerned with managing the production of goods through its industries, not with controlling environmental quality. The Ministry of Health and the Ministry of Interior have many other functions, many of which conflict with water quality management. While this situation does not differ substantially in many more developed countries, a relatively strong central coordinating or managing body almost always has the role of evaluating progress, identifying problems, proposing solutions, and recommending revisions to laws and institutions as necessary. Egypt lacks such a body, although the Egyptian Environmental Affairs Agency (EEAA) has some of the appropriate roles (coordination, studies and evaluations). Following are discussions of the institutions with major roles in water quality management.

B1. Ministry of Public Works and Water Resources

The central institution in water quality management is MPWWR. This ministry is generally responsible for providing suitable quality water to all Egyptian users (municipalities for drinking water, industries, and irrigation), but the emphasis has typically been on irrigation, the use that consumes by far the most water in Egypt. Other needs have simply been met from excess water available. In any case, the management of water quality has occupied a relatively small proportion of the ministry's overall activity.

Law 48 charges MPWWR with the administrative aspects of implementation. The ministry was given the responsibility to review applications for discharge licenses from municipal and industrial facilities, inspect facilities to ensure that adequate treatment facilities are in place, ensure the Ministry of Health samples and analyzes the effluent, and issue licenses to discharge if all appropriate conditions are met. Once a license is issued, if the Ministry of Health reports violations of the license, MPWWR issues a violation notice that requires the facility to improve its discharge quality. After three months, if subsequent sampling by the Ministry of Health indicates no improvements, MPWWR fines the facility for failure to comply with Law 48.

It is not clear how much of this function is being carried out at present (records are not available). It is the responsibility of a small decentralized staff who are not trained in sanitary engineering, industrial engineering, or pollution control administration. The staff inadequacy, coupled with implementation problems (mentioned below), have rendered the licensing program to be largely ineffective in pollution control for industrial and sanitary wastes.

Irrigation inspectors in the governorates carry out most activities required under the law. Irrigation inspectors (about 70 in number across Egypt), organized in six directorates, have police authority for pollution control activities. Most of these staff are civil engineers who have broad experience in irrigation management but relatively few skills in managing a regulatory program, enforcing regulations, or inspecting treatment facilities for compliance with the law. It is not known what proportion of time they spend on activities related to Law 48. With training, the skills of the engineers would increase rapidly, and they could become much more effective.

In practice, the licensing and enforcement does not work as planned, primarily because a high proportion of industry is government-owned or controlled. When MPWWR fines a GOFI industry for non-compliance, for example, another (national level) government agency has to pay the fine. If there is no budget to install treatment at the facility, there is probably no money to pay the fine. Payment of fines by the sugarcane processors on the Upper Nile, for example, would consume all profits generated at those facilities. The government has chosen not to collect the fines in order to maintain the industry's profitability. Other industries may also have received special consideration in order to preserve employment and a level of economic self-sufficiency.

The same situation occurs at the municipal sewage treatment plants. Poorly operating plants that violate discharge standards can be fined, but for no real purpose. The notice of violation is significant, and based on a violation, action should be taken. But if the sewage treatment plant has no money, treatment will not be upgraded and the fine will not be paid. The sewage treatment plants are particularly hard hit because it is the governorates' responsibility to operate and maintain them, and in general they cannot adequately perform this function.

Other functions carried out by MPWWR are required by law, but not of the ministry. It has a monitoring program on the River Nile, drains, and direct-discharging industries associated with the River Nile Institute (formerly the Aswan High Dam Side-effects Research Institute), monitors the salt content of drainage waters in the Delta (the Drainage Institute), and selected groundwater sites (the Groundwater Institute). While the Drainage Institute publishes annual yearbooks of drain water quality, which simplifies trend analysis and geographical analysis, other monitoring programs publish data only occasionally.

B2. Egyptian Environmental Affairs Agency

The role of the EEAA is currently in flux. Since its inception in 1982, it has had a weak coordinating role among the agencies with responsibilities for water quality management (and other environmental matters). The Government of Egypt now appears to want to give the agency more authority, particularly with regard to reviewing and recommending new environmental laws or revisions to existing environmental laws, supervising the collection of environmental data, and disseminating information to government agencies and the general public, implementing an environmental impact assessment program, and enforcing environmental legislation in the governorates. This substantially expands its current role, but is not yet finalized in law. The agency's role with regard to water quality management is not certain, although Egypt's National Environmental Action Plan implies that it would be significant.

The proposed law for changing EEAA's role creates a new agency, the Central Environmental Agency (CEA), whose director would have ministerial status. A Cairo-based part of the agency would have functions such as law review, policy setting, and planning, but the governorates would also have departments of the environment that would review environmental impact assessments and enforce environmental laws. Other functions in the governorates might include issuing environmental permits and environmental education, but

the current version of the law apparently does not assign these roles; because they conflict at least partly with existing legislation (Law 48/1982), they might never formally be assigned.

While the EEAA staff currently numbers nearly 100, few have significant experience in water quality management or water pollution control. It is not clear that EEAA would have the expertise to carry out the more significant role in water quality management described above without extensive training of existing staff.

B3. Ministry of Health

The Ministry of Health (MH) has been given a central role in water quality management, especially in setting standards for the quality of the following:

- Potable water sources (River Nile and canals)
- Drain waters that can be mixed with other waters for drinking water
- Industrial and sewage treatment plant discharges
- Wastes discharged from river vessels.

Law 48/1982 mandates the MH role in standard setting. The possibility that EEAA would assume a more significant role in standard setting is being discussed. Without an amendment to Law 48/1982, the MH responsibility would remain unchanged, but its role in meeting the responsibility might be reduced.

Besides developing standards, the ministry must sample and analyze all industrial and municipal effluents, and all water treatment plant influents and effluents as well. This is a significant work load, since approximately 600 major industrial facilities and several hundred water or sewage treatment plants must be sampled and analyzed at least quarterly.

MH has laboratories in all governorates to monitor industrial and sanitary waste discharges and sources of drinking water. The ministry claims to analyze 40,000 samples per year, about the right number of samples for which they are responsible. However, very few of these data are available to any other organization, even those that legitimately need them (GOFI, MPWWR). Although required by law, there is no evidence that the results of analyses showing violations are provided either to MPWWR or to the violating industry or treatment plant for enforcement or corrective action.

For about one year, the ministry was involved in monitoring the River Nile at locations near MPWWR's stations. This program, supported by EEAA, is no longer operating and is unlikely to start up again.

Other MH responsibilities include the management of significant health problems in Egypt, including schistosomiasis (bilharzia) and water-related enteric diseases such as diarrhea. In most areas, however, the management of the general health does not appear to cross over into water quality management, particularly since standards for the bacteriological quality of waters suitable (or treatable) for drinking appear too lenient, given the seriousness of prevalent health problems. The level of fecal coliforms allowed in the Nile, canals, and

- 22

drains appears very lenient for water contact (i.e., washing, swimming), and the lenient standards, the failure to enforce them, and the high incidence of parasitism and disease appear to be linked.

B4. Ministry of Housing, Reconstruction, and New Communities, National Organization for Potable Water and Sanitary Drainage

The National Organization for Potable Water and Sanitary Drainage (NOPWASD) is a major organization within the Ministry of Housing, Reconstruction, and New Communities that has responsibility for planning, design, and construction of collection systems, municipal sewage treatment plants, distribution systems, and municipal water treatment plants. Once facilities have been installed, NOPWASD organizes training for local operators, but on completion of training, operations and maintenance is left to individual governorates.

NOPWASD infrequently (once every few years), inspects each treatment plant to determine the state of the plant, the quality of the operating staff, and its performance in terms of output quality. With the cooperation of the governorates, plant modifications or additional training are carried out to improve plant performance when substantial problems are found. The adequacy of the remedial action largely depends on the level of cooperation from the governorate. Some governorates cooperate with NOPWASD in a truly collaborative effort to maintain water and waste treatment activities at a high level. In others, poor cooperation has led to essentially non-functional treatment plants, with little hope of rectifying the problems in the short term. The current poor condition of most sewage treatment plants in Egypt suggests that the governorates or NOPWASD do not take this function seriously.

Nevertheless, of all the organizations with responsibility for water quality management, NOPWASD is apparently achieving the most. There are major programs for constructing sewage treatment plants in Cairo and Alexandria and plans to install up to 116 new sewer systems and sewage treatment plants in small cities. There is apparently no plan to develop sewage collection or treatment systems in villages, or to renovate facilities in major cities. Even cities that have significant impact on others (Sohag, for example) are not slated for upgrades, although their treatment systems are reportedly non-functional.

B5. Ministry of Industry, General Organization for Industry; Other Ministries

The government has owned the majority of industries in Egypt for the last few decades. In response to pressures to privatize most of these industries, a program has been set in motion. Nevertheless, GOFI still manages about 330 industrial facilities.

Several types of facilities, however, are not managed by GOFI. The Ministry of Energy manages 13 power plants, and the Ministry of Tourism manages some hotels and river vessels. Privately owned industries come under limited GOFI control, and there are about 200 major private industries (it is significant that the number of large private industries is unknown). The number of small private industries is estimated to exceed 20,000. Law 48 covers the discharges from all of these.

Under a 1982 decree from the Ministry of Industry, all industrial facilities must install and operate pollution control equipment as required by Law 48/1982. This decree, however, is not enforced. Within GOFI, an Environmental Management Department has the responsibility of helping industries implement the requirements of the applicable laws. This unit appears to have been ineffective in the water pollution arena, but has about 15 engineers who provide guidance and training in identifying the types of pollution control equipment that might be needed, process changes that could help reduce discharges, provide technical assistance to operate newly installed equipment, and help obtain financing to install needed equipment. GOFI lacks the authority to require individual plants to install treatment facilities (although a Ministry of Industry Decree requires all plants to comply with Law 48). The Treasury allocates funds for government-owned industries; even if the Treasury is not in a position to allocate necessary funds, a plant manager must still keep a plant functioning. With too little funding, pollution control is one of the first items omitted.

Like other institutions in Egypt, the role of GOFI and the Ministry of Industry is changing rapidly. The impetus for change in this ministry is privatization.

C. CONCLUSION

From this brief description, it can be assumed that the laws are sufficiently stringent and the institutions appropriate for effective implementation of those laws. Although the laws are not perfect, their implementation would go a long way to improve Egypt's aquatic environment. It was also consistently stated, however, that none of the applicable laws are enforced, and pollution control is essentially non-existent. There are several apparent reasons for this, the most significant being the government's failure to take environmental action seriously and to insist on implementation of existing laws. This attitude is now changing; the organization assigned the role of supervising the enforcers will probably be EEAA. This is a step forward, although EEAA may lack the expertise to carry out this function.

Regarding other major programs, however, ministries cooperate little in carrying out provisions of Law 48 or other laws. For example, MH, NOPWASD, GOFI, MPWWR, and EEAA do not discuss among themselves the major pollution problems, the solutions, and the organizations best positioned to control adverse discharges. Because each organization knows only a small part of the total picture, cooperation and collaboration are essential for effective water quality management.

SECTION III
WATER QUALITY MANAGEMENT AND MONITORING PROGRAMS

This section describes the current distribution of water quality problems and analyzes the government's plans to deal with these problems. It also evaluates the effectiveness of the water quality management process, the institutions that implement it, and the legislation on which it is based.

A. DISTRIBUTION OF WATER QUALITY PROBLEMS

Section I presents the types and sources of water quality problems of the Nile and ranks them in terms of hazards to human health and to the environment. This section describes the geographical distribution of these problems.

The distribution of pollutants can be discussed on two levels: the distribution of sources and the distribution of effects. Some pollutants, pathogens and parasites, for example, are generated throughout the system and affect water use over the entire system, affecting the entire rural population. They are generated by the improper disposal of sanitary wastes.

Other pollutants may be generated on a system-wide basis, but have only local impact. Salinity, the major pollutant affecting the usability of water for irrigation, is such a pollutant. Salinity, discharged throughout the system, results in continually increasing concentrations downstream, but reaches threshold levels of concern only in the lower reaches of the Delta. Increased salinity affects agricultural water use but has little impact on the river environment at the concentrations normally found. However, salinity increases upstream are a major concern to downstream users.

Other pollutants are discharged locally and have predominantly local effects. Heavy metals, because they often attach to particles and settle at the bottom of rivers or drains, fall into the latter category. Significant effects are found only near metal discharges, but they can be severe.

A1. Systemwide Water Quality Problems

Untreated sanitary waste poses the single greatest hazard to the health of rural Egyptians, and is the only real system-wide generated problem with system-wide effects. Fecal coliforms, which strongly indicate contamination by human wastes, are major sign of general rural sanitation problems. However, their presence in the Nile River and canals used as sources of domestic water supply and other uses for major cities and towns is a general concern. Fecal coliforms, often in excess of 1,500 MPN/100 ml with some concentrations of 5,000 MPN/100 ml or more are found throughout the Nile River and canals. Considering the high volumes of water in the system, these levels indicate the presence of large quantities

of raw or inadequately treated and disinfected water. Even higher concentrations are found in many drains. Concentrations of more than 1,500 MPN/100 ml render the water unsafe and unsuitable for human contact and of more than 5,000 MPN/100 ml, it is suspect as a raw water supply without careful treatment and disinfection.

A2. Localized Problems

Heavy metals discharged by specific industries to the Nile River, drains, and sewer systems are believed to create severe but localized problems in the Nile system. Although there are few data to determine the distribution of heavy metal problems, the following areas with concentrations of industrial plants are likely to produce heavy metals:

- The Helwan and Shoubra El Kheima areas near Cairo and plants within Cairo which discharge to both the River Nile and the Cairo sewer system. These discharges are most likely to affect the Nile River from Helwan to the Delta Barrage, and the Bahr El Baqar, Rahway, and Bilbeis drains.

- The Alexandria area discharging directly to Lake Maryut, to drains leading to the lake, and to the Alexandria sewer system which discharges to the lake. Sediments in the lake are likely to contain high concentrations of heavy metals.

Limited data on metals in fish (Annex E) confirm that levels are elevated in Lake Maryut, Lake Manzala, and the Nile River near Cairo.

A2a. Nile Delta

Some conservative or semi-conservative pollutants are discharged throughout the system, increasing in concentration as water moves downstream and becoming a problem when concentrations increase beyond threshold levels. The following Nile Delta problems arise primarily through agricultural use of water.

Pesticides. Pesticides occur throughout the system, but the highest concentrations are probably in the Delta drains, posing a threat to aquatic life and possibly to humans eating fish from the lakes receiving the drains. Pesticides now in use are biodegradable, but with current levels of application, concentrations will eventually cause concern. More effective application will reduce but not eliminate pesticide problems.

Salinity. Excessive salinity affects nearly 17 bcm/yr of drainage water in the Delta. Currently 3.4 bcm/yr is officially reused, with another 3.0 bcm/yr planned for annual reuse by early 1993. Another 7.0 bcm/yr with less than 2,000 ppm is currently suitable for reuse after mixing with freshwater. Some 12.8 bcm/yr, averaging 3,000 ppm is discharged to the northern lakes or the Mediterranean Sea. As additional drain water is reused, the salinity of the remaining drainage will continue to increase. This drain water is the sole fresh water supply to the northern lakes. At some time in the near future, additional increase in water supply will not be available from reuse of drainage. As the drainage water supply decreases,

more sea water from the Mediterranean will be needed to replace it, or the net outflow from the lakes will decline. Both alternatives will increase the salinity.

A2b. Northern Lakes

Lakes Maryut, Idku, Burullus, and Manzala comprise the northern lakes located adjacent to the Mediterranean Sea. These lakes, separated from the sea by narrow spits, are shallow, no more than two meters in depth. They have one or more openings or gates to the sea which permit exchange of water and serve as the only discharge. Evaporation is high compared to inflow and storage because of the low depth/area ratio. The lakes are the principal depository for the discharge from the agricultural drains. This discharge, now about 11 bcm/yr, has decreased by about 20 percent in the last 15 years and is expected to decline to about 9 bcm/yr by the year 2000. Salt concentrations vary, but may include saline water near sea inlets, brackish water throughout much of the lake, and fresh water near major drain discharges. The lakes support a large fishery, and many fish farms have been constructed in the shallow water by diking and channeling the water. Land is being reclaimed from the lakes for agriculture, continually reducing the water surface area. The lakes support a large bird population and serve as a stopover during migration.

Two of the lakes, Maryut and Manzala, are polluted by inflow from sanitary and industrial wastes carried in the agricultural drains and by direct discharge of these wastes into the lakes.

Decisions must be made soon about the character, size, and quality of the lakes and necessary action must begin. The lakes serve as the final sump for agricultural drain water and as the final treatment for municipal and industrial wastes of the Nile system. Their water quality is steadily declining. If the lakes continue to serve this role, the water will be unfit for any biological use, but Egypt will have no incentive to invest in water pollution control for incoming wastes. An important decision will be the amount and quality of water to be dedicated to the lakes if they are to be maintained. Dedication of water for this purpose will reduce the quantity available for reuse and irrigation.

Policy decisions are needed to establish the future uses of agricultural drains discharging to the lakes and to develop water quality criteria which will regulate waste discharges to the drains. Substantially more treatment will be required of most discharges if quality of the lakes or quality for reuse is to be protected, if uses of the drains are broadened, or if the assimilative capacity of the drains is not used. If more drain water is reused as planned, less drain water will be available for waste assimilation. Conversely, some drains are so severely polluted now that water of low salinity cannot be reused because of pollution.

Lake Maryut. Lake Maryut is the most polluted northern lake. It also is shallow with its only supply coming from agricultural drains. The lake receives agricultural drainage water from five major drains, liberally fortified with municipal and industrial wastes, as well as separate discharges of municipal and industrial wastes. The Drainage Research Institute reported in a survey that 62 major industrial factories discharge into the lake. Outflow is by

evaporation and pumping through Max Pumping Station to the sea. Discharge totals about 2.4 bcm/yr with an average salinity of 6,900 ppm. The lake is reported to be more saline than Lake Manzala and to have some concentrations of heavy metals, an appreciable organic loading, and a very high fecal coliform level.

Lake Manzala. Lake Manzala receives about 3.6 bcm/yr of water averaging 2,400 ppm salinity from five agricultural drains. Much of the drain water is highly polluted. Bahr El Baqar Drain contributes about 1 bcm/yr, much of it concentrated raw or partially treated sanitary and industrial waste from Cairo. Bahr El Baqar Drain extends as a continuous oxidation pond about 170 km from Cairo to Lake Manzala and is reported to be partly anaerobic. A NO_3 level of 45.0 ppm has been reported. The discharge is too saline for planned irrigation reuse. When the Cairo secondary treatment plants are completed, the organic loading is expected to materially decrease. Since the salinity in the upper reaches of the drain is about 950 ppm, there are reuse possibilities, depending on decisions regarding the future of Lake Manzala. Bahr Hadous Drain discharges about 1.45 bcm/yr per year of waste averaging 2,150 ppm TDS, which also contains municipal and industrial wastes from Delta cities and towns. Other inflow reportedly is less polluted, but with some high salinity from groundwater.

Lake Manzala serves as the final repository for much municipal and industrial waste from the Eastern Delta, including Damietta and Port Said, and much of that from Cairo. The inflow will decrease in the coming years with increased reuse of drainage water, but the waste load will continue to increase, placing more stress on the lake. Organic loading into the lake will decline with completion of sewage treatment plants in Cairo and Port Said. However, it is expected that continued waste loading, coupled with further reduction in water surface area, will materially change the character of the lake. Furthermore, some inflow from Bar Hadous Drain will be diverted in two stages to the Al Salam Project when it is completed in early 1993. Only limited data are available about the levels of heavy metals, pesticides, or even DO. The quality, based on observations of inflow quality, is now considered to be poor and can only decline with time. Decisions about the lake must be made soon to effectively direct expenditures.

A2c. Rosetta Branch

Mohit and Rahawy Drains west of Cairo receive primary treated wastes from Cairo treatment plants Zenein and Abu-Rawash, including industrial wastes. Abu-Rawash is now primary treatment, Zenein is secondary, but both reportedly bypass raw sewage. BOD loads of up to 900 tons per day are suggested by HADSERI. Discharge is to Rosetta Branch 25 km below the Delta Barrage. The organic load depresses the DO in Rosetta Branch to 4 mg/l or less during the winter closure period. The organic loading should be materially reduced when the treatment plant upgrading is completed in 1996.

A2d. Groundwater

Fecal contamination of shallow groundwater is very pervasive and widespread in and near most villages that lack an adequate sewage collection system. It is caused by raw

sewage and leachate that infiltrates from individual or community cesspits near or into the groundwater. This contamination renders the shallow groundwater unsuitable for domestic use, although it currently is a major supply, serving an estimated 80 to 90 percent of villages.

Shallow fresh groundwater near Cairo, with a water table of two meters or less, is about 50 meters thick. Thickness of fresh water increases to about 200 meters in the Middle Delta, gradually thinning and pinching out in the northern Delta. Here the brackish water lies under an upward gradient, extending to near the surface, mixes with drain water, and increases soil salinity. Tile drainage or other means may be needed to remove the saline water. Salinity intrusion renders the drain water unsuitable for reuse in many areas. The saline groundwater and drain water in the northern Delta is generally not suitable for domestic or irrigation use.

In the northern Delta, seawater has intruded into shallow near-surface groundwater in historic times. This water is under a positive head and seeps into drains and the northern lakes, increasing salinity and rendering some drain water unusable for irrigation, even when mixed with canal water. However, the source is uncontrollable and no effective corrective measures are available. The groundwater levels must be kept below the root zone by tile drainage or surface drains to maintain irrigated agriculture here. As more water is used upstream, an effective salt balance will become more difficult to maintain with lower lake, canal, and drain levels.

B. EVALUATION OF CURRENT AND PROPOSED ENVIRONMENTAL ACTIONS

Section I establishes a general hierarchy of problem pollutants, presenting the reasons why some should receive high priority and others low priority. In the previous section, we outlined the major areas of concern in Egypt. This resulted in a priority list geographically focused on the northern Delta:

- Water-borne pathogens and parasites
- Pesticides
- Heavy metals
- Salinity

In general, our analysis agrees with GOE efforts to control pollutants and their effects.

B1. Pathogens and Parasites

The major pollution control effort is the construction of new sewage treatment plants in Cairo, Alexandria, and scores of other locations, presumably to control pathogens (although there are other benefits, including removal of organic materials and heavy metals). In addition, a series of long-standing public education spots on Egyptian television attack the problem from the other side, by attempting to reduce human exposure to contaminated water

by warning people not to bathe, swim, or wash dishes or clothes in drains. Since the series began, the incidence of infant diarrhea has reportedly declined, so it is considered a success.

Both of these project areas are steps toward reducing the still high incidence of parasitism and water-borne disease in Egypt, but additional steps are necessary where the problem is still the greatest: in rural areas. The provision of sewage treatment plants for all people is obviously not feasible, but some steps need to be taken to break the cycle of exposure and disease caused by the absence of sewers, the presence of open sewers, or the pumping of cesspits directly to waterways.

B2. Pesticides

The use of pesticides is not controlled, and until recently, the major incentives provided by the Government of Egypt (GOE) increased usage through subsidies. The Minister of Public Works and Water Resources announced recently that herbicides would no longer be used to control aquatic plant growth in drains. At about the same time, the GOE announced it was phasing out the subsidies on pesticides and fertilizers over the next few years. Both actions are to be lauded for their foresight and potential long-term benefits. However, they do not go far enough to minimize the expected impacts, particularly since the GOE has announced that it will raise food prices to compensate for the loss of the subsidy on pesticides, an action which has exactly the same effect as a subsidy itself. Even in a perfect competitive market, however, where supply and demand, set food and pesticide prices, pesticides could be overused. Environmental damage is not costed during either the manufacture or the use of pesticides, and farmers almost always see the benefits of use as outweighing the costs. Other mechanisms must therefore be sought to reduce their use in the longer term.

B3. Heavy Metals

Both GOFI and EEAA are paying priority attention to industrial dischargers of heavy metals. EEAA is focusing on the clean-up of discharges to Lake Maryut, particularly heavy metals. The reason for this focus is that Lake Maryut is still being fished, despite the dangers involved. GOFI is also reportedly focusing on reducing heavy metal discharges from industry, but its geographic focus is not known. Hopefully, EEAA and GOFI are working together on this problem, but this could not be confirmed. Heavy metals appearing in municipal sludge preclude its use as a soil amender. In any case, heavy metals are significant problems only under certain circumstances, which occur in isolated locations in Egypt. Control efforts should be directed to solve priority areas first (one of which is Lake Maryut).

B4. Salinity

Salinity is more a problem of irrigation than of water quality, and can be minimized only through better management and control of the use of irrigation water (increasing efficiency of water use, for example) and in pollution control. Just as past pesticide subsidies encouraged excessive pesticide use and concomitant environmental damage, the

failure to raise on-farm irrigation costs to the social opportunity cost of water has encouraged over irrigation, which accelerates salinity problems. The subject of extensive research and investigation, salinity is not dealt with further here.

C. EVALUATION OF THE WATER QUALITY MANAGEMENT PROCESS

The previous section said that the major pollution control efforts in Egypt are heading in the right direction although not yet operating at an effective level. This progress is somewhat surprising in that there is very little coordination among ministries and essentially no management of the water quality management process. Perhaps the substantial involvement of donor organizations has led to a de facto management process in which international experts have done repeated evaluations. If so, then apparently those experts substantially agree on the specific actions that should be taken. But Egypt should take more responsibility for the overall management of water quality. It has much of the expertise, a reasonably strong direction, financing for the near term, and an opportunity to develop expertise in-house in the meantime.

To achieve greater self management, the Egyptian program should be improved in three major areas:

- Management of the process of water quality management
- Data management
- Enforcement

C1. Management of the Process of Water Quality Management

The overall goal of a water quality management program is to improve water quality to an acceptable level.[1] To achieve this, an agency or ministry must assume these responsibilities:

- Setting objectives
- Developing action plans
- Overseeing plan implementation
- Evaluating progress towards objectives
- Revising objectives or action plans as warranted

The management role is the same as that of any other organization. To be successful, any organization must set directions, make plans, carry them out, determine whether they worked or not, make more plans and so on. In other words, it must manage the water quality management process as if it were an organization managing any other process. The only difference is that the end goal is an acceptable level of water quality, not the production of furniture or the construction of a water treatment plant.

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[1] "Acceptable" means meeting waterways standards. If discharge are sufficiently lax that waterways standards are not met, discharge standards for the offending facilities must be made more strict.

Management programs are cyclical by their very nature. The five-year and annual plans for the GOE are two examples of cyclical plans. For the specific case of a water quality management program, the following tasks should be carried out on a cyclical basis:

C1a. Setting Objectives

- Identify problems to be solved.
- Prioritize problems according to their risk of causing human health impacts.
- In conjunction with implementing ministries, select the highest priority problems and set targets for problem reduction.
- Distribute all objectives to the ministries having responsibility for water quality management and publicize general goals in news releases.

C1b. Developing Action Plans

- Identify alternative ways of achieving objectives, seeking suggestions from implementing ministries.
- Estimate probability of success of each alternative.
- Estimate rough cost of each alternative.
- Determine who can or would do the work.
- Have the ministry that would do the work develop an implementation plan for the most promising alternative(s) (most effective and/or most cost effective).

C1c. Overseeing Action Plan Implementation

- Approve implementation plans developed by ministries for work to meet objectives.
- Assist in implementing actions for which no ministry currently has responsibility by letting contracts or helping a ministry to issue contracts or develop expertise.

C1d. Monitoring Progress

- Watch progress of works programs in relation to schedules.
- Monitor water quality in River Nile, canals, drains, lakes, and discharges, and progress toward meeting environmental standards.

C1e. Revising Objectives or Action Plans

- Determine where progress in meeting environmental goals is not sufficient to keep up with population and industrial growth and develop additional objectives or action plans to increase the rate of water quality improvement.

- Determine where discharges are meeting all legal requirements but water quality goals cannot be attained in order to make the discharge standards stricter for the offending facilities.

- Revise timetables for action plan completion if present schedules are unrealistic and long-term goals are not thereby sacrificed.

If an Egyptian agency or ministry carries out these functions effectively, considerably more progress can be made in the next 10 years than was made in the last 10. However, the management program will require the complete support of the GOE and a great deal of donor assistance.

In addition to above list of functions that the water quality management organization must carry out, other actions not related to planning cycles are necessary. From time to time, the management agency needs to review the resources it has at its disposal to achieve its goals. This should be done every two to three years.

For the water quality management agency to be effective, it has to know what parts of the total program are effective and what parts are not. Thus, it must be in a position to evaluate the performance of other ministries in water quality management. An organization that is otherwise perfectly competent might not have the appropriate staff to carry out its responsibilities in water quality management. If a ministry's failure to perform is a substantial impediment to effective water quality control, the water quality management agency must find some way to obtain the necessary staff, resources, and expertise to perform that function. Similarly, if a ministry is legally required to carry out a function, which fails to achieve desired results, then the management agency should be able to argue for a legal change to make the function effective or to drop it. These two examples point to actions that should have been but were not taken over the last 10 years (since the passage of Law 48), because no ministry or agency believed it had the mandate to do so.

C2. Data Management

A successful water quality management program needs widespread sharing of data and information. These data and information need to be in a form that facilitates selection of data that are meaningful for a given purpose and timely analysis. While considerable data have supposedly been collected as part of a water quality management program, most have never been published in any usable form, even as a database. This is unacceptable when electronic data storage and retrieval systems are a small fraction of the cost of a single sample run down the Nile River and several orders of magnitude less than the cost of making compiling data on all major industries and sewage treatment plants in Egypt.

Data must also be timely. Just as samples must be analyzed within a specified time of being taken in order to be valid, the results of the analysis need to be released within a specified time of being analyzed in order to be useful. Data released three years after being taken are not useful for solving real-time problems, and environmental management has a strong real-time component. If the data are important enough to obtain, they are important enough to publish immediately after being compiled. Their value is in their use, not in their mere existence. Even after the publication of raw data, papers that interpret and analyze the data are still valid. Releasing the data early provides a strong incentive to produce such analyses as quickly as feasible.

In Egypt, there is no system to store and retrieve most data that are collected in water quality management programs. One reason given for not releasing data was that it would simply be too much work to compile. (Others reasons were that no one knows where data are, that data are stored in an inaccessible location, and that they "weren't any good"). Even if an individual ministry has an effective system for some data management, it normally does not extend to all parts of the same ministry (MPWWR, GOFI) that are involved in water quality management, let alone to other involved ministries (Ministry of Interior, for example). In fact, some ministries (Ministry of Health) apparently do not keep copies of the data they are responsible for collecting.

This is a major problem. Indeed, two donor countries (Denmark and Germany) have each proposed projects to assist in overall data management. The focus of these efforts is wider than water quality data, however, so major development projects are envisioned, primarily to support EEAA. However, it will be at least three years before either data management system will be useful, and there are current data management needs. Until these systems are available, each ministry must ensure that ALL[2] data obtained for water quality management is stored in a database (the software and hardware does not matter) so it can be sorted, analyzed, and exchanged with other computer systems as needed. The relative cost is very small, and the benefits are immense. If these data were available in a common format (dBASE, for example), almost anyone could take the data, analyze them in different ways, and advance the cause of water quality management in Egypt at almost no cost to the government.

C3. Enforcement

The current legislative framework for enforcement is not adequate. The licenses and penalties are not sufficient to cause either municipal or industrial dischargers to comply with discharge standards. A licensing system with financial penalties for non-compliance works in a private enterprise economy where the survival of a business (or treatment authority) depends on its ability to choose between paying fines or installing treatment and taking the consequences of its decisions. However, it is ineffective when one part of the government pays a fine to another part of the government, particularly when the same treasury directly

[2]It is not appropriate to screen data, even if those responsible for it believe it to be inaccurate. Faulty data should be flagged in a database, not removed from it.

controls funds for both parts. There are ways to make this approach work, but they require reorganization of the national budgetary system, which is probably not warranted in this case. However, as the privatization of industry proceeds, a licensing and fining mechanism should become more effective, so the few current efforts now underway to implement a licensing system should not be disbanded. But additional mechanisms should be found to encourage compliance by government-owned facilities. (This is also a problem in the United States.)

D. EVALUATION OF WATER QUALITY MONITORING PROGRAMS

Currently, at least four ministries and a research arm of the government are involved in collecting and analyzing data relevant to water quality monitoring: MPWWR (River Nile Institute, Drainage and Groundwater Institutes), Ministry of Health (MH) (central and governorate laboratories, in part in support of GOFI), Ministry of Housing, Reconstruction, and New Communities (MHRANC, NOPWASD), Academy of Scientific Research and Technology (ASRT, Inland Fisheries and Oceanography), and Ministry of Agriculture (MA). In fact, programs in each of these organizations except for ASRT are designed with water quality management information needs in mind. At least three are sampling effluents of sewage treatment plants (MPWWR, MH, MHRANC); three are sampling water quality in the Nile River (MPWWR, ASRT, MH); two are sampling industrial effluents (MPWWR, MH); and none are sampling water quality of the northern lakes. None are routinely sampling sediments or fish either. MA essentially analyzes only drain water samples provided by MPWWR for pesticides, and much of MH's activity appears to be in support of GOFI. Given what appears to be considerable activity, very few data are available, and organizations essentially do not communicate on data collection programs, analytical protocols, or data sharing.

Each organization mentioned in the previous paragraph has valid and legitimate needs for data, and should be given the responsibility for collecting the data needed to carry out its roles. They should not, however, duplicate the efforts of other ministries by setting up their own programs, particularly if the data generated are not available to others.

A water quality monitoring program should provide the information needed to make management decisions in a timely fashion. Decision making in a water quality management context entails, in part:

- Determining whether water quality is improving or not (trend analysis)
- Determining where water quality most needs improvement (problem analysis)
- Determining compliance of discharges with license conditions (or standards)
- Locating discharges that are not licensed or violate license conditions
- Identifying the nature and extent of specific pollution problems
- Determining whether a suspected problem exists or not

The information on which these decisions can be based is available only sporadically, despite the involvement of several ministries.

55

Figure 2 and the paragraphs that follow it briefly describe the kinds of programs that are effective for each of these purposes.

Trend Analysis

Frequency of samples:
Once a month

Spatial density of samples:
Every 250 km

Number of parameters
Extensive (or good indicators)

Unkown Source Identification

Frequency of samples:
When problems are suspected

Spatial density of samples:
High, in a line down waterway

Number of parameters
A few characteristic parameters

Hot Spot Identification

Frequency of samples:
Once a year or less

Spatial density of samples:
Every few km

Number of parameters
A few key parameters

Nature and Extent Assessment

Frequency of samples:
Once

Spatial density of samples:
High, in a grid or transect

Number of parameters
A few characteristic parameters

Compliance Monitoring

Frequency of samples:
Long term: quarterly;
short term: daily

Spatial density of samples:
At discharge point only

Number of parameters
Licensed parameters

Problem Confirmation

Frequency of samples:
Once

Spatial density of samples:
Low, at suspected problem

Number of parameters
Problem parameters only

Figure 2. Characteristics of monitoring programs set up for different purposes

36

Trend Analysis. To be effective, a water quality management program needs to determine whether it is having any impact on water quality and whether its resources are directed toward areas of greatest need. Monitoring programs with few stations, frequent sampling, and extensive parameter lists (or a few good surrogate indicators) generally provide the most useful information for this purpose.

"Hot spot" Identification. Areas where water quality is farthest below water quality goals can often be cleaned up by focusing on a few dischargers. Unlike the program described above, however, a program that samples once (or infrequently) at many stations over a broad area for a few parameters provides the most information for determining the location of problem areas.

Compliance Monitoring. Discharges tend to be extremely variable (see Figure 3), and single measurements have little meaning. The best monitoring programs for industrial discharges have a component that tries to determine, over the short term (ranging from a day to a week), the variability of the discharge for major parameters, and a component for determining the long-term average discharge.

Unknown Source Identification. In many small villages raw sewage or septage is dumped into the nearest waterway, and many small industries are probably not licensed. These sources cannot be controlled unless they are identified. The best way to find them is to sample drain outflows at random, for a few key parameters, and sample the length of drains once for problem parameters, when significant unknown discharges are suspected (drain discharges are unusually elevated). Problem discharges occur just upstream from the places where pollutant concentrations dramatically increase.

Nature and Extent Assessment. The effect of the discharge from the Bahr el Baqar Drain is a good example of a problem that needs assessment. The nature and extent of such problems are usually best determined by analyzing many samples for two or three parameters in a grid or a transect away from a source to determine how rapidly the concentrations of problem pollutants decline. For persistent toxic pollutants, concentrations in sediments and fish are often the best indicators of the extent of the problem.

Problem Confirmation. Several parts of the Nile River, canals, and drains have been designated "black spots" in the Egyptian Environmental Action Plan. Most of these areas were selected only because they were known to receive large discharges from sanitary waste treatment and industrial facilities. Since there are few data with which to evaluate the impacts of these problems on water use, it is necessary to take a few samples to determine whether constituents are elevated to dangerous levels at the point of drain discharge. If they are, a nature and extent survey might be necessary, or with clearly defined problems, actions could be taken directly.

Each of the above is a valid reason to conduct a large- or small-scale monitoring program. No single program, however, can cover all the contingencies. Monitoring, like the management program, must be fluid, focusing efforts in areas that help most to determine the best management actions.

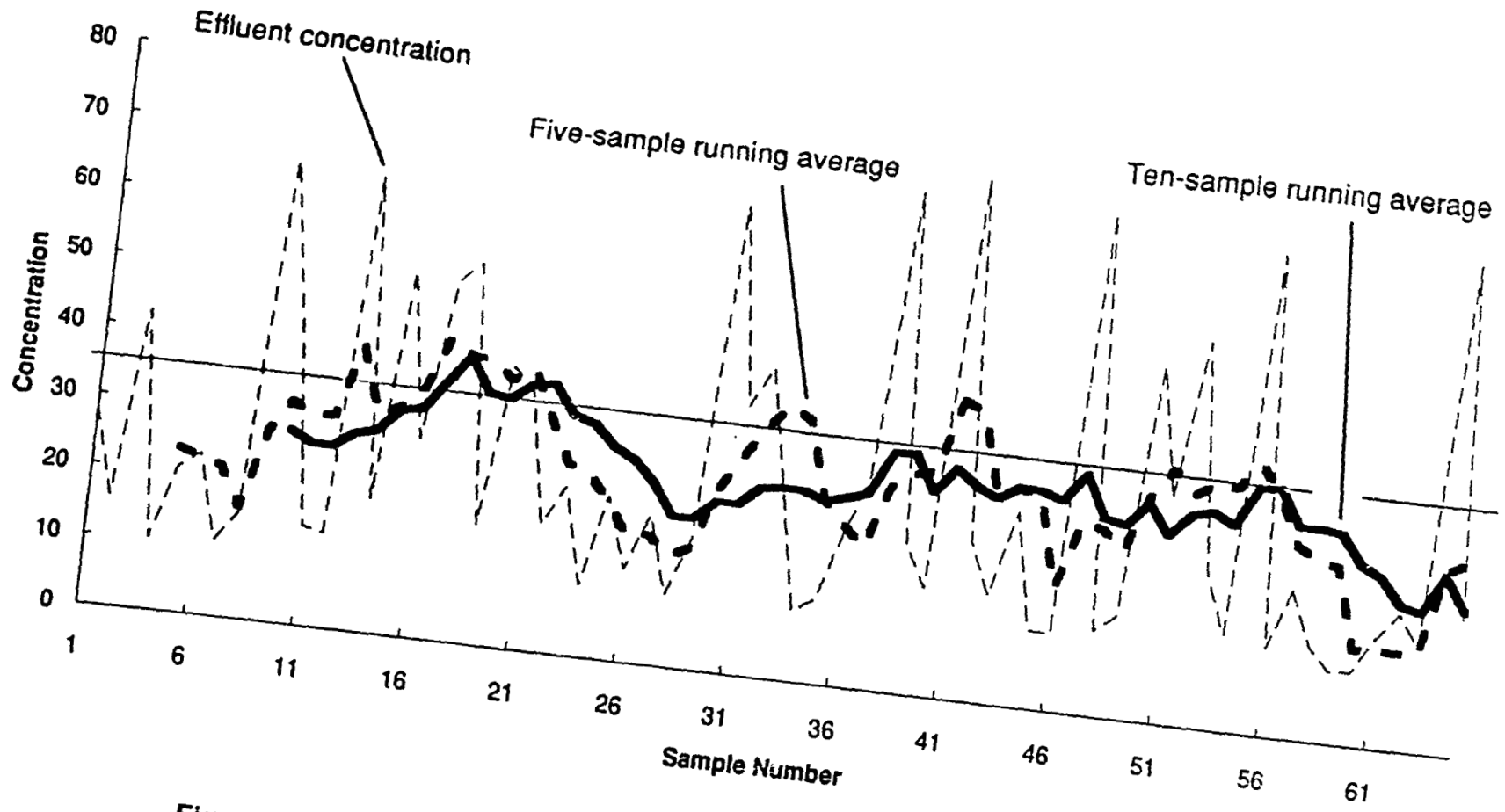

Figure 3. Typical variation in concentration of industrial effluents with five-sample and ten-sample running averages

It must be emphasized that the reason for a water quality monitoring program is to generate data for management. Therefore, the water quality managers must have a substantial role in defining what questions need to be answered.

It is important to recognize that a water quality monitoring program should sample more than just water. Sediments may contain high concentrations of heavy metals, hydrocarbons, and nutrients that add to water concentrations under appropriate circumstances, appearing as if there were unknown point source discharges. Fish, because they concentrate heavy metals and certain organic compounds, are sensitive indicators of pollution, and pose human health threats when they bioaccumulate toxic pollutants. Because of their mobility, fish are not, however, a good indication of the location of pollution.

E. EVALUATION OF INSTITUTIONAL FRAMEWORK OF WATER QUALITY MANAGEMENT

Several points are made in the evaluation of the management process and the monitoring programs that imply that the institutional setting for water quality management is not perfect. On the other hand, it is not bad. Many countries have similar programs with at least as many institutions involved as Egypt has. They use the institutions with the expertise that is appropriate for the job at hand, as Egypt has tried to do. And they have laws that are sometimes inappropriate for controlling pollution. They are not perfect either, but in general they have been more successful in reducing problematic sources of pollutants and improving water quality because they have had waste management programs for many more years, and have funded them at reasonably high levels.

Most countries with reasonably successful water quality management programs have a government organization that is independent of other government management organizations with responsibility for nation-wide water quality management. If it is part of a ministry, it is usually one whose primary orientation is planning. The only organization that fits this description in Egypt is the EEAA, but it has no responsibility for overall water quality management, only a weak coordinating role that historically has not been effective. As mentioned in the previous chapter, however, the government proposes to strengthen EEAA (or CEA) so it can have a more dominant role in environmental management. Some ministries that also have responsibilities for water quality management hope that this stronger role is effective, but they are skeptical that significant changes will occur. They note that previous attempts to give EEAA and others authority over water quality management have failed, and ask why this one should be different.

Two problems are apparent in making EEAA the water quality management agency: first, it has had relatively little experience in this role; and second, the staff may not be sufficiently versed in water quality management to provide meaningful leadership in an area where some ministries have considerable expertise. Under these circumstances, short-term expectations of EEAA should not be high.

In fact, few organizations in Egypt have expertise in water quality, pollution control, waste treatment technology, legal and regulatory development, ecology, and human health. A few categories of professionals appear to be in particularly short supply:

Managers. Management principles are similar in most organizations, and Egypt has skilled managers. However, few managers in Egypt know enough about water quality evaluation, planning, and regulation to effectively define, secure and deploy the resources needed, and to establish management goals and assess the effectiveness of the organization in meeting them.

Data Management Specialists. The state of data management in most ministries is very poor. Few people have true computer skills and most cannot help design simple data management systems, obtain appropriate hardware and software, and train and assist inexperienced users in word processing and data management.

Policy Analysts/Regulatory Analysts. Not many people understand water quality management issues and have the training, expertise, and experience to evaluate the legal and policy framework for water quality management. As the management program develops, such expertise will be necessary to identify ways to encourage government agencies, industries, and the general public to take actions that minimize adverse effects on the environment.

Chemists/Analysts. Few chemists can participate in the design of monitoring programs and surveys because their essential training and expertise is bench chemistry. And even though the total number of chemists is probably adequate, few have advanced degrees. The Ministry of Health, for example, is proud that physicians lead and manage the labs. However, it is hard to imagine that a physician's knowledge of environmental chemistry and analytical protocols is sufficient to provide adequate leadership in this highly technical and rapidly expanding field.

Biologists/Ecologists. With the exception of Inland Fisheries and Oceanography, no organizations appear to have biologists available to help determine what water quality problems to address. Biologists are critical to the implementation of any kind of toxicity testing program, and toxicity testing is one way to avoid a very costly chemical screening.

The ministries also lack specific expertise. For example, senior chemists are needed in MH. MPWWR needs biologists, chemists, sanitary engineers, and policy analysts/ regulatory analysts; NOPWASD needs biologists, and EEAA needs policy analysts/regulatory analysts, sanitary engineers, biologists, and chemists. Each area where expertise is apparently lacking should have at least one person with 10 years or more experience, preferably with a higher degree and familiarity with the Egyptian setting, and at least one junior person who can provide additional support while gaining experience.

E1. Legislation

Most of the perceived problems with Law 48 can be circumvented simply by enforcing the law in a reasonable way, rather than as it stands. The problems with the law include:

- Several provisions are over strict and some required action is impossible.
- The purpose of the waterway standards is not apparent; they are based on only two uses of water, drinking and irrigating.
- The penalty provisions are too weak to obtain compliance.

E1a. Over Strict Provisions

At least four major requirement of the law are over strict: that all discharges meet drinking water standards, that non-compliant facilities comply in a three-month period, that all facilities install treatment (and sewage treatment plants to install secondary treatment), and (by inference) not allow treated sewage to be discharged to the Nile River or canals. None of these is a major problem, and the law, which is not enforced at all, can be selectively enforced in the future, ignoring provisions that do not make sense. The reasons that these provisions are unnecessary are explained below.

Treatment Requirements. It is unreasonable to expect all industrial facilities to treat their effluent to meet drinking water standards. First, if the effluent meets standards without treatment, why is treatment necessary? Second, if a facility discharges a pollutant that does not harm human health or the waterway, then there it should be no penalty, even if it does not meet discharge standards.

Take the case where the sugar refineries at Sohag discharge extremely high levels of organic matter to the Nile River. Water quality data on the Nile indicate that even in the worst conditions, oxygen concentrations do not drop below 5.0 mg/l. Since the standard is 5.0 mg/l, which can be met under the existing circumstances, why is additional treatment required?

Since the government owns all plants, treatment should be installed only at enough plants to prevent violations of the receiving water standard. If different corporations owned the facilities, it would still be possible to require treatment at only one facility as long as the non-treated facilities paid rent to the treated facility to cover the cost. Alternatively, the facilities could join together to construct a plant to treat all their effluents on a cost-share basis. These solutions are all appropriate, even though they are not actually legal.

This approach has potential problems, however. An industry that is located where the BOD discharge is having an adverse impact (causing water quality violations) could easily argue that it was being penalized simply because of its location. But pollution control penalties are no different from transportation cost penalties or worker cost-of-living penalties associated with facility location. It is just one more consideration to include in the balance sheet. If it is still profitable to stay at that location, then the plant can do so. If it cannot,

41

close down or move. In the future, all pollution control costs should be included in decisions on where to build new facilities.

Regarding the requirement to install secondary treatment for sewage treatment plants, any treatment is better than no treatment. If no treatment is the only alternative to primary treatment, it is better to install primary treatment.

Compliance Periods. The law generally requires that a facility not meeting effluent standards has three months to comply. If it does not, then it is subject to penalties. This is totally unrealistic except for the smallest of simple facilities, and even then it probably would not be possible to locate, purchase, install, test, and put a treatment system into operation within three months. For major facilities, the time span could be up to three years before treatment could be operating. However, simply not enforcing the three-month period is not good enough, a mechanism is needed to allow the water quality manager to oversee the installation process.

Sewage Treatment Plant Discharge to the River Nile or Canals. The implied restriction on the discharge of treated sewage to the Nile River and canals is similar to the one requiring secondary treated effluent. If raw sewage is now being discharged to the river and canals (which is legal), then it would be far better to discharge primary-treated sewage than to continue to discharge raw sewage. As soon as the plant was built and operating, however, it would be illegal. Even if the plant were discharging secondary-treated sewage, it would be considered illegal. Obviously it would be preferable to discharge a secondary-treated waste to a drain, but this might be impossible. If not, the discharge of treated waste is better than the discharge of raw waste.

E1b. Waterway Standards

The promulgation of waterways standards in the decree has three apparent contradictions.

First, the standards set for discharges apparently conflict with those for waterways. It is clear that the discharge standards are meant to apply to all dischargers, but it is not clear what should happen if the waterway standards are not being met. Logically, if a waterway standard is not being met, there must be a discharge (or group of discharges) that exceeds standards, and the violation indicates that the violating discharger(s) should be found and brought into compliance. If, after all dischargers are compliant, the waterway standard is still exceeded, then the logical solution is to revise the licenses of all contributing dischargers, reducing the allowed discharge to levels that would ensure compliance with the waterway standard. However, no facility (authority) in the law or the decree allows more stringent discharge limits than are required by the standards in the decree.

Second, there are standards for two kinds of waterway: (1) the Nile River and canals and (2) drains and lakes. The standards for discharge to drains and lakes are less stringent than those for discharge to the Nile and canals (fewer parameters and higher concentration levels). This is contradictory in that essentially all drains in Upper Egypt discharge back to

42

the Nile, and the possibility is strong that a drain could cause a River Nile waterway standard to be exceeded because industrial and sanitary wastes discharging to the drains are not controlled for several parameters. In this case, no action could be taken to reduce discharges to drains because the decree has no authority to do so. In Lower Egypt, this is less likely to be a problem since most drains discharge only to the northern lakes or the sea.

Third, waterway standards are set to protect only water used for drinking, with other uses ignored. Water is also used for industry, irrigation, and a habitat for fish that are later eaten. While it is generally accepted that standards are usually adequate for drinking water that is directly consumed, bioaccumulation of toxic organic compounds and heavy metals in fish may exceed accepted toxicant levels even if waterway standards are being met. This means that the waterway standards are too lax when fishing is a use that should be protected.

At the same time, drains like Bahr el Baqar receive large amounts of mostly untreated sanitary and industrial waste. The appearance and odor of this drain are so bad that people come in contact with the water only by accident. With the completion of the Cairo sewers and the installation of treatment for direct discharging industries, the quality may improve. Also, the drain itself provides a certain level of treatment throughout its length (a 170 km-long oxidation ditch). It may be appropriate in this situation to set standards based on the necessary quality of its discharge to Lake Manzala, rather than on other, more unrealistic goals.

E1c. Penalty Provisions

It was stated above that the provisions of Law 48 and Decree 8 have not been enforced primarily because the government owns the majority of dischargers and can choose not to penalize itself when it violates its own laws. However, even if all dischargers were privately owned, the system of licensing and fines would still be ineffective because the fines are apparently not a suitable incentive to install treatment, and courts would be reluctant to impose jail sentences on offenders. Unfortunately, Law 48 restricts the fines to LE 2,000, a substantial amount for a small industry with four or five workers, but virtually nothing to an industry with several thousand workers. Since the fine is supposed to be a disincentive, a mechanism is needed to determine the level of fines (with a much higher maximum) appropriate to the situation.

SECTION IV
ALTERNATIVES

This section presents a series of alternatives for improving water quality in Egypt. They are organized according to the problems that were identified in Section 3. Each problem is stated and briefly explained, and the pros and cons of alternative solutions are presented. Following the last alternative for each problem are recommendations on which alternative or group of alternatives to select. Conclusions and recommendations are carried over into Section 5, Recommendations.

A. ALTERNATIVES RELATED TO SPECIFIC POLLUTANT PROBLEMS

The first series of alternatives relate to strategies for dealing with the specific pollutant problems identified in Section 3. They are presented in the following order: pathogens and parasites, herbicides and pesticides, heavy metals, and salinity.

Problem 1: *What should be the strategy to control water-borne pathogens and parasites?*

Explanation: In general, little attention has been paid to the water quality aspects of water-borne pathogens and parasites, even though they are the single most important water-related human health problem. Current programs include building major and minor sewage treatment plants, building water treatment plants, and educating the public on bathing, washing, and drinking water from canals and drains. Sewage treatment plants in intermediate cities do not meet standards. Sewers in major cities apparently leak badly and are in need of refurbishing/replacement. Sanitation in Egypt must be dramatically improved.

Alternatives

a) *Develop television spots (similar to the current spots on bathing and washing in waterways) demonstrating acceptable and unacceptable ways to dispose of human waste; teach basic sanitation in schools.*

Pros

- Is relatively effective and inexpensive (television campaign).
- Is effective and long-lasting (school-based learning).

Cons

- Requires a major change in the way a large number of Egyptians dispose of waste.
- Might not reach the rural population that needs it most.

- Requires some government action to provide alternative locations to dispose of sewage and sewage sludges that are generated in non-sewered communities.

- Requires evaluation of best disposal methods for wastes that are not dumped into drains.

b) *Enforce against the dumping of night soil and other human wastes directly into canals (first priority) and drains (second priority) in rural Egypt.*

Pros

- Helps break the cycle of infection associated with disposal of human wastes in water used for other purposes.

- Costs less than providing sewers and/or treatment services to the majority of households in Egypt.

Cons

- Requires (government-provided) alternative disposal methods.

- Requires an active enforcement program for which there is little precedent in Egypt.

c) *Develop covered sewers for all households and industrial facilities in areas with populations over n,000 people and provide primary treatment for all areas with populations over m,000 people (n < m).*

Pros

- Reduces current extensive human exposure to raw sewage through open sewers or lack of sewers.

- Provides basic sewage treatment to many rural communities that would otherwise contaminate downstream water users.

- Simplifies later connection of waste treatment plants in smaller villages if and when it becomes appropriate.

Cons

- Just transfers wastes more quickly to larger drains where more people could be affected.

- Is relatively expensive, particularly in more remote areas.

d) *Continue to build major secondary sewage treatment plants throughout major cities.*

Pros

- Controls pathogens that are discharged to drains from major cities, reducing exposure of people downstream from discharge.

- Has support of large donors (United States and Britain).

- Appears effective for pollutants besides parasites and pathogens (heavy metals, volatile organics, BOD, TSS).

Cons

- May not provide the greatest reduction in disease per dollar invested.

- Secondary treatment is not always necessary and primary treatment would probably give same improvement regarding pathogens and parasites.

- Other actions proposed in the National Environmental Action Plan, such as reducing water use, may also reduce need for new treatment facilities.

e) *Evaluate and repair nonfunctional or poorly functioning waste treatment plants in medium-sized cities.*

Pros

- Reduces chance of exposure for downstream water users.

- Is relatively inexpensive way to reduce pathogens since major capital costs have already been incurred.

Con

- The control of raw sewage may have greater benefits per dollar spent.

Discussion: Water-borne pathogens and parasites constitute the most serious problem in Egypt. None of the alternatives fully addresses the problem. In essence, all the alternatives listed here need to be implemented. It is only a matter of setting priorities and securing funding. The biggest problem is in rural areas where funds are insufficient to carry out major works but where human suffering from water-borne diseases is the greatest.

Without some action, however, urban Egypt will develop the same problems as rural Egypt over the next 10 to 15 years. Therefore, a broad approach is recommended that covers educating the public, constructing facilities in rural areas, repairing or refurbishing ineffective facilities, building major new facilities, and enforcing against poor waste disposal practices.

Problem 2: *What should be the strategy to control pesticides?*

Explanation: Even though data supporting the claim are limited, the belief is widespread that pesticides are heavily overused in Egypt. Coupled with WHO concern about the

estimated 2 million people that have been acutely affected by pesticide abuse, this belief represents a significant concern over the accumulation of herbicides and pesticides in fish and food crops and the possible damage to humans resulting from their consumption.

Alternative

a) *Reduce subsidies on pesticides.*

Pros

- Discourages use through higher costs, a universal disincentive, particularly in less developed countries.

- Saves government expenditure in an area where it is neither necessary nor desirable.

Cons

- Has no effect if food prices are raised to compensate for the increased cost of pesticides.

b) *Develop an education program on the use of pesticides and disseminate it widely to farmers and others in farming communities (over television, if necessary, but at a minimum on pesticide containers, and through distributors and extension staff) so that 1) appropriate pesticides are used on each crop; 2) dose rates are adequate to control pests but are not applied to excess, and 3) pesticides are used at the appropriate time in pest life cycles and plant irrigation cycles to minimize their transport to other sites through drainage.*

Pros

- Could succeed with sufficient reinforcement.

- Needed information should be partially available from similar research carried on in other arid countries.

Cons

- Provides no reinforcement of desired actions except from other farmers who may be skeptical about reducing pesticide use.

c) *License pesticide use.*

Pros

- Provides a strong controlling mechanism for the rate and timing of pesticide applications.

- Ensures that the best pesticide is used for a given pest on a given crop if implemented appropriately.

Cons

- Involves creating a substantial government bureaucracy to develop the information needed for a permitting system

- Costs a lot.

Discussion: The first two alternatives need to be implemented. The government is already committed to the first, but it is unlikely to have much impact if food prices are raised in proportion to pesticide cost (so the farmer will not be disadvantaged). The point is to reduce a farmer's income, making the pesticides more expensive relative to the crop's value.

The second alternative is likely to have at least as much effect as the first but may take longer to achieve. It is needed, however, because the removal of subsidies, by itself, would probably not be sufficient to alter patterns of pesticide use. The third alternative is not feasible.

Problem 3: *What should be the strategy to control heavy metals?*

Explanation: Heavy metals are significant pollutants in a variety of areas in Cairo and northern Egypt. They are pollutants that are typically controlled through wastewater treatment and pretreatment and pollution prevention/waste minimization techniques, but also have unique characteristics in receiving waters that might make straight, nationwide treatment requirements unnecessary.

Alternatives

a) *Require all heavy metals dischargers to immediately implement procedures to attain Decree 8/1983 discharge standards.*

Pros

- Controls all the discharges of heavy metals to waterways.

- Makes all dischargers (suffer equally).

Cons

- Requires immediate investment in control technologies.

- Requires cleanup of discharges that may not be necessary.

- Removes some of the limited cleanup effort available from the government from facilities that are having adverse impacts on waterways.

b) *Require heavy metals discharges to the River Nile, canals, and lakes to immediately institute procedures to meet Decree 8/1983 standards. Evaluate discharges from drains, and require treatment of all heavy metal discharges to drains that do not meet River Nile waterway standards at points where they discharge to the Nile, canals, or lakes.*

46

Pros

- Allows cleanup activities to focus on areas where discharge is most likely to occur.

- Stages major investment in control technologies dealing with high-priority, known problems, delaying other expenditure until other problems are confirmed.

- Provides a mechanism to identify other potential contamination sources.

Con

- Opens the government to the (logical) criticism that some facilities are required to meet standards while others are not.

c) *Determine the locations where heavy metals are concentrating above safe levels in fish or crops and find discharges (or sediments) that are contributing to these elevated levels. Require offending dischargers to reduce discharge loads to Decree 8/1983 levels or cover over or remove sediments that are releasing offending pollutants to the water. Ignore other dischargers, at least in the short term.*

Pros

- Targets direct preservation of significant uses of water as they are affected by pollution, and thus efficiently addresses and protects uses.

- Delays major investment in control technologies until problems are identified.

- Allows evaluation of the extent of heavy metal pollution in Egypt in order to place a priority on its control.

Cons

- Requires gathering and interpreting data from a wide area prior to taking action.

- Opens the government to the (logical) criticism that some facilities are and some are not required to meet standards.

Discussion: For this problem, alternative b is recommended because it is a good combination of immediate action on heavy metals (one of the worst types of pollutants) and determination of other significant problems. The only reservation to this approach is that waterway standards may need to be more stringent in some areas to prevent the bioaccumulation of heavy metals in fish to levels of concern (see problem x), and if implemented, a cost penalty may accrue to facilities that meet the immediate clean-up mandate.

Problem 4: *What should be the strategy to control salinity?*

Explanation: Salinity increases, particularly in the Delta, limit the use of Nile water for agriculture, drinking, and to some extent, industry. Options for control are somewhat limited, except for careful management of irrigation use, and a limit on the use of water for

domestic and industrial purposes unless it can be returned clean enough to be reused which will not always be possible.

Alternatives

a) *Price water to major user to cover the cost of its management, including dams, diversions, pumps, canal and drain maintenance, water treatment, and sewage treatment.*

Pros

- Leads to rapid decline in water use if major users have to pay for their water on a pro rata basis.

- Provides incentives to reduce water loss due to inefficient water distribution systems if governorates have to pay for the water they produce through water treatment plants and a charge for water use based on the cost of the water that was treated and the cost of treatment.

- If a credit were given to governorates for reusable water discharged from fully operational sewage treatment plants or to industries for discharges from industrial facilities, then more water would be available to reduce salinity.

Cons

- Is totally impractical to measure the water distributed to individual farms or fields.

- Is totally impractical to measure the water consumed by individual users in major urban areas.

- Is difficult to estimate the total cost of maintaining water supply in Egypt, but it must be a very large amount.

b) *Manage the use of water.*

Pros

- Allows rational allocation of water to uses that are not well controlled or cannot be controlled by water pricing.

- Provides a framework for long-term planning of water requirements.

Cons

- Requires much better understanding of water needs and uses than are currently available.

- Is almost impossible to manage water use at the individual field level.

- Requires unofficial reuse to be more completely evaluated or controlled, both difficult tasks.

Discussion: Both these alternatives are required, and the GOE is committed to establishing some level of water pricing. In isolated areas, an extensive, computerized system is controlling the availability of water. While these steps are important and constitute significant improvements over past actions, emphasis must be placed on early implementation of a more geographically widespread system of water allocation, and the mechanism for pricing and charging for water use must be implemented as soon as possible.

B. ALTERNATIVES RELATED TO WATER QUALITY MANAGEMENT PROCESS

This section presents three sets of alternatives for addressing problems related to the lack of an overall management organization or process for water quality, a lack of data availability and interchange among affected individuals, and an inability to effectively enforce discharge reductions for government owned industry.

Problem 6: *There is no defined or implied process for the management of water quality in Egypt.*

Explanation: To succeed, any major long-term activity needs to be managed in the context of specific goals, with available resources channeled effectively toward those goals. This must be a continuous process in which objectives are set, actions taken, progress toward objectives measured, and corrections made when necessary. Water quality is not now being managed in Egypt.

Alternatives

a) *Hire consultants to design and carry out a water quality management program.*

Pros

- Satisfies goal of having a program.
- Is probably an effective way to overcome the apparent shortage of effective managers in the Egyptian government.
- Implements the program more quickly than might otherwise occur.

Cons

- Relegates decision making from Egyptian government to non-Egyptian, non-government staff.
- Does not encourage development of Egyptian government expertise in management.

b) *Set up working group comprising ministries involved in water quality management to develop a planning process and determine how to make it work.*

Pros

- Attains goal of having a program.

- Helps to ensure that the ministries involved in developing the process would support it after the planning was completed.

- Develops process that is sensitive to government needs and Egyptian circumstances.

Cons

- Requires sufficient experience in water quality management, which might not be available in Egypt, to understand what is needed from the group and how the plan might be implemented.

- Faces inter-ministry rivalry that may prevent the working group from completing its job.

c) *Develop water quality management process with Egyptian government staff and support from management consultants and water quality management experts.*

Pros

- Provides high level of expertise and understanding to the process where it is needed most, but does not relegate decisionmaking to non-Egyptians.

- Constitutes the most effective option for developing Egyptian staff to carry on the function once designs have been completed.

Cons

- None comes to mind.

Discussion: The need to define a process for water quality management is a critical issue. At present, few people understand what water quality management entails and how to organize it. Therefore, the development process has several requirements. First, GOE staff must be involved so they can understand what they are supposed to achieve and how to do it. This leaves only the last option, although without the advice of a few consultants, an effective program is not likely to be developed.

Problem 7: *Data management aspects of the water quality management and monitoring programs in Egypt are poor.*

Explanation: Essentially no data or data summaries are routinely available to determine trends of pollutant concentrations over time or space. Data on individual discharges from industry and sewage treatment plants generally are not available though they reportedly exist. In addition, the data has substantial gaps from a water quality management point of view.

Alternatives

a) *Construct a large, full-featured database to accept all data required for water quality management and ensure that any data generated are placed in it.*

Pros

- Locates, in one place, all data necessary for planning and compliance evaluation.
- Ensures compatibility of data among environmental and discharge monitoring programs in terms of sample handling and analytical techniques, if implemented properly.
- Allows routine development of specialized reports and analyses that show relationships among compliant dischargers, noncompliant dischargers, and water quality.

Cons

- Costs a lot to develop, but donor support is available from Denmark and Germany.
- Is not available for at least three years but is needed now.
- Is more complicated to use (because of the diversity of data that it is designed to keep) than simpler alternatives.
- Probably needs to be designed by computer scientists not currently resident in Egypt.

b) *Give priority to developing small data management teams in each area of significant data collection activity.*

Pros

- Allows the internal development of useful tools in the context of ongoing work.
- Provides additional expertise outside of data management for selecting hardware and software options and training other technical staff in computer use.

Cons

- Discourages the development of fully interchangeable data management systems across all groups involved in water quality management, inhibiting the analysis of simultaneously obtained data on discharges and the environment.
- Requires that data management staff be sufficiently familiar with the types of data being generated to be helpful in the design of appropriate data management tools in the short term.

- Requires resources for staff support in areas that may seem to be outside a particular ministry's terms of reference.

Discussion: Large, single purpose data systems are generally very hard to control. Our experience with them has never been positive, even though experts have to design and write them. In Egypt, much of the expertise might have to come from outside the country, which poses several other problems, including a lack of knowledge of the skill level of the staff who must make the system work.

Most computer-literate staff like to manipulate and analyze data themselves, and have developed a number of tools for this purpose. Thus, it seems redundant to develop a large database system that would make it more difficult for them to do so. Smaller, less complicated systems that are developed at the locations where they will be used are almost always preferable to large centralized systems. In any case, if a centralized system is developed, the tools developed in the various ministries should be useful in transferring data to the central system when necessary.

Problem 8: *There is no effective mechanism to ensure compliance among government-owned facilities.*

Explanation: In the Egyptian government bureaucracy, fines and jail sentences are not enforceable because the courts have apparently refused to hold senior managers responsible for failing to install treatment at their facilities. The managers have to have control before they can be held responsible, and unless they control the budgets, they cannot be in control.

Alternatives

a) *Set up compliance schedules for long-term development of appropriate control technologies or process modifications for GOE-owned industries and lobby treasury for annual allocations for more treatment facilities.*

Pros

- Allows focus of valuable GOE resources on most egregious factories in the short term, allowing slower progress for insignificant non-compliers.

- Stages installation of controls to meet available finances.

Cons

- Requires that sufficient knowledge be available to decide which industries in which geographic areas need attention.

b) *Require new factories to meet all standards, but allow existing GOE-owned factories to discharge until they are no longer competitive, or set secondary standards for existing GOE-owned factories that are not now in compliance.*

Pros

- Phases in better pollution control over the long term.
- Focuses attention at the design stage where pollution control is cheapest and most effective.
- Allows those with the highest costs for load reduction to minimize expenditure.

Cons

- Could perpetuate a situation in which existing factories are causing substantial damage.
- Sends wrong message by penalizing those firms that have already spent money to comply.

c) *Enforce standards only for those factories responsible for a problem (e.g., metals from electroplaters, where metal waterway standards are not being met); ignore those not discharging metals in the same area.*

Pro

- Constitutes the most selective and probably the most cost effective approach.

Cons

- May give factories in "clean" areas a competitive advantage over those in "dirty" areas.
- Allows continued water quality degradation in some areas because factories would not be forced to control discharges where there was not a significant problem, even if they were exceeding standards.

Discussion: The major problem is to decide, in a multi-agency setting, where to spend valuable resources in cleaning up pollution. At present, funds are insufficient to fix all problems, so it is necessary to focus on a few critical areas. Areas that have the most potential to improve environmental quality at the least cost should be chosen, at least initially. Option c is preferred.

C. ALTERNATIVES RELATED TO WATER QUALITY MONITORING

Egypt's water quality monitoring programs have been designed and carried out for various reasons over the years. The following alternatives relate to how the overall monitoring program might be structured.

Problem 9: *Monitoring programs are not providing enough appropriate information for water quality management.*

55

Explanation: Monitoring programs are more directed to collecting data than to answering questions about the state of water quality and how to improve it. Abundant data are available on parameters that are not problems, and very little on those that are problems. There is no interlaboratory calibration, and quality assurance procedures are limited.

Alternatives

a) *Divide monitoring activities into several areas (analyzing trends, locating "hot spots," locating sources, evaluating compliance, evaluating problems), identify staff in one ministry to be responsible for each, and give them resources to do the job.*

Pros

- Maintains focus on real goal of monitoring, rather than simply on data collection.
- Places report monitoring in the perspective of water quality management.
- Might overcome some inter-ministry rivalries.
- Clarifies directions for other monitoring programs and pollution control activities through analyses of water quality data.

Cons

- Continues to discourage data sharing, depending on how it is organized.
- Probably requires transfer of staff from one ministry to another unless one ministry is allowed to rapidly expand to meet the additional load.
- Requires management (to determine expenditures on trend analysis, compliance monitoring, etc.).

b) *Rationalize location of current monitoring activities now done in different ministries and develop coordinating mechanism to help direct individual ministry efforts.*

Pros

- Makes best use of existing programs and expertise.
- Provides direction and sets explicit goals for all monitoring programs.
- Encourages data sharing.
- Provides a forum for developing a mechanism for inter- and intralaboratory quality control.

Cons

- Relies on existing programs and staff that have ingrained approaches.

- Requires breakdown of existing barriers among ministries.

- Requires sufficient overview to help allocate resources among different areas (but no single ministry or agency has this overview).

c) *Have expatriate consultants design detailed monitoring program to be carried out by rote.*

Pros

- Provides data for decision making.

- Yields technically defensible program.

Cons

- Bases program on minimal understanding of the River Nile, canals, and drains.

- Cannot change when information needs to be changed.

- Does not reflect the real need for data but an idealized concept of what data should be developed for management.

Discussion: The monitoring issue is complicated by the fact that water quality management is dispersed among several generally uncooperative ministries. This must change. While the easiest solution would be for one ministry to assume all the monitoring functions as in alternative a, this would waste resources.

D. ALTERNATIVES RELATED TO INSTITUTIONAL ASPECTS

The situation in Egypt in which a number of ministries have roles in water quality management is not unusual. Two alternatives deal with substantial gaps in the requirements for a successful program: overall management and expertise.

Problem 10: *No single agency or ministry is charged with managing the water quality management program.*

Explanation: As described in Section III, a single body needs to have responsibility for implementing a water quality management program. The primary roles are to prioritize problems, help decide among alternative solutions, coordinate and direct remedial efforts, ensure ministries are doing as they planned, and recommend changes where needed to make the management process more effective.

Alternatives

a) *Create an organization to have overall administrative responsibility for implementing the Act, and give it executive powers over the other major parties involved (NOPWASD, GOFI, MPWWR, MH, MI).*

61

Pros

- Allows efficient allocation of resources across ministries so that the program of water quality management has consistent goals and direction.

- Assures that a single agency has responsibility to review the water quality management program to determine its overall impact and recommend needed changes.

- Provides an identified group to negotiate proposed changes in budgets, law, or regulations with various ministers to improve GOE's ability to control pollution.

Cons

- Creates an organization that directs some activities of various ministries outside the normal chain of command—a situation that might not work in Egypt.

- Does not necessarily rely on expertise in various ministries already involved with water quality management.

- Could be difficult to attract people with sufficient training and expertise to make the organization effective.

- Creates an additional organization in a situation where there are already too many organizations with different goals

b) *Give an existing ministry overall administrative responsibility to implement the law and executive powers over the other major parties involved.*

Pros

- Allows efficient allocation of resources across ministries to give the program of water quality management consistent goals and direction.

- Assures that an agency has the responsibility to review the impact of the water quality management program and recommend needed changes.

- Identifies a group to negotiate proposed changes in budgets, laws, or regulations with various ministers to improve GOE's ability to control pollution.

Cons

- Might dilute the focus of the overall water quality management efforts with other goals of the selected ministry.

- Does not necessarily rely on expertise in the ministries already involved with water quality management.

- Could be difficult to attract people of sufficient training and expertise to make the organization effective.

c) *Give an existing agency, not now involved in water quality management, overall administrative responsibility to implement the law and planning power over the other major parties involved.*

Pros

- Allows efficient allocation of resources across ministries to give the program of water quality management consistent goals and direction.
- Assures that an agency has the responsibility to review the impact of water quality management program and recommend needed changes.
- Identifies group to negotiate proposed changes in budgets, laws, or regulations with various ministers to improve GOE's ability to control pollution.
- Interferes the least with the affairs of each ministry, but still provides overall leadership.

Cons

- Adds another institution to an already confused group of institutions with roles in water quality management.
- Requires the nominated agency to expand into areas in which it has little expertise.
- Does not necessarily rely on expertise in the ministries already involved with water quality management.
- Could be difficult to attract people with sufficient training and expertise to make the organization effective.

Discussion: One group should have overall responsibility for implementing water quality management (see also, for example, the following problem). But no group currently has a mix of civil and sanitary engineers, public health specialists, chemists, aquatic biologists/ecologists, mammalian toxicologists, and lawyers to provide the integrated services necessary for an effective program. Of the options presented above, an independent agency is probably more appropriate than an existing ministry, but to create an agency expressly for this purpose appears counterproductive.

MPWWR has some of the required expertise, most of which is high quality. It is probably in the best position to take the administrative lead if a ministry were selected. To implement a full water quality management program, however, requires the redeployment (or acquisition) of a sizable staff with expertise not currently available in the ministry, which weakens the argument for selecting MPWWR. Compared to the Ministry of Health and the Ministry of Interior, MPWWR is the logical choice for a water quality management group because of its higher level of expertise in the water field. GOFI and NOPWASD would not be appropriate because their major focus is on unrelated activities (GOFI) or on the construction of water or sewage treatment plants (NOPWASD).

Of independent agencies, EEAA appears to have governmental support for this role, but it is not clear whether it can obtain the appropriate mix of expertise to carry out the role effectively, and whether other ministries would let EEAA have a leadership role in water quality management. Nevertheless, because of the momentum already established in defining EEAA's role to include overall coordination, the best solution apparently is to help EEAA develop into the management body it needs to be.

Problem 11: *There is a general lack of expertise in Egypt for implementing the water quality management program.*

Explanation: Water quality management requires a number of disciplines for effective implementation. For industrial waste, process engineers and waste treatment engineers are required; for sanitary waste, waste treatment engineers, public health specialists, and water resource engineers; for the evaluation of effects, biologists, ecologists, toxicologists, chemists, and hydrologists; for agricultural drainage, soil scientists, agronomists, and water use specialists; for monitoring, chemists, toxicologists, statisticians, and data management specialists; and for legal and enforcement issues, lawyers, regulatory analysts and policy analysts. Few of these specialists are currently involved with the water quality management program in Egypt.

Alternatives

a) *Rely on expatriate expertise for major initiatives and for areas where Egyptian agencies need major development.*

Pros

- Is immediately available.
- Provides for expertise on an as-needed basis from donors.

Cons

- Does not develop Egyptian expertise where it is badly needed.
- Does not make good use of expertise in Egypt outside of the ministries.

b) *Develop training programs for all levels of staff (junior to senior) on topics related to water quality management (toxicity testing, chemical analysis, impact analysis, regulation enforcement, etc.) and project management.*

Pros

- Uses whatever expertise is already available in Egypt
- Allows the more rapid development of effective Egyptian control over the water quality management program.
- Develops better local managers.

Cons

- Takes several years to develop sufficient expertise to manage program effectively (it took over 10 years in the U.S.).

- Requires expatriate staff to do training.

c) *Aggressively hire mid- to senior-level Egyptians with expertise in management; water quality; industrial pollution control; chemistry, biology, ecology, and toxicology; and data management and analysis.*

Pros

- Makes best use of expertise in Egypt.

- Expands base of experts routinely available to deploy on water pollution control problems.

Cons

- Expands bureaucracy past point where money is available to support it, unless existing staff are redeployed to other areas.

- Relies on available expertise which may have the wrong orientation for an effective management program.

- Could be difficult to justify additional staff.

d) *Assess available staff in ministries that are directly involved in pollution control, review the mix of disciplines available, and determine where they can be deployed most effectively.*

Pros

- Minimizes need for additional staff.

- Costs least of all options.

Cons

- Requires staff with expertise who may not wish to transfer to the ministry that needs them most.

- Requires staff that probably is not available in the numbers required.

Discussion: Water quality management is an interdisciplinary problem, but ministries in Egypt do not currently encourage interdisciplinary work. To break down these barriers, for the longer term, it would be better to obtain as many Egyptian experts as possible and locate them together so they can work on problems on a daily basis. To accomplish this, options b, c, and d are most appropriate; option a should be used only in urgent or critical situations.

E. ALTERNATIVES RELATED TO LEGISLATIVE ASPECTS OF WATER QUALITY MANAGEMENT

Several aspects of Egypt's water quality management legislation appear to be counter to the goals of the program. These are outlined below.

Problem 12: *Decree 8/1983 states that no industrial facility can discharge to waterways without treatment.*

Explanation: This decree puts a heavy emphasis on treatment for industrial wastes, but very little on treatment for sanitary wastes. The requirement that industrial facilities provide treatment is not an effective management strategy because treatment may not be necessary to meet standards for some industries, and it may be just as effective to incorporate raw material changes, process modifications, and waste recovery into a production process to achieve discharge standards as it is to install treatment.

Alternatives

a) *Remove language that requires or implies that industrial facilities must install waste treatment.*

Pros

- Allows industry more flexible approach in achieving discharge standards.
- May allow Egyptian industries to remain more competitive on international markets.
- Is correct way to change government policy.

Cons

- Requires greater effort on part of government to determine compliance with discharge standards.
- Requires modification of executive decree.
- May be seen as relaxation of an environmental standard, an action that might not be accepted with the current international focus on the environment.

b) *Do not enforce articles requiring treatment and ignore implications that treatment is required for all industrial facilities.*

Pros

- Accomplishes major intent of the law (to control discharges of pollutants) without posing unnecessary burdens on industry.

- Clearly states that government policy is for waste treatment when it is required to meet discharge standards.

Cons

- Leaves the implementing agency open to criticism that it is not enforcing the law.

- May allow inference that the government no longer thinks that waste treatment for industry is important.

Discussion: In design of decree, some confusion apparently arose about the need for treatment for sanitary wastes and for industrial wastes. Sanitary wastes should always be treated if at all possible to control pathogens. If industrial wastes meet discharge standards without treatment, then treatment should not be required. In implementing such an approach, formal amendment of the decree is recommended.

Problem 13: *To allow only three months to locate, purchase, and install pollution control equipment before penalties apply is unrealistic.*

Explanation: Identifying appropriate treatment technologies, finding suppliers, and installing and testing the equipment is time-consuming and exacting. It is unrealistic for even simple facilities to have treatment installed in three months.

Alternatives

a) *Do not enforce the three-month compliance period in the law, but negotiate compliance schedules with individual industries as appropriate.*

Pros

- Overcomes one major criticism on the "unreasonableness" of the law.

- Allows regulators to make decisions about appropriate timeframes knowing the condition of the plant, its plans to install equipment, its financial resources, and its probable effect on the environment.

- Discharge standards would more likely be met if both regulators and dischargers agreed that three months is an unreasonable time limit.

Cons

- Could be considered illegal since it appears contrary to the law's intent.

- Could raise claims in the regulated community that preferential treatment is given to certain facilities.

- Seems preferable from a legal standpoint to modify the law.

b) *Add this clause to the law: "within 90 days or a period of time approved by the Ministry of Irrigation."*

Pros

- Overcomes one major criticism on the "unreasonableness" of the law.
- Allows regulators to decide on appropriate timeframes knowing the condition of the plant, its plans to install equipment, its financial resources, and the probable effect on the environment.
- Seems more likely to be effectively implemented than the current law.

Cons

- Must be passed by the legislature.
- Could be viewed as a relaxation of standards by the legislature or the public, providing a disincentive for passage in the current international climate.
- Could generate claims in the regulated community that certain facilities receive preferential treatment.

c) *Modify the law to remove time limits for compliance.*

Pros

- Overcomes one major criticism on the "unreasonableness" of the law.
- Allows regulators to decide on appropriate timeframes knowing the condition of the plant, plans to install equipment, its financial resources, and the probable effect it is having on the environment.

Cons

- Implies that time limits are not important, removing incentives for facilities to take action. (The same can be said of the 90-day compliance period).
- Could be viewed as a relaxation of standards by the legislature or the public, providing a disincentive for passage in the current international climate.

Discussion: This is essentially a political argument. If it is possible to get the legislature to pass the suggested modification, then it should be done. If getting legislative modification is simply an impediment to getting the job done, then simply fail to enforce the law's current limits. Removing all limits makes the law unenforceable since there has to be a specified time by which treatment is done.

Problem 14: *The requirements for secondary treatment for sewage treatment plants are over restrictive.*

Explanation: The standards for sanitary waste discharges (sanitary drainage) require secondary treatment for all treatment facilities. This unnecessarily increases the cost of treatment in locations where BOD and heavy metals control are not a major consideration and creates a strong disincentive to provide any treatment in situations where primary treatment is better than no treatment.

Alternatives

a) *Transform the absolute standards to treatment plant performance standards and set a standard for primary treatment plant performance. (The secondary plant performance is already in place, but needs to be renamed).*

Pros

- Encourages the construction of treatment plants.
- Stretches limited dollars to achieve the greatest possible reduction in water-borne pathogens and parasites.
- Allows the monitoring of performance of treatment plants to ensure they are operating properly, which is more important than the absolute level of BOD and TSS in the effluent.

Cons

- Requires modifications that could be perceived as making standards less stringent, whereas in fact it better protects Egyptians from water-borne disease.
- Requires development of new standards.

b) Remove standards for sanitary sewage treatment plants entirely.

Pros

- Might encourage construction of primary treatment plants.
- Removes any possibility that primary treatment plants are violating the law.

Cons

- Is, in fact, a relaxation of standards because no mechanism then ensures that all kinds of treatment plants are operating as designed.
- Implies that sanitary sewage treatment does not have high enough priority to warrant the expense.

Discussion: There really is only one option here. The existing standards cannot stay as they are, and removing them entirely is too extreme because it implies that sanitary waste treatment is not necessary. The compromise, adding a standard for primary-treated effluents,

is the right combination of encouraging treatment while providing some control by identifying plants that are not operating properly.

Problem 15: *There is general confusion about the purpose and use of the waterway standards in Decree 8/1983.*

Explanation: Analyses of Law 48 and the implementing regulations say that dischargers should not be held responsible for the waterway standards not being met. While this is true when a discharger is meeting discharge standards and the waterway standards are not being met, it is not true that the waterway standards have no utility. They exist to indicate to the regulating agency that discharges are exceeding standards.

Alternatives

a) *Develop a document (or series of documents) that explains how to interpret the various aspects of the law and executive decrees, including waterway standards and their meaning.*

Pros

- Provides a simple way to remove confusion.
- Assists in obtaining compliance with other parts of the law if document is provided to responsible individuals in the ministries and major industries.

Cons

- Requires government support to interpret the law so that it can be consistently implemented.
- Does not have the force of law and could be unenforceable in courts for unforeseen reasons.

b) *Revise the decree to specify more clearly how waterway standards (and other standards and requirements) should be used in the regulatory program.*

Pros

- Consolidates the opinions and requirements of the law and decree in one definitive source.
- Ensures the articles are enforceable, provided the articles and explanations are carefully written.
- Removes confusion above several relatively simple points.

Cons

- Requires a re-evaluation of the law and decree to clarify all provisions.

- May not be necessary because this conclusion is based on an English translation of the law and decree. In Arabic, the meaning may be clear.

- Requires modification of the decree.

Discussion: As with the waterway standards discussion to follow, the best solution appears to be the one whereby clarifying detail is provided in the decree. Examples of the detail required are given in the article-by-article evaluation of the law and decree in Annex C.

Problem 16: *The waterway standards for drains in Upper Egypt and the northern lakes in Lower Egypt are inappropriate.*

Explanation: Drains in Upper Egypt discharge directly to the River Nile and should be subject to the same discharge standards as if effluents were discharging to the Nile. The standards are now less stringent than those for discharges to the Nile. Similarly, the standards are more lax for discharges to the northern lakes. This is totally inappropriate given the fact that fish farming and fishing is a major use of the northern lakes, and exposure to pathogens, heavy metals, and pesticides might render the fish unsafe to eat.

Alternatives

a) *Set discharge standards for different waterways that are based on the water quality necessary to protect the most restrictive uses of those waterways.*

Pros

- Defines areas where the intent is to allow the most restrictive uses (fish culture and fishing) and where no use is acceptable (open sewers).

- Allows discharge standards to be tailored to required waterway quality rather than uniformly requiring sometimes unattainable standards.

- Allows fish standards to be set in all waterways where fish are caught for human consumption, including the Nile River and branches.

Cons

- Requires more sets of standards to be defined.

- Requires more government expertise to implement, which may be unavailable.

- Costs more to implement for the government regulation agency.

- Costs more to implement for industry because standards in some places would be relaxed while those in others would be increased, probably a net increase.

b) *Give the drains in Upper Egypt and the northern lakes the same waterway standards and discharge standards as the River Nile and canals.*

Pros

- Uses a more consistent approach than the current approach.
- Relies on existing standards so new ones would not be required.
- Costs relatively less for the regulating agency and industry to implement than the previous alternative.

Cons

- Does not go far enough to allow different uses for different water bodies. Leaves only two: drinking water and fishing water, when at least one other category (open sewer) is probably needed.
- Does not allow more stringent standards for the few drains in Lower Egypt that discharge to the Rosetta Branch.

Discussion: The water quality management program has had a general lack of direction. If affected parties could agree that water uses are numerous and require different standards to implement, a dramatic move toward a rational approach to water quality management in Egypt would occur. The only way to accomplish this is to open the discussion on all standards, not just existing ones, so political decisions can be made on which waterways are useful for what. The northern lakes, for example, can be treated as fish production areas or as sanitary and industrial sewage treatment facilities, but not both. In our opinion, the former is more acceptable than the latter, but we accept that Egyptians must decide. We think that standards need to be revisited and redesigned (see next item); therefore, we encourage erecting several sets of standards, depending on the most restrictive water use proposed for a waterway.

Problem 17: *Water quality standards for waterways and discharges are based solely on the need to use the waterways for drinking water.*

Explanation: Egypt's drinking water standards strongly resemble both waterway standards and discharge standards. We infer that this means that the standards are based on the need to protect the quality of drinking water. While this is appropriate in some cases, standards to protect for fish production are usually stricter for several parameters (heavy metals, pesticides) than standards to protect drinking water. This is because heavy metals and pesticides accumulate in fish, rendering them unsafe for human consumption when they are reared in water that is a source of drinking water. The only restrictive requirement in the current standards is a more stringent requirement for fecal coliforms in the lakes that raise fish. This is not acceptable.

Alternatives

a) *Adopt standards for waterways from other countries that protect against accumulation of heavy metals and pesticides to dangerous levels in fish.*

Pros

- Is cheaper, quicker, and easier than developing standards in Egypt.
- Represents the best level of scientific advice available at the time of implementation.
- Protects waterways for fish production if the standards are met.

Cons

- Relies on standards for fish that are probably not native to Egypt and are not based on Egyptian conditions.
- Standards would be considerably stricter than existing standards for the protection of fish, and thus, more expensive for industry to meet.

b) *Do nothing about the waterway standards for fish production.*

Pros

- Does not change the status quo.
- Minimizes direct costs.

Cons

- Leaves a potential need for drastic action in a few years to revive a fishery that has been destroyed by pollution unless the discharges of metals and pesticides are seriously curtailed.
- It is better to recognize that the standards should be more stringent than can be met now than to assume that if the standards are met, everything will be fine.

Discussion: The recommended approach to this problem is to adapt standards from some other country and evaluate them as applied to local species and conditions over the next few years. Evaluating the standards with local species and conditions will reveal that some standards can be relaxed and some made more stringent, but all standards will be more stringent than those now in place. Without adopting more stringent standards, serious pollution threatens a waterway, but the impression is given that no harm can occur because all waterway and discharge standards are being met.

Problem 18: *There are no standards for herbicides, pesticides, or toxic organic compounds.*

Explanation: Acceptable water quality has been defined for many of the more standard pollutants, but no promulgated guidelines apply for acceptable levels of herbicides, pesticides, or toxic organics. This means that if these compounds are measured in waterways, there is no way to determine whether there should be concern and whether immediate action is required to protect human health.

Alternatives

a) *Develop (or adopt from other sources) standards for chemicals known to be toxic, and especially those known to persist over time.*

Pros

- Encourages controlling agency to focus on most dangerous chemicals that are commonly discharged.

- Can be done with relatively little effort if standards are borrowed from other accepted sources (U.S. EPA, WHO, etc.).

Cons

- Makes compliance evaluation more difficult because the number of pollutants requiring analysis would increase, and the analytical techniques required are more complex.

- No matter how many pollutants were added, it would not be a complete list since it could always be argued that other pollutants are just as harmful as those regulated.

- Costs too much to enforce additional standards without a much stronger GOE commitment to pollution control.

b) *Develop additional standards for toxicity, and regulate based on toxicity (not on concentrations of individual pollutants).*

Pros

- Saves on monitoring costs because toxic organics, avoiding a wide range of metals analyses.

- Avoids developing or adopting pollutant-by-pollutant standards which do not now exist in Egypt.

- Protects the environment reasonably well.

Cons

- Does not consider bioaccumulation (but then neither do existing standards).

- Requires expertise to conduct and interpret toxicity tests that is not widely available in Egypt.

- Makes control more difficult because toxic components of harmful discharges usually must be identified before appropriate control measures can be adopted.

Discussion: Egypt must continue to be aware of the threats of toxic discharges and eventually take action to prevent them. Using toxicity tests to determine whether an effluent or receiving water is toxic would be far simpler than developing water quality standards for myriad chemical compounds, especially with an ever-increasing list of potentially toxic organic compounds. Several forms of toxicity tests are available including mammalian tests that allow extrapolation of data on toxic doses to experimental organisms, to toxic doses to man, but simpler tests using aquatic organisms are just as valuable and somewhat more sensitive.

Although native Egyptian organisms have not been used (to our knowledge) to determine overall effluent toxicity, existing short-term (two-day) tests used in the United States are sufficiently stringent and repeatable to serve as suitable substitutes.

Toxicity tests could be used as a screening mechanism, as well. By testing periodically for toxicity (every six months), other chemical analyses could be done only when a discharge has failed a toxicity test. Although this is somewhat limiting in that routine data on chemical parameters might never be taken, so little data are available now that this loss is minor.

Problem 19: *Standards promulgated to protect against pathogens and parasites are too lax.*

Explanation: The standards for pathogens and parasites are based on the presence of indicator organisms: fecal coliforms. They are common in the feces of mammals; their presence in water means that the water has been contaminated with human or animal waste. With their presence, the disease-causing organisms also found in the feces of humans are probably also present. The levels allowed for fecal coliforms are too high to adequately protect against disease. The level was based on an acceptable level of pathogens for sources of drinking water that were to be treated.

Alternatives

a) *Adopt standards for parasite life stages in water.*

Pros
- Could help reduce rates of parasitic infections if actions were taken for municipal treatment plants to meet standards.

Cons
- Needs models from other countries or WHO to adapt biological standards but few exist.

- Requires laboratory capacity to analyze effluents and compare results with standards but little is available.

71

b) *Lower fecal coliform standards from an MPN of 5,000 per 100 ml to 5 for industrial waste and 50 for municipal waste. Set fecal Streptococcus standard of 5/100 ml.*

Pros

- Would help to reduce the number of water-borne parasites and pathogens that can infect humans if municipal treatment plants strove to achieve the standards.

- Comes closer to standards used in other parts of the world (where disease and parasites have been substantially controlled).

Cons

- Means an increase in the monitoring requirement for fecal bacteria.

- Does not directly address the pathogenicity of sewage.

Discussion: Discharge standards for parasites would probably not be effectively implemented, at least in the short term, because few staff are trained to do the testing, and those now involved in analytical testing commonly lack the kind of expertise required (biology, microbiology). A number of laboratories do routine testing for fecal coliforms (and it could be set up with relatively little difficulty for fecal streptococci), thus adopting a stricter standard for fecal coliforms and streptococci which would probably enhance protection of waterways from discharges of parasite eggs or other infective life stages.

Problem 20: *Fines specified in Decree 8/1965 are too low to provide an economic incentive to control the discharge of pollutants and the period to which the fine applies is not specified.*

Explanation: It is very important in any legislation to be clear about penalties. Only when penalties are commonly understood can the people affected by the law objectively decide whether they wish to comply. At the same time, if the penalties are too low, the people affected by the law will choose to pay them rather than to comply with the law. Since compliance is the aim of the law, penalties that are too low render it ineffective.

Alternatives

a) *Increase the penalties associated with violations to a more burdensome level.*

Pros

- Achieves goal of increasing the fines payable by non-complying industries.

- Might provide a suitable economic incentive for some or many industries to control discharges.

Cons

- May make little difference to non-complying private companies that find payment of a small fine is still less expensive than installing treatment.

- Requires an amendment to Law 48 which sets a cap on fines.

- Runs the risk that public factories might neither pay the fines nor control discharges, no matter what the fines are.

b) *Define a violation as each day of discharge that exceeds licensed pollutant concentration limits, assuming that if a single observation does not show compliance, then the discharge has not been in compliance since the time of the previous sample.*

Pros

- Provides a method to dramatically increase the fines payable by non-complying industries.

- Could be interpreted as complying with Law 48, and thus not requiring modification of the law.

- Would provide a suitable economic incentive for many industries to control discharges (fines could exceed LE 700,000 per year with the current fine rate).

Cons

- May not reflect a real situation in that a facility not complying on the day of sampling may not have complied over most of the time leading up to the sampling day. The scheme could thus be inequitable.

- Runs risk that non-complying public facilities might neither pay the fines nor control discharges.

c) *Set fines by the relative magnitude of violation, perhaps at a fixed amount for each 10 percent of a standards violation, or double fine for each 10 percent of standards violations.*

Pros

- Provides method to dramatically increase fines payable by non-complying industries.

- Provides suitable economic incentive for many industries to control discharges when the fines reached a certain level.

- Penalizes industries that flagrantly violate their licenses.

Cons

- Could lead to disagreements between industry and the water quality management agency over quality of the analytical results.

- Requires amendment to Law 48 because current version places a cap on allowable fines.

73

- Runs risk that non-complying public facilities might neither pay the fines nor control discharges.

d) *Institute a program to increase penalty rates with consecutive violations of the discharge standards. Penalties could double, triple, or increase ten-fold with each new, consecutive violation.*

Pros

- Constitutes method to dramatically increase the fines payable by non-complying industries.

- Could be interpreted as consistent with Law 48 and not requiring an amendment to the law.

- Provides a suitable economic incentive for all industries to control discharges when the fines reach a certain level.

- Penalizes industries that consistently violate their licenses more than those that violate only intermittently.

Cons

- Runs risk that non-complying public facilities might neither pay the fines nor control discharges.

Discussion: Setting fines according to the level of damage caused by exceeding license concentration limits has an intellectual appeal not shared by other schemes. Unfortunately, it has been very difficult to implement, and simpler schemes seem more appropriate for Egypt. Of the remaining schemes, alternative d (penalizing industries that consistently violate) seems the most equitable and the most likely to have the desired effect. Increasing the fine from LE 2,000 (as high as LE 50,000, for example) might be extremely difficult for some industries and easy for others. Large industries, particularly those that could cause the most environmental damage, could benefit most from a flat rate fine no matter what the level. Continuously doubling the fine will eventually provide sufficient inducement for installing treatment. The doubling also demonstrates that the agency implementing Law 48 is serious about controlling discharges.

SECTION V
RECOMMENDATIONS

The following recommendations are based on an evaluation of the alternatives presented in Section IV. Recommendations are in the form of an action plan outlining what needs to be accomplished over the short term and the long term. Actions are required in four major categories:

- Specific pollutant problems
- Developing management programs
- Monitoring programs
- Revisions to laws and decrees

A. ACTIONS REQUIRED FOR SPECIFIC POLLUTANT PROBLEMS

The four major pollutant areas identified in Section IV are pathogens and parasites, pesticides, heavy metals, and salinity. Approaches to dealing with these problems vary somewhat, but each approach uses available tools in the most effective way possible.

A1. Pathogens and Parasites

The action plan for pathogens and parasites is fourfold. Part A identifies acceptable practices for disposing of human wastes (feces and urine) in rural Egypt. Part B is a program to educate school teachers and the general public. Part C covers a monitoring program to identify areas where priority attention is needed. Part D deals with evaluating and upgrading existing sewage treatment plants.

Part A: Identifying Acceptable Disposal Practices for Human Wastes

1) Identify range of current practices for disposing of human wastes (such as latrines, cess pits, open sewers, drainage to streets, closed sewers).

2) Evaluate whether each practice has significant potential for people to come in contact with untreated wastes or to contaminate water with untreated wastes.

3) Develop safe alternative disposal methods for practices that are likely to infect people.

4) Set up trials of alternative disposal methods to determine their acceptability in rural areas.

5) Modify methods as needed to develop acceptance in rural areas.

75

Part B: Developing and Implementing Education Programs

1) Identify, from the implementation trials above, what methods appear acceptable to rural people.

2) Identify, as specifically as possible, the reasons rural people would alter their behavior and use alternative disposal methods.

3) Develop arguments to present in schools and on television to convince rural people to substitute safer methods for their unacceptable waste-disposal methods.

4) Develop school materials, including educational coloring books with environmental themes, and television spots that demonstrate better disposal methods.

5) Run frequent television spots (at least five per day) to influence behavior in rural Egypt.

6) Develop a course to train teachers on how to educate children to change their disposal habits and persuade their parents to do likewise.

7) Conduct several workshops for teachers in various parts of Egypt and encourage them to incorporate sanitation in their teaching programs.

8) Develop refresher courses for teachers to take every couple of years.

Part C: Identifying Areas that Need Priority Attention

1) Sample the mouths of all drains, including those discharging to drains, at least five times over six months for fecal coliforms.

2) Take the geometric mean of the data for each drain.

3) Determine those drains that have the highest fecal coliform counts (top 20 percent).

4) Inspect the drains by walk-through (or boat-through) for obvious sources of fecal coliforms (sewers without treatment, malfunctioning treatment plants).

5) If obvious untreated discharges are found, determine what is appropriate: new disposal practices, new treatment facility, or upgraded or repaired treatment facility.

6) If any works are required, put on priority list for construction.

7) If no obvious discharges are found, determine disposal practices in the community.

8) Target the community for education on new disposal practices.

9) Initiate local media campaign including radio and television spots and brochures. Once alternative disposal methods are available, begin enforcing prohibition against dumping of raw wastes into drains.

10) Using EPA recommended techniques, resample and analyze acceptable drains at mouth every year. (This duplicates recommendation in monitoring section.)

11) Resample and analyze unacceptable drains every three months, reinforcing more new disposal methods if drain is still among the top 20 percent polluted.

Part D: Identifying Treatment Facilities for Priority Action

1) Identify all sewage treatment facilities and determine the waterway into which they discharge.

2) Enter data on these facilities into a sewage treatment facility database (see Annex F).

3) Determine the operating condition of each by inspection and analysis of effluent (or get data from recent samples, if possible).

4) If operating suboptimally (< 45 percent BOD removal for primary, < 90 percent BOD removal for secondary), determine what is required to raise these selected operational parameters to acceptable operating condition.

5) Sample the waterway into which they discharge five times within six months for fecal coliforms, taking samples downstream to allow mixing with drain, canal, or river.

6) Rank non-functioning or poorly functioning facilities for priority action by the size of the discharge times the geometric mean of fecal coliforms in the discharge.

7) Evaluate ranking of pathogen loads and adjust list for the number of people who would be exposed, the feasibility of modifying existing plants or constructing new plants, and other priorities that are currently being addressed.

8) Devise a priority list for the design, construction, and operation of sewage treatment plants; for the repair of existing, poorly operating plants; and for alternative human waste disposal facilities, if required.

A2. Pesticides

The action plan for pesticides is in two parts. Part A presents the use of pesticides in Egypt, the toxicity of the various pesticides used, and recommended dosage and timing for various crops is determined. In the second, a monitoring program to determine priority actions is presented.

Part A: Pesticide Use and Recommended Use

1) Identify pesticides in use and build a conformance table for brand names and active ingredients; determine through literature reviews the relative toxicity to humans from consuming contaminated food (including fish).

2) Determine the volumes (mass) of pesticides used per year, preferably by governorate or similar geographic scale, and set up mechanism to continuously receive information for at least five years.

3) Determine the trend in use of pesticides over the last five years for the top 10 active ingredients used (or for more pesticides if the active ingredients comprise less than 75 percent by weight of total usage).

4) Through literature reviews, determine appropriate dosage rates for the top 10 active ingredients for various crops.

5) Estimate where dose rates are likely to exceed recommended dose rates for the top 10 active ingredients.

6) Determine the active ingredients that are likely to become concentrated in fish in different governorates (through leaching or runoff), based on data on usage versus recommended usage.

Part B: Pesticide Monitoring

1) Sample drains at their mouths (including at other drains) quarterly for one year and analyze for the top 10 pesticides (at least 75 percent by weight of active ingredients) used in Egypt.

2) Target areas with pesticide concentrations consistently higher than WHO standards or USEPA Water Quality Criteria (Acute) for special attention from agricultural extension staff and/or irrigation engineers.

3) Where drains have consistently high concentrations of pesticides in the first year, resample quarterly during the second and third years to see if quality improves.

4) Resample other drains yearly to determine whether significant changes are occurring in pesticide residues.

5) Where concentrations exceed standards at a given drain, resample quarterly until three consecutive samples are below standards.

6) In water where pesticide concentrations exceed standards, sample fish annually and analyze for pesticides that exceed standards.

78

7) If fish flesh exceeds safe levels as determined by WHO or U.S. FDA standards, warn local population not to eat fish or to restrict consumption of fish consistent with the magnitude of the concentrations found; target area for special attention from agricultural extension staff and/or irrigation engineers.

8) Resample fish with pesticide levels that exceed food standards every six months until they are again acceptable.

A3. Heavy Metals

The action plan for heavy metals has two parts. Part A deals with the quality of water and continuing discharges. Part B deals with sediment and fish.

Part A: Water and Discharges

1) Identify all dischargers of heavy metals (industries) and locate the waterways into which they discharge.

2) Enter data in database (see required information in Annex F).

3) Determine the compliance status of all direct dischargers to the Nile River, canals, or lakes for heavy metals.

4) For those facilities discharging to the Nile River, canals, or lakes for which there are no data to determine compliance status. sample the discharge three times for heavy metals at random intervals over three months.

5) Institute enforcement action or develop compliance schedules for all non-compliant direct dischargers to the Nile River, canals, or lakes.

6) Sample drains at their mouth that receive heavy metal discharges at random intervals over three months.

7) For drains that exceed waterway standards, identify the facilities discharging heavy metals in each drain.

8) Determine the compliance status of facilities discharging to drains exceeding waterway standards.

9) If data on compliance status is not available, sample each discharge to drains that do not meet waterway standards three times at random intervals over three months.

10) Begin enforcement action or develop compliance schedules with industries not complying with standards.

11) Monitor progress on quarterly basis, of each discharger against whom action was required until compliance is obtained for three consecutive samples.

12) Monitor compliant dischargers annually to ensure continued compliance. (This duplicates a requirement in monitoring section.)

13) To ensure continued compliance upstream, monitor at mouth, on quarterly basis, discharge of drains receiving heavy metal discharges. (This duplicates recommendation in monitoring section.)

Part B: Sediments and Fish

1) Determine the concentration of heavy metals in sediments in six samples in an arc downstream from each discharge to the Nile River, canal, or lake.

2) Determine the concentration of heavy metals in sediments at two nearby but presumably uncontaminated sites (upstream).

3) If the concentration of metals in sediments below the discharge is more than 10 times that above the discharge, sample fish from below the discharge.[1]

4) If concentrations in fish exceed recommended levels, issue warnings and close area to fishing.

5) Sample fish quarterly at locations where concentrations exceed recommended levels for food until levels are below standards for three consecutive samples; remove restrictions on fishing and fish consumption.

6) Sample sediments above and below discharges annually to ensure continued safe fishing and fish consumption.

A4. Salinity

Salinity is an irrigation and water supply problem, as well as a water quality issue. The action plan for salinity is therefore in several parts, a base program of water management and environmental actions, and a second series of specific project studies and program activities.

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[1] This value has been chosen arbitrarily. It may be better to mount a small research project to detect any relation between metal concentrations in sediments and metal concentrations in fish and use absolute values in sediments rather than relative values.

Part A: Develop a water management framework to determine actions that reduce salinity problems and increase usable water supply

1) Use established water quality objectives in the Delta in conjunction with water supply estimates to identify critical sources of salinity and water supply areas.

2) Develop alternative strategies and projects for meeting water quality objectives and achieving efficient water use. Alternative strategies include flow alteration, changes in water quality objectives, alternative cropping patterns, and farm and irrigation management.

3) Extend the SIWARE salinity and drainage model to all parts of the Delta and use it to evaluate the effect of various strategies and alternative projects on water quality and agricultural production. Analyze the costs, benefits, and environmental effects.

4) Establish pilot projects in selected areas for shifting cropping patterns, improving farm management, or using other strategies to reduce consumptive requirements and improve production.

5) Analyze pilot project results and revise pilot projects if necessary. Integrate pilot project results with alternative strategies. Select and implement specific actions developed.

Part B: Continue to evaluate official and unofficial drain water reuse and mixing projects for salinity control and development of additional water supplies

1) Take an inventory of unofficial drain water reuse and identify possible projects to mix and reuse drain water for irrigation

2) Review water supply and quality, cropping patterns, consumptive use, leaching requirements, irrigation efficiency, and drainage water quantity and quality. Use the SIWARE salinity model to assess water quality and drainage relationships and to determine the impact of unofficial reuse on water supply and quality.

3) Select a range of alternative actions for official and unofficial use and model their effects on the Delta waterways, the agricultural environment, drainage volume and salinity, and northern lakes.

4) Assess the economic, environmental, and social consequences of the actions and projects.

5) Select the projects that best meet the development goals and objectives, meet minimum environmental quality standards and can be financed, and then develop implementation plans for selected projects.

Part C: Assess minimum Delta outflow to achieve salt balance in the system and meet goals and objectives

1) Develop specific salinity outflow goals to meet northern lake requirements and avoid salt buildup or other undesirable effects in the Nile system.

2) Compile information on present and future development and water supply and use in the Delta and develop a range of alternatives.

3) Define the allowable and potential outflow and salinity levels of discharge from the Delta, utilizing the SIWARE model and other analytical tools.

4) Use this information to guide management and development of the Delta with particular reference to the role of reuse projects and unofficial use.

Part D: Identify, review, and evaluate specific measures that offer promise in increasing the usable water supply to the Nile system

Jonglei Project

1) Reassess the Jonglei project in upper Sudan. If prospects for completion are remote, remove from water supply forecasts and water quality projections.

2) If prospects are promising, review the project with particular reference to timing and impact on water supply and quality.

3) Review the environmental aspects of the project to determine if environmental consequences permit further consideration.

4) Assess the cost and benefits of the water to Egypt as a basis for a decision on whether to continue to pursue.

Bank Vegetation Removal

1) Conduct a preliminary study of the potential water savings and water quality improvements resulting from removal of phreatophytes and bank vegetation along the canal and drain banks of the Nile system. Include environmental benefits and detriments, such as elimination of wildlife habitat, aesthetics, and erosion.

2) If water will be saved and costs are low, formulate a pilot study in two areas of different density with control areas. Estimate evapotranspiration and evaporation and evaluate typical water loss and savings. Determine costs and benefits. Select most promising areas.

3) Expand to as large an area as is economically feasible.

Cropping Patterns

1) Select likely candidates and conduct preliminary studies of changing cropping patterns from high to low water using plants that will increase the net agricultural production and meet Egypt's goals for food self-sufficiency and import concerns.

2) For promising crops, develop feasibility studies to assess impact on water supply and quality and evaluate economic feasibility and social acceptance.

B. ACTIONS REQUIRED TO DEVELOP MANAGEMENT PROGRAMS

Actions required to develop management programs are organized in two parts. Part A covers the overall management and leadership of water quality management. Part B covers data management.

Part A: The Management Process and Management Organization

1) Form a committee comprising senior staff from the following organizations: MPWWR, GOFI, NOPWASD, MH, MI, AST, NRC, MA, and EEAA (EAC) to initiate negotiations for setting up a single organization with responsibility for water quality management in Egypt.

2) Develop a consensus on the roles, responsibilities, and authorities of the committee and the proposed organization, and agree on how the organization should be staffed and run.

3) Reach consensus on the roles of other member organizations of the committee, remembering that the management process requires a diversity of functions and expertise.

4) Evaluate existing detailed plans for each organization and locate any gaps, contradictions, or overlaps in proposed or ongoing activities.

5) Reassess individual priorities within ministries to determine whether the activities most important to the success of water quality management are sufficiently high in priority to be accomplished effectively.

6) Identify resources available in each organization to implement a water quality management program including staff numbers, educational level, and expertise; budgets and funding sources; and facilities and equipment

7) Identify gaps in expertise, funding, and facilities that must be filled and collectively determine where new expertise should be organizationally located.

8) Set up programs to train existing staff in areas where expertise is lacking or the level of staff expertise is too low to be used effectively.

83

Part B: Data Management

1) In the full water quality management committee, identify the data that are available from the last 10 years of sampling and analysis (but have not been generally available for analysis by any group) and agree to conditions and methodologies that will be used to bring these data into a common database, equally available to all groups who have a legitimate use for the data (including all organizations in the committee).

2) Set up a subgroup of the water quality management committee (or their nominees) to develop a consensus on the methodologies, procedures, and protocols to be used in data storage, publication, and analysis of monitoring program data as part of the water quality management program.

3) Agree on a location for a centralized database, and determine the simplest and least expensive hardware and software required to operate it.

4) Set up a schedule to convert data from the various ministry databases to the centralized database, and keep to the schedule.

C. ACTIONS REQUIRED TO REVISE MONITORING PROGRAMS

The monitoring program is organized in four parts. Part A relates to quality control. Part B lists activities to determine compliance with industrial discharge standards. Part C involves long-term trend monitoring. Part D describes groundwater monitoring. Other aspects of the monitoring program dealing with specific problems are presented in the sections dealing with those problems.

Part A: Quality Assurance/Quality Control

1) Set up a subcommittee of the multi-ministry committee described below to agree on standard procedures and protocols for sampling, sample preservation, sample storage, analytical procedures, and required recordkeeping for all parameters that are part of the water quality monitoring program. In setting these standards, the subcommittee should review the current USEPA QA/QC methodology obtained from EPA-ORD-OMSQA (Office of Monitoring Systems and Quality Assurance) and modify as necessary to reflect conditions in Egypt.

2) Require each laboratory to be involved in monitoring water quality to analyze blind standards for each parameter at least once each week and report results to all other laboratories in the program.

3) At least once every two years, conduct a round robin evaluation of analytical techniques for every laboratory involved in the program.

94

Part B: Industrial Plant Compliance Monitoring

General monitoring of industrial plant compliance is as recommended below. Portions of the monitoring program are included under the specific categories of pathogens, heavy metals, and pesticides listed previously because of the significance of those parameters to the water quality of the Nile system.

1) Find all industrial discharges to the Nile River, drains, and lakes. Enter information about each in the industrial database (see Annex F). Exempt non-contact cooling water discharge.

2) Sample each industrial waste discharge initially for compliance with standards. Analyze for permitted pollutants and for toxicity, heavy metals, pesticides, fecal coliform, pH, temperature, and TSS.

3) For each discharge found to not comply with standards, monitor quarterly until three consecutive quarters are found to comply.

4) For industries in compliance, sample yearly on a random basis 20 percent of the industries discharging more than 1,000 m^3 per day, 10 percent discharging from 500 to 1,000 and 5 percent of industries discharging less than 500 m^3 per day. Sample for permitted pollutants, toxicity, temperature, TSS, and pH.

5) If the wastes are toxic, determine source of toxicity and take remedial action. Sample quarterly for toxicity until three consecutive samples are non-toxic.

Part C: Long-term Trends

The monitoring program to determine long-term trends of water quality in the Nile River, branches, and drains is as follows:

1) At Aswan and each major river barrage and at Farasqur and Edfina on the Rosetta and Damietta Branches, sample monthly for two years at midstream at one-meter depth and bottom for pH, temperature, TDS, heavy metals, TSS, nutrients, pesticides, turbidity, DO, and fecal coliform. After two years, sample quarterly.

2) Initially and at five-year intervals thereafter undertake hotspot baseline measurements on the river and branches at 10 km intervals at midstream, one-meter depth, and bottom for the following constituents: pH, temperature, TDS, TSS, pesticides, heavy metals, turbidity, DO, and fecal coliform.

3) If constituent values in the long-term measurements or hotspot measurements have significantly changed, repeat measurements for that segment of the river to determine source and reason.

4) At the mouth of each drain, including drains flowing into other major drains, sample quarterly for one year for pH, temperature, TDS, TSS, toxicity, nutrients, turbidity, DO, and fecal coliform in addition to pesticides and heavy metals as established in those specific programs. Thereafter, sample at two-year intervals unless anomalies or values exceeding standards are found. For those, sample at quarterly intervals until concentrations return to normal values or the source and cause are found and corrective measures taken.

5) At the discharge of each drain into the northern lakes, sample quarterly for pH, temperature, TDS, TSS, toxicity, nutrients, turbidity, DO, and fecal coliform. If values significantly exceed standards or if the discharges are toxic, survey drain and sample upstream to find source and cause. Take remedial action.

Part D: Groundwater Monitoring

The general approach to groundwater monitoring is presented below. Specific requirements for monitoring include measuring parameters that are significant in pollution control, as well as those important in irrigation.

1) Identify existing wells downstream from major potential pollution sources (or in the Delta, in a loose grid, selected at random for each sampling).

2) Sample and analyze for fecal coliforms, nitrates, and total organic carbon (TOC) at least once per year.

3) With fecal coliforms above 500 MPN/100 ml, nitrates above 45 mg/l, or TOC above 200 mg/l, identify more wells in the immediate area to try to pinpoint source (with widespread contamination, immediate area may span several square kilometers).

4) Sample and analyze those wells for elevated parameter values and, if TOC is elevated, for pesticides.

5) Advise appropriate authority (NOPWASD, GOFI) of the source of identified contaminants for placement on priority list for attention.

D. REQUIRED MODIFICATIONS TO LAW 48/1982 AND DECREE 8/1983[2]

1) Develop waterway standards for the following uses: fishing and fish culture, drinking after treatment, drinking without treatment, irrigation, and open sewer. Develop discharge standards for primary and secondary treated sanitary sewage, borrowing standards, as appropriate, from other countries.

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[2] See Annex C for specific recommendations on new language in the article-by-article analysis of the law and decree.

2) Specify the target use for the Nile River and branches, each canal, each drain, and each lake so that it is clear what standards apply to what waterways. Remove definitions in the law and decree of potable and non-potable, and fresh and brackish waters.

3) Remove the requirement allowing only treated industrial waste to be discharged.

4) Extend to all waterways the prohibition against discharging raw sanitary waste to potable waterways.

5) Lower the standard for discharge of fecal coliforms to 1,000/100 ml.

6) Lower the waterway standard for fecal coliforms to 500/100 ml for all uses except drinking without treatment; lower standard for drinking without treatment to 10/100 ml.

7) For non-toxic pollutants (BOD, TSS, nitrogen, phosphorus, temperature) permit discharges above discharge standards provided that waterway standards are not exceeded.

87

ANNEX A

SUMMARY OF PRESIDENTIAL DECREE 93/1962 AND MINISTERIAL DECREE 649/1962

ANNEX A. Summary of Presidential Decree 93/1962 And Ministerial Decree 649/1962

Presidential Decree 93/1962

Chapter 1

Public Sewage System and Discharge to It

Article 1 "Sewage systems" are installations designed for collecting waste liquids from houses; factories; public, commercial, and industrial establishments; as well as leakage waters and rains for the purpose of disposing of them in a sanitary way.

The system will be considered a public system if it is established with public funds or if it follows a public road, or follows a private road open to public traffic and is connected to a public system.

Article 2 The Sewerage Department may construct a sewage system in private roads without indemnifying the owner of the road, and without collecting costs incurred from landlords who would benefit from the system.

Article 3 Buildings on roads with sewerage shall be connected to the sewerage system if they are within 30 meters of the road. *(Translation unclear on intent of the rest of this article. It probably means the following: A land owner must make the internal connection to his building within two months of notice. If this is not done, the Sewerage Department may install the connection at the expense of the land owner. A land owner can request the Sewerage Department to install the connection at his expense.)*

Article 4 Only the Sewerage Department will make the final connection of buildings to sewers, and this shall be done at the expense of landowners. Landlords whose rent is less than 5 (five) LE are exempt from this expense; landlords whose rent exceeds 5 (five) LE but is less than 10 LE are exempt from half this expense. The Sewerage Department may remove any connections in violation of this Law at the expense of the land owner.

Article 5 The Sewerage Department may connect any building (at the land owner's expense) with the sewer of another provided the sewer can withstand the additional drainage.

Article 6 No waste can be discharged to the sewer without the permission of the Sewerage Department.

Article 7 Wastes from public and industrial establishments decreed by the Minister of Housing and Utilities may not be discharged to a sewer without a license from the Sewerage Department. The Sewerage Department shall issue a license as long as the discharge conforms to the laws and regulations in force. The Sewerage Department may stop the discharge of any unlicensed wastes.

Article 8 Wastes from establishments identified in the previous article must conform to standards and specifications decreed by the Minister of Housing and Utilities (after approval by the Minister of Health). Applicable standards and specifications shall be listed in each license.

Article 9 Sample of discharge shall be taken periodically and analyzed at laboratories determined by the Minister of Health and decreed by the Minister of Housing and Utilities. The decree shall set out the procedures for decision-making after objection, re-analysis fees LE 5 [five], and the circumstances under which the fees would be refunded. A discharger may object to the results of an analysis within 1 (one) month of notification.

If a discharge does not meet the standards and specifications listed in the license, the responsible person must identify a means of treatment to bring the discharge into compliance within 6 (six) months. This time period may be extended with the approval of the Sewerage Department.

89

If there is evidence of a hazard, the person responsible must correct the problem within a time period specified by the Sewerage Department, or the Department may carry out corrective works at the person's expense.

If there is immediate danger, the Sewerage Department may request the Governor to issue a decision to stop the discharge.

Chapter 2
Water Course and Drainage into Them

This chapter consisted of 3 (three) articles, 10 - 12. All were deleted by Law 48 of 1982.

Chapter 3
General Rules

Article 13 No private sewer systems may be built except with permission of the Sewerage Department. All such systems shall conform to all technical requirements and specification decreed by the Minister of Housing and Utilities.

Article 14 Liquid wastes may not be carried in open sewers, but in sewers conforming to the requirements and specifications decreed by the Minister of Housing and Utilities.

Article 15 The Minister of Housing and Utilities, after approval of Minister of Health, shall issue a decree on standard specifications for taking and analyzing samples and the specifications and requirements for wastes to be used for irrigation and other purposes.

Article 16 Deleted by Law 48/1982.

Article 17 Fees and charges resulting from the implementation of this Law shall be collected administratively, and have privilege over the realties on which fees are due, and on their rents.

Chapter 4
Penalties and Conclusive Rules

Article 18 Sets out penalties for various types of violations.

Article 19 Deleted by Law 48/1982.

Article 20 The Sewerage Department is the responsible administrator of this Law.

Article 21 Laws 35/1946, 96/1950 and 196/1953 are superseded.

Article 22 This Law will come into force 1 (one) month after publication in the Official Journal. The Minister of Housing and Utilities shall issue regulations and decrees necessary for its implementation.

Ministerial Decree 649/1962

Chapter 1
Submitting Applications

Article 1 (a) The Department of Housing and Utilities (DHU) in each city shall be the Sewerage Department for the sewerage within its administrative area.

The DHU must specify the streets with sewers of adequate capacity to accept additional sources of waste and notify landlords to apply for sewerage connection within 2 (two) months. For new buildings, a 3 (three) month limit applies.

Landlords who don't apply within the required time shall be subject to the provisions of Law 93/1962.

(b) Landlords or their representatives should apply to the DHU.

(c) Specifies what should be in an application.

(d) The DHU shall inspect and test the discharge and determine any conditions or specifications that are necessary prior to connecting the building to the sewer. The landlord shall be notified of these conditions and specifications.

Chapter 2
Inspection and Separation Chambers

Article 2 Specifies the need for and the specifications of inspection chambers.

Article 3 Specifies general pretreatment requirements for various types of industrial wastes (solid materials, oils and greases, and other materials specified by the body in charge of the treatment works).

Chapter 3
Materials Harmful to the Sewerage

Article 4 If the DHU finds the discharge to be damaging to the sewage or sewer, it shall inform the landlord and require the sewage to be treated prior to discharge. If the landlord does not comply, then the discharge shall be stopped.

Article 5 If the discharge does not naturally drain to a sewer, upon notice from the DHU, the landlord will be responsible for pumping the waste to the sewer, including bearing the costs of plant and operation.

Article 6 Missing inspection covers shall be replaced at the landlord's expense.

Chapter 4
Sewer Extensions, Connections to Extensions, and Costs of Connection

Article 7 Specifies the DHU can extend sewerage networks to the extent allowed by budget, and will connect buildings as specified in the Law, that buildings exempted from the fee shall be connected at DHU's expense, and that connection priority will be given in paved streets.

Article 8 Defines connections and public sewers in Articles 4 and 6 of the Law.

Article 9 The cost of connection to the sewer will be collected from each establishment connected.

Chapter 5
General Provisions

Article 10 The following establishments are required to obtain a license from DHU prior to discharge:

Facilities washing wheat, grains or cereals
Tile factories
Soap factories
Slaughter houses
Dye houses
Drug and chemicals factories
Milk pasteurization factories
Radioactive processes
Photography and film developing laboratories
Wine distilleries
Macaroni factories
Booza establishments
Oil mills
Tanneries
Painting workshops
Spinning and weaving factories
Iron and steel mills

Article 11 (1) The standards applying to sewage discharged to a public sewer, water courses, or to be used for irrigation and methods of taking and analyzing samples shall be according to the rules determined by the Minister of Public Health.

(2) Canceled by Law 48/1982.

Chapter 6
Standards for Discharges to Sewers and for Land Application

First Specifies the standards and specifications (concentration limits) for liquid wastes being discharged into public sewers. See the attached table.

Second Sets out standards and specifications (concentration limits) for liquid wastes from public sewer operations, private sewer operations, and industrial treatment facilities that are to be used for irrigation or to be applied to the land. See the attached table.

Chapter 7
Method and Time Limits for Taking Samples of Liquid Wastes and Approved Analytical Laboratory

Specifies, in general, the ways to take samples, requiring samples to be taken at least twice each year from each discharge. Samples can only be analyzed at the laboratory in the Ministry of Health's Water Division.

92

ANNEX B

SUMMARY OF LAW 48/1982 AND DECREE 8/1983

ANNEX B: Summary of Law 48/1982 And Decree 8/1983

Law 48/1982

Article 1	"Waterways" means potable waters (the two branches of the River Nile and streams; feeders and canals of all levels) and nonpotable waters (drainage of all levels, lakes, ponds, closed water areas, and oozes).
Article 2	No solid, liquid or gaseous waste products shall be disposed of in waterways without permission of the Ministry of Public Works and Water Resources (MPWWR, formerly Ministry of Irrigation).
Article 3	The Ministry of Health shall sample and analyze treated wastes from establishments permitted to discharge to waterways on a periodic and on a random basis, as necessary, and report the results to the MPWWR. Sampling and analysis shall be paid for by each establishment. If the results of the analysis indicate that a discharge is not in compliance with standards and specifications of the license and the discharge does not pose immediate danger, then the establishment shall have 3 (three) months to correct the problem. If it is not corrected within three months, MPWWR shall withdraw the license. If the discharge poses immediate danger, then the problem shall be fixed immediately by MPWWR, at the establishment's expense, or the license shall be withdrawn
Article 4	No license shall be given to an establishment during construction unless suitable treatment units are built to commence operating when the building begins operation. Existing buildings have 1 (one) year to install suitable treatment units.
Article 5	Owners of residential or tourist vessels on the Nile River shall not discharge wastes to the river, but to cesspits. If found to discharge to the river, an owner has 3 (three) months to introduce a means of collecting the wastes on board. Should the collection system not be provided in this time, the license shall be withdrawn.
Article 6	MPWWR is responsible for issuing licenses to new vessels and for renewing existing licenses.
Article 7	Vessels used for transportation or tourists shall not allow the leakage of fuels into waterways and shall also be subject to Article 5.
Article 8	The Sewerage Department shall construct one or more model units for treating waste products of factories, houses, other buildings, and vessels to demonstrate the kinds of units that would result in discharges that conform to the specifications and measures in this law.
Article 9	License applicants shall provide an inspection certificate from the Sewage Department indicating acceptable performance of installed treatment units.
Article 10	The Ministry of Agriculture should determine that a chemical used as a pesticide shall not result in waterways pollution while spraying, washing of spraying equipment or containers, or as drainage from sprayed land according to measures agreed upon by the Ministry of Agriculture, MPWWR, and Ministry of Health.
Article 11	The MPWWR should not allow the water in a waterway to be used after a chemical has been used to control weeds until it is ascertained that it is safe to do so.

Article 12	No ditch water may be re-used unless its fitness for re-use has been demonstrated. The Ministry of Agriculture shall, after consultation with the Ministry of Health, treat ditch waters that will be re-used.
Article 13	Police in the Ministry of Interior shall inspect along the waterways, and assist Ministries who have responsibility for implementing this law by reporting on violations and removing pollution sources.
Article 14	A special fund with income from levies, fines, and cost remuneration will be set up to finance the costs of implementing this Law.
Article 15	The executive regulations implementing this Law shall define levies and expenses due under this Law. Levies should not exceed the limits shown in the attached table *(not available)*.
Article 16	Sets out penalties for violations.
Article 17	The MPWWR shall issue executive regulations, after consultation with other concerned ministries, within 3 (three) months.
Article 18	Cancels Articles 10,11,12,16 and 19 of Law 93/1992.
Article 19	Irrigation Engineers, to be specified by order of the Minister of Justice, with agreement of the Minister of Irrigation, will have police power in matters of violation of this law.
Article 20	This will become law 3 (three) months after publication in the Gazette.

Section 1
Definitions

Article 1 Defines terms relating to all surface water and ground waters in Egypt; defines solid wastes and liquid wastes; defines establishments (as the locations of all commercial or industrial locations, including rental establishments).

Section 2
Licenses to Discharge Treated Liquid Wastes into Waterways

Article 2 Solid wastes of any kind cannot be stored on the banks of waterways without a permit from the Ministry of Irrigation.

Article 3 Chemical or poisonous substances cannot be stored, dumped, or discharged to waterways without a permit from the Ministry of Irrigation.

Article 4 Industrial wastes discharged into waterways must not contain any chemical insecticide, radioactive material, or materials that float or could be harmful to humans, animals, plants, fish, or birds; which affect water potability, or domestic, industrial, or agricultural water use.

Article 5 River vessels may discharge wastes into potable waterways after obtaining a license, treating to standards set out in the accompanying table, and paying a fee (replacement brought about by Ministerial Decree 43/1985). Among other requirements, the waste must be sterilized, the discharge point should allow for sampling prior to discharge, the Ministry of Health shall have the right to inspect and take samples, detailed plans of the treatment unit must be submitted with a license application, and the vessel may discharge the waste only while moving.

Article 6 The Ministry of Irrigation may authorize discharging treated industrial liquid wastes into underground water reservoirs under the conditions specified in this regulation.

Article 7 Cooling water discharge may not be authorized except if it is taken from the same waterway into which it discharges (or one with similar water quality), and is used in a completely closed system (non-contact cooling water). It must otherwise comply with appropriate standards except for temperature and oil and grease.

Article 8 Radioactive materials may not be discharged to ground water.

Article 9 Discharge pipes must be above water level, easily accessible, and obvious.

Article 10 A discharge should not occur to a waterway less than 3 km above a drinking water intake, nor less than 1 km below it.

Article 11 Drinking water purification filter backwash must be treated before discharge.

Article 12 Applications for discharge permits shall be submitted to the appropriate regional Irrigation Inspector. Also specifies the required contents of an application, and deposits required.

Article 13 Inspections and technical studies shall be kept by the regional Irrigation Engineer.

Article 14 The regional Irrigation Engineer must obtain the results of analyses, and the extent of their conformance with standards, from the Ministry of Health.

96

Article 15 The Ministry of Health shall take samples of the waste, analyze them, and report the results to the Ministry of Irrigation.

Article 16 Licenses shall be issued by the General Manager of the General Irrigation Department after technical inspections and chemical analysis results have been received.

Article 17 Sets out the contents of a license.

Article 18 A license may be in effect for no more than two years, and must be renewed at least two months before expiry.

Article 19 When a license is issued, the MPWWR, the applicant, Ministry of Health, and the Water Police (Ministry of Interior) should all receive copies.

Article 20 If a license application is rejected, the MPWWR shall notify the applicant with reasons within 60 (sixty) days of submittal. The applicant has 15 (fifteen) days after notification to appeal.

Article 21 If an appeal is received, the MPWWR shall investigate the appeal and issue a final determination within 30 (thirty) days. Such determinations are final.

Article 22 The penalties in Law 48 apply to all violators of this decree.

Article 23 If a license is lost, MPWWR will issue a new one for 10 (ten) E.

Section 3

The Control of Compliance with License Conditions

Article 24 The Ministry of Health shall sample and analyze each discharge at least once every three months. The samples shall be taken at different times.

Article 25 The MPWWR may request the Ministry of Health to sample and analyze treated wastes on dates considered appropriate by the MPWWR, in addition to the samples listed in Article 24.

Article 26 Sets out the information that the Ministry of Health must provide to the MPWWR on samples analyzed.

Article 27 If discharges exceed standards to such a degree that there is immediate danger (undefined in the Law or Decree), the MPWWR shall notify the establishment to correct the problem immediately, and if this is not done, then the Ministry shall have the right to correct the problem and charge the establishment for the cost.

If this occurs, the license may be withdrawn or the discharge stopped, and the Water Police and local government authorities shall be notified to effect such decisions.

Article 28 If discharges exceed standards and there is no immediate danger, the MPWWR shall notify the establishment who then has three months to correct the problem.

Article 29 The MPWWR shall advise the Ministry of Health of actions taken under Article 28 and the Ministry of Health shall take a sample on the day following the three-month period, and after analyzing it, shall forward the results to the MPWWR [illegible] the appropriate form.

Article 30 If the analyzed samples (Article 29) do not meet appropriate standards, or appropriate treatment has not been installed, the MPWWR must withdraw the license.

Article 31 Establishments discharging at the time this decree comes into effect must notify the MPWWR about aspects of the establishment and its discharges.

Article 32 The MPWWR shall maintain records on establishments at Irrigation Engineering Centers.

Article 33 The MPWWR shall modify its records on receipt of the notifications specified in Article 31, and shall notify the Department of Health to sample and analyze the discharges.

Article 34 The Ministry of Health shall notify the applicant and the MPWWR of the results of sample analysis.

Article 35 The owner of the establishment must treat wastes to meet applicable standards within one year of this decree.

Article 36 After the period indicated in Article 35 expires, the Ministry of Health shall sample and analyze the effluent and report the results to the applicant and the MPWWR.

Article 37 The MPWWR shall withdraw the license of any establishment that has not complied with the requirements of Article 35. Penalties specified under Law 48 may also be applied.

Article 38 The MPWWR alone has the right to license the construction of building any establishment that will discharge wastes to a waterway. The applicant must also comply with requirements of other agencies or Ministries.

Section 4
Houseboats and Other Vessels

Chapter 1 Houseboats

Article 39 Defines houseboat.

Article 40 As of the effective date of this decree, the MPWWR will issue licenses for the construction of new houseboats, and the re-licensing of existing houseboats, after approvals have been obtained from others involved in these matters.

Article 41 Sets out contents of applications for houseboat construction permits.

Article 42 Indicates that the Irrigation General Manager or Nile Irrigation Inspector of MPWWR have the authority to issue licenses, and specifies the contents of a license.

Article 43 Licenses must be renewed 3 (three) months before they expire.

Article 44 Damaged licenses can be replaced.

Article 45 Staff of the MPWWR should inspect houseboats at least every three months, and require violations to be fixed within three months.

Article 46 After a notice of violation and a 3-month period as specified in Article 45, the houseboat shall be reinspected. If it is still in violation, the license shall be canceled.

Article 47 The MPWWR shall record information about license applications and approvals at the Irrigation Engineering Centers or the Nile Irrigation Inspectors (Headquarters?).

Article 48 Owners of houseboats must apply for a license, giving information about ownership and other things within three months of the decree being published.

98

Article 49 The MPWWR shall inspect vessels submitting applications and make a determination on their suitability for license.

Chapter 2 Other Boats

Article 50 For applying Article 7, each floating plant (barge and tug) shall be considered the machine, whatever its purpose.

Article 51 Articles 39 to 49 are equally applicable to other boats, except that the license period shall be 3 (three) years.

Article 52 Water Police shall determine what house boats and river units improperly dispose of their waste and report them to MPWWR. The MPWWR can inspect without notice whenever vessels are present in anchorage.

Article 53 The MPWWR has the right to notify the Water Police to investigate contraventions of the law.

Article 54 MPWWR has the right to notify the Ministry of Health to take samples of house boat and river unit discharges, and report on their compliance with appropriate standards of discharge.

Section 5
Taking and Analyzing Samples

Article 55 Authorized staff of the MPWWR and the Ministry of Health may enter any establishments to inspect discharges, take samples, and investigate violations.

Article 56 Sets out conditions for taking samples.

Article 57 Specifies that the Ministry of Health laboratories shall analyze all samples immediately, and if storage is required, what storage conditions shall be.

Article 58 Specifies where and how samples are to be taken.

Article 59 Specifies record keeping requirements for the sample taker.

Section 6
Standards

Articles 60 - 69 Set out specific standards for water courses and discharges. The wording that is significant is that no discharges can be licensed to discharge into waterways that do not meet the standards indicated. The various standards are provided in a separate table. Also, Article 67 requires that sanitary drainage water or discharges containing sanitary drainage water shall be chlorinated.

Section 7
Special Fund for Charges and Fines Proceeds

Articles 70 - 80 Lay out conditions and considerations for management of a fund that receives revenue in the form of fines and fees and has expenditures relating to correcting problems and otherwise supporting the enforcement of Law 48.

Section 8
General Provisions

Articles 81 - 83 Set fees and establish the effective date of the decree.

ANNEX C

ARTICLE-BY-ARTICLE ANALYSIS OF LAW 48/1982 AND DECREE 8/1983

ANNEX C. Article-by-Article Analysis of Law 48/1982 and Decree 8/1983

Law 48/1982

Article 1	Remove the definitions of "fresh" and "unfresh" water bodies. These provide confusion for drains in Upper Egypt that discharge back to the Nile and for the northern lakes. Both require more stringent standards than are allowed under these definitions.
Article 2	OK
Article 3	It is desirable to expand laboratory capacity beyond that available in the Ministry of Health. Alternative language: "The Ministry of Health Laboratories or laboratories certified by the Ministry of Health are to carry out periodic sample analyses of effluents from establishments licensed to discharge into a waterway." The remaining part of this article is acceptable as is.
Article 4	The following is alternative language to clarify the intent of the first paragraph of this article: "When in the public interest, the Ministry of Irrigation may allow the construction of establishments that will discharge industrial wastes provided the wastes to be discharged to waterways will conform to discharge standards set in accordance with this law."
Article 5	The following is alternative language to clarify the intent of the first paragraph of this article: "Owners of residential, tourist, or other floating vessels on the River Nile or branches must treat all wastes prior to discharge. If treatment is not available on the vessel, the wastes must be stored and disposed of into a sewerage system or sanitary drainage collection point."
Article 6	OK
Article 7	OK
Article 8	Delete this provision. It is unrealistic.
Article 9	New facilities should be inspected, but not necessarily any treatment units (they may not be necessary). Alternative language: "The applicant for a license must demonstrate to the Ministry of Irrigation that the discharge will comply with discharge standards."
Article 10	The current provision is vague and should be replaced with "The Ministries of Health, Agriculture, and Irrigation shall determine, by mutual agreement, which pesticides shall be acceptable for use, on what crops, and at what dose rates. This information shall be specified by joint decree of the three Ministers, and shall be made available to all farmers through announcements on television, radio, and newspapers and by labels on pesticide containers. Use of pesticides on unacceptable crops, or at unacceptable doses shall be punishable by fines of LE 100, a jail term not exceeding 60 days, or both. The penalty shall double with each consecutive violation."
Article 11	Delete this article. Article 10 adequately covers this provision.
Article 12	OK
Article 13	Article 19 also gives Irrigation Engineers police powers. Irrigation Engineers and Water Police both should be mentioned here. Alternative language: "The Water Bodies Police in the Ministry of Interior and Irrigation Engineers have authority to inspect facilities, gather evidence, and arrest violators under this law."

icle 14	OK, but may need modification depending on the proposed law giving EEAA (CEA) additional responsibilities for finance.
Article 15	OK
Article 16	The fine is too low to be effective. Alternative language: "...In case of repeated violations, the penalty shall be doubled with each consecutive violation."
Article 17	OK
Article 18	OK
Article 19	Delete. Already covered in Article 13.
Article 20	OK

102

ANNEX C. Article-by-Article Analysis of Law 48/1982 And Decree 8/1983 (continued)

Decree 8/1983

Article 1	OK
Article 2	OK
Article 3	OK
Article 4	This provision is overly restrictive because everything added to water is detrimental to some aspect of water quality at sufficiently high levels. The missing words here are "must not contain any chemical insecticides, radioactive materials, or materials which are suspended or float on waterways, or any other material in such amounts as to cause harm to humans, animals, plants...". In fact, the words "must not contain any material in amounts that cause harm..." is simpler and just as valid. In any case, while the intent is clear, standards should be developed for this, and should include groundwater (see Article 8). If the standards are simply incorporated into discharge licenses, then this article is unnecessary.
Article 5	This article is too restrictive. A possible alternative: "It is prohibited to license the discharge of any untreated or raw human or animal wastes into any waterway or groundwater reservoir." If the waste is treated to a sufficient degree, no harm is posed by its discharge to any waterway. Since drains often discharge to the "fresh" water in this article, it does not make sense to restrict discharges to fresh water only.
Article 6	Let article 5 cover human wastes and article 6 cover industrial wastes. This article is also too restrictive. If industrial wastes meet standards, there is no reason for them to be treated. Alternative language: "It is prohibited to license the discharge of an industrial waste into a waterway or groundwater reservoir unless it meets the discharge standards and conditions of this decree."
Article 7	OK, but could be handles more simply as a column in a standards table. See below.
Article 8	Combine this article with article 4. This article prohibits discharges of radioactive materials "and the like" into groundwater. It should be combined with the same prohibition for surface waters.
Article 9	OK (except remove the adjective "treated")
Article 10	OK, but 1 km downstream seems excessive. 300 or 400 m (except remove the adjective "treated")
Article 11	It should not be necessary to specify that treatment is required. Discharge standards should be enough. In this particular case (drinking water filter back-wash), it may be necessary to point out to irrigation engineers that periodic back-washing is necessary and that the quality of the back-wash is not generally acceptable for direct discharge, but not in a separate article.
Article 12	OK, provided the deposits are at a level sufficient to cover costs of sampling, analysis, and enforcement.
Article 13	OK, but Irrigation Engineers will need training to be able to carry this out.
Article 14	It would be better to "get the opinion of a laboratory certified by the Ministry of Health for the taking and analysis of samples of liquid wastes..." rather than require only the Ministry of Health to do the analyses.

Article 15	Provided the Ministry of Health takes the samples and distributes them to appropriate laboratories for analysis, it doesn't matter who does the analysis. Alternative language: "The Ministry of Health is responsible for taking samples of liquid effluents at times it will choose, and for informing the Ministry of Irrigation of the analytical results and its opinion according to the format cited in Article 26 of this Decree."
Article 16	OK
Article 17	OK
Article 18	Two years is a very short license period. A five-year period is more appropriate, particularly if long-term compliance schedules are set up in individual licenses (see below)
Article 19	OK
Article 20	OK
Article 21	It would be better to hold a public hearing to decide the case or submit to arbitration, mediation, or similar conflict resolution techniques. The article as it stands gives absolute power to the Ministry of Irrigation, always a difficult responsibility to bear.
Article 22	OK
Article 23	OK, but trivial. Why does a factory need a valid copy of their license?
Article 24	Replace the "The Ministry of Health" with "A laboratory certified by the Ministry of Health." Remove the word "treated."
Article 25	Replace the "Ministry of Health" with "a laboratory certified by the Ministry of Health." Remove the word "treated."
Article 26	Replace the "Ministry of Health" with "a laboratory certified by the Ministry of Health." Remove the word "treated."
Article 27	The major change that must be made to this article is that the Ministry of Health need not be involved on a case-by-case basis in determining whether "an immediate danger" is presented by a particular discharge. Rather, general guidelines should be decreed as to when it would be appropriate for MPWWR to take immediate action. If pollutant concentrations were more than 5 times the licensed limits, for example.
Article 28	Replace "within 3 months of the date of notification" with "within a time period specified by the Ministry of Irrigation."
Article 29	As the result of taking enforcement action against a facility, MPWWR may set up a compliance schedule, and thus a three-month automatic sampling scheme might not be appropriate. Samples should be taken by a laboratory certified by the Ministry of Health at the request of MPWWR at a time that is appropriate. Alternative language: "The latter will undertake collection of a new sample on the day following the end of the period of time mentioned in the previous article, analyze..."
Article 30	Should be changed. Three months is inadequate time to install and perfect the operation of most treatment processes. An order to stop discharging should only be issued if the facility does not meet the time schedule mentioned in article 28.

Article 31	OK, but no longer relevant.
Article 32	OK, but should include the records associated with compliance samples, inspections, notices of violations, fine exacted, etc.
Article 33	OK, but no longer relevant.
Article 34	OK, but no longer relevant.
Article 35	No longer relevant, and may not be a sufficient time to install appropriate treatment at some facilities.
Article 36	OK, but no longer relevant.
Article 37	Should be more like Article 30, but is no longer relevant anyway.
Article 38	There may be some confusion about this article. In one translation, it seems to imply that all the permits and licenses required to build a new factory must be organized by the MPWWR. In this translation, MPWWR does not appear to need to coordinate all permits, although it clearly states that MPWWR must be the last permit obtained, with all other permissions being obtained first. It is not clear why either of these points is significant, and therefore this article should be eliminated.
Article 39-54	Cover much the same ground as the previous articles. The only difference is they relate to river vessels. It makes more sense to define the process for all dischargers first and then include only the special provisions for river vessels than to repeat most of these again.
Article 55	OK, but should include river vessels.
Article 56-59	This is not sufficient detail for guidance on sampling and analysis. It would be more appropriate to reference a standard, widely available set of procedures such as STANDARD METHODS FOR THE ANALYSIS OF WATERS AND WASTEWATERS and ensure that there is training on sampling and analysis for all organizations that will be involved in it. Specifying the level of detail that is here leads one to believe that what is printed is all one needs to do to sample. Much more guidance is necessary.
Articles 60-69	All standards need to be revisited. Not only are the standards inconsistent, but it is not clear to what they relate. It would be better to erect a single, large table that has both waterways standards and discharge standards. Such a table appears in the following Annex. To avoid confusion, specify the names of parameters in English (according to the way they are given in Standard Methods), unless a conformance table between the Arabic names and English names are given. Translations of the law are very confusing, and the Arabic version would be confusing to people using Standard Methods as to which parameters to measure for.

ANNEX D

COMPARISON OF EGYPTIAN STANDARDS WITH EACH OTHER AND U.S. AND WHO STANDARDS

ANNEX D. Comparison of Egyptian Standards with Each Other and US and WHO Standards

	Ministerial Decree 9/1989			Ministerial Decree 8/1983												
				Discharges to Fresh Waters						Non-fresh Waters						
	Discharges	Land application		Industrial Wastes				Drains	Ambient	Discharges		Ambient				
	To	Sandy	Clay	Discharge to Upper Nile		Discharge to Delta		for mixing	Fresh				Drinking	MCLs	WHO	WHO 1984
	Sewers	Soil	Soil	> 1,000 cm	< 1,000 cm	> 1,000 cm	< 1,000 cm	with fresh	Waterways	Sanitary	Industrial		Water	USA	Egypt	
Dissolved oxygen								≥5	>5	>4		>4				
pH	6 > 10		6 ≥ 9	6 > 9		6 > 9		7 > 8.5	7 > 8.5	6 ≥ 9	6 > 9	7 > 8.5	6.5 ≥ 9.0		6.5 ≥ 9.2	6.5 ≥ 8.5
Total dissolved solids	2,000		2,000	1,200	1,500	800	1,000	500	500	2,000	2,000	650	1,500		1,500	1,000
Fixed ash of dissolved solids				1,100	1,000	700	900									
Total suspended solids	500		80	30	40	30	30			50	60					
Fixed ash of suspended solids				20		20										
Biochemical Oxygen Demand	400		60	30	40	30	30	10	6	60	60					
Chemical Oxygen Demand (dichromate)	700		50	40	60	40	40	15	10	80	100					
Sulfides (as S)	10	1	0.1	1		1				1	1					
Sulfate	1			1					200				400	400	400	400
Cyanide	0.1		0.1					0.1	0.1		0.1		0.05	0.2	0.05	0.1
Phosphate	5			1		1		1			10					
Organic nitrogen									1							
Ammonia (as N)	100							0.5	0.5							
Nitrate	30			30	40	30	30	45	45	50	40		45	10	45	45
Fluoride	1			0.5		0.5		0.5	0.5		0.5		0.8	4	0.8	1.5
Phenol	0.005			0.002	0.005	0.001	0.002	0.02	0.02		0.005	0.005	0.002		0.002	
Residual chlorine	10			1		1										
Chlorides													600		600	250
Formaldehyde	10															
Oils, greases, and resins	100	10	5	5	10	5	10									
Oils and greases								1	0.1	10	10					
Detergents				0.05		0.05		0.5	0.5			0.5				
Total alkalinity								50 ≥ 200	20 ≥ 150							
Coliforms, MPN/100 ml				2,500		2,500		5,000		5,000	5,000	5,000		1		
Tannin and lignite								0.5								
All metals (includes † items)				1		1				1	1					
Aluminum														1	0.2	0.2
Arsenic				†0.05		†0.05		0.05	0.05				0.05	0.05	0.05	0.05
Barium														2		
Cadmium				†0.01		†0.01		0.01	0.01				0.01	0.005	0.005	0.005
Chromium				†0.05		†0.05		0.01	0.05					0.1	0.05	0.05
Copper				†1		†1		1	1				1.5	1.3	1	1
Iron				†1		†1		1	1				1		1	0.3
Lead				†0.05		†0.05			0.05				0.1	0.05	0.05	0.05
Manganese				0.5		0.5		1.5	0.5				0.5		0.5	0.1
Mercury				†0.001		†0.001		0.001	0.001				0.001	0.002	0.001	0.001
Nickel				†0.1		†0.1								0.1		
Selenium									0.01				0.01	0.05	0.05	0.01
Silver				0.05		0.05								0.05		
Silver, mercury, brass, nickel, zinc, chromium, cadmium, and solder	(< 50 m3/day (> 50 m3/day															
Silver plus Mercury	1															
Zinc				1		1		1	1				15		5	5
Pesticides, total										None	None					

107

ANNEX E

INFORMATION FOR INDUSTRIAL DATABASE

ANNEX E. Information for Industrial Database

- Name of firm
- Location
  - Governorate
  - City, town, or village
  - Street and number
  - Latitude and longitude
- Waterway type
  - River
    - Main, Damietta, Rosetta
    - River kilometer
  - Drain
    - Drain name
      - Drain discharges to
        - Lake (Name), River Nile (or branch), Mediterranean Sea
        - Distance to lake, river, or sea
  - Sewer
    - Name of treatment plant receiving sewer
      - Treatment plant discharges to drain to
        - Lake (name), River Nile (or branch), Mediterranean Sea
        - Distance to lake, river, or sea
  - Lake
    - Lake name
  - Mediterranean Sea
  - Land
    - Latitude and longitude of disposal site
    - Area of site
    - Underlying aquifer
  - Groundwater
    - Latitude and longitude of discharge well
    - Aquifer
- Primary manufacturing process
  - Steam electricity production, petroleum refining, pharmaceutical production, tanning, pulp and paper, cement production, iron and steel, brick making, electroplating, food processing, fertilizer manufacture, pesticide manufacture, plastics and organic chemicals manufacture, spinning, weaving, ginning, textile dyeing, other (specify)
- Operational mode
  - Continuous
  - Batch
    - For each kind of batch produced
      - Frequency
      - Discharge per batch
      - Discharge characteristics (see below)
- Volume of discharge
  - Maximum, minimum, and mean
- Treatment used
  - Sedimentation, precipitation, dissolved air flotation, distillation, air stripping, reverse osmosis, other (specify), none
  - Biological
    - Activated sludge, oxidation ponds, trickling filter, other (specify)

109

- Discharge characteristics (monitoring)
  - Toxicity (LC50)
  - Heavy metals
    - Cadmium
    - Copper
    - Hexavalent chromium
    - Cobalt
    - Lead
    - Nickel
    - Mercury
    - Selenium
    - Zinc
  - Toxic organics
  - Cyanide
  - BOD
  - TSS
  - TDS
  - Total N
    - Kjehldahl N
    - NO3
    - NO2
  - Total phosphorus
- Inspection results
  - Date of last inspection
  - Compliance status at last inspection
    - No attempt to comply; Making good faith effort, but substantially noncompliant; Substantially compliant, but with a few minor exceptions; Compliant
  - Facility evaluation
    - New (last 10 years)
      - Well maintained; Maintenance OK; Poorly maintained
    - Medium (10 to 25 years)
      - Well maintained; Maintenance OK; Poorly maintained
    - Old (more than 25 years)
      - Well maintained; Maintenance OK; Poorly maintained

110

ANNEX F

INFORMATION FOR SEWAGE TREATMENT PLANT DATABASE

ANNEX F. Information for Sewage Treatment Plant Database

- Name of treatment plant
- Location
  - Governorate
  - City, town, or village
  - Street and number
  - Latitude and longitude
- Waterway type
  - River
    - Main, Damietta, Rosetta
    - River kilometer
  - Drain
    - Drain name
      - Drain discharges to
        - Lake (Name), River Nile (or branch), Mediterranean Sea
        - Distance to lake, river, or sea
  - Lake
    - Lake name
  - Mediterranean Sea
  - Land
    - Latitude and longitude of disposal site
    - Area of site
    - Underlying aquifer
  - Groundwater
    - Latitude and longitude of discharge well
    - Aquifer
- Population served
- Industries discharging to sewers
- Design capacity
- Volume of discharge
  - Maximum, minimum, and mean
- Treatment used
  - Sedimentation, precipitation, dissolved air flotation, distillation, air stripping, reverse osmosis, other (specify), none
  - Biological
    - Activated sludge, oxidation ponds, trickling filter, aqua life, other (specify)
- Discharge characteristics (monitoring)
  - Toxicity (LC50)
  - Heavy metals
    - Cadmium
    - Copper
    - Hexavalent chromium
    - Cobalt
    - Lead
    - Nickel
    - Mercury
    - Selenium
    - Zinc
  - Toxic organics
  - Cyanide
  - BOD
  - TSS

- TDS
- Total N
  - Kjehldahl N
  - NO3
  - NO2
- Total phosphorus
- Fecal coliform
- Fecal streptococci

Inspection results

- Date of last inspection
- Compliance status at last inspection
  - No attempt to comply; Making good faith effort, but substantially noncompliant; Substantially compliant, but with a few minor exceptions; Compliant
- Facility evaluation
  - New (last 10 years)
    - Well maintained; Maintenance OK; Poorly maintained
  - Medium (10 to 25 years)
    - Well maintained; Maintenance OK; Poorly maintained
  - Old (more than 25 years)
    - Well maintained; Maintenance OK; Poorly maintained