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**ARAB REPUBLIC OF EGYPT**  
**CHANNEL MAINTENANCE PROJECT**  
**STAFF APPRAISAL REPORT**

May 29, 1986

Projects Department  
Europe, Middle East and North Africa Region  
Agriculture I

## CURRENCY EQUIVALENTS

Currency Units:		Egyptian Pound (EE)
EE 1.00	=	US\$0.75
US\$1.00	=	EE 1.33
EE 1.00	=	100 Piastres (PT)

(As of October 1985)

## WEIGHTS AND MEASURES

<u>Egyptian and/or Metric Units</u>		<u>English/US Units</u>
1 feddan (fed)	=	1.038 acres (ac)
1 kilometer (km)	=	0.621 miles (mi)
1 meter (m)	=	3.281 feet (ft)
1 square kilometer (km <sup>2</sup> )	=	0.386 square miles (sq m)
1 cubic meter (m <sup>3</sup> )	=	35.315 cubic feet (cu ft)
1 metric ton (m ton)	=	2204.623 pounds (lbs)
1 kilogram (kg)	=	2.205 pounds (lbs)
1 liter (l)	=	1.057 quarts (qts)

## GOVERNMENT OF ARAB REPUBLIC OF EGYPT FISCAL YEAR

July 1 - June 30

**PRINCIPAL ABBREVIATIONS AND ACRONYMS USED**

<b>AWP</b>	<b>= Annual Work Program</b>
<b>CAO</b>	<b>= Central Audit Organization</b>
<b>CMB</b>	<b>= Channel Maintenance Board</b>
<b>EDC</b>	<b>= Egyptian Dredging Company, Ministry of Irrigation</b>
<b>EPADP</b>	<b>= Egyptian Public Authority for Drainage Projects, Ministry of Irrigation</b>
<b>FAO/CP</b>	<b>= Food and Agricultural Organization/World Bank Cooperative Program</b>
<b>GOE</b>	<b>= Government of Egypt</b>
<b>HAD</b>	<b>= High Aswan Dam</b>
<b>ICB</b>	<b>= International Competitive Bidding</b>
<b>IDC</b>	<b>= Irrigation and Drainage Company, Ministry of Irrigation</b>
<b>IFAD</b>	<b>= International Fund for Agricultural Development</b>
<b>IPSA</b>	<b>= Irrigation Public Sector Authority, Ministry of Irrigation</b>
<b>IS</b>	<b>= Irrigation Sector, Ministry of Irrigation</b>
<b>LCB</b>	<b>= Local Competitive Bidding</b>
<b>MEC</b>	<b>= Mechanical Excavation Company, Ministry of Irrigation</b>
<b>M&amp;E</b>	<b>= Monitoring and Evaluation</b>
<b>MIS</b>	<b>= Management Information System</b>
<b>MOA</b>	<b>= Ministry of Agriculture</b>
<b>MOI</b>	<b>= Ministry of Irrigation</b>
<b>O&amp;M</b>	<b>= Operation and Maintenance</b>
<b>PECs</b>	<b>= Public Excavation Companies, Ministry of Irrigation</b>
<b>PPAR</b>	<b>= Project Performance Audit Report</b>
<b>PPD</b>	<b>= Project Preparation Department, Ministry of Irrigation</b>
<b>TC</b>	<b>= Technical Committee</b>
<b>UEDC</b>	<b>= Upper Egypt Dredging Company, Ministry of Irrigation</b>
<b>USAID</b>	<b>= United States Agency for International Development</b>
<b>WRC</b>	<b>= Water Research Center, Ministry of Irrigation</b>
<b>WRI</b>	<b>= Weed Research Institute, Ministry of Irrigation</b>

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This report is based on the findings of an appraisal mission which visited Arab Republic of Egypt in September/October 1985 composed of Messrs. S. A. Rehman and C. J. Perry (Bank), and Messrs. P. Economides, Jan de Vos, A. Rizk and N. E. Otto (Consultants).

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LOAN AND PROJECT SUMMARY

Borrower: Government of the Arab Republic of Egypt.

Amount: US\$70 million equivalent.

Terms: Twenty years, including five years grace, at the standard variable interest rate.

Implementing Agency Ministry of Irrigation.

Project Objectives and Description: The objectives of the project would be to improve channel maintenance, and reduce its cost. The project would introduce modern channel maintenance practices, replacing the traditional system of excavation with a balanced cycle of weed mowing, herbicide treatment and desilting. This change has become necessary following the commissioning of the High Aswan Dam: the reduced silt load in the Nile below Aswan has changed the principal maintenance requirement from silt removal to the control of weeds, and the current practice of using heavy excavating equipment for this purpose is not only expensive and inefficient, but damages the channel section. The Bank loan would be disbursed over eight years, during which time the equipment fleet of the channel maintenance contractors--including, for the first time, private sector companies--would be upgraded, and cycle-based maintenance schedules would be introduced over the entire 48,000 km network of public channels. Technical Assistance would be provided to the Irrigation Sector, the Weed Research Institute, and the Public Sector Excavation Companies to improve management, planning and monitoring together with specialist support on specific technical issues, giving special attention to improving the control in the use of chemicals.

Benefits and Risks: The project would lead to improved maintenance at lower costs. Better maintenance will directly benefit the entire irrigated area by improving the

capability of the canals to meet peak irrigation demands, and also the effectiveness of surface and subsurface drains in speedily removing excess water. The project would also reduce the budgetary burden of maintenance costs. Similar maintenance techniques have been successfully used elsewhere and, on a pilot basis in Egypt; thus the risks of failure are negligible.

<u>Estimated Project Costs: 1/</u>	Local	Foreign	Total	% of
	---(US\$ million)---			Total
Equipment, materials, and technical assistance for Contractors	25.6	57.4	83.0	66
Equipment and technical assistance for Ministry of Irrigation	5.8	3.6	9.4	7
Total Base Cost	31.4	61.0	92.4	73
Physical Contingencies	1.9	3.1	5.0	4
Price Contingencies	14.8	14.7	29.5	23
<b>Total Project Cost</b>	<b>48.1</b>	<b>78.8</b>	<b>126.9</b>	<b>100</b>

Financing Plan:

Bank	-	70.0	70.0	55
GOE	48.1	8.8	56.9	45
<b>Total</b>	<b>48.1</b>	<b>78.8</b>	<b>126.9</b>	<b>100</b>

Estimated Disbursements:

	Bank Fiscal Year							
	1987	1988	1989	1990	1991	1992	1993	1994
	---(US\$ million)---							
Annual	3.0	8.0	12.0	12.0	10.0	10.0	9.0	6.0
Cumulative	3.0	11.0	23.0	35.0	45.0	55.0	64.0	70.0

Economic Rate of Return: Given that the project would improve maintenance at lower cost, the Net Present Value approach has been used to evaluate project benefits. The NPV, at a discount rate of 12%, would be US\$44 M, and would become negative only for substantial increases in capital costs (50%) or annual operating costs (30%).

1/ Minor differences due to rounding.



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**I. INTRODUCTION**

1.01 Egypt has a total area of one million (M) square kilometers (km<sup>2</sup>) or 238 M feddans (fed). About 96% of the area of the country is desert, and the remaining 4%, concentrated mostly in the valley of the Nile and its delta, is densely populated averaging 1,300 persons/km<sup>2</sup> and is agriculturally productive. This arable area of some 6.4 M fed amounts to only 0.14 fed per capita--amongst the lowest levels of availability in the world.

1.02 The productivity of this limited land resource depends upon irrigation (para. 2.06). Following completion of the High Aswan Dam (HAD) and the provision of perennial supplies to all irrigated areas, cropping intensities and water use per unit of area increased. A consequence of intensified irrigation has been a rising groundwater table, and increased problems of waterlogging and salinity. More intensive irrigation also requires higher peak discharges from the canal system; thus the demands placed on both the irrigation and drainage channels have become more severe. In parallel with these changes, the HAD resulted in much reduced silt loads in the irrigation water, and--due to the clear water and increased use of fertilizers--much improved conditions for weed growth in irrigation and drainage channels (paras. 3.01 and 3.16). Thus, while the demands on the system were increasing, the maintenance needs were changing from silt removal to weed control, and constituted a key constraint to efficient functioning of both the irrigation and drainage channels (para. 4.01). The Government of Egypt (GOE) has therefore accorded high priority to improving the drainage conditions in the agricultural land as well as to removing the constraints that prevent the channels from operating at their design potentials (paras. 2.12 and 3.05).

1.03 The need for improved channel maintenance became particularly apparent during implementation of the first four Bank-supported sub-surface drainage projects (paras. 3.06 and 3.07). The proposal for a project to improve channel maintenance was discussed in general terms in Washington during the visit of the Minister of Irrigation in September 1983. During a follow-up Bank mission in March 1984, the project outline and timetable for preparation were agreed. Accordingly, the Project Preparation Department (PPD) of the Ministry of Irrigation (MOI), using consultants recruited under an IDA Technical Assistance Credit (1162-EGT), prepared the project. In response to the MOI's request, two Food and Agricultural Organization/World

Bank Cooperative Program (FAO/CP) preparation assistance missions visited Egypt during November 1984 and May 1985. The appraisal was based on the FAO/CP Project Preparation Report (92/85 CP EGY 34 dated July 24, 1985), and the MOI's 12-Year Channel Maintenance Plan (Report dated September 24, 1985) prepared in compliance with a covenant under the Drainage V Project (Loan 2652-EGT).

## II. THE AGRICULTURAL SECTOR

### A. Resource Base

2.01 Egypt has a population estimated at about 47 M in 1985, increasing at an annual rate of about 2.6%. Almost 50% of the population is rural, its proportion having steadily declined from 62% in 1960. Average per capita annual income is US\$640/annum.

2.02 Farm sizes are generally small, averaging 2-3 fed. Under the Agrarian Reform laws, some 1 M fed were redistributed to those having little or no land, and farm sizes were restricted to a maximum of 50 fed. Leasing is common: almost half of all land is farmed under some form of leasehold. In part, this allows consolidation of fragmented holdings. Although no formal land consolidation plan is in operation, a benefit of Government's annual crop consolidation plan is that it allows large, contiguous areas of the major crops to be grown by individual farmers.

2.03 The land base for agricultural production consists of 5.5 M fed of "old" lands and 0.9 M fed of reclaimed lands--the so called "old-new" lands. The old lands include all of the more fertile areas in the valley of the Nile and the delta where about 97% of Egypt's total agricultural production is generated. The old-new lands were developed from the late 1950s through the early 1970s, primarily on the marginal sandy soils along the western edge of the delta. A large proportion of these reclaimed lands, about one-third, have not been fully productive. Some additional land is being reclaimed but the potential for increasing output is much greater and the costs substantially less per unit of output on old lands than on reclaimed new lands. (See Maps, IBRD 19445 and 19447, for irrigated areas).

2.04 The topography in old lands is flat with a gentle slope towards the north. Generally, the soils are alluvial and fine textured, tending to be coarser in the south. The alluvium averages 9 to 10 meters (m) in the delta, and varies from 4 to 15 m in thickness in the valley. In each case, the alluvium overlies deep deposits of water bearing sands and gravels. Soils throughout the Old Lands are fertile and highly productive. With proper irrigation and drainage, a variety of crops and some fruits can be grown. Salinity and water logging problems exist in areas where drainage is not adequate for perennial irrigation.

2.05 Water Resources. The Nile River accounts for more than 95% of Egypt's water resources. Of the average annual supply of 74 billion (milliards) cubic meters (m<sup>3</sup>) provided by the HAD net of reservoir losses of 10 milliards m<sup>3</sup>, the Nile Waters Agreement (1959) 1/ allocates 55.5

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1/ Between Egypt and Sudan.

billiards m<sup>3</sup> to Egypt and 15.5 billiards m<sup>3</sup> to the Sudan. The live storage capacity of the HAD is 130 billiards m<sup>3</sup>, which provides over-year storage and thus enables a very reliable water supply. Because groundwater reservoirs underlying the Nile Valley and the Delta are supplied by deep percolation of irrigation water, groundwater is not in itself a resource. However, the Nile system has sufficient water to meet current water requirements and, with proper conservation and management, it seems unlikely that water will be a constraint to the development program in the immediate future.

2.06 The climate is characterized by a mild winter, and a hot summer. The normal mean monthly temperatures are high in Upper Egypt, ranging from 16.8°C to 34.2°C at Aswan, and gradually decrease northwards to a range of 13.7°C to 26.6°C on the Mediterranean coast. Annual rainfall averages about 120 millimeters (mm) at the northern periphery of the delta, and decreases sharply moving southward to only 26 mm around Cairo. Upper Egypt is virtually rainless. Because of scanty rainfall, the nation's farm lands are almost entirely dependent on irrigation, which allows year-round cropping (para. 1.02).

## B. Sectoral Performance and Constraints

### Agriculture in the Economy

2.07 While the importance of agriculture in the Egyptian economy declined significantly during the 1970s, it still represents about 18% of GDP and 40% of total civilian employment. Historically, the agricultural sector was a major contributor to the Egyptian economy, providing the bulk of employment and output, and crucial to Government revenue and foreign exchange earnings. The sector's dominant role was reinforced by its strong performance between 1955 and 1969. During this period, agricultural production grew at a rate of over 3% annually--an exceptional performance, given the relatively high base level.

2.08 In the 1970s, the pace of growth declined to around 2% due to levelling of crop yields in old lands and a lower output than was expected from reclaimed lands (para. 2.03). Given that the high growth rates of the previous decade included the impact of the HAD, this does not reflect a significant change in the underlying growth trend. However, other factors accentuated the impact of slowed agricultural growth on the economy in general: first, population continued to grow annually at over 2.5%; secondly, per capita income grew very rapidly, and thirdly, consumer prices for foodstuffs were held to extremely low levels, compounding the demand increases generated by the first two factors. These developments led to dramatic increases in per capita consumption over the period 1974-80. Annual rates of increase for some major crops were: wheat 4.8%, sugar 7.8%, white meat 7.6% and fish 8.3%.

2.09 The net effect of these trends is summarized in Table 2.1:

**Table 2.1: Agricultural Sector Developments**

**Some Key Indicators**

	<u>1960</u>	<u>1974</u>	<u>1983</u>
Share of Agriculture in value added (%)	28	25	18
Agricultural Exports as % of total Exports	33	25	9
Agricultural Trade Balance (US\$M, current prices)	255	300	-3,000
Self-sufficiency (%) in major products:			
Wheat	70	37	23
Rice	144	111	100
Sugar	114	96	50 <sup>1/</sup>
Pulses	92	81	73 <sup>1/</sup>
Cotton	400	232	170
Meat	95	99	63
Population Index	100	138	180

1/ 1982 data.

**Agricultural Constraints**

2.10 Three primary constraints to agricultural growth are: (i) the very limited availability of agricultural land (para. 2.03); (ii) the difficult situation with respect to waterlogging and soil salinity (para. 2.04), and (iii) weaknesses in the institutions responsible for providing support services (para. 2.13). In addition, outmigration of labor--both to cities and abroad--has resulted in labor shortages at times of peak demand. Further, the Government intervenes significantly to affect cropping patterns and procurement prices, causing distortions in the relative prices of products, and generally depressing the level of farm incomes. However, in the last three years, Government has increased the prices of some agricultural commodities, with a view to providing improved incentives to producers.

2.11 The land constraint is exacerbated by urban and industrial encroachment into agricultural land, estimated at 20,000-40,000 fed/year, and by falling productivity, due to waterlogging and soil salinity. Institutional constraints are important because the main source of increase in the growth of agriculture will continue to be the old lands (para. 2.03), where productivity is already high, requiring sophisticated, well-organized, and high quality supporting services, particularly extension. Constraints of a general nature include overlapping responsibilities among Ministries, low public sector wages, and excessive governmental intervention into pricing and marketing arrangements; more specific issues are the lack of communications between researcher and farmer, and the inadequate operation and maintenance (O&M) of the irrigation and drainage systems. The labor constraint is difficult to quantify. Undoubtedly, there are labor shortages at times of peak agricultural demand, manifested by high and rapidly rising wage rates. The main contributory factors appear to be the migration of rural labor to urban areas and other countries in the Middle East, and the impact of remittances on

work incentives for agricultural labor. The future prospects for the labor market are increasingly uncertain as the fall in oil prices reduces the demand for Egyptian labor abroad.

### Public Investment in the Sector

2.12 In the current Five-Year Plan for 1982/83-1986/87 <sup>1/</sup>, the proportion of total investment allocated for agriculture has been increased to 13% compared to 8% in the late 1970s, with an additional 6% allocated for fertilizer plants, and for agricultural storage and processing facilities. However, the above constraints, and the growing gap between agricultural production and consumption, are only partially addressed in the plan allocations. More than half of the total investment in agriculture is for new lands reclamation--an activity that seeks to address the primary constraint of land scarcity, but which has been markedly unsuccessful in the past (para. 2.03). Further, if a large program of this nature is undertaken without a careful assessment of viability in each instance and ranking of priorities, it will result in suboptimal investments and will also compete for the limited water resources (para. 2.05). Of the residual investment in the sector, drainage, with an allocation of about 30%, is appropriately the largest single item.

### Agricultural Supporting Services

2.13 The Supporting Services including research, extension and input supply account for only a small share of the public expenditure in the sector, although increases in cropping intensity and yield will be the main sources of agricultural growth. In January 1983, research and extension services were integrated under the Agricultural Research Center to ensure better coordination of the two activities, and to improve their quality. However, this reorganization did not yield the expected improvements and, in early 1985, a Ministerial Decree returned the extension service to central Ministry of Agriculture (MOA) control under an Undersecretary having specific responsibility for extension affairs. MOA proposes to maintain and strengthen the interrelationships between extension and research by regular interaction between officials of these services at all levels. Furthermore, MOA has established extension as a separate function but coordinated with agricultural regulatory affairs. A Director General of Extension has been appointed with a modest supporting staff based in Cairo. These changes will take time to have their full effect at the field level--through provision of adequate numbers of mobile, trained extension staff. However, a career path has been opened up, and the extension service will be in a much stronger position to develop effectively, unencumbered by regulatory functions. This approach is based on experience from the International Fund for Agricultural Development (IFAD)--supported Minya and Fayoum Agricultural Development Projects (IFAD Loans 114-EG and 157-EG), appraised and supervised by the Bank. The effects of these recent changes remain to be demonstrated, but the Egyptian Major Cereals Improvement Project and the Rice Research and Training Project,

<sup>1/</sup> For a more detailed review, see IBRD Report No. 5269-EGT, Arab Republic of Egypt - Review of Medium Term Investment Program, October 1984.

supported by the United States Agency for International Development (USAID), have shown that very large gains in productivity can be attained where research technology is disseminated to farmers through intensified extension. Under both these projects, substantial yield increases have been achieved over large areas, and it is clear that even higher yield levels can be obtained under Egyptian agro-climatic conditions.

2.14 Agricultural credit and inputs, such as seeds, fertilizers and pesticides, are currently supplied to the farmer mostly through the Governorate level Banks for Development and Agricultural Credit and, to a limited extent, through village cooperatives. Inputs are often provided on credit and their costs are deducted from the amount due to the farmer from sale of compulsory quota crops, such as cotton and wheat. While highly developed and widely available, the current structure of these services does not provide the farmer with much choice among alternative channels and often leads to parallel markets for inputs which are, at official prices, in short supply. Input supply services were provided by the village cooperatives up to 1977, and there are currently plans to reactivate that system in addition to allowing increased private sector participation in input marketing.

### C. IDA/Bank Involvement in the Sector

2.15 Bank Group Operations. Past operations in the sector have sought to address major elements in the development strategy. The Bank serves as the executing agency for Water Master Plan, a UNDP-financed project (EGY/84/007) for planning water development and use. The Technical Assistance Project (Credit 1162-EGT) was designed to help Government develop an institutional capacity to undertake planning and feasibility studies for agricultural projects; as a result, suitably equipped PPDs have now been established in the Ministries of Irrigation, and Land Reclamation. The major component of Bank lending, in terms of number of projects and resources committed, has been a series of five drainage projects covering about 2.6 million fed of irrigated area (para. 3.06). The ongoing Irrigation Pumping Stations Rehabilitation Project (Loan 2270-EGT) is the first phase of a national program to prevent crop losses due to irrigation/drainage pump failures and to strengthen the institution responsible for pumping stations. The first Agricultural Development Project (Credit 830-EGT) sought, as a pilot project, to raise productivity in two governorates, by improving the standard of farm mechanization and strengthening agricultural credit, cooperatives and extension services. Despite initial difficulties, progress has been made with the project, leading to the Second Agricultural Development Project (Loan 2561-EGT). The Fruit and Vegetables Project (Loan 1276-EGT) includes a variety of components--credit to fruit and vegetable processors and exporters, construction of the West Nubariya Drain, and a seed farm. This project has also been satisfactorily completed, except for the development of the seed farm.

2.16 In the two IFAD Projects, for which the Bank acts as executing agency, emphasis is placed on research and extension services (para. 2.13). Other agricultural projects financed by IDA/Bank include the Agroindustries I and II Projects (Credit 988-EGT and Loan 2243-EGT), and the Fish Farming Project (Credit 1111-EGT). The New Lands Development Project - West Nubariya (Credit 1083-EGT) involves the reclamation of 24,000 fed desert land and settlement of 4,000 small holders. The agro-industries projects are

progressing satisfactorily but the Fish Farming and the New Lands Projects have been facing problems of implementation delays.

2.17 Lessons Learned. The main elements of Bank Group involvement in the sector have focussed directly on assisting Government to maintain and increase productivity in the old lands. Of the completed projects, Project Performance Audit Reports (PPARs) have been issued only for the first two drainage projects (Credit 181-UAR and 393-UAR). Much has been learned about the problems of the Irrigation and Drainage Subsector during the Bank's long association with, and substantial support to, GOE's drainage program (para. 3.06). In turn, this has improved the efficiency of the major organization involved, the Egyptian Public Authority for Drainage Projects (EPADP). Bank's involvement in the sector, and in particular with drainage, has highlighted the following important lessons, which have been incorporated into the design of the proposed project, that: (a) the most effective projects are simple, and preferably involve only one implementing Ministry; (b) newly established organizations are generally slow in mobilization; (c) the project implementation period needs to take account of factors that may cause delays, such as, procurement problems, shortage of staff, and inadequate budgetary allocations for projects, and (d) the strengthening of Government agencies involved in furthering development of existing resources is the highest priority.

#### D. Other Donor Support to Irrigation and Drainage

2.18 A brief summary of other externally supported programs and projects in the subsector of irrigation and drainage follows:

- (a) Dutch-Egyptian Bilateral Program. Dutch technical assistance for drainage and channel maintenance started in December 1975. A report on aquatic weed control was issued in 1978. The Dutch Government has also supported research by the Weed (Control) Research Institute (WRI) on biological weed control. In addition, a four-year (1983/87) ongoing program aims at training the staff of EPADP in construction management and maintenance of drainage facilities (para. 6.14).
- (b) USAID Program. Three projects funded by USAID relate to improving irrigation facilities and to strengthening manpower development. Of the two completed projects, the Agricultural Canal Reconstruction and Maintenance Project provided channel maintenance equipment amounting to about US\$30 M between 1978 and 1982. The ongoing Irrigation Management Systems Project <sup>1/</sup> covers 10 sub-projects with USAID input totalling US\$139.5 M. Started in 1981, it is currently scheduled for completion in July 1987. The sub-projects include: replacement of 11,000 deteriorated water control structures throughout the Irrigation System; a telemetry system (260 locations) to monitor and improve system operation; training and manpower development, and irrigation improvement.
- (c) The Canadian International Development Agency is also funding an irrigation and drainage improvement program in some 50,000 fed in the East Delta (see Map, IBRD 19445).

<sup>1/</sup> USAID 263-0132 of July 1981.

### III. IRRIGATION AND DRAINAGE SYSTEMS AND THEIR MAINTENANCE

#### A. The Nile River Irrigation and Drainage Systems

##### General

3.01 In Egypt, irrigation initially depended on annual flooding of the Nile. The area served was gradually extended by a canal system which has evolved since the 1840s when perennial irrigation began on a significant scale. The system is functional, but in many respects is not as efficient as it could be. A serious problem exists with regard to maintenance of irrigation and drainage channels, caused both by the improper techniques currently in use and by the unique combination of conditions which encourages profuse weed growth (paras. 1.02 and 3.16).

##### Irrigation and Drainage Facilities

3.02 Irrigation Facilities. Releases of water to the system are controlled by the HAD and the old Aswan Dam. Seven barrages on the main Nile River and its two branches divert about 80% of the water into 13 main canals by gravity; the remaining 20% is diverted by pumping. Currently, there are some 460 irrigation pumping stations, of which 178 are considered main pumping stations. The total length of the public canal system is approximately 31,000 km. The privately owned farm header ditches (called mesqas) extend to over 80,000 km. (See Maps, IBRD 19445 and 19447 for Irrigated Areas and Annex 4, Chart 1, World Bank - 30166:4, for Schematic Diagram of Irrigation System).

3.03 Water is released from the HAD for irrigation, power, navigation, municipal and industrial uses. For agricultural use, which constitutes about 90% of total demand, the water is supplied according to seasonal estimates of demand based on irrigated area, crops, climate, soils, and efficiency of the irrigation system. Since the HAD was commissioned, the gross amount of water supplied to irrigated areas has been sufficient to support an irrigation intensity of close to 200%.

3.04 The hierarchy of public canals includes main canals, branch canals and distributaries. The canals deliver water into mesqas serving 50 to 500 fed. Mesqas, in turn, feed marwas or farm ditches serving usually one to five farms of a total area of 20 to 30 fed. System operation is based on rotation in the canals, coupled with rotation among farmers at the mesqa level. Most farmers in the old lands receive water in the mesqas typically one-half meter below the elevation of the fields, and lift it from there to the marwas using animal-driven sakias (water wheels) and increasingly diesel-powered pumps. Studies carried out under the USAID-supported "Egyptian Water Use and Management Project" inter alia indicate that daytime irrigation was preferred by farmers; thus during the night, some farmers allowed water to flow through the system to the drains or across their fields and into drains.

3.05 While the HAD has allowed control over the seasonal availability of water, the control of water distribution is weak. The limited control which exists is further weakened by badly deteriorated water control structures, and the difficulty--due to the flat topography--of measuring flows in the channels. The effect of these two factors is further aggravated by the poor state of maintenance of canals. The first two problems are being addressed



with USAID financing (para. 2.18 (b)), and that of maintenance is the subject of the proposed project. An essential outgrowth of the "Egyptian Water Use and Management Project" is the setting up of an organization within MOI for providing technical assistance, construction assistance and economic analysis for upgrading and integrating irrigation with on-farm development. This organization is also supported by USAID under the Irrigation Management Systems Project (para. 2.18 (b)) and, once tested and accepted, will be the basis of a long-term improvement program throughout the old lands.

3.06 Drainage Facilities. The drainage system comprises: (a) open drains totalling 16,700 km in length (see Annex 4, Charts 2 and 3, World Bank-30166:5 and 30166:6, for Schematic Diagrams of Main Open Drains); (b) subsurface drains installed in an area of about 2.6 M fed, and (c) 73 main and 23 minor pumping stations. Subsurface drains are being installed at an annual rate of about 170,000 fed, and will eventually cover most of the irrigated area. Since 1970, the GOE's drainage program has been supported by the Bank Group through a series of five projects, aggregating to US\$246 M of credits/loans (paras. 2.15 and 2.17). Of 2.7 M fed so far provided with improved open drains and subsurface drainage, about 70% has been supported by Bank projects.

3.07 The economic returns to proper drainage are high (about 25%) and farmers are enthusiastic. However, the maintenance--particularly of open drains--continues to be substandard. The PPARs of the first two drainage projects (para. 2.17) recommended that the Government should organize an adequate maintenance operation which would safeguard the investments made on drainage.

3.08 Channel Lengths. The total length of canals and drains is estimated to be about 48,000 km. Table 3.1 below gives length of canals and drains by bed-width. (see details by Governorate in Annex 4, Table 1). Mesqas total over 80,000 km in length, of which some 12,000 km (15%) are large mesqas, serving 200 fed or more (para. 3.02).

Table 3.1: Approximate Channel Lengths (km)

	<u>Bed-width (m)</u>				<u>Total</u>
	<u>&lt;2</u>	<u>2-5</u>	<u>5-10</u>	<u>&gt;10</u>	
Canals	14,400	10,600	2,900	3,300	31,200
Open Drains	8,600	5,800	1,500	800	16,700
Total	<u>23,000</u>	<u>16,400</u>	<u>4,400</u>	<u>4,100</u>	<u>47,900</u>

Source: MOI, Project Planning Department

## B. Existing System of Channel Maintenance

### Responsibilities

3.09 The MOI is directly responsible for the operation and maintenance (O&M) of all public irrigation canals (through its Irrigation Sector, or IS)

and drainage channels (through both the IS and EPADP). The WRI, which operates under the Water Research Center (WRC), provides technical support to both these agencies in weed control. Mesqa maintenance is the responsibility of the farmers, who may undertake the work themselves, employ private contractors, or request the MOI to maintain the channel at their expense. Where mesqa maintenance is unsatisfactory, the MOI has legal authority to perform work at the expense of the farmers. (See Annex 3, Chart 1, World Bank - 30166:2, for MOI General Organization.)

3.10 The Irrigation Sector is responsible for providing technical guidance to, and supervision of, the field organization for O&M of the canal system and, at present, maintenance of some 8,200 km of open drains. Under the direction of a First Undersecretary, the headquarters' organization has three main departments, each headed by an Undersecretary, concerned with budget and accounts, maintenance and water distribution. The field units comprise 19 Irrigation Directorates which are subdivided into 41 Inspectorates and 167 Districts. The IS has a work force of 9,500 staff (excluding helpers), of whom some 600 engineers and over 1,000 technicians are directly concerned with O&M activities. Directorates range in size from 170,000 to 600,000 fed of land under irrigation and are appropriately staffed to carry out all O&M functions. The Directorate staff, in turn, provide supervision of the District Engineers who, with technicians, are directly responsible for O&M of the system in areas up to 50,000 fed.

3.11 The EPADP, a semi-autonomous authority, was established in 1973 to implement IDA-financed drainage projects (para. 3.06). In 1979, the Authority was also given responsibility for the maintenance of open drains associated with subsurface drains. At present, it is responsible for some 8,500 km of open drains and will take over increasingly responsibility for this from the IS with the expansion of subsurface drains (para. 3.06). The Undersecretary for Maintenance in EPADP administers 9 field Directorates which, in turn, are divided into 50 Centers, and for maintenance of field drainage into 214 Subcenters. Directorates range in size from 150,000 to 300,000 fed of drained land and Centers from 40,000 to 50,000 fed. The staffing structure and management functions of Drain Maintenance Directorates and Centers are similar to those of Irrigation Directorates and Districts, respectively (para. 3.10).

### Planning and Budgeting

3.12 Channel maintenance is financed through the Government's general budget. Annual budgets are established by the MOI in three categories: (i) salaries and wages for permanent MOI employees in the IS and EPADP; (ii) maintenance contracts between the IS and EPADP on the one hand, and four Public Excavation Companies (PECs) and private contractors on the other, and (iii) a fund for chemical weed control. The budgetary process is satisfactory, but the allocation of funds is oriented to traditional channel excavation rather than to current maintenance needs, particularly for weed control (paras. 4.01 and 4.04). Table 3.2 gives the total 1983/84 MOI expenditures for channel maintenance.

**Table 3.2: Summary of 1983/84 Maintenance Expenditure**

<u>Item</u>	<u>IS</u>	<u>EPADP</u>	<u>Total</u>	<u>(%)</u>
	(££ million)			
Staff and operation costs	10.8	1.8	12.6	22
Maintenance contracts with PECs and private contractors	36.0	6.0	42.0	74
Weed Control fund (herbicides and labor)	2.2	0.2	2.4	4
<u>Total:</u>	<u>49.0</u>	<u>8.0</u>	<u>57.0</u>	<u>100</u>

3.13 Annual maintenance expenditure in 1983/84 averaged ££ 1,200/km, and the average cost/fed of irrigated land was ££ 10, or about 1% of the gross annual agricultural income. Total expenditures (££ 42 M) on maintenance contracts have increased by about 50% since 1980/81. This level of funding would be adequate to meet expenditures projected for the maintenance schedule proposed under the project (para. 5.21).

3.14 The budget allocation among the 19 Directorates of the IS and 9 of EPADP (paras. 3.10 and 3.11) is made at the central level of each organization. The work load is also allocated at the central level among the PECs, which operate under the direction of the Irrigation Public Sector Authority (IPSA), and execute 80-90% of the work. This allocation is generally made through a negotiation process based on the capacity of the companies, their equipment fleets, and non-maintenance work load.

3.15 At the Directorate level, the detailed schedule of works by channel reach is prepared, and work orders are issued to the PEC designated for the Directorate. Also, the Directorates award contracts to private contractors on the basis of Local Competitive Bidding (LCB) procedures. The Directorate staff are responsible for quality control and following up progress of work.

### Execution of Channel Maintenance Works

3.16 Maintenance Needs and Methods. Construction of the HAD has greatly reduced sediment deposits in canals (paras. 1.02 and 4.01). Growth of weeds in both canals and drains has increased due to the presence of agricultural fertilizers in the drainage waters, perennial use of the channels, and the clearer irrigation water which allows more sunlight to reach the weeds (para. 1.02). Despite this drastic change, MOI continues to rely on large-scale excavation as the principal means of maintenance.

3.17 The traditional method of excavation is either by draglines, maintained and operated by PECs, or by private contractors using labor intensive methods. In 1983/84, 87% of expenditures were paid to PECs and 9% to private contractors. Chemical maintenance expenditure (4%) was mainly for Acrolein or Magnacide H injection into large canals for submersed weed

control, and for spraying with Ametrine against water hyacinth.

3.18 Mechanical Maintenance. The programmed volume of earthwork has increased from 58 Mm<sup>3</sup> in 1980/81 to 100 Mm<sup>3</sup> in 1983/84. In part, this has resulted from increasing the area of dewatering from 18 Mm<sup>2</sup> to 33 Mm<sup>2</sup> because, in the field, excavation and dewatering are accomplished in the same operation. Table 3.3 summarizes the work done by each PEC and other contractors in 1983/84. However, the quantity recorded for excavation is "pay quantity" (guaranteed depth of 30 cm) which is substantially larger than the actual excavated quantity.

Table 3.3 Summary of Work (1983/84)

<u>Executing Agency</u>	<u>Excavation</u> <u>Mm<sup>3</sup></u>	<u>Dewatering</u> <u>Mm<sup>2</sup></u>
a. PECs administered by MOI:		
Egyptian Dredging Co.	40.2	12.7
Mechanical Excavation Co.	38.0	10.9
Upper Egypt Dredging Co.	7.6	2.4
Irrigation and Drainage Co.	<u>1.4</u>	<u>-</u>
Subtotal PECs of MOI:	87.2	26.0
b. Other Contractors <u>1/</u>	<u>13.0</u>	<u>6.8</u>
Total:	<u>100.2</u>	<u>32.8</u>

1/ Include Beheira Mussamah Company administered by the Ministry of Land Reclamation.

3.19 Manual Work. Manual weed removal is still used for canals and, to a limited extent, for drains with bed-width less than 5 m. Manual maintenance is declining because of the increasing labor costs and reduced labor availability. It is mainly done by private contractors, with a small amount by the PECs in association with their mechanical work.

3.20 Chemical Weed Control. The annual expenditures of only 4% of the total maintenance budget understates the importance of herbicides in the control of weeds (para. 3.17). Herbicides provide the only effective method of controlling submersed weeds in the larger canals, and are also important in controlling water hyacinth.

3.21 For the control of emerged and ditchbank weeds, excavation is sometimes combined with the application of Dalapon (Dowpan M) and Glyphosate. These herbicides represent minimal health hazards. While both these herbicides have a good potential for controlling ditchbank weeds, current treatments are not very effective because of inadequate spraying equipment and incorrect application methods. Floating weeds, mainly water hyacinth, are treated with Ametrine through aerial or mechanical spraying. Ametrine is a moderately effective herbicide with minimal health hazards, although restrictions apply to its use near potable water intakes.

3.22 Following experiments carried out with participation of the World Health Organization, the MOI has used Acrolein successfully for the last ten years to control Bilharzia and to manage submersed aquatic weeds. No adverse effects on people have been reported. The herbicide is very effective, but is considered to be an undesirable hazard to the aquatic environment, and is thus a "restricted use" herbicide. While MOI has satisfactory regulations governing the use of Acrolein, its transport, storage and application is, in practice, poorly managed, and must be rectified if its use is to be safely and effectively continued (paras. 5.18 and 8.02).

3.23 The MOA has the responsibility for authorizing the use of any given herbicide. The decision to use herbicides for control of ditchbank or submersed weeds is taken at the Directorate level and they are applied by the staff of Irrigation Districts or EPADP's Centers (paras. 3.10 and 3.11).

### Existing Equipment and Maintenance Facilities

3.24 The PECs have traditionally used draglines and suction dredgers for excavation. Hydraulic excavators were introduced for the first time in 1977. Between 1980 and 1983, a small number of weed mowing buckets and wheel tractors with side-mounted booms were procured, but this equipment has hardly been used because of the low unit rates paid for weed mowing. However, a revised contract--effective since September 1985--provides for remunerative rates for weed mowing. The PECs production equipment fleets consist of 646 draglines (246 over 15 years old), 374 hydraulic excavators, 80 wheel tractors with side booms, 34 suction dredgers and 41 bulldozers (see details of equipment by company in Annex 6, Table 1). However, a large number of draglines and almost all dredgers are currently used for non-maintenance works. The equipment fleets used for channel maintenance are deficient in weed mowing equipment, supporting equipment (transporters, workshops) and small (7-ton) hydraulic excavators. Despite the age of the fleet, the equipment availability factor is satisfactory.

3.25 The Egyptian Dredging Company (EDC) and Mechanical Excavation Company (MEC) have their own workshop facilities, Irrigation and Drainage Company (IDC) uses three mobile workshops and Upper Egypt Dredging Company (UEDC) has no repair facilities. Besides repairs and overhauls, workshops of the EDC and MEC produce spare parts, mainly for draglines. Workshops of EDC and MEC need to be expanded to include facilities for servicing modern equipment and vehicles. Also, the present management information system (MIS) and the inventory control system in each PEC store need to be upgraded to provide accurate information on operations and on the availability of spare parts and materials (paras. 5.05 and 6.18). Map, IBRD 19446 shows the location of offices, workshops and stores of the PECs.

## IV. APPROACH FOR CHANNEL MAINTENANCE

### A. Background

4.01 With the completion of the HAD, weed control has replaced sediment removal as the dominant maintenance problem (paras. 1.02 and 3.16). Despite this change, the system of channel maintenance is still based on removing large quantities of silt at a frequency of 3-6 years for canals and 2-4 years

for drains. This is an ineffective method of keeping channels free of weeds; in addition, it results in unstable channel sections causing poor flowing conditions and loss of agricultural land.

4.02 Recognizing this, the MOI, with assistance from FAO/CP, has prepared a 12-Year Action Plan to improve the maintenance of canals and drains throughout the old lands (para. 1.03). The proposed project would finance the first time-slice of the plan. The project implementation period, six and a half years, represents the transition period between current practices and the proposed future maintenance system (see Annex 2, Tables 1 and 2).

### B. Maintenance Consideration

4.03 Silt Removal Requirements. The total amount of silt estimated to be deposited in the channels is about 10 to 12 Mm<sup>3</sup>/year, which is only 10% of the "pay quantity" of 100 Mm<sup>3</sup> in 1983/84 (para. 3.18).

4.04 Aquatic Weeds and Their Distribution. In Table 4.1, the distribution of aquatic weeds is summarized according to habitat, and to the total length of channels affected.

Table 4.1: Type and Distribution of Aquatic Weeds

	<u>Weed Type</u>				<u>Total Infested</u>	<u>Total Length</u>
	<u>Mixed</u>	<u>Emersed 1/</u>	<u>Submersed 1/</u>	<u>Floating</u>		
Canals (km)	3,757	947	15,890	527	21,121	31,182
Canals (%)	12	3	51	2	68	100
Drains (km)	6,198	2,455	1,063	1,626	11,342	16,686
Drains (%)	37	15	6	10	68	100
Total (km)	9,955	3,402	16,953	2,153	32,463	47,868
Total (%)	21	7	35	5	68	100

1/ Emersed weeds have their roots submersed, but their foliage is above the water level and, like floating weeds, can be sprayed; submersed weeds are entirely below the water, and must be treated by injection of herbicides into the water.

Source: MOI.

4.05 Submersed weeds (mainly pond weeds and coontails) constitute the major aquatic problem in irrigation canals. They reduce the carrying capacity, particularly in large canals. Mixed weeds, usually a combination of floating, emersed and ditchbank weeds, comprise the most serious infestation problem in drains. Ditchbank and emersed weeds (mainly Phragmites mixed with Echinochloa) combined encroach on canals and drains, causing capacity loss. Floating species (mainly water hyacinth) comprise the least amount of the total distance infested.

### C. Evaluation of Technical Alternatives for Channel Maintenance

4.06 The following technical alternatives which could be used to improve channel maintenance were considered and assessed:

- (a) Lining of canals is prohibitively expensive unless other benefits, such as reduced seepage or higher discharge are important. Furthermore, this solution cannot be applied to drains.
- (b) Biological control is an attractive method of weed control. For submersed weeds, few biological agents are known other than grass carp. The present effort of the WRI to devise ways of using carp under Egyptian conditions is progressing, but is a long-term program. The rotational operation of distribution canals (para. 3.04), and control of Bilharzia by spraying Bayluscide in canals and drains are incompatible with weed control by fish because there is no water in canals during the off-period and Bayluscide kills fish.
- (c) Mechanical control involves continually removing bio-mass. This has no influence on reducing re-growth of aquatic weeds, and in fact stimulates growth. Weed control based exclusively on continual mechanical removal of bio-mass would be excessively costly, requiring a very large number of excavators equipped with mowing attachments.
- (d) Chemical weed control might be a less costly solution. After a first removal of bio-mass from the canals and drains, control could be assured through frequent applications of herbicides. However, under the Egyptian conditions, intensive use of herbicides presents serious environmental hazards and risks for crops, animals and humans.

### D. Establishing Integrated Channel Maintenance

4.07 On the basis of experience available in Egypt and elsewhere, maintenance cycles have been established for each category of canals and drains for which the MOI is responsible (para. 3.08 and Annex 4, Table 1). The proposed system of maintenance for each channel type is based on an integrated cycle of desilting, weed mowing and, for channels of more than 2m bed-width, application of herbicides (Annex 2, Table 1). Together, these techniques allow cheaper, more effective maintenance than presently practised (para. 5.21), while limiting the use of hazardous herbicides. In addition, the project would support continued efforts to develop biological controls.

4.08 Small channels of up to 2 m bed-width will be maintained without the use of herbicides. The maintenance cycle for these channels would include periodical desilting and frequent mechanical weed mowing. Maintenance works would be awarded to private or public contractors on the basis of LCB procedures acceptable to the Bank, with award of contracts at the Directorate level (paras. 3.10, 3.11 and 3.15). Assurances to this effect were obtained at negotiations (para. 8.01 (a)(i)).

4.09 While the maintenance of mesqas is at present the responsibility of farmers (para. 3.09), decisive steps should be taken by the Government to improve their condition. Poor maintenance leads to shortages at the

tail-ends, and, consequently, to requests for extension of the irrigation cycle, disrupting schedules, and increasing the return flows to the drains. The Irrigation Directorates of MOI (para. 3.10) would closely monitor, in collaboration with the concerned agricultural cooperatives, the maintenance of mesqas serving more than 200 fed (in total, about 12,000 km) and, where necessary, carry out required maintenance works at the cost of beneficiaries para (3.09). Such works would be carried out by private or public sector contractors under the supervision of MOI. Also, the Irrigation Directorates working in close cooperation with the concerned agricultural cooperatives would ensure maintenance of smaller mesqas by farmers and, should they fail to do so properly, would undertake such maintenance at their cost (para. 3.09). Assurances on the above were obtained at negotiations (para. 8.01(b)).

4.10 For channels of more than 2 m bed-width, the cycle would include periodical desilting, mechanical weed mowing followed by herbicide spraying of re-growth and subsequent spot mowing and spot application of herbicides for the control of ditchbank weeds. Submersed aquatic weeds will continue to be managed with the use of Acrolein applied in the early summer followed by mechanical excavation and underwater weed mowing in spot locations. Utilizing the PECs to accomplish all maintenance activities, including herbicide applications, will place the responsibility on a narrower group of personnel. Training of such personnel will be accomplished by equipment suppliers' technicians (para. 5.04) and WRI specialists (paras. 6.10 and 6.15) and this arrangement will provide for more skilled applications and greater control. Because of their low mammalian toxicities when properly applied, effectiveness and wide acceptability, the chemicals recommended for spraying are Dalapon, Glyphosate, Diquat and Ametrine (para. 5.17 and Annex 5). The use of this limited number of herbicides for spraying makes implementation simpler. Submerged weed treatment with Acrolein will be made by the same spraying crews, thus better utilizing resources and reducing the number of personnel requiring technical training. Health risks of Acrolein can be reduced to acceptable levels only if all transport, storage, and application techniques specified by the herbicide manufacturer and the MOI directives are followed. Also, this herbicide should be transported and stored in heavy-walled steel containers rather than the present 55 gallon steel barrels. Assurances on these matters were obtained at negotiations (paras. 8.01(a)(ii) and (iii), 8.01(c) and 8.02).

4.11 Various benefits will follow from introducing maintenance based on the proposed approach. First, and most important, maintenance will be better, and more efficient functioning of the canals and drains will help improve agricultural production. Secondly, the use of mowing and chemical methods to control ditchbank weeds will allow stabilization of the banks because the root systems will be left in place, and damage caused by using excavators to remove weeds will be avoided (para. 4.01). Thirdly, an integrated plan of maintenance will be more economical than the present system (see para. 5.21 and Annex 1, Tables 7 and 8, for cost comparison).

4.12 Proposed Actions. Introduction of the new system will take some time, and must be phased in a way which is consistent with readjustment of working practices, the availability of equipment and training of personnel. The proposed transition is based on using the existing equipment as far as possible, while introducing the new equipment primarily as a substitute for worn out machinery. In this way, the financial burden will be minimized, and the economic benefits maximized.



4.13 For the introduction of the proposed integrated maintenance system, the major changes would be the replacement of draglines with hydraulic excavators equipped with mowing and silt buckets, the use of wheel tractors with side-mounted booms for removal of weeds from small canals, and the introduction of self-propelled sprayers for application of herbicides. The assessment of the new equipment required takes account of the existing equipment which would be at or nearing the end of its economic life during the project implementation period (para. 3.24). While the quantities of new equipment to be procured are substantial, their cost is less than the cost of replacing the existing fleet with similar equipment to continue with the present system (see Annex 1, Table 7).

4.14 The general scheduling of maintenance will remain the responsibility of MOI, but the introduction of a cycle-based system of maintenance will mean that the contractors will have responsibility for planning the execution of works during the cycle. To allow for this, contracts to both private contractors and PECs should be structured on the duration of the maintenance cycle. In addition, it is recommended that contracts be based on areas, rather than canal reaches. This will enable the companies to improve efficiency in machine utilization. Assurances on the above were obtained at negotiations (para. 8.01(a)(iv)).

4.15 Equipment required will be procured under International Competitive Bidding (ICB) procedures and both public and private contractors awarded channel maintenance contracts will have access to such equipment under similar terms. Assurances to this effect will be obtained at negotiations (para. 8.01(a)(v)). The increased opportunities for private sector participation represented by the access to bidding for small channels amount to about 50% of the total length of public channels to be maintained annually.

4.16 Also, an assurance was obtained at negotiations that MOI would strictly follow the Bank guidelines, as contained in OPN 11.01, the MOI's existing directives, and the manufacturers' recommendations to ensure the safe transport, storage, handling and application of herbicides, including Acrolein (para. 8.01 (c)). Assurances were also obtained that: (a) Acrolein would be handled in heavy-walled steel containers (para. 8.02); (b) PECs' personnel handling herbicides would continue to be trained by equipment suppliers' technicians and WRI specialists (para. 8.01(iii)), and (c) a testing and monitoring program would be established by December 31, 1987 to monitor Acrolein in critical locations in channels (para. 8.02). In addition, evidence of handling, storage and application safety of Acrolein according to the Government Guidelines will be a condition of Loan effectiveness (para. 8.02). A time-bound action plan to meet this target was agreed at negotiations for: (a) upgrading and rationalizing all existing stores for safe storage of herbicides; (b) improving safety of inland transportation; (c) providing personal and mechanical equipment needed for safe application, and (d) strengthening supervision to ensure that all safety devices are operational and hygienic working procedures are strictly followed (para. 8.02).

## V. THE PROJECT

### A. Project Rationale and Objectives

#### Project Rationale

5.01 Two factors are of major significance in any consideration of agricultural development in Egypt. First, the main source of growth, at least in the short run, will have to be from the old lands (para. 2.03). Second, any strategy for increasing agricultural production in these lands must give high priority to removing major constraints on the performance of installed irrigation and drainage facilities. By aiming at improvement of the maintenance of canals and drains throughout the old lands, the project would make an important contribution to removing an increasingly severe constraint to the reliability and equity of water distribution as well as to the adequate functioning of drainage and be fully consistent with the recommendations made for improved channel maintenance in many reports, such as: (a) ARE: Irrigation and Drainage Subsector, Report No. 3371-EGT (May 1982); (b) ARE: Issues of Trade Strategy and Investment Planning, Report No. 4136-EGT (January 1983); (c) ARE: Selected Issues in Agriculture, Irrigation and Land Reclamation, Report No. 4133-EGT (May 1983), and (d) ARE: Review of Medium-Term Investment Program, Report No. 5269-EGT (October 1984).

#### Project Objectives

5.02 Project components would support the Government's objectives of: (a) increasing agricultural production by more efficient functioning of canals and drains; (b) minimizing the need to undertake major investments for the rehabilitation of these channels, and (c) containing or reducing maintenance costs. To achieve these, the project would: (a) assist MOI in introducing maintenance methods appropriate to current needs; (b) strengthen the existing institutional capacity of the agencies concerned with project implementation, and (c) increase the productivity of the staff and equipment of the PECs involved in channel maintenance.

### B. Summary Description of Project Components

5.03 The project would include the following components:

- (a) An Investment Component to modernize Egypt's channel maintenance capabilities, including: (i) procurement of heavy equipment, workshop machinery, vehicles, machine tools and spare parts for contracting agencies; (ii) purchase of vehicles, office, laboratory and field equipment for the IS and WRI; (iii) import of herbicides for weed control, and (iv) construction and/or improvement of residential buildings, workshops and stores.
- (b) Incremental Recurrent Costs for Institutional Development aimed at: (i) strengthening the IS for improved efficiency in the planning, coordination and control of channel maintenance operations, and (ii) enhancing the resources of the WRI for more effective participation in weed control and for setting-up a monitoring and evaluation (M&E)

system. In addition, the project would assist each PEC to adjust to the new system of maintenance through establishing a work evaluation unit together with an efficient MIS.

- (c) Technical Assistance and Training Component, including: (i) 75 person-months of suitably qualified and experienced experts to strengthen channel maintenance programs and procedures by the IS, WRI and EPADP as well as 27 person-months of such specialists to assist PECs in improving planning, manpower development and equipment operation and maintenance; (ii) 51 person-months of local consultants to bring about improvements in PECs' accounting, financial and inventory control areas, and (iii) appropriate in-service training programs for professional and technical staff of the PECs and agencies concerned with project implementation.

### C. Detailed Features

#### Equipment and Spare Parts for Maintenance (Base Cost US\$67.8 M)

5.04 The project would provide for phased replacement of the existing heavy equipment by a balanced mix of mowers, excavators, and self-propelled herbicide sprayers as well as of the support equipment and vehicles (paras. 3.24 and 4.13). The existing equipment would also require investments in spare parts and assemblies for limited rehabilitation (para. 3.24). Draglines would be replaced by more efficient, hydraulically operated excavators and wheel tractors with side mounted booms, each type having both mowing and mud buckets. The spare parts for new equipment are estimated at 5-10% of their purchase value for each operating year. The contracts for the procurement of heavy equipment and herbicide sprayers would include provision of training aids as well as the services of equipment suppliers' technicians during the guarantee period of one year to assist in maintenance and operational training. A detailed description of proposed heavy equipment and estimated foreign costs are given in Annex 2, Table 3, and those of vehicles produced locally in Annex 2, Table 5.

5.05 The project would provide minimum necessary new equipment and machine tools for strengthening the existing workshops to cater for the needs of new machinery, as well as data processing equipment for the upgrading of PECs' operational and inventory control systems (paras. 3.25 and 6.18). Mobile workshops and testing equipment would also be provided. A list of equipment and tools to be purchased for the base workshops under the project with estimated foreign costs are shown in Annex 2, Table 4.

#### Equipment and Vehicles for the IS and WRI (Base Cost US\$3.6 M)

5.06 The efficiency of both the IS and WRI is hampered by lack of vehicles and office equipment. The project would finance the upgrading of these facilities as necessary for project implementation. Office equipment for the WRI would include computer facilities for data processing and recording, statistical analysis and monitoring studies. In addition, WRI would need specialized field and laboratory equipment to conduct aquatic weed studies and monitor herbicide residue. The estimated foreign costs of required equipment and goods are presented in Annex 2, Table 5.

### Chemicals for Weed Control (Base Cost US\$13.5 M)

5.07 To restrict the use of herbicides to the minimum necessary, the proposed plan relies upon an integrated weed control scheme for channels of more than 2 m bed-width (para. 4.10). Based on lengths of canals and drains to be treated annually for the various weed types, corresponding areas and the manufacturers' recommended rates of application, the estimated quantities and foreign costs of chemical herbicides to be provided under the project are summarized in Annex 2, Table 6.

### Civil Works (Base Cost US\$2.2 M)

5.08 The project would provide for the construction of: (a) four stores for storage of herbicides in accordance with the guidelines of the Government and two stores for spare parts; (b) a building for EDC to expand its repair facilities, and (c) one 4-flat building in each of the 19 Irrigation Directorates for essential additional housing for field staff (paras. 3.10 and 6.07). About US\$200,000 would also be provided for the rehabilitation of existing stores. The IS would be responsible for the construction of new stores for herbicides and residential flats. Following completion, the IS would hand over, free of cost, the stores for herbicides to PECs.

### Institutional Reforms (Base Cost US\$2.8 M)

5.09 The project would introduce a number of measures to improve the effectiveness of both the IS and WRI. First, at the central level, the office of the Undersecretary Maintenance would be strengthened to perform a key role in project implementation (para. 6.05). Secondly, at the field level, two staff members devoted only to maintenance would be added in each Irrigation Directorate/District (para. 6.06). Thirdly, the WRI would be strengthened for providing adequate support to the IS and EPADP in weed control and M&E, including training of field staff in the use of herbicides and monitoring related aspects (paras. 6.10 and 6.11). The project would finance the incremental staff and related O&M costs. A detailed description of these costs is given in Annex 3, Table 1.

### Technical Assistance, Training and Study Tours (Base Cost US\$2.5 M)

5.10 The intensification of channel maintenance, particularly using the mechanical and chemical modes in the correct magnitude and order, the upgrading of work quality and the general improvement of the productivity of the equipment and personnel involved would require considerable skills development. This would concern most staff involved in project activities in the IS and WRI, in the EPADP and also within the four PECs. Project proposals in this regard have been based on the information available about local expertise and facilities, while keeping expatriate technical assistance and overseas study tours to the minimum.

5.11 Management Agencies. The project would provide the following technical assistance and training: (a) a specialist in channel maintenance (36 person-months in resident status and 3 in short-term assignments) and an expert in equipment evaluation (7 person-months in short-term assignments) to

strengthen programs and procedures by concerned organizations as well as to assist in manpower planning and development (para. 6.13); (b) three experts in chemical, biological and botanical weed control, one analytical chemist and one hydraulic engineer (a total of about 29 person-months in short-term assignments) to strengthen WRI's work in both chemical and biological weed control (para. 6.13), and (c) about 30 study tours for senior officials and in-country and on-the-job training on maintenance programs and procedures for about 270 officials with the rank of junior engineer and above (para. 6.14).

5.12 IPSA and PECs. The project would finance the following consultancy services and training: (a) two specialists in corporate planning and MIS as well as one each in manpower development, workshop management and equipment operations (a total of about 27 person-months in short-term assignments) to strengthen PECs in the respective areas (para. 6.17); (b) local consultants to be provided by a local firm specializing in financial management (a total of about 51 person-months) to define improved budgetary, cost accounting and inventory control procedures as well as to carry out the necessary training programs (para. 6.17), and (c) 14 study tours and in-country and on-the-job training of about 245 engineers and 1,325 foremen, mechanics and operators (para. 6.22).

5.13 Annex 3, Table 2 gives the details and timetable for technical assistance and training for the IS/WRI, and Annex 6, Table 3 for PECs. Assurances were obtained at negotiations that the MOI would promptly carry out plans for manpower development by concerned agencies (particularly, the IS, WRI and PECs) and that, for assistance as necessary in project implementation, would contract suitably qualified expatriate and local consultants on terms, conditions and schedule satisfactory to the Bank (para. 8.01(d)).

#### D. Other Features of the Project

##### Status of Engineering

5.14 No engineering design is involved with the proposed project since all activities relate to the maintenance of existing channels. Maintenance works will be planned annually on the basis of maintenance cycle established for each category of channels (para. 4.07). Priorities will be determined according to the condition of each channel by MOI at the Directorate level. The work schedule for the first year of the project was presented by MOI, and agreed upon, during negotiations (paras. 6.25 and 8.01(n)).

5.15 Specifications and tender documents for the procurement through ICB of equipment and materials will be prepared by the IS in collaboration with EPADP and the PECs. The PECs (in particular EDC) and EPADP have considerable experience in preparing such tenders. Documents for the first bids for equipment and herbicides will be prepared by November 30, 1986 and tenders will be issued by January 31, 1987. Subsequent tenders will be issued at two-year intervals. Design for minor civil works for construction of stores and workshops, as well as for staff houses, will be prepared as needed by the IS and civil engineering sections of the PECs.

## Environmental Issues

5.16 Improved maintenance of canals and drains would have positive effects on the general environment and rural health. The decline in desilting would reduce a potential environmental problem caused at present by large-scale excavation and resulting spoil which could be polluted with other wastes. Improved weed control would help in destroying a favorable habitat for Bulinus truncatus snails and thus would contribute to a reduction in incidence of urinary schistosomiasis, constituting a major health benefit. Improved drain and canal flows will reduce the incidence of disease-bearing stagnant water.

5.17 However, the project also has features that could have an unfavorable impact on the environment if not carefully planned and implemented. For aquatic weed control, the use of herbicides to control regrowth following mechanical removal of weed biomass is critical to the success of the project. The four herbicides (Dalapon, Glysophate, Diquat and Ametrine) proposed for the control of emergent and floating weeds have low mammalian toxicities (para. 4.10) and are recommended and approved for similar use in many areas of the world. However, it is necessary that herbicide label recommendations on the handling and application are strictly followed to avoid any significant adverse impacts (Annex 5).

5.18 Submersed weed management by the use of Acrolein has been extensively practiced in Egypt since 1975 with no reported adverse effects on people (para. 3.22). However, it is classified as a restricted use herbicide requiring strict adherence to regulations concerning transport, storage and application by trained, experienced and designated authorities. It can safely be used for irrigation channel maintenance provided the MOI Guidelines for handling and storage as well as label recommendations are strictly followed. Because there are no known effective and acceptable alternatives, its continued use in the project is proposed.

5.19 While assurances were obtained from GOE at negotiations that MOI field staff would strictly follow MOI directives, the Bank Guidelines, as contained in OPN 11.01, and label recommendations on the transport, storage and application safety of herbicides (paras. 4.16 and 8.01 (c)), the project would promote adherence by: (a) handling of Acrolein in heavy-walled steel containers and upgrading of all existing stores (paras. 4.10 and 4.16); (b) providing four new stores to be built in accordance with MOI Guidelines for safe keeping of herbicides and proper equipment for their application (paras. 5.04 and 5.08); (c) placing the responsibility for storage and use of herbicides with PECs' crews to be trained by the guarantee technicians of equipment suppliers and weed botanists/extension agents of WRI (paras. 4.10, 4.16 and 6.10); (d) improving supervision by the IS and EPADP through training of their staff members by the WRI and MOI Training Center (paras. 6.10 and 6.14); (e) establishing a testing and monitoring program to monitor Acrolein in critical locations in channels and application safety of all herbicides (paras. 4.16, 6.11 and 6.28), and (f) carrying out adequate supervision and a mid-term review for the success of proposed measures in controlling any adverse impact (para. 6.26).

### E. Cost Estimates

5.20 Total cost of the project is estimated at about US\$126.9 M (EE 168.8 M), including US\$15.7 M (EE 20.9 M) import duties and taxes and US\$29.5 M (EE 39.2 M) for inflation. The foreign exchange cost would be about US\$78.8 M (EE 104.8 M) or 62% of total cost. The cost estimates for equipment, vehicles, herbicides and civil works are based on unit prices taken from recent contracts issued for similar items in Egypt and on quotations from suppliers, appropriately adjusted to early 1986 estimated baseline price levels. Consultant services under the project total 102 person-months for experts in various fields and 51 person-months for local experts specializing in financial management. The average costs/person-month for both expatriate and local experts are based on the prevailing rates in the country. Staff salaries and trainee allowances are based on wage rates within the PECs and EPADP. Physical contingencies equivalent to 10% of the baseline costs have been allowed for civil works, technical assistance and staffing, as well as 5% for all other items. Price contingencies are based on increases in local costs of 14% in 1986 and 13% per annum thereafter and in foreign exchange costs of 7.2%, 6.8%, 6.8%, 7.0%, 7.1% in the years 1986-90, respectively and 4% per annum for the following two years. Cost estimates for the proposed project are summarized in Table 5.1 below and detailed in Annex 1, Tables 1 to 6.

**Table 5.1: Project Cost Summary by Component**

	(LE '000)			(US\$ '000)			% Foreign Exchange	% Total Base Costs
	Local	Foreign	Total	Local	Foreign	Total		
<b>I. INVESTMENT COSTS</b>								
A. CIVIL WORKS	2,979.2	-	2,979.2	2,240.0	-	2,240.0	-	2
B. EQUIPMENT FOR MAINTENANCE CONTRACTORS	29,740.9	60,463.1	90,204.0	22,361.6	45,461.0	67,822.6	67	73
C. EQUIPMENT FOR MOI	1,608.6	3,201.3	4,809.9	1,209.4	2,407.0	3,616.4	67	4
D. CHEMICALS FOR WEED CONTROL	2,599.9	15,293.7	17,893.6	1,954.8	11,499.0	13,453.8	85	15
E. TECHNICAL ASSISTANCE	1,210.3	2,130.7	3,341.0	910.0	1,602.0	2,512.0	64	3
<b>Total INVESTMENT COSTS</b>	<b>38,138.9</b>	<b>81,088.8</b>	<b>119,227.6</b>	<b>28,675.8</b>	<b>60,969.0</b>	<b>89,644.8</b>	<b>68</b>	<b>97</b>
<b>II. RECURRENT COSTS <sup>1/</sup></b>								
A. INSTITUTIONAL ADJUSTMENTS	3,666.8	-	3,666.8	2,757.0	-	2,757.0	-	3
<b>Total RECURRENT COSTS</b>	<b>3,666.8</b>	<b>-</b>	<b>3,666.8</b>	<b>2,757.0</b>	<b>-</b>	<b>2,757.0</b>	<b>-</b>	<b>3</b>
<b>Total BASELINE COSTS</b>	<b>41,805.7</b>	<b>81,088.8</b>	<b>122,894.5</b>	<b>31,432.8</b>	<b>60,969.0</b>	<b>92,401.8</b>	<b>66</b>	<b>100</b>
Physical Contingencies	2,483.1	4,161.0	6,644.1	1,867.0	3,128.6	4,995.5	63	5
Price Contingencies	19,681.2	19,539.3	39,220.5	14,797.9	14,691.2	29,489.1	50	32
<b>Total PROJECT COSTS</b>	<b>63,970.0</b>	<b>104,789.1</b>	<b>168,759.0</b>	<b>48,097.7</b>	<b>78,788.8</b>	<b>126,886.5</b>	<b>62</b>	<b>137</b>

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<sup>1/</sup> Incremental recurrent costs.

5.21 **Recurrent Costs.** Annex 1, Table 8 presents an estimate of annual recurrent funds required from Government's general budget for the routine maintenance of channels (para. 3.13). Based on analysis of the costs of operation of the PECs in terms of equipment costs, overheads and costs for supporting services, the annual cost of executing maintenance works for public channels would decline in constant prices from £E 44.6 M (US\$33.5 M) in 1985/86 to £E 34.7 M (US\$26.1 M) in 1992/93. During each year of project implementation, Government would need to provide about £E 1.3 M (US\$1.0 M), duly adjusted for inflation, for the import of currently used quantity of Acrolein for the control of submersed weeds (paras. 4.07 and 4.11).

#### F. Financing Plan

5.22 The proposed Bank loan of US\$70.0 M would finance 89% of the project's foreign exchange cost, or about 55% of total project costs. The Bank loan would be repayable over 20 years, including 5 years of grace at the standard variable interest rate and would finance: (a) procurement of maintenance, support and workshop equipment as well as spare parts required for new equipment and for the limited rehabilitation of existing equipment; (b) purchase of office, field and laboratory equipment for the IS and WRI; (c) procurement of herbicides, and (d) foreign costs of technical assistance and training. GOE would finance: (a) US\$48.1 M equivalent in local costs, including taxes and duties of US\$15.7 M, and (b) US\$8.8 M to cover the foreign costs involved in locally produced vehicles such as cars, buses, lorries and one-ton pick-ups and spare parts for such vehicles as well as locally available office, field and laboratory equipment. During negotiations, an assurance was obtained that GOE would provide promptly, as needed, the funds, facilities, services, and other resources required for the project (para. 8.01(e)). MOI presented in negotiations a proposed work program for the first year of implementation, which was agreed upon during negotiations (para. 6.25). A financing plan would be prepared for each year of project implementation based on the annual work program (AWP) and, following review by the CMB, would be furnished to the Bank, by June 30 each year, for its comments (paras. 6.02, 6.25 and 8.01(n)). Table 5.2 summarizes the proposed financing plan for project costs.

Table 5.2: Project Financing Plan 1/

Project Component	Local Costs GOE	Foreign Costs		Total Costs 2/	Foreign Exchange %
		GOE	IBRD		
----- (US\$ M) -----					
<b>A. <u>Investment Costs</u></b>					
Civil Works	3.35	-	-	3.35	0
Equipment for Contractors	33.82	6.68	51.14	91.64	63
Equipment for MOI	1.47	2.11	0.85	4.43	67
Chemicals for Weed Control	2.71	-	15.92	18.63	85
Technical Assistance and Training	1.44	-	2.09	3.53	59
<b>B. <u>Incremental Recurrent Costs</u></b>					
	5.31	-	-	5.31	0
	48.10	8.79	70.00	126.89	62

1/ Minor discrepancies in costs are due to rounding.

2/ Physical and price contingencies included in each component.



5.23 Also, an assurance was obtained at negotiations that the Government, through suitable budgetary provisions, would make available to MOI, during each year of project implementation, sufficient funds based upon the estimated costs (para. 5.21) and taking into account the effects of inflation, or agreed target in line with AWP's (para. 6.25) to meet recurrent expenditures for the appropriate maintenance of irrigation and drainage channels and facilities (para. 8.01(f)).

**G. Procurement**

5.24 Procurement for all items under the project would be carried out under the responsibility of the First Undersecretary, IS, who will be assisted for this purpose by EPADP and PECs (para. 5.15). Table 5.3 lists the methods proposed to be used for procurement of equipment, herbicides, civil works and consultant services for the project. At negotiations, assurances were obtained from MOI on all the procurement arrangements noted below (para. 8.01(g)).

**Table 5.3: Summary of Proposed Procurement Arrangements a/**

<u>Project Component</u>	<u>ICB b/</u>	<u>LCB</u>	<u>Other b/</u> <u>(US\$M Equivalent)</u>	<u>N/A c/</u>	<u>Total</u>
Maintenance Equipment	39.5 (39.5)	9.7 (1.2)	10.4 d/ (10.4)	32.0	91.6 (51.1)
Equipment for MOI	0.4 (0.4)	2.4 (0.3)	0.2 (0.2) d/	1.4	4.4 (0.9)
Herbicides	15.9 (15.9)	-	-	2.8	18.7 (15.9)
Civil Works	-	3.4	-	-	3.4
Technical Assistance and Training	-	-	2.1 (2.1)	1.4	3.5 (2.1)
Strengthening Institutions	-	-	-	5.3	5.3
<b>Total</b>	<b>55.8</b> <b>(55.8)</b>	<b>15.5</b> <b>(1.5)</b>	<b>12.7</b> <b>(12.7)</b>	<b>42.9</b>	<b>126.9</b> <b>(70.0)</b>

a/ Figures in parenthesis are the amounts to be financed by Bank loan; minor discrepancies due to rounding.

b/ Foreign exchange costs only, with local costs included under item "N/A".

c/ Local costs, including US\$15.7 M for import duties and taxes.

d/ Representing cost of spare parts to be procured directly from original foreign manufacturers, or other small items to be procured by obtaining quotations from at least three suppliers.

5.25 Equipment/Goods. Maintenance equipment (including spare parts amounting to 20% value of all such equipment), laboratory equipment and goods for MOI and herbicides would be grouped into appropriate packages and procured under ICB in accordance with Bank Guidelines, published in May 1985 (see Annex 2, Tables 3 to 6). The total value of these items (excluding local costs) will be about US\$ 55.8 M, representing about 71% of the foreign cost of the project, or 80% of the Bank loan. Qualifying domestic manufacturers would receive a preference in bid evaluation of 15% or the import duty, whichever is lower. Additional spare parts amounting to about US\$ 10.1 M or 14% of the Bank loan will be required for the repair of new equipment during the life of the project and limited rehabilitation of existing equipment. They will be procured directly from the manufacturer of each type of equipment on the basis of negotiated prices, or by quotations if there is more than one established supplier.

5.26 Exempted from ICB procedures would be transport vehicles such as cars, pick-ups (3/4 or 1 ton), lorries and buses which are produced/assembled locally. Such vehicles will be procured locally with financing by GOE (see Annex 2, Table 5) following local procedures acceptable to the Bank. Also, exempted from ICB procedures would be small items costing less than US\$100,000, to be procured following LCB procedures in accordance with the Bank Guidelines. The total value to be disbursed on items procured in this manner would not exceed US\$1.5 M. Small contracts of up to US\$50,000 equivalent for office, laboratory and field equipment may be awarded on a competitive basis to reliable suppliers after quotations have been obtained from at least three such suppliers. The aggregate amount of such procured goods would not exceed US\$500,000 equivalent. LCB procedures are generally consistent with the need for economy and efficiency in the execution of the project. However, in order to make LCB procedures acceptable to the Bank, assurances were obtained at negotiations that (a) representatives of foreign bidders would be allowed to bid; (b) all bidders would be treated equally in terms of eligibility for any preferences or the requirement of furnishing bids or performance bonds, and (c) all bids received after the time stipulated should not be considered and be returned unopened (para. 8.01(g)).

5.27 Civil Works. Civil works for stores, workshop building and staff houses of an estimated total value of US\$ 3.35 million (including contingencies) as well as for routine maintenance of channels up to 2 m bed-width and, as needed, of mesqas (paras. 4.08 and 4.09) will be let out to private and public contractors following LCB procedures acceptable to the Bank (para. 5.26). These works are not suitable for ICB because they are small and scattered throughout the country.

5.28 Contract Review. All bidding packages for goods and works to cost over US\$0.5 M equivalent would be subject to prior Bank Review of procurement documentation. This would result in a coverage of about 80% value of the contracts. The balance of contracts would be subject to random post review by the Bank after contract award.

5.29 Consultant Services. Consultants for the various project activities, including 102 person-months of suitably qualified and experienced experts in various fields (paras 6.13 and 6.20) and 51 person-months of local experts in financial management (para. 6.20), will be engaged in accordance with the Bank Guidelines for the Use of Consultants (issued in August 1981).

## H. Disbursements

5.30 Disbursements of the Bank loan would be made for:

- (a) 100% of the foreign exchange cost or the domestic ex-factory cost of equipment, spare parts, double cabin pick-ups and herbicides. Disbursement for locally procured items would be at the rate of 50% (US\$67.5 M);
- (b) 100% of the foreign exchange costs of Technical Assistance and overseas training (US\$0.5 M), and
- (c) Unallocated (US\$2.0 M).

5.31 Disbursement under category (a) would be made against full documentation except for reimbursements against contracts valued at US\$10,000, or under, which would be presented on the basis of statement of expenditures. Category (b) disbursements would be made against certified statements of expenditure; supporting documents would be retained by the IS for review by the Bank. Existing controls over this procedure which have been found to be satisfactory under ongoing projects will also apply to this project.

5.32 It is anticipated that disbursements would be completed by June 30, 1994, about one year after scheduled project completion. The disbursement schedule is marginally faster than the country average (eight years versus nine), but the nature of the expenditures to be financed—primarily procurement of equipment—together with the fact that maintenance is an ongoing activity, with an existing system already in place for planning, execution, and budgetary provision for works which would not be radically altered under the project, justify a slightly shorter period of disbursement. Based on the project implementation timetable (Annex 2, Chart 1, World Bank 30166:1.), the disbursement schedule for Bank financing is shown in Annex 1, Table 9 and summarized in Table 5.4 below:

**Table 5.4: Estimated Disbursement Schedule**

<u>Disbursements</u>	<u>Bank Fiscal Year</u>							
	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>
	----- (US\$ M) -----							
Annual	3.0	8.0	12.0	12.0	10.0	10.0	9.0	6.0
Cumulative	3.0	11.0	23.0	35.0	45.0	55.0	64.0	70.0

5.33 Special Account. A special account would be set up to finance eligible expenditures of the items to be financed by the Bank (paras. 5.22 and 5.30). Bank financing would be channelled through a commercial bank to be nominated by the Central Bank of Egypt. The special account, to be administered by the First Undersecretary IS, would be operated as follows: (a) the Bank, as requested by GOE immediately following loan effectiveness, would deposit initially a sum of US\$3 M in the special account corresponding to the Bank's share of the average four months' projected eligible expenditures; (b) subsequently, the special account would be replenished based on the

reimbursement applications received from the IS for the various eligible items financed under the loan; (c) a replenishment request would normally be sent to the Bank when US\$2.0 M were utilized, or once a month, whichever is sooner; (d) should the Bank determine at any time that any payment out of the special account was made for any expenditure or in any amount not eligible, the Government would promptly, upon notice from the Bank, deposit the corresponding ineligible amount into the special account, or if the Bank so requests, refund to the Bank an amount equal to the sum not eligible, and (e) if it is determined by the Bank that any amount outstanding in the special account will not be required to cover further payments for eligible expenditures, the Government would refund to the Bank such outstanding amount. Although most withdrawals from the proceeds of the proposed loan would be handled through the special account, the Bank would continue to accept, in appropriate cases, but for a minimum of US\$100,000, withdrawal applications for direct payment in accordance with agreements to reimburse. Assurances were obtained at negotiations that the Government would, for the purposes of the project, open and maintain in dollars a special account on terms and conditions satisfactory to the Bank (para. 8.01(h)). The closing date of the Loan would be June 30, 1994.

#### I. Auditing and Accounts

5.34 All agencies involved in channel maintenance would be subject to GOE expenditure control and auditing procedures, which are considered satisfactory. Project accounts would be maintained separately, and in a readily identifiable form, by the IS, EPADP and WRI. The IS would consolidate the accounts to reflect, in accordance with sound accounting practices the operations, resources and expenditures related to the project. Also, to allow a better understanding of their operations, the PECs would prepare annual budgets and annual accounts in a form clearly identifying channel maintenance related functions. The Central Audit Organization (CAO)—an independent auditing agency currently responsible for auditing accounts of all MOI's agencies—would continue to audit project accounts of the concerned organizations on a timely basis. Generally, the CAO performs continuous audit, prepares two or three interim reports each year, and consolidates its findings in an annual report. The CAO, which is auditing the IDA/Bank-financed ongoing projects, and also carried out the audits of the two completed drainage projects was favorably commented upon in the completion reports (paras. 2.17 and 3.07). During negotiations, assurances were obtained from the Government and MOI on the above accounting and auditing procedures, and that: (a) certified copies of the audited accounts of the project and special account for each fiscal year audited, and of the auditors' final report would be furnished to the Bank as soon as available, but in any case not later than six months after the end of such fiscal year, and (b) the auditor's report will be of such scope and in such detail as the Bank shall have reasonably requested, and, that it would include, inter alia, a statement that the funds advanced by the Bank for the special account and disbursed against statements of expenditure had been used for the purposes for which they were provided (para. 8.01(i)).

## VI. ORGANIZATION AND IMPLEMENTATION

### A. Project Management

#### General

6.01 The project would be implemented through existing institutions of the MOI, namely, the IS, the EPADP and the WRI, with the First Undersecretary of the IS providing the key role of Project Director (paras. 3.09 and 3.10). Policy direction and project coordination would be provided by establishing a Channel Maintenance Board (CMB) and a Technical Committee (TC) in the MOI by a Ministerial Decree. The proposed strengthening of the concerned agencies and the coordination between them would maintain the present relationships of responsibility and authority. The establishment of the CMB (para. 6.02) and TC (para 6.03) by a Ministerial Decree as well as the assignment of the key staff comprising a General Director and a senior engineer in the IS (para. 6.05) and one weed research scientist, two chemical analysts, and one system analyst in the WRI (paras. 6.10 and 6.11) would be conditions of Loan effectiveness (para. 8.02). The remaining staff required for the strengthening of the IS (para. 6.05), its field directorates (para. 6.06) and the WRI (paras. 6.10 and 6.11) would be assigned during the second half of 1987. (See Annex 3, Chart 2, World Bank 30166:3, for Project Organizational Flow Chart).

#### Central Level

6.02 Channel Maintenance Board. Through CMB, the MOI would ensure the effective implementation, coordination and monitoring of the project. A suitably qualified and high ranking official nominated by the Minister of Irrigation would be Chairman of the CMB, and the First Undersecretaries of the IS and Planning and Follow-up Department as well as the Chairmen of EPADP, WRC and IPSA would be its members. The CMB would meet, as required, to:  
(a) ensure the coordination in implementation and in performance among the implementing agencies; (b) review and approve consolidated AWP and financing plans which would be submitted to the Bank for its comments by June 30 of each year (paras. 5.22, 6.25 and 8.01(n)), and (c) monitor the status of project execution. In the performance of its functions, the Board would be assisted by the TC and a permanent secretariat headed by the Undersecretary Maintenance of the IS (paras. 6.03 and 6.05).

6.03 Technical Committee. The TC would be chaired by the First Undersecretary, IS, and have the Undersecretary, Maintenance as its Executive Secretary. Other members would include the Undersecretary, Maintenance of EPADP, and the representatives of IPSA, the four PECs, and the Director of the WRI. The TC would meet at least once every three months to: (a) monitor project activities in relation to project objectives; (b) ensure that the AWPs for project implementation are consistent with project targets (Annex 2, Chart 1, World Bank 30166:1); (c) review specifications for all project related goods and ensure their procurement in accordance with planned packages and time schedules; (d) evaluate equipment performance and recommend to the CMB payment rates of various types of channel maintenance activities, including weed control; (e) monitor training programs of participating agencies, and (f) carry out all other work or studies which the CMB may assign.

## Irrigation Sector

6.04 Proposals to strengthen the IS are summarized in the following paragraphs. Also, technical assistance would be provided to reinforce the IS to effectively implement the project (para. 6.12).

6.05 Office of the Undersecretary Maintenance. At present, the primary responsibilities of the office are procurement of herbicides and consolidation of maintenance statistics. The staff consists of only the Undersecretary and clerical personnel. It would be strengthened by the addition of a Director General and a senior engineer for planning and follow-up, a manpower coordinator and his assistant, two accountants, and necessary support staff (para. 5.09). The expanded office would act as a secretariat for the CMB and TC, providing assistance in the functions described in para. 6.03. In addition, the secretariat would be responsible to: (a) process procurement of goods and herbicides; (b) monitor and maintain statistics on channel maintenance expenditures; (c) prepare and submit Bank loan reimbursement applications; (d) prepare consolidated quarterly progress reports in a format satisfactory to the Bank and, following review by the CMB, furnish the same to the Bank within 90 days from the end of the period covered by each report, and (e) prepare a Project Completion Report and submit it to the Bank within six months of the completion date of the project. GOE assurances with respect to reporting requirements were obtained at negotiations (para. 8.01(j)).

6.06 Field Units. To strengthen the existing structure for channel maintenance activities, a position of chief engineer maintenance would be established in each Irrigation Directorate and a maintenance assistant in each District (paras. 3.10 and 5.09). These staff members would be exclusively meant for the maintenance of channels.

6.07 Staffing Status. The MOI is very conscious of the importance of the IS and, at present, all key positions (General Directors, Inspectors and District Engineers) are filled by qualified engineers despite general staff shortages due to low salaries and poor working conditions. While the proposed project cannot address the problem of Government wages, it would, nevertheless, provide additional housing for field units in order to meet a crucial need for attracting and retaining staff (para. 5.08) During negotiations, an assurance was obtained from MOI that, until the completion of the project, the above key positions and those of chief engineers maintenance and maintenance assistants would be kept filled with adequately qualified personnel (para. 8.01(k)).

## Egyptian Public Authority for Drainage Projects

6.08 The Maintenance Department in EPADP currently employs 96 civil engineers, 85 agricultural engineers and over 300 technicians. This level of technical staff is adequate to plan and implement drain maintenance works proposed under the project. Also, an assurance was obtained under Drainage V Project (Loan 2652-EGT) that EPADP would review with the Bank the technical staff requirements for each year of project implementation, and would provide the required additional staff, including civil and agricultural engineers on a timely basis; however, this was reiterated during negotiations (para. 8.01(1)).

## Weed Research Institute

6.09 The WRI is responsible for conducting applied research to evaluate different methods of aquatic weed management and the O&M of open channels. The present professional staff totals 13, consisting of a Director, 4 fishery biologists, 2 agricultural engineers and 6 civil engineers. The proposed project would strengthen the WRI as indicated in the following paragraphs.

6.10 Weed Control Unit. This unit would be strengthened by the addition of one senior botanist, two weed research scientists, two laboratory technicians and five botanically trained weed scientists and technicians. These staff members would be trained using existing facilities of GOE, and short-term consultancies (paras. 5.09 and 6.12). The unit would also be responsible for continuing demonstration and assistance in the training and guidance of the herbicide application crews of the PECs and selected MOI maintenance staff (paras. 4.10, 5.04 and 6.15).

6.11 Monitoring and Evaluation Unit. A unit would be established in WRI to monitor the effectiveness of the proposed maintenance cycles, particularly the use of chemical herbicides and their residues. This unit would require addition of two analytical chemists, two computer system analysts, five data coders, a senior monitoring engineer and five field monitoring assistants. These staff members would be provided training through existing facilities of MOI, and other agencies of GOE. Also, short-term consultancies would be required to strengthen capabilities in M&E and chemical residue analysis (paras. 5.09 and 6.12). The unit staff would provide training to, and receive assistance from, the field staff of both the IS and EPADP in establishing and conducting monitoring activities. The maintenance assistants in Districts and Centers will be trained in weed control and monitoring and assigned these tasks as additional duties.

## Technical Assistance and Training

6.12 Technical Assistance. In order to support transition to cycle-based, integrated maintenance, technical assistance would be provided to the IS and EPADP in the planning and scheduling of maintenance cycles, manpower development, and machinery evaluation techniques (para. 6.04). WRI would also receive assistance in specialized areas of botanical, chemical and biological weed control.

6.13 A channel maintenance specialist (36 person-months in resident status) would be recruited by the IS so as to be in position not later than July 1, 1987. The programs and procedures developed, with the assistance of the channel maintenance specialist, to administer, control and monitor the project would also be applied by the EPADP and the WRI. Follow-up support by this specialist is aimed at ensuring continued improvement. The equipment specialist would assist in carrying out evaluation of the performance of new machinery and of related cost aspects, in particular, of weed control operations. Short-term consultancies by chemical and botanical weed control specialists throughout the project implementation period would strengthen the capabilities of the WRI in this crucial area, and those of a biological weed control specialist, together with a hydraulic engineer specializing in screen design, would further the ongoing work in developing methodology for utilizing

grass carp for submersed weed control. The analytical chemist would, inter alia, assist in developing a water sampling network for in-channel monitoring of Acrolein subsequent to applications, and train WRI personnel in appropriate methods of sampling and analysis of Acrolein. Proposed short-term consultancies would initially assist in upgrading existing methods and procedures in respective fields, with follow-up visits to help in the improvement of such methods and procedures. The program of technical assistance is summarized in Table 6.1 below:

**Table 6.1: Summary and Timetable of Technical Assistance**

Agency	Consultant Specialty	Purpose	Assignment Duration (Person-months)						Total
			FY87 /88	FY88 /89	FY89 /90	FY90 /91	FY91 /92	FY92 /93	
IS/ EPADP	Channel Maintenance and Training	To develop and implement programs and procedures for channel maintenance and manpower development	12 a/	12 a/	12 a/	1	1	1	39
	Maintenance Equipment	To evaluate new machinery	2	-	3	-	2	-	7
WRI	Botanical Weed Control	To train WRI staff	3	1	1	-	-	-	5
	Chemical Weed Control	To train WRI staff	3	3	3	1	1	1	12
	Biological Weed Control	To further biological weed control and design of structures to allow use of grass carp	4 b/	2 b/	1	1	-	-	8
	Analytical Chemist	To improve herbicide residue analysis	2	1	1	-	-	-	4

a/ In resident status.

b/ Included in each one person-month of hydraulic engineer; the remainder being for biological weed control specialist.

6.14 Training. The training coordinator in the IS (para. 6.05), assisted by the channel maintenance specialist (para. 6.13), would design the training program in detail. Most training of civil engineers and irrigation technicians would be performed through the MOI's Manpower and Development Center which was established under the WRC in 1982 with assistance from USAID (para. 2.18(b)). Encouraged by the results so far, the MOI has requested



further support from USAID for upgrading the Training Center into a national institute. About 104 person-months of training is planned over the life of the project. Where training cannot be provided through Egyptian facilities, training and study tours are currently arranged by MOI through bilateral arrangements. A total of 18 person-months of such training tours would be financed by the project. The present level of EPADP training under the Dutch Program (para. 2.18(a)) and the opportunities offered by the MOI's Training Center are nearing the maximum levels that can be assimilated. Consequently, project assistance would be focussed on in-service training through the channel maintenance specialist (para. 6.13). The training program for the IS, EPADP and WRI is summarized in Annex 3, Table 2.

6.15 As a supplement to the proposed training, the WRI would develop and implement an on-the-job training program in the use of herbicides (para. 6.10). It would be directed mostly to the herbicide application crews of the PECs as well as to the supervisory District/Center engineers and technicians to enhance skills in this vital area.

### **B. Public Excavation Companies**

6.16 The organizational structure and facilities of the PECs have developed to meet their traditional pattern of work. The MEC organization (Annex 6, Chart 1, World Bank 30166:7) is typical of all the PECs involved in channel maintenance. They are adequately staffed, with an average of over 4 technical persons/production machine (see staffing details by company in Annex 6, Table 2). The liquidity position of the main PECs is sound, and their repair and store facilities are generally successful in ensuring low down-time of equipment, despite the high average life of the equipment (para. 3.24).

6.17 However, with the introduction of new machines, and the proposed cycle-based maintenance system, improvements to the management information and inventory control systems of the PECs would be required (para. 3.25). Other aspects of PECs' management requiring improvement include corporate planning, financial management, workshop operations, and preventive maintenance of the equipment fleet (para. 5.12).

6.18 Establishing Corporate Planning Unit and Management Information System. A planning and monitoring unit would be established, by July 1, 1987, in each PEC involved in carrying out the project (paras. 3.18, 3.25 and 5.05). GOE assurance to this effect was obtained at negotiations (para. 8.01(m)). In 1987/88, the corporate planning and MIS specialists recruited by IPSA would assist in making these units functional and effective (para. 6.20). Follow-up support by these specialists would help in strengthening these units (para. 6.20). Each company would also procure a computer to establish an MIS (para. 5.05).

6.19 Establishing Financial Management Systems. Local consultants specializing in financial management would be contracted by IPSA in July 1987 to assist PECs in developing and setting-up financial management and inventory control systems, including support for introducing computer facilities for both these systems (paras. 5.05 and 6.20). Beginning in October 1987, financial management and inventory control personnel in each PEC would be trained on-the-job.

6.20 Improvements to Workshop Operations and Equipment Management. Specialists in these fields would initially assist in introducing appropriate technologies and methods for workshop operations as well as in setting up procedures for preventive maintenance, and monitoring of equipment performance. Table 6.2 below summarizes the schedule of Technical Assistance to be provided to IPSA and the PECs.

**Table 6.2: Summary and Timetable of Technical Assistance to PECs**

Consultant Speciality	Purpose	Assignment Duration (Person-Months)					Total
		FY87 /88	FY88 /89	FY89 /90	FY90 /91	FY91 /92	
Corporate Planning	Assist PECs' in establishing Planning cells	6	-	1	-	-	7
Manpower Development	Formulate Develop- ment Program	3	-	1	-	-	4
Information Systems	Assist PECs' in establishing MIS	4	-	1	-	-	5
Workshop Op'n. Equipment	Upgrade Workshop operation	4	-	2	-	1	7
Equipment Specialist	Upgrade preventive maintenance and evaluation	2	-	1	-	1	4
Financial Management	Develop Financial Management & Inventory Control Systems & provide Associated Training	42	5	4	-	-	51

6.21 Staff Training. The EDC and MEC have satisfactory off-site training facilities, including class rooms, training aids, and materials. Short courses are given in the training centers for engineers, mechanics and equipment operators. In addition, on-site training for mechanics and heavy equipment operators is provided by the four PECs.

6.22 The proposed project would provide: (a) 10 person-months of study tours to advanced countries having comparable mechanized operations in channel maintenance; (b) the services of a suitably qualified and experienced manpower development specialist to assist PECs in defining improved on-site and off-site training programs (paras. 5.12 and 6.17); (c) necessary training aids as part of equipment supply contracts to strengthen the existing facilities (para. 5.04), and (d) 475 person-months of local off-site training of engineers, mechanics and operators. Local off-site training would be standardized for various categories of staff, with uniform course content. Training for mechanics and operators would be on the modular system whereby

trainees can progress via a series of short courses interspersed with periods of job experience under supervision on site. The PECs would use their facilities and the services of guarantee technicians from equipment suppliers for providing on-site training to mechanics and machine operators (para. 5.04). Special emphasis in this regard would be given to training of PECs' crews in operating self-propelled sprayers for application of herbicides. The training program for IPSA and the PECs is summarized in Annex 6, Table 3.

### C. Project Implementation

6.23 Project implementation is scheduled for six and a half years (see Implementation Schedule, Annex 2, Chart 1, World Bank 30166:1). The introduction of the proposed integrated channel maintenance system would start during the second half of the fiscal year 1986/87 and progress gradually to cover the total number of channels (para. 3.08). The cumulative application of the proposed maintenance system to public channels is planned to be as follows: 1987/88, 20%; 1988/89, 39%; 1989/90, 63%; 1990/91, 92%; 1991/92, 98%; and 1992/93, 100% (see details by channel type in Annex 2, Table 2). Accordingly, by July 1992, the new system will be applied to all public irrigation and drainage channels.

6.24 Most of the equipment and herbicides procurement will be completed by December 31, 1991. Civil works for new stores for chemicals would commence in July 1987 and be completed during fiscal year 1989. Construction of staff houses and repairs of workshop buildings would commence in July 1987 and be completed by June 1990. Overseas training of senior staff from MOI and PECs would be carried out during fiscal years 1988 to 1990 while training of local staff would commence in July 1987 and continue throughout the project. Experts in various fields would be engaged first during the fiscal year 1988 and would continue short-term services until the end of the project. Local consultants in financial management would complete their task by December 1990.

6.25 Annual Work Programs. The AWP, covering all project components and channel maintenance works, would be a key project implementation mechanism (paras. 5.14, 5.22 and 6.03). Each AWP would include: (a) a review of progress achieved, in light of targeted objectives, in project execution in the preceding year, including manpower development and training of field personnel in the use of herbicides; (b) a brief description of all activities to be undertaken in the following fiscal year, including maintenance works, training of personnel, deployment of equipment and staff, and requirements for the purchase of equipment, herbicides and spare parts, and (c) an estimate of funding requirements for such activities, together with a financing plan to secure the funds required in local and foreign currencies (para. 5.22). The AWP would enable GOE to review progress, scrutinize forthcoming program and provide the necessary budgetary and other support needed for the project. All implementing agencies would submit AWP to the IS by April 30 each year. The consolidated AWP would be reviewed by the CMB, and furnished to the Bank, by June 30 in each year, for its comments (paras. 5.22 and 6.02). Assurances on the above arrangements were obtained during negotiations and, for the first year of implementation, the MOI work program was discussed and agreed upon at negotiations (para. 8.01(n)).

6.26 Mid-Term Review. GOE and the Bank would undertake, at the end of the

year 1989, a mid-term review of the project. The primary aim will be a review of the physical implementation of the project and of the progress accomplished in meeting its objectives (para. 5.19). Emphasis would be given to: (a) progress on the introduction of integrated maintenance and its impact on keeping channels clean; (b) the efficiency in the storage, handling and application safety of herbicides; (c) evaluation of weed control systems and of equipment; (d) progress with manpower development programs, and (e) the impact of reforms in PECs on upgrading their operations. As an input to such reviews, each consultant financed by the project during 1989/90 would prepare a report outlining his findings (paras. 6.14 and 6.17). Based on the mid-term review, and other supporting work, project components may be modified if and where required, and project funds reallocated. GOE agreement on these matters was obtained at negotiations (para. 8.01(o)).

#### D. Monitoring and Evaluation

6.27 Monitoring. The IS, assisted by the WRI and the channel maintenance specialist (first three years), would have the responsibility of collecting, reviewing and monitoring information regarding the physical and financial aspects of the project. Monitoring would be carried out principally through periodic progress reports (para. 6.05), the AWP mechanism (para. 6.25) and the proposed mid-term review (para. 6.26). This program would provide the CMB with early warning signals regarding current and/or potential implementation problems and the status and progress of the project as related to the proposed schedule (Annex 2, Chart 1, World Bank 30166:1).

6.28 With the assistance of the experts to be employed under the project, the IS and WRI would prepare a M&E program for the project, to be furnished to the Bank for its comment, by September 30, 1987. Such program would include: (a) the standard procedures to be followed by the implementing agencies; (b) the forms for data collection, and (c) the computerized procedures for data manipulation and analysis. Collection of field data would be the primary responsibility of the staff members of the Irrigation Districts and Drainage Centers (paras. 3.10 and 3.11) who would receive training and assistance from the WRI (para. 6.11). Emphasis with regard to field data would be put on: (a) surveys for weed occurrence in September and October each year, and subjectively quantifying (light, moderate, heavy) in each canal and drain by reaches; (b) pre/post-excavation surveys to determine hydraulic condition of the channels and quantities of silt to be removed; (c) assessment of the area for weed mowing; (d) chemical weed treatments, including location, type of herbicide and quantity used, type of equipment used and, subsequent to application, a visual survey to ascertain effectiveness of the treatment, and (e) proper application practices for Acrolein, including sampling and analysis for its presence at water intakes and other critical locations as specified in the water sampling network and techniques to be established by WRI with assistance from a qualified chemist (para. 6.13). The Directorates would submit field information, together with valid cost data to their Head Offices and the WRI within 30 days from the end of each reporting period. After consolidation, the WRI would provide data to the IS for the preparation of quarterly reports and for review by the CMB/TC. Also, with assistance of experts, IPSA/PECs would develop standardized criteria, procedures and forms for monitoring equipment performance and workshop operations.

6.29 Evaluation would concentrate on assessing: (a) the effectiveness of

the integrated maintenance system; (b) the cost of the proposed methods; (c) the improvement in the use of herbicides; (d) efficiency in equipment maintenance, availability and usage, and (e) the possibility in reducing the use of herbicides. Also, evaluation of field data would develop information on specific channel reaches in order to determine trends in condition, treatment effectiveness, weed problems, proper procedures for application of Acrolein are being implemented, etc.

6.30 Assurances were obtained at negotiations that the MOI would: (i) prepare a M&E program to be furnished to the Bank, for its comments, by September 30, 1987; (ii) implement the agreed M&E program, and (iii) include the findings and analysis of the agreed program in the quarterly progress reports for the project (paras. 6.05 and 8.01(p)).

## VII. PROJECT JUSTIFICATION, BENEFITS AND RISK

### A. Project Justification

7.01 Egyptian agriculture depends on both irrigation and drainage, and thus, also, on the proper maintenance of the channel system. Since the completion of the HAD in 1968, the need for maintenance has both increased, and changed. The increase in the volume of water diverted for irrigation, and the fact that irrigation is now perennial, has sharply augmented the quantity of the drainable surplus. More intensive cropping has increased the peak irrigation demand.

7.02 To meet these requirements, GOE has invested heavily in subsurface drainage, and has also begun renovation of the irrigation system. Maintenance methods, however, have remained essentially unchanged and are now quite unsuited to current needs. Excavation, which was the main requirement to keep the channels free of the annual silt load, is an expensive and ineffective means of dealing with the problem of weed infestation which has increased since the completion of the HAD.

### B. Project Benefits and Risks

7.03 The modern maintenance practices are both cheaper and more effective in controlling weeds than the current system of excavation. The expenditures to upgrade the existing fleet would be lower than the cost of providing replacement equipment (see Annex 1, Table 7). The operating costs of the new equipment would be lower than the cost of operating the heavy draglines and excavators now used, and thus the project would lead to a reduction in the costs of maintenance, together with an increase in the quality of maintenance. At full development, the total annual cost of maintaining public channels would decline from £E 44.6 M to £E 34.7 M in 1986 prices (see Annex 1, Table 8). With positive benefits and negative incremental costs in every year except--marginally-- year 2, the conventional rate of return calculation is not applicable. The Net Present Value of the project over 30 years at 12% discount rate is £E 44 M. Switching values for major components, at which the Net Present Value would become negative, would be: capital costs of machinery +50%, and operating costs of machinery +30%. These values are based solely on the cost savings, and would be higher if the benefits of improved maintenance were included.

7.04 Analytically, since the precise relationship between water table levels, irrigation deliveries and yields is not well enough defined to allow precise calculation of the variation of agricultural production with alternative levels of maintenance, the objective is to minimize the costs of keeping the channels functional. The cost of annual maintenance is less than the cost of bi-annual maintenance because weeds rapidly become more difficult to remove and inhibit. Given the annual cycle of weed growth, it is rarely necessary to clear canals more than once a year, and thus the proposed annual cycles are close to the optimum. Experience may indicate the need for minor modifications due to local conditions, but similar methods have been used successfully elsewhere (and on a pilot basis in Egypt), and thus the risks of failure are negligible.

### C. Land Tax in the Project Area

7.05 While there is no direct recovery of the costs of channel maintenance in Egypt, the agricultural sector is subjected to a variety of taxes. The basic annual land tax currently averages about £E 6-10/fed: the tax is levied on owners of holdings in excess of 3 feddans, and on smaller holdings if the owner has non-agricultural sources of income. The basic land tax is augmented by a variety of additional taxes, including the Governorate (15% of land tax), and the National Security Tax (66% of land tax) which are levied on the user of the land. "Additional tax" at 50% of the land tax is paid by the owner, as is the Municipality tax (2% of land tax). In addition to these direct taxes on land, there is substantial indirect taxation of agriculture through the pricing and procurement system, partially offset by subsidies on inputs.

7.06 Of the various taxes levied on agriculture, the basic land tax is the most appropriate means to recover maintenance costs: it is proportional to the area served, it is adjusted periodically to reflect changes in productivity or additional infrastructural investments, and it does not distort incentives in the way that crop taxes and controls do. Recovery rates for land tax are very high. Basic revenues from agricultural land over the past 5 years are detailed in Table 7.1 below:

**Table 7.1: Land Tax Revenues for Agricultural Lands, Egypt  
1980-1984**

<u>Year</u>	<u>Main Tax</u>	<u>Governorate Duties (a)</u> <u>(£E)</u>
1980	24,940,837	3,670,083
1981	27,033,800	4,124,322
1982	27,483,076	4,120,402
1983	27,208,886	4,074,416
1984	28,496,456	4,278,600

Source: Tax Department, Land (Estate) Taxes Unit.

(a) About 15% of the main tax, paid in addition to the main tax.

7.07 The cost of maintaining the mesqas serving the farms is the direct responsibility of the farmers (para. 3.09). At full development, the annual maintenance costs for public channels borne by the GOE (in 1986 prices) will

be about £E 35 M (para. 5.21), whereas current collections of land tax together with Governorate duties amount to £E 32.7 M. Assurances were obtained at negotiations that: (a) during the period of project implementation, GOE and the Bank will from time to time exchange views and reach an understanding on the specific targets and measures for recovery of the maintenance costs of irrigation and drainage channels, and (b) such measures will be discussed in the context of an action plan formulated by GOE, by December 1987, in accordance with its regulations in force and which will aim at achieving such cost recovery in the time frame of the Project (para. 8.01 (q)).

### VIII. SUMMARY OF AGREEMENTS TO BE REACHED AND RECOMMENDATION

- 8.01 At negotiations, assurances were obtained from GOE and/or MOI that:
- (a) maintenance would be executed according to the following guidelines:
    - (i) channels of up to 2 m bed-width would be maintained without the use of herbicides, with works awarded to private or public sector contractors on the basis of LCB procedures acceptable to the Bank (para. 4.08);
    - (ii) channels of more than 2 m bed-width would be maintained by PECs according to agreed maintenance cycles (para 4.10);
    - (iii) PECs personnel handling herbicides would be trained by equipment suppliers' technicians and WRI specialists and that application of herbicides would be by such trained and certified crews using proper equipment (para. 4.10), and
    - (iv) contracts to private and public contractors would be structured on areas and the duration of the maintenance cycle for each channel type so as to ensure the most efficient use of equipment (paras. 4.08, 4.10 and 4.14), and
    - (v) contractors awarded channel maintenance contracts would have access to required equipment on similar terms (para. 4.15);
  - (b) in collaboration with the concerned Agricultural Cooperatives, the Irrigation Directorates of MOI would: (i) monitor the maintenance of the mesqas serving more than 200 fed and, where necessary, carry out required maintenance at the cost of beneficiaries, and (ii) ensure maintenance of smaller mesqas by farmers and, should they fail to do so properly, to undertake such maintenance at their cost (para. 4.09);
  - (c) the Bank guidelines as stated in OPN 11.01, the MOI's existing directives, and the manufacturers' recommendations for the handling, storage, and application safety of all herbicides, including Acrolein, would be strictly followed (paras. 4.10 and 4.16);
  - (d) MOI would promptly carry out plans for manpower development and would contract suitably qualified and experienced expatriate and local consultants on terms, conditions and schedule satisfactory to the Bank (para. 5.13);
  - (e) GOE would provide, promptly as needed, the funds, facilities, services and other resources required for the project (para. 5.22);
  - (f) GOE, through suitable budgetary provisions, would make available to MOI sufficient funds based upon the estimated costs and taking into

account the effects of inflation (para. 5.21) or the agreed target in line with AWP's (para. 6.25) to meet recurrent expenditures for the appropriate maintenance of irrigation and drainage channels and facilities (para. 5.23);

- (g) MOI would procure equipment and goods in accordance with the procedures consistent with those set forth in the Bank Guidelines of May 1985 and details prescribed for the project (paras. 5.24 to 5.28) and hire consultants' services in accordance with the Bank Guidelines of August 1981 (para. 5.29);
- (h) GOE would, for the purposes of the project, open and maintain in dollars a special account on terms and conditions satisfactory to the Bank (para. 5.33);
- (i) maintenance of project accounts, special account and routine maintenance related expenditures, preparation and use of statements of expenditures, and the carrying out of financial reporting and auditing will be as set forth in para. 5.34;
- (j) the IS would prepare quarterly progress reports in a format satisfactory to the Bank and, following review by the CMB, furnish the same to the Bank within 90 days from the end of the period covered by each report, and would also prepare a Project Completion Report for submission to the Bank within six months of the completion date of the project (para. 6.05);
- (k) MOI would ensure that, until the completion of the project, all key positions in the Irrigation Directorates are filled with adequately qualified personnel; such positions to include the General Directors, Inspectors, District Engineers, Chief Engineers for Maintenance and Maintenance Assistants (para. 6.07);
- (l) as envisaged under Drainage V Project, EPADP would continue to review with the Bank the technical staff requirements for each year of project implementation, and would provide the required additional staff, including civil and agricultural engineers, on a timely basis (para. 6.08);
- (m) a planning and monitoring unit would be established, by July 1, 1987, in each PEC involved in carrying out the project (paras. 3.18, 3.25 and 6.18);
- (n) the project AWP, prepared in accordance with content and detail set forth in para. 6.25, would be reviewed by the CMB and furnished to the Bank, by June 30 in each year, for its comments, and, for the first year of implementation, the MOI work program was discussed and agreed upon at negotiations (paras. 5.22, 6.02 and 6.25);
- (o) GOE and the Bank would undertake, at the end of the year 1989, a mid-term review of the project, and, based on such review, project components may be modified if and where required, and project funds reallocated (para. 6.26);



- (p) MOI would prepare, with the assistance of the IS, WRI and the experts to be employed under the project, a M&E program for the project, to be furnished to the Bank for its comments, by September 30, 1987, implement the agreed program and include findings and analysis of the M&E program in the quarterly progress reports for the project (paras. 6.05 and 6.30).
- (q) during the period of project implementation, GOE and the Bank will from time to time exchange views and reach an understanding on the specific targets and measures for recovery of the maintenance costs of irrigation and drainage channels, and that such measures will be discussed in the context of an action plan formulated by GOE, by December 1987, in accordance with its regulations in force and which will aim at achieving such cost recovery in the time frame of the Project (para. 8.01(q)).

8.02 A principal issue involved in the project is the present poor handling and use by MOI of Acrolein or Magnacide H for the control of submersed weeds (paras. 3.22 and 5.18). During negotiations, an agreement was reached with MOI on a time-bound action plan for: (a) upgrading and rationalizing all existing stores in accordance with the MOI Guidelines for safe storage of Acrolein and other herbicides; (b) improving safety of inland transportation; (c) providing personal and mechanical equipment required for safe applications, and (d) strengthening supervision to ensure that all safety devices are operational and hygienic working procedures are strictly followed (para. 4.16). Evidence of meeting agreed targets for handling, storage and application safety of Acrolein according to the Government directives will be a condition of loan effectiveness (para. 4.16). Agreement was also reached with MOI that: (a) Acrolein would be handled in heavy-walled steel containers rather than the present 55 gallons barrels (paras. 4.10 and 4.16), and (b) a testing and monitoring program would be established by qualified chemists by December 31, 1987 to monitor Acrolein in critical locations in channels (paras. 6.13 and 6.28). Additional conditions of loan effectiveness would be: (a) establishing the CMB and TC by a Ministerial Decree (paras. 6.01 to 6.03), and (b) formal action required for the assignment of key staff comprising a General Director and a senior engineer in the IS (paras. 6.01 and 6.05) and one weed research scientist, two chemical analysts, and one system analyst in the WRI (paras. 6.01, 6.10 and 6.11). Also, an assurance was obtained at negotiations that the remaining staff required to strengthen the IS (para. 6.05), its field Directorates (para. 6.06) and the WRI (paras. 6.10 and 6.11) would be assigned during the second half of 1987.

8.03 The above agreements having been obtained, the proposed project would be suitable for a Bank loan of US\$70.0 M for 20 years, including 5 years grace, at the variable interest rate. The Borrower would be the Government of Arab Republic of Egypt.

ARAB REPUBLIC OF EGYPT  
CHANNEL MAINTENANCE PROJECT  
Project Components by Year  
(LE '000)

	Base Costs							Total	
	1986/1987	1987/1988	1988/1989	1989/1990	1990/1991	1991/1992	1992/1993	LE	US\$ '000)
A. PROVISION OF EQUIPMENT AND SUPPORT TO MAINTENANCE CONTRACTORS	16,852.2	18,663.0	18,634.9	21,895.4	12,480.9	11,325.6	10,520.5	110,382.6	82,994.4
B. PROVISION OF EQUIPMENT AND SUPPORT TO MINISTRY OF IRRIGATION AGENCIES	1,401.1	3,590.3	2,027.8	2,183.8	903.8	1,194.0	1,231.3	12,511.9	9,407.4
<b>Total BASELINE COSTS</b>	<b>18,253.2</b>	<b>22,253.4</b>	<b>20,662.6</b>	<b>24,079.3</b>	<b>13,384.5</b>	<b>12,519.6</b>	<b>11,751.8</b>	<b>122,894.5</b>	<b>92,401.8</b>
Physical Contingencies	914.9	1,258.8	1,142.8	1,313.7	716.3	671.2	625.3	6,644.1	4,995.5
Price Contingencies	824.6	3,103.7	4,940.4	8,223.3	6,268.5	7,534.5	8,328.2	39,220.5	29,489.1
<b>Total PROJECT COSTS</b>	<b>19,992.6</b>	<b>26,616.2</b>	<b>26,745.9</b>	<b>33,596.3</b>	<b>20,377.3</b>	<b>20,725.3</b>	<b>20,705.3</b>	<b>168,759.0</b>	<b>126,888.5</b>
Taxes	2,820.6	3,354.1	3,096.8	3,853.2	2,477.5	2,588.1	2,654.6	20,944.8	15,748.0
Foreign Exchange	13,100.9	17,020.5	17,200.6	22,128.6	12,462.5	11,495.3	11,382.5	104,789.1	78,788.8

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ARAB REPUBLIC OF EGYPT  
CHANNEL MAINTENANCE PROJECT  
Project Components by Year

	Totals Including Contingencies (LE '000)								Totals Including Contingencies (US\$ '000)							
	1986/1987	1987/1988	1988/1989	1989/1990	1990/1991	1991/1992	1992/1993	Total	1986/1987	1987/1988	1988/1989	1989/1990	1990/1991	1991/1992	1992/1993	Total
A. PROVISION OF EQUIPMENT AND SUPPORT TO MAINTENANCE CONTRACTORS	18,498.4	22,222.9	23,532.5	20,124.2	18,708.1	18,427.8	18,206.9	140,992.9	13,879.3	16,716.4	17,913.2	22,849.8	14,967.6	13,935.9	12,888.4	122,778.6
B. PROVISION OF EQUIPMENT AND SUPPORT TO MINISTRY OF IRRIGATION AGENCIES	1,533.3	4,383.4	2,913.3	2,472.1	1,688.2	2,207.5	2,498.4	18,786.1	1,152.0	3,295.0	2,190.5	2,816.8	1,594.3	1,727.4	1,878.8	14,168.8
<b>Total PROJECT COSTS</b>	<b>18,992.8</b>	<b>26,618.2</b>	<b>26,445.9</b>	<b>22,596.3</b>	<b>20,397.3</b>	<b>20,635.3</b>	<b>20,705.3</b>	<b>158,779.0</b>	<b>15,032.2</b>	<b>20,012.2</b>	<b>20,103.7</b>	<b>25,666.6</b>	<b>16,561.9</b>	<b>15,663.3</b>	<b>14,767.2</b>	<b>136,947.4</b>

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ARAB REPUBLIC OF EGYPT  
CHANNEL MAINTENANCE PROJECT  
Summary Account by Project Component  
(LE '000)

	PROVISION OF EQUIPMENT AND SUPPORT TO MAINTENANCE CONTRACTORS *****	PROVISION OF EQUIPMENT AND SUPPORT TO MINISTRY OF IRRIGATION AGENCIES *****	Total *****	Physical Contingencies -----	
				%	Amount *****
<b>I. INVESTMENT COSTS</b>					
A. CIVIL WORKS	899.6	2,278.6	2,978.2	10.0	297.8
B. EQUIPMENT FOR MAINTENANCE CONTRACTORS	90,204.0	-	90,204.0	5.0	4,510.2
C. EQUIPMENT FOR MOI	-	4,809.9	4,809.9	5.0	240.5
D. CHEMICALS FOR WEED CONTROL	17,893.6	-	17,893.6	5.0	894.7
E. TECHNICAL ASSISTANCE	1,585.4	1,755.9	3,341.3	10.0	334.1
<b>Total INVESTMENT COSTS</b>	<b>110,582.6</b>	<b>8,844.4</b>	<b>119,427.0</b>	<b>5.3</b>	<b>6,277.4</b>
<b>II. RECURRENT COSTS 1/</b>					
A. INSTITUTIONAL ADJUSTMENTS	-	3,688.8	3,688.8	10.0	368.7
<b>Total RECURRENT COSTS</b>	<b>-</b>	<b>3,688.8</b>	<b>3,688.8</b>	<b>10.0</b>	<b>368.7</b>
<b>Total BASELINE COSTS</b>	<b>110,582.6</b>	<b>12,533.2</b>	<b>122,894.5</b>	<b>5.4</b>	<b>6,644.1</b>
Physical Contingencies	5,633.4	1,919.7	7,553.1	0.0	0.0
Price Contingencies	33,977.0	5,243.5	39,220.5	5.3	2,093.9
<b>Total PROJECT COSTS</b>	<b>149,992.9</b>	<b>18,786.4</b>	<b>168,779.3</b>	<b>5.2</b>	<b>8,738.0</b>
Taxes	18,126.9	1,817.9	20,044.8	4.0	987.4
Foreign Exchange	98,865.7	5,968.4	104,834.1	4.9	5,110.0

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1/ Incremental Recurrent Costs.

2/ Shown against Baseline Investment Costs above.

ARAB REPUBLIC OF EGYPT  
CHANNEL MAINTENANCE PROJECT  
Summary Accounts by Year

	Base Costs (LE '000)							Foreign Exchange		
	1986/1987	1987/1988	1988/1989	1989/1990	1990/1991	1991/1992	1992/1993	Total	%	Amount
<b>I. INVESTMENT COSTS</b>										
A. CIVIL WORKS	-	1,148.1	1,000.2	828.8	-	-	-	2,976.2	0.0	0.0
B. EQUIPMENT FOR MAINTENANCE CONTRACTORS	16,217.3	15,915.5	18,031.2	18,482.4	8,972.8	7,691.0	8,913.7	90,204.0	87.0	80,483.1
C. EQUIPMENT FOR NOI	1,395.8	1,894.3	226.8	250.0	75.0	355.4	542.3	4,809.6	88.6	3,291.3
D. CHEMICALS FOR WEED CONTROL	634.9	1,398.9	2,211.2	3,132.4	3,415.6	3,558.8	3,541.7	17,883.6	85.5	15,293.7
E. TECHNICAL ASSISTANCE	-	1,512.0	621.1	671.7	179.6	153.0	103.7	3,341.0	63.8	2,139.7
<b>Total INVESTMENT COSTS</b>	<b>18,248.0</b>	<b>22,069.8</b>	<b>20,090.7</b>	<b>23,348.4</b>	<b>12,643.9</b>	<b>11,768.2</b>	<b>11,101.4</b>	<b>119,227.6</b>	<b>88.0</b>	<b>81,068.8</b>
<b>II. RECURRENT COSTS 1/</b>										
A. INSTITUTIONAL ADJUSTMENTS	45.2	183.5	571.9	712.9	751.5	751.5	650.4	3,668.8	0.0	0.0
<b>Total RECURRENT COSTS</b>	<b>45.2</b>	<b>183.5</b>	<b>571.9</b>	<b>712.9</b>	<b>751.5</b>	<b>751.5</b>	<b>650.4</b>	<b>3,668.8</b>	<b>0.0</b>	<b>0.0</b>
<b>Total BASELINE COSTS</b>	<b>18,293.2</b>	<b>22,253.4</b>	<b>20,662.6</b>	<b>24,061.3</b>	<b>13,395.4</b>	<b>12,519.6</b>	<b>11,751.8</b>	<b>122,896.5</b>	<b>88.0</b>	<b>81,068.8</b>
Physical Contingencies	914.9	1,239.9	1,142.8	1,213.7	718.3	671.2	625.3	5,844.1	82.9	4,181.9
Price Contingencies	824.8	2,103.0	4,840.4	8,223.3	6,268.9	7,534.5	8,326.2	39,220.9	49.8	19,539.2
<b>Total PROJECT COSTS</b>	<b>19,992.8</b>	<b>24,616.2</b>	<b>26,745.9</b>	<b>33,598.3</b>	<b>20,377.3</b>	<b>20,725.3</b>	<b>20,705.3</b>	<b>188,758.0</b>	<b>82.1</b>	<b>104,789.1</b>
Taxes	2,820.8	3,354.1	3,088.8	3,953.2	2,477.5	2,568.1	2,654.8	20,044.8	0.0	0.0
Foreign Exchange	13,100.9	17,020.5	17,200.6	22,126.8	12,482.9	11,495.3	11,382.5	104,789.1	0.0	0.0

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1/ Incremental Recurrent Costs.

ARAB REPUBLIC OF EGYPT  
CHANNEL MAINTENANCE PROJECT  
Summary Accounts by Year

Totals Including Contingencies  
(LE '000)

Totals Including Contingencies  
(US\$ '000)

	1986/1987	1987/1988	1988/1989	1989/1990	1990/1991	1991/1992	1992/1993	Total	1986/1987	1987/1988	1988/1989	1989/1990	1990/1991	1991/1992	1992/1993	Total
<b>I. INVESTMENT COSTS</b>																
A. CIVIL WORKS	-	1,534.7	1,509.4	1,415.3	-	-	-	4,459.3	-	1,153.9	1,134.9	1,084.1	-	-	-	3,372.9
B. EQUIPMENT FOR MAINTENANCE CONTRACTORS	17,769.5	18,864.5	20,495.7	25,482.2	13,885.6	12,989.2	12,588.5	121,875.2	12,380.5	14,153.8	15,410.3	19,159.5	16,399.0	9,788.3	9,495.1	91,635.5
C. EQUIPMENT FOR NOI	1,480.1	2,316.8	281.7	332.0	106.0	541.5	835.8	5,893.8	1,112.9	1,742.0	211.8	249.8	79.7	607.1	828.4	4,431.5
D. CHEMICALS FOR WEED CONTROL	690.0	1,625.1	2,744.8	4,159.6	4,826.1	5,273.5	5,458.1	24,777.1	518.8	1,221.9	2,083.7	3,127.5	3,628.6	3,985.0	4,163.8	18,629.4
E. TECHNICAL ASSISTANCE	-	2,030.0	851.3	991.6	311.5	284.8	222.6	4,691.9	-	1,528.3	640.1	745.6	234.2	214.2	167.4	3,527.7
<b>Total INVESTMENT COSTS</b>	<b>18,938.5</b>	<b>26,371.1</b>	<b>25,682.8</b>	<b>33,380.6</b>	<b>18,929.2</b>	<b>19,089.0</b>	<b>19,105.0</b>	<b>161,697.3</b>	<b>14,992.1</b>	<b>19,827.9</b>	<b>19,486.8</b>	<b>24,348.3</b>	<b>14,332.5</b>	<b>14,352.8</b>	<b>14,384.7</b>	<b>121,978.9</b>
<b>II. RECURRENT COSTS 1/</b>																
A. INSTITUTIONAL ADJUSTMENTS	53.2	245.1	863.1	1,215.7	1,448.0	1,638.3	1,600.3	7,661.7	49.0	184.3	648.9	814.9	1,088.8	1,250.3	1,293.2	5,309.8
<b>Total RECURRENT COSTS</b>	<b>53.2</b>	<b>245.1</b>	<b>863.1</b>	<b>1,215.7</b>	<b>1,448.0</b>	<b>1,638.3</b>	<b>1,600.3</b>	<b>7,661.7</b>	<b>49.0</b>	<b>184.3</b>	<b>648.9</b>	<b>814.9</b>	<b>1,088.8</b>	<b>1,250.3</b>	<b>1,293.2</b>	<b>5,309.8</b>
<b>Total PROJECT COSTS</b>	<b>19,992.8</b>	<b>26,616.2</b>	<b>26,745.9</b>	<b>34,596.3</b>	<b>20,377.3</b>	<b>20,727.3</b>	<b>20,705.3</b>	<b>169,759.0</b>	<b>15,032.2</b>	<b>20,012.2</b>	<b>20,109.7</b>	<b>25,200.4</b>	<b>15,321.3</b>	<b>15,602.9</b>	<b>15,567.9</b>	<b>178,088.9</b>

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1/ Incremental Recurrent Costs.

ARAB REPUBLIC OF EGYPT  
CHANNEL MAINTENANCE PROJECT  
BREAKDOWN OF SUMMARY ACCOUNTS  
(US\$ '000)

	Base Costs				Physical Contingencies				Price Contingencies				Total (Inc) Cont.				Physical Cont. Plus Price Cont. on Physical Cost.	Base Costs + Price Cont. on Base Costs
	For. Each	Local (Excl. Taxes)	Duties & Taxes	Total	For. Each	Local (Excl. Taxes)	Duties & Taxes	Total	For. Each	Local (Excl. Taxes)	Duties & Taxes	Total	For. Each	Local (Excl. Taxes)	Duties & Taxes	Total		
<b>I. INVESTMENT COSTS</b>																		
A. CIVIL WORKS	-	2,240.0	-	2,240.0	-	224.0	-	224.0	-	888.9	-	888.9	-	3,252.9	-	3,252.9	204.0	2,048.9
B. EQUIPMENT FOR MAINTENANCE CONTRACTORS	45,461.0	13,721.0	8,640.8	67,822.8	2,273.1	888.1	432.0	3,593.1	10,007.3	7,732.7	2,801.7	20,541.7	57,821.4	22,138.8	11,874.3	91,834.5	4,283.8	87,271.9
C. EQUIPMENT FOR ARI	2,407.0	94.0	1,119.4	3,616.4	120.4	4.7	55.8	180.9	431.7	8.9	109.8	634.2	2,958.0	105.8	1,288.8	4,432.6	211.0	4,221.6
D. CHEMICALS FOR WEED CONTROL	17,495.0	-0.0	1,934.8	13,453.8	675.0	-	87.7	872.7	3,848.8	-0.0	854.3	4,902.0	15,822.8	-	2,768.8	18,629.4	587.1	17,742.3
E. TECHNICAL ASSISTANCE	1,002.0	810.0	-	2,512.0	160.2	91.0	-	251.2	323.8	440.8	-	764.6	2,085.8	1,441.8	-	3,527.7	320.7	2,207.0
<b>Total INVESTMENT COSTS</b>	<b>60,989.0</b>	<b>18,995.0</b>	<b>11,710.8</b>	<b>89,694.8</b>	<b>3,128.8</b>	<b>1,005.8</b>	<b>505.5</b>	<b>4,710.1</b>	<b>14,881.2</b>	<b>8,009.4</b>	<b>3,451.8</b>	<b>27,212.2</b>	<b>78,786.8</b>	<b>27,040.2</b>	<b>15,748.8</b>	<b>121,575.8</b>	<b>8,087.2</b>	<b>113,488.6</b>
<b>II. RECURRENT COSTS 1/</b>																		
A. INSTITUTIONAL ADJUSTMENTS	-	2,757.0	-	2,757.0	-	275.7	-	275.7	-	2,278.0	-	2,278.0	-	5,309.8	-	5,309.8	482.7	4,827.1
<b>Total RECURRENT COSTS</b>	<b>-</b>	<b>2,757.0</b>	<b>-</b>	<b>2,757.0</b>	<b>-</b>	<b>275.7</b>	<b>-</b>	<b>275.7</b>	<b>-</b>	<b>2,278.0</b>	<b>-</b>	<b>2,278.0</b>	<b>-</b>	<b>5,309.8</b>	<b>-</b>	<b>5,309.8</b>	<b>482.7</b>	<b>4,827.1</b>
<b>Total</b>	<b>60,989.0</b>	<b>18,722.0</b>	<b>11,710.8</b>	<b>82,401.8</b>	<b>3,128.8</b>	<b>1,281.5</b>	<b>505.5</b>	<b>4,915.8</b>	<b>14,881.2</b>	<b>11,347.3</b>	<b>3,451.8</b>	<b>29,680.3</b>	<b>78,786.8</b>	<b>32,349.7</b>	<b>15,748.8</b>	<b>126,885.3</b>	<b>8,569.9</b>	<b>135,455.2</b>

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1/ Incremental Recurrent Costs.

**ARAB REPUBLIC OF EGYPT**  
**CHANNEL MAINTENANCE PROJECT**

**Projected Costs of Maintenance Equipment  
With and Without Project**

Years	Existing Fleet for Channel Maintenance			Equipment Procurement 1/ Without Project			Equipment Procurement 1/ With Project				
	Draglines		Excavators 15 ton	Draglines		Excavator 15 ton	Excavator Buckets	Excavators		Sprayers	W-Tractor/ Excavator
	0.6 m <sup>3</sup>	1.2 m <sup>3</sup>		0.6 m <sup>3</sup>	1.2 m <sup>3</sup>			15 ton	20 ton		
1985/86	359	125	327	-	-	-	-	-	-	-	-
1986/87	319	134	350	14	-	-	-	35	5	-	-
1987/88	279	134	337	33	-	13	8	25	24	5	16
1988/89	239	134	315	33	13	73	-	25	13	7	36
1989/90	188	116	182	20	16	63	33	-	28	7	74
1990/91	163	116	156	-	-	42	48	-	-	1	40
1991/92	163	116	93	-	-	34	40	-	-	2	10
1992/93	150	108	93	-	-	5	30	-	-	-	-
<b>Total Procurement</b>				<b>100</b>	<b>29</b>	<b>230</b>	<b>159</b>	<b>50</b>	<b>100 2/</b>	<b>27</b>	<b>176</b>

- 1/ Compared for only public channels and equipment to be procured under Drainage V Project (Loan 2562-EGT) excluded from overall estimated requirements.  
2/ Estimated requirement is 148 but available draglines 1.2 m<sup>3</sup> make-up the deficiency.

U/Cost	Equipment Costs Without Project - \$000			Equipment Procurement 1/ With Project - \$000				
	Draglines		Excavator 15 ton	Excavator Buckets	Excavators		Sprayers	W-Tractor/ Excavator
	0.6 m <sup>3</sup>	1.2 m <sup>3</sup>			15 ton	20 ton		
1986/87	1,568	-	-	-	-	3,150	408	-
1987/88	3,696	-	832	64	1,775	2,160	408	720
1988/89	3,696	2,080	4,672	-	1,775	1,170	571	1,620
1989/90	2,240	2,560	4,032	264	-	2,520	571	3,330
1990/91	-	-	2,688	384	-	-	82	1,800
1991/92	-	-	2,176	320	-	-	163	450
1992/93	-	-	320	240	-	-	-	-
<b>Total</b>	<b>11,200</b>	<b>4,640</b>	<b>14,720</b>	<b>1,272</b>	<b>3,550</b>	<b>9,000</b>	<b>2,201</b>	<b>7,920</b>

Total = \$30.5 M

Total = \$24.0

1/ Totals vary due to rounding.



**ARAB REPUBLIC OF EGYPT**  
**CHANNEL MAINTENANCE PROJECT**

**Annual Total Cost of Maintenance Works (LE'000)**

Years	Public Channels												Total Annual Costs 1/			Private Channels 2/		
	D<2	D2-5	D5-10	D10-25	D25	C<2	C2-3	C3-5	C5-10	C10-25	C25	Misc.	With Project	Without Project	Project Savings	M PEC's	M Pst	
1985/86	5,735	7,402	3,138	1,183	262	6,394	2,994	7,050	3,824	3,694	444	2,459	44,580	44,580	0	2,076	1,483	
1986/87	6,001	7,702	3,318	1,264	293	6,808	3,186	7,372	4,000	3,863	480	2,578	46,864	44,580	-2,284	2,276	1,626	
1987/88	5,920	6,325	2,742	1,342	343	6,562	2,943	6,563	4,275	4,150	541	2,780	44,500	44,580	80	2,270	1,621	
1988/89	6,105	6,535	2,867	1,144	365	7,931	2,178	4,669	3,240	4,289	573	3,958	43,650	44,580	730	2,926	2,090	
1989/90	5,942	5,270	2,484	1,014	280	8,071	2,663	4,142	2,238	3,057	428	4,873	39,663	44,580	4,917	3,345	2,389	
1990/91	5,780	3,636	1,955	915	285	7,855	1,837	3,252	2,501	3,083	436	8,110	36,644	44,580	7,946	3,818	2,727	
1991/92	5,618	3,636	1,955	792	256	7,855	1,837	3,252	2,981	2,628	405	8,500	38,474	44,580	9,106	3,818	2,727	
1992/93	4,923	3,636	1,955	792	231	7,855	1,837	3,252	2,981	2,272	384	8,500	34,688	44,580	9,892	3,818	2,727	
Annual Savings at Full Development															9,892			

1/ Estimated annual costs of maintaining channels in 1986 prices; minor differences in totals due to rounding.

2/ Estimated cost of maintaining mesqas, each serving more than 200 Fed (in total, about 12,000 km). MDI will carry out maintenance of mesqas only if not maintained properly by farmers. Such maintenance will be done at the cost of beneficiaries.

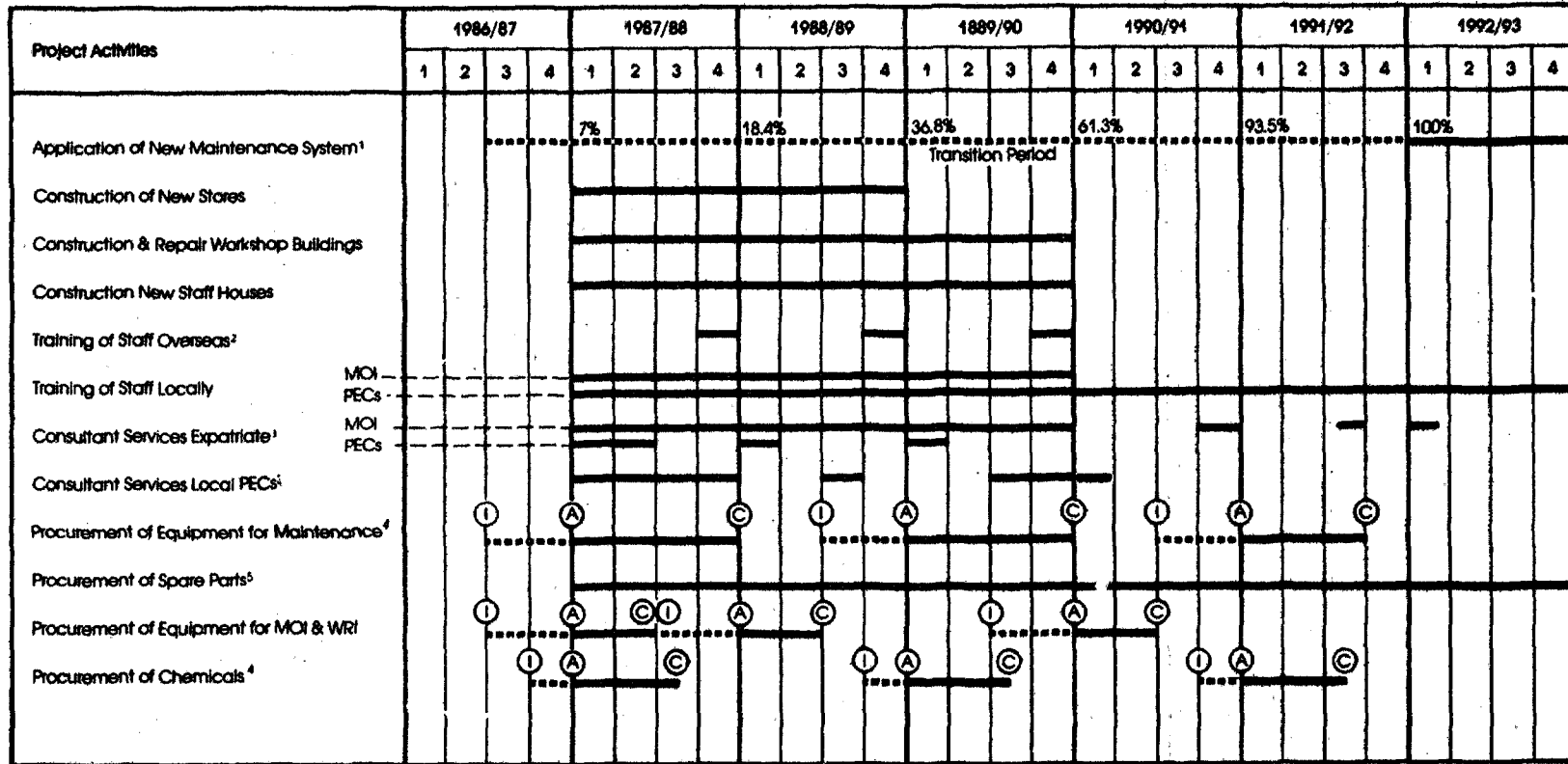
**ARAB REPUBLIC OF EGYPT**  
**CHANNEL MAINTENANCE PROJECT**

**Estimated Schedule of Disbursement of Bank Loan a/**

<u>Fiscal Year and Semester</u>	<u>Bank Disbursements</u>		
	<u>Bi-Annual Disbursements</u>	<u>Cumulative Disbursements</u>	<u>Cumulative % Disbursed</u>
	-----US\$ M Equivalent-----		
<u>1987</u>			
December 31, 1986	0.0	0.0	0
June 30, 1987	3.0 b/	3.0	4
<u>1988</u>			
December 31, 1987	3.0	6.0	9
June 30, 1988	5.0	11.0	16
<u>1989</u>			
December 31, 1988	6.0	17.0	24
June 30, 1989	6.0	23.0	33
<u>1990</u>			
December 31, 1989	6.0	29.0	41
June 30, 1990	6.0	35.0	50
<u>1991</u>			
December 31, 1990	5.0	40.0	57
June 30, 1991	5.0	45.0	64
<u>1992</u>			
December 31, 1991	5.0	50.0	71
June 30, 1992	5.0	55.0	79
<u>1993</u>			
December 31, 1992	5.0	60.0	86
June 30, 1993	4.0	64.0	91
<u>1994</u>			
December 31, 1993	4.0	68.0	97
June 30, 1994	2.0	70.0	100

a/ Expected Effectiveness Date: Not later than December 31, 1986  
Expected Closing Date: June 30, 1994  
b/ Assuming special account established.

# ARAB REPUBLIC OF EGYPT CHANNEL MAINTENANCE PROJECT Implementation Schedule



- (I) Issue of Tender
- (A) Award
- (C) Completion of Delivery

<sup>1</sup> For details see Table 2, Annex 2.  
<sup>2</sup> Short-term study tours.  
<sup>3</sup> For details see Tables 6.1 & 6.2.  
<sup>4</sup> For details of procurement packages, see Table 3 & Annex 2.  
<sup>5</sup> As required.

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**ARAB REPUBLIC OF EGYPT**  
**CHANNEL MAINTENANCE PROJECT**

**Channel Maintenance Activities with Current and Proposed System**

Channel Category	Current System of Maintenance 1/							Proposed System of Maintenance 2/			Years of General Application	Transition 4/ Period Years
	Total Length 3/ Km	Dragline Km	Excav. Km	Total Km	Mowing Km	Spraying Km	Desilt Km	Spot Mowing Km	Spot Spraying Km	Total Km		
<b>I. Public Drains</b>												
Drain < 2m	8,637	-	4,319	4,319	8,637	-	4,319	-	-	12,956	91/92	5
Drain 2-5m	5,751	2,876	2,876	5,752	1,898	1,898	1,898	474	474	6,642	90/91	4
Drain 5-10m	1,457	729	-	729	481	481	481	120	120	1,683	90/91	4
Drain 10-25m	571	188	-	188	143	286	143	36	36	644	91/92	5
Drain >25m	270	68	-	68	45	135	45	22	22	269	92/93	6
<b>Total Drains</b>	<b>16,686</b>	<b>3,861</b>	<b>7,195</b>	<b>11,056</b>	<b>11,204</b>	<b>2,800</b>	<b>6,886</b>	<b>652</b>	<b>652</b>	<b>22,194</b>		
<b>II. Public Canals</b>												
Canal <2m	14,409	-	7,201	7,201	19,155	-	4,753	-	-	23,908	90/91	4
Canal 2-3m	3,928	-	1,977	1,977	988	1,977	988	247	247	4,447	90/91	4
Canal 3-5m	6,710	-	3,365	3,365	1,683	3,365	1,683	421	421	7,573	90/91	4
Canal 5-10m	2,880	950	-	950	576	1,152	576	288	288	2,880	91/92	5
Canal 10-25m	2,705	676	-	676	446	1,353	446	223	223	2,691	92/93	6
Canal >25m	550	138	-	138	91	275	91	45	45	547	92/93	6
<b>Total Canals</b>	<b>31,182</b>	<b>1,764</b>	<b>12,543</b>	<b>14,307</b>	<b>22,939</b>	<b>8,122</b>	<b>8,537</b>	<b>1,224</b>	<b>1,224</b>	<b>42,046</b>		

1/ Based on excavation of all categories of channels.

2/ Integrated maintenance involving different work-cycle for each category of channels.

3/ See Annex 4, Table 1 for channel lengths by Governorate.

4/ Transition period from current to proposed system of maintenance based on equipment availability.

ARAB REPUBLIC OF EGYPT  
CHANNEL MAINTENANCE PROJECT

Application of Proposed Integrated Maintenance System  
(Cumulative Percentages of Channel Lengths)

Channel Category	Total Length 1/ Km	1986/87 %	1987/88 %	1988/89 %	1989/90 %	1990/91 %	1991/92 %	1992/93 %
<b>I. Public Drains and Canals</b>								
Drains <2m	8,637	5	15	30	50	70	90	100
Drains 2-5m	5,751	10	20	37	60	100	100	100
Drains 5-10m	1,457	10	20	37	60	100	100	100
Drains 10-25m	571	10	27	52	77	82	100	100
Drains >25m	270	10	25	42	58	75	92	100
Canals <2m	14,409	5	10	27	55	100	100	100
Canals 2-3m	3,928	10	35	60	85	100	100	100
Canals 3-5m	6,710	10	35	60	85	100	100	100
Canals 5-10m	2,880	10	30	50	70	90	100	100
Canals 10-25m	2,705	8	25	42	58	75	92	100
Canals >25m	550	8	25	42	58	75	92	100
Weighted Average	47,868	7.5	20.5	39.2	62.9	91.9	97.6	100

1/ See Annex 4, Table 1 for public channel lengths by Governorate.

ARAB REPUBLIC OF EGYPT  
CHANNEL MAINTENANCE PROJECT

ICB Procurement Schedule for Maintenance and Support Equipment 1/

Equipment	Unit Value (CIF) (US\$)	Tender 1 2/ Award 07/87 (No.)	Tender 2 2/ Award 07/89 (No.)	Tender 3 2/ Award 07/91 (No.)	Total (No.)	Total Value 3/ (US\$'000)
<b>Equipment for Contractors</b>						
-Hydraulic Excavator 20t w/ mow and mud buckets	89,700	59	41	-	100	8,970.0
-Hydraulic Excavator 15t w/ mow and mud buckets	71,000	25	25	-	50	3,550.0
-Hydraulic Excavator 7t w/ mow and mud buckets	44,800	26	37	25	88	3,872.0
-Wheel Tractor 80 KW w/ side boom	44,800	26	37	25	88	3,872.0
-Motor Grader	125,000	2	4	-	6	750.0
-Motor Sprayer with Trailer	81,500	10	14	3	27	2,200.5
-Mow Bucket 4 m	7,000	8	29	63	100	700.0
-Mow Bucket 3 m	6,300	-	24	35	59	371.7
-Desilt Bucket 1.5	1,500	11	42	19	72	108.0
-Desilt Bucket 1.2	1,000	-	24	28	52	52.0
-Low Loader 30 and 60 tons	85,000	11	9	-	20	1,700.0
-Mobile Workshops	75,000	3	3	3	9	675.0
-Pick-ups Double Cabin	10,000	25	15	10	50	500.0
-Spare Parts for above 4/	sum					5,464.8
Base Cost						32,786.0
Contingencies 5/						6,714.0
<b>Total Cost</b>						<b>39,500.0</b>

- 1/ Based on phased replacement of existing equipment resulting in progressive introduction of integrated maintenance of channels.
- 2/ Procurement of production equipment would include suppliers' technicians during guarantee period of one year and necessary training aids for training of operational personnel.
- 3/ Foreign costs only.
- 4/ About 20% purchase value of equipment but representing only part of total spare parts cost for new equipment which amounts to about US\$15.0 million, including contingencies. Also, excludes about US\$4.2 million, including contingencies, for spare parts and assemblies to be purchased for limited rehabilitation of existing equipment.
- 5/ Include price contingencies based on projected escalation rates for foreign costs.

**ARAB REPUBLIC OF EGYPT**  
**CHANNEL MAINTENANCE PROJECT**  
**Workshop Equipment 1/**

<u>EQUIPMENT</u>	<u>CIF</u> <u>Cost 2/</u> <u>(US\$)</u>
<b><u>I. Stationary Equipment</u></b>	
General Metalworking Equipment	150,000
Special Metalworking Equipment	100,000
General Tools	50,000
Special Tools	40,000
Welding Equipment	20,000
Testing Equipment	40,000
Metal Treating Equipment	20,000
Woodworking Equipment	10,000
Subtotal Stationary Equipment	<u>430,000</u>
<b><u>II. Mobile Equipment</u></b>	
Service Trucks with Hydraulic Cranes	150,000
Forklifts Rough Terrain	90,000
Heavy Duty and Small Size Fuel Trucks	<u>100,000</u>
Subtotal Mobile Equipment	<u>340,000</u>
Base Cost	770,000
Contingencies 3/	<u>90,000</u>
Total	<u>860,000</u>

- 1/ Procurement through ICB (excepting minor workshop items) will be based on a review of requirements and specifications by a workshop operation specialist during 1987/88.
- 2/ Foreign costs only.
- 3/ Estimated value includes contingencies based on projected escalation rates for foreign costs.

**ARAB REPUBLIC OF EGYPT**  
**CHANNEL MAINTENANCE PROJECT**

**Transport Vehicles and Office, Field and Laboratory Equipment**

Equipment	Quantity	Estimated Cost 1/ (US\$ '000)
<b><u>For IS &amp; WRI</u></b>		
Standard Pick-ups 2/	10	75.0
Cars 2/	62	341.0
Motorcycles 3/	270	270.0
Computer with software 4/	sum	130.0
Office Equipment 3/	sum	75.0
Laboratory Equipment & Supplies 4/	sum	750.0
Field Equipment 4/	sum	210.0
Spare Parts for above Equipment and replacement for Laboratory Equipment	sum	557.0
Base Cost		2,408.0
Contingencies 5/		552.0
Total Cost		2,960.0 6/
<b><u>For PECs</u></b>		
Lorries 8 to 10 tons 2/	25	875.0
Buses 2/	20	580.0
Standard Pick-ups 2/	103	772.5
Cars 2/	80	440.0
Spare Parts for above Vehicles	sum	966.5
Misc. Light Equipment and Spares	sum	950.0
Computers with Software 4/		250.0
Base Cost		4,834.0
Contingencies 5/		1,802.0
Total Cost		6,636.0 7/

1/ Estimated foreign cost net of taxes and duties.

2/ To be procured following local procedures for vehicles produced/assembled in Egypt.

3/ To be procured through LCB.

4/ To be procured by inviting quotations from at least three suppliers.

5/ Estimated value includes 5% physical contingencies and price contingencies based on projected escalation rates.

6/ About US\$2.43 million to be financed by GOE.

7/ About US\$6.35 million to be financed by GOE.



ARAB REPUBLIC OF EGYPT  
CHANNEL MAINTENANCE PROJECT

ICB Procurement Schedule for Herbicides 1/

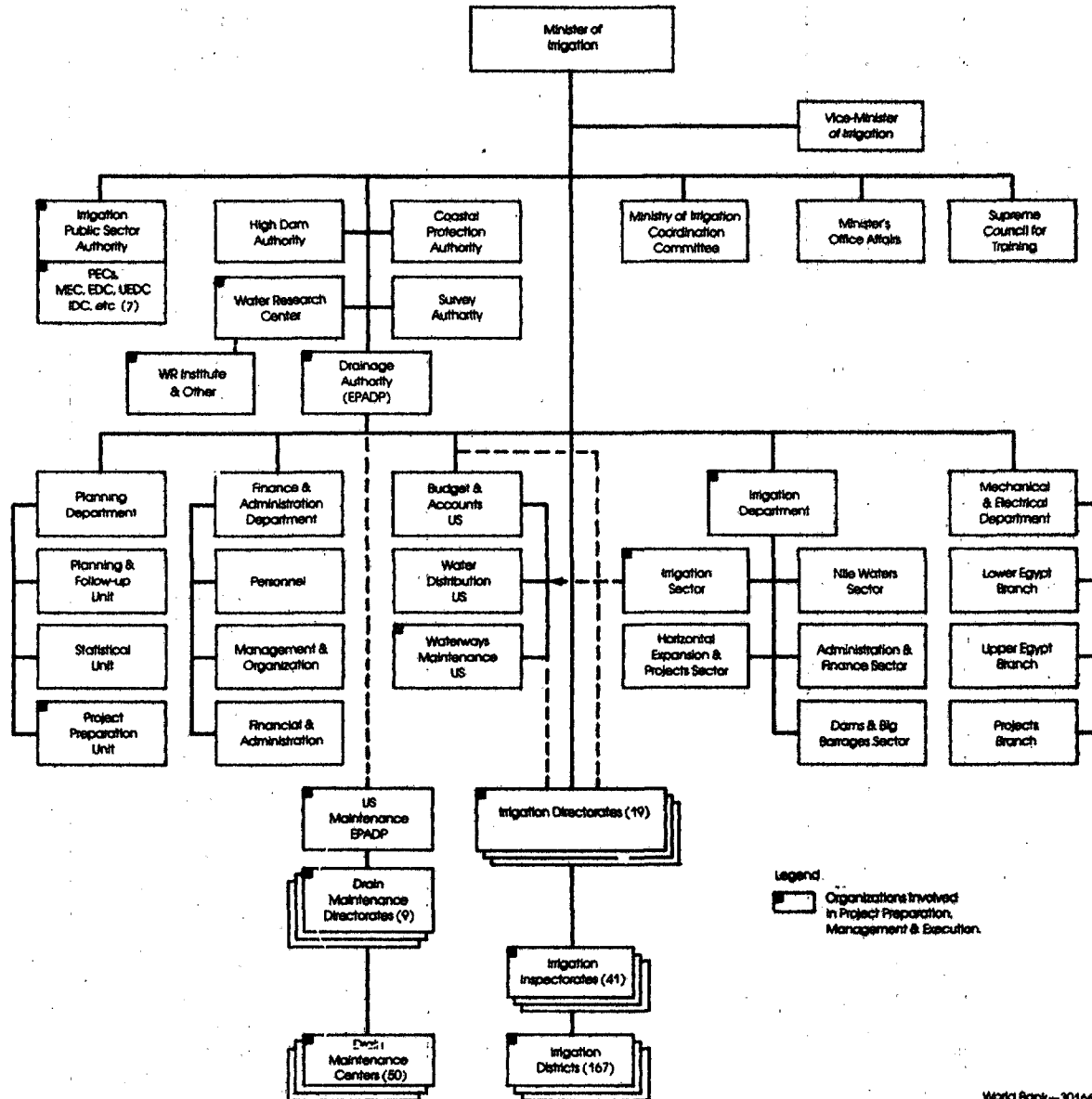
Chemicals for Weed Control	Unit	Unit Value CIF (US\$) 2/	Tender 1 Award 07/87	Tender 2 Award 07/89	Tender 3 Award 07/91	Total Quantity	Total Value 2/ (US\$'000)
- Ametrine	liter	3.07	15,000	38,000	71,000	124,000	380.7
- Diquat	liter	17.47	19,500	53,500	105,160	178,160	3,112.4
- Glyphosate	liter	26.40	27,000	80,000	126,960	233,960	6,176.5
- Dalapon	kg	3.25	47,400	127,230	240,920	415,550	1,350.6
- Ortho X-77	liter	3.90	13,000	34,530	67,770	115,300	449.7
- Morax	liter	1.00	3,900	10,100	19,800	33,800	33.8
		Base Cost					11,503.7
		Contingencies 3/					4,690.3
		Total Cost including Contingencies					16,194.0

1/ Quantities based on channel lengths to be treated annually for various weed types, corresponding areas and manufacturers' recommended application rates.

2/ Foreign costs only.

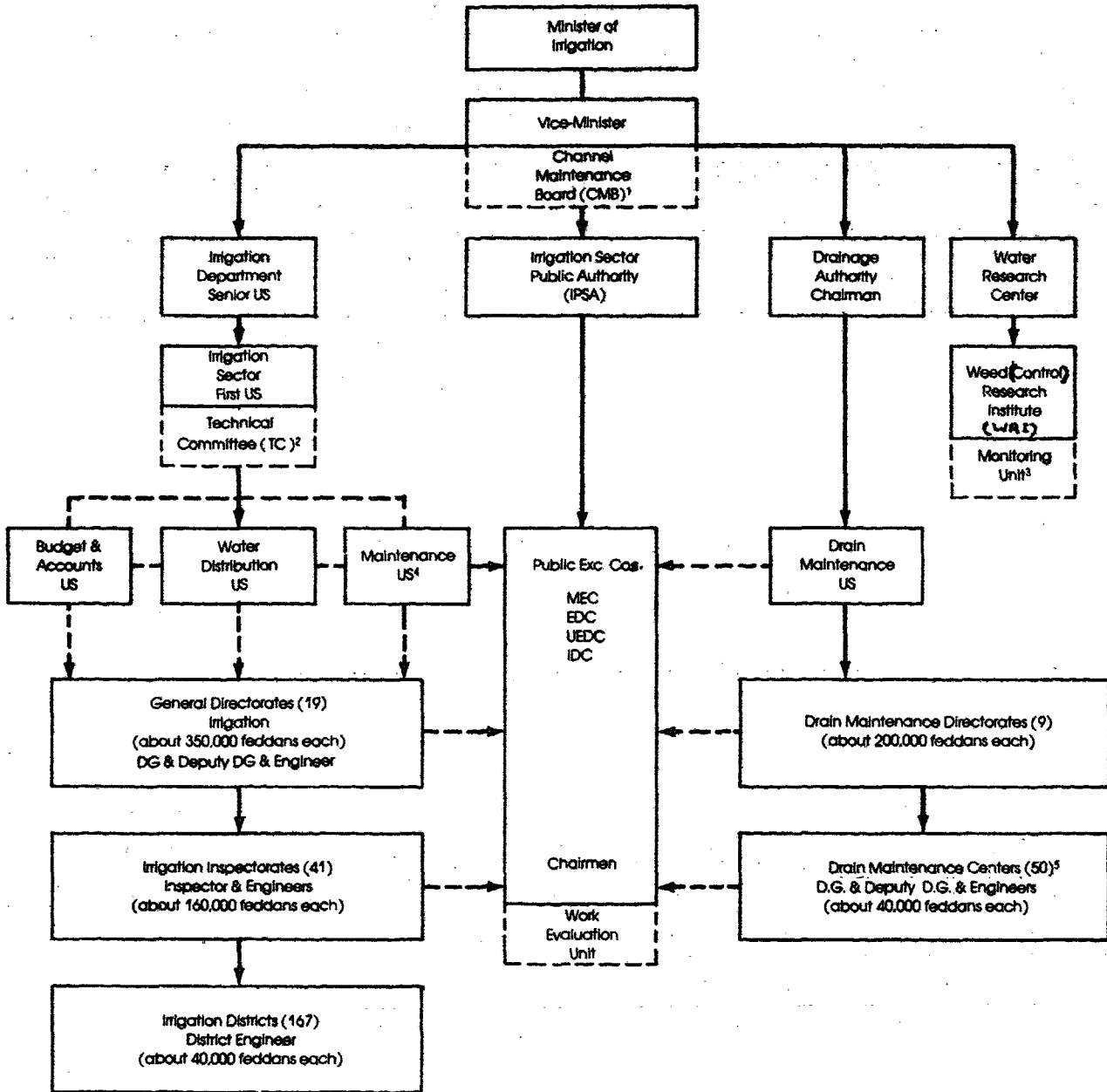
3/ Estimated value includes physical contingencies (5%) and price contingencies based on projected escalation rates for foreign costs.

**ARAB REPUBLIC OF EGYPT  
CHANNEL MAINTENANCE PROJECT  
Ministry of Irrigation General Organization**



Legend:  
 Organizations Involved in Project Preparation, Management & Execution.

ARAB REPUBLIC OF EGYPT  
CHANNEL MAINTENANCE PROJECT  
Organizational Flow Chart for Channel Maintenance



Legend:

New Units to be Established

<sup>1</sup> CMB for policy direction & coordination.

<sup>2</sup> TC for technical aspects & for assisting CMB in the performance of its functions.

<sup>3</sup> For monitoring channel maintenance activities & use of chemical herbicides.

<sup>4</sup> Strengthened Office of Undersecretary Maintenance would work as secretariat for both the CMB & TC.

<sup>5</sup> Number of centers/subcenters is increasing with expansion of subsurface drainage.

**ARAB REPUBLIC OF EGYPT**  
**CHANNEL MAINTENANCE PROJECT**  
**Incremental Base Costs of Institutional Reforms**

	Base Costs 1/ (LE ' 000)							Total
	1986/1987	1987/1988	1988/1989	1989/1990	1990/1991	1991/1992	1992/1993	
<b>Incremental Recurrent Costs</b>								
<b>A. Secretariat to Maintenance Board</b>								
Staff Salaries	-	27.9	27.9	27.9	27.9	27.9	27.9	167.6
Office Supplies	-	2.7	2.7	2.7	2.7	2.7	2.7	16.0
O&M Transport	-	10.6	18.6	18.6	29.3	29.3	29.3	135.7
<b>Sub-Total Secretariat to Maintenance Board</b>	<b>-</b>	<b>41.2</b>	<b>49.2</b>	<b>49.2</b>	<b>59.9</b>	<b>59.9</b>	<b>59.9</b>	<b>319.2</b>
<b>B. MDI Field Offices</b>								
Staff Salaries	-	1.3	240.7	361.8	361.8	361.8	361.8	1,689.1
O&M Cars	-	31.9	67.8	67.8	67.8	67.8	67.8	371.1
O&M Motorcycles	-	-	20.0	39.9	67.8	67.8	67.8	263.3
<b>Sub-Total MDI Field Offices</b>	<b>-</b>	<b>33.3</b>	<b>328.5</b>	<b>469.5</b>	<b>497.4</b>	<b>497.4</b>	<b>497.4</b>	<b>2,323.5</b>
<b>C. Weed Research Institute</b>								
Staff Salaries	45.2	45.2	45.2	45.2	45.2	45.2	-	271.3
Office Supplies	-	5.3	10.6	10.6	10.6	10.6	10.6	58.5
O&M Cars	-	4.0	21.3	21.3	21.3	21.3	21.3	110.4
Biological Research	-	-	39.9	39.9	39.9	39.9	39.9	199.5
<b>Sub-Total Weed Research Institute</b>	<b>45.2</b>	<b>54.5</b>	<b>117.0</b>	<b>117.0</b>	<b>117.0</b>	<b>117.0</b>	<b>71.8</b>	<b>639.7</b>
<b>D. Weed Monitoring Unit</b>								
Staff Salaries	-	45.2	45.2	45.2	45.2	45.2	-	226.1
Office Supplies	-	5.3	10.6	10.6	10.6	10.6	-	67.9
O&M Cars	-	4.0	21.3	21.3	21.3	21.3	21.3	110.4
<b>Sub-Total Weed Monitoring Unit</b>	<b>-</b>	<b>54.5</b>	<b>77.1</b>	<b>77.1</b>	<b>77.1</b>	<b>77.1</b>	<b>21.3</b>	<b>384.4</b>
<b>Total Base Costs</b>	<b>45.2</b>	<b>183.5</b>	<b>571.9</b>	<b>712.9</b>	<b>761.5</b>	<b>761.5</b>	<b>650.4</b>	<b>3,666.8</b>
<b>Total Base Costs (US\$M)</b>	<b>34.0</b>	<b>138.0</b>	<b>430.0</b>	<b>536.0</b>	<b>565.0</b>	<b>565.0</b>	<b>489.0</b>	<b>2,757.0</b>

1/ Minor differences due to rounding.

## ARAB REPUBLIC OF EGYPT

## CHANNEL MAINTENANCE PROJECT

## Summary of Training Program and Technical Assistance for Implementing Agencies

	Unit	86/87	87/88	88/89	89/90	90/91	91/92	92/93	Total
<b>MOI and EPADP Staff</b>									
<b>I. Manpower Development</b>									
(a) Special Training 1/ Manpower Development Coordinators (IS and EPADP)	month	-	2	-	-	-	-	-	2
Agency Planners (IS and EPADP)	month	-	2	-	-	-	-	-	2
Senior Maintenance Staff (IS and EPADP)	2-week	-	9	9	9	-	-	-	27
(b) Local Manpower Development for Mechanical and Chemical Maintenance 2/ Chief Maintenance Engineers (MOI)	month	-	19	-	-	-	-	-	19
Weed Specialists (WRI)	month	-	5	-	-	-	-	-	5
Chief Engineers, Inspectors (MOI)	2-week	-	20	21	-	-	-	-	41
Deputy General Directors (MOI)	2-week	-	10	9	-	-	-	-	19
Deputy General Directors (EPADP)	2-week	-	4	4	-	-	-	-	8
District Engineers (MOI)	1-week	-	56	56	57	-	-	-	169
Maintenance Engineers (EPADP)	1-week	-	8	8	-	-	-	-	16
<b>II. Technical Assistance 3/</b>									
-Channel Maintenance Specialist (IS) 4/	month	-	12	12	12	1	1	1	39
-Chemical Weed Control Specialist (WRI)	month	-	3	3	3	1	1	1	12
-Biological Weed Control Specialist (WRI)	month	-	3	1	1	1	-	-	6
-Botanical Weed Control Specialist (WRI)	month	-	3	1	1	-	-	-	5
-Hydraulic Engineering Specialist (WRI) 5/	month	-	1	1	-	-	-	-	2
-Mechanical Engineer Specialist (IS)	month	-	2	-	3	-	2	-	7
-Analytical Chemistry Specialist (WRI) 6/	month	-	2	1	1	-	-	-	4

1/ Estimated on the basis of overseas study tours.

2/ To be provided using local facilities.

3/ Estimate based on expatriate experts.

4/ First 36 months in resident status.

5/ Screen designs for Biological weed control.

6/ To set up in-channel sampling network and to improve chemical residue analysis.

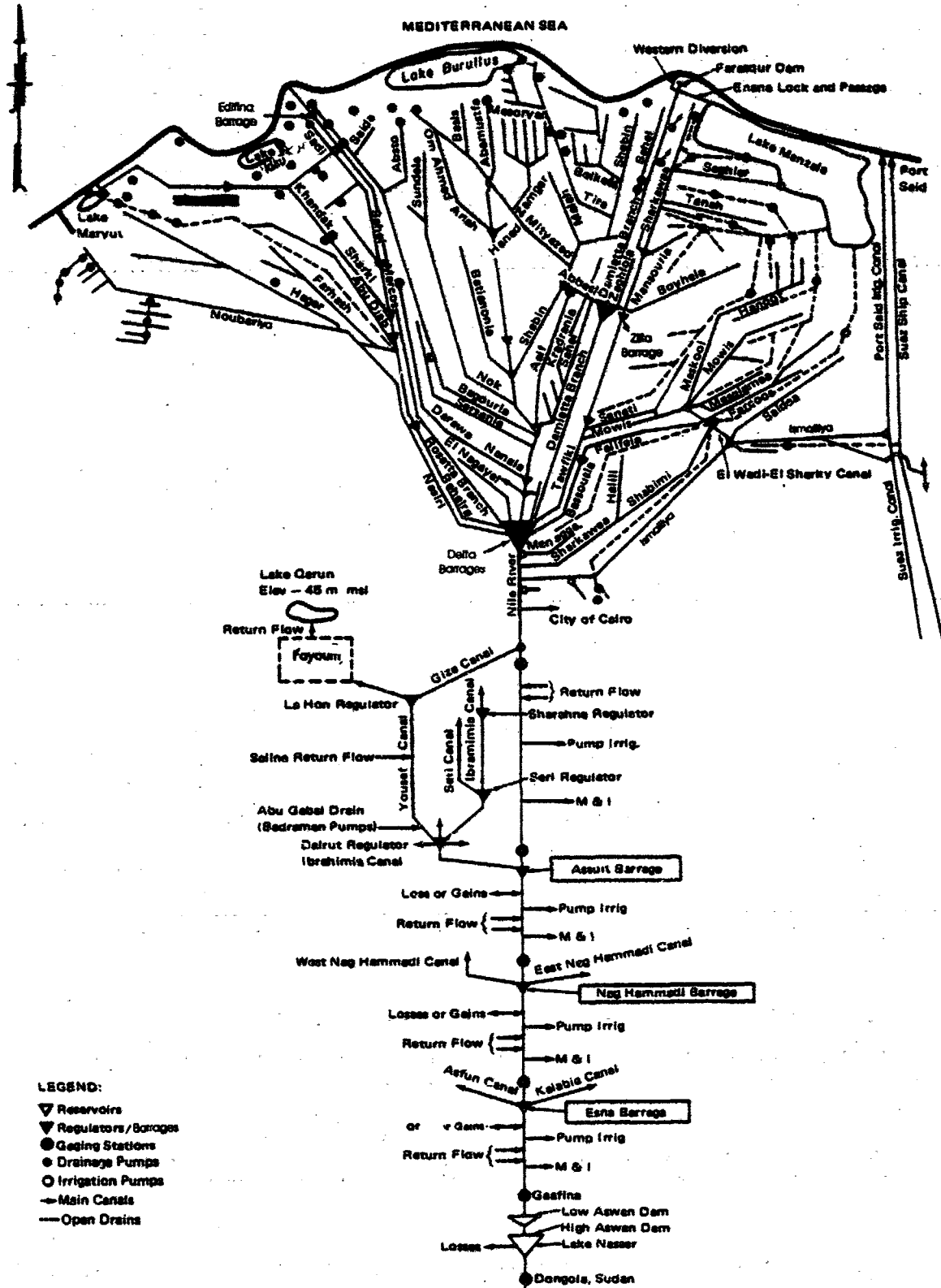
**ARAB REPUBLIC OF EGYPT**  
**CHANNEL MAINTENANCE PROJECT**

**Lengths of Canals and Drains Divided According to Bed-Width 1/**

Governorate or Irrigation Directorate	Canals by Bed-Width							Drains by Bed-Width							Total Length of Channels
	More than 10 m		10 to 5 m	5 to 2 m	2 m or less	Total	More than 10 m		10 to 5 m	5 to 2 m	2 m or less	Total			
	navig.	not nav.					navig.	not nav.							
<b>West Delta</b>															
Nubariya		211	330	118	328	827	1,603	-	-	-	25	532	384	941	2,544
Behaira	216	46	262	167	675	1,204	2,308	93	93	241	883	679	1,896	4,204	
<b>Subtotal West Delta</b>	<b>335</b>	<b>257</b>	<b>592</b>	<b>285</b>	<b>1,003</b>	<b>2,031</b>	<b>3,911</b>	<b>-</b>	<b>93</b>	<b>93</b>	<b>266</b>	<b>1,415</b>	<b>1,063</b>	<b>2,837</b>	<b>6,748</b>
<b>Middle Delta</b>															
Kafr-el-Sheikh	23	92	115	266	693	613	1,687	39	91	130	119	502	480	1,231	2,918
Gharbiya	92	92	184	51	480	1,088	1,803	15	-	15	59	206	713	993	2,796
Menoufiya	164	68	232	267	450	1,088	2,037	-	-	-	48	230	680	958	2,995
Dakahlia North	74	133	207	135	330	701	1,373	-	39	39	87	192	783	1,101	2,474
<b>Subtotal Middle Delta</b>	<b>353</b>	<b>385</b>	<b>738</b>	<b>719</b>	<b>1,953</b>	<b>3,490</b>	<b>6,900</b>	<b>54</b>	<b>130</b>	<b>184</b>	<b>313</b>	<b>1,130</b>	<b>2,656</b>	<b>4,283</b>	<b>11,183</b>
<b>East Delta</b>															
Dakahlia South	126	106	232	258	1,057	627	2,174	64	114	178	126	1,069	118	1,491	3,665
Sharkiya	116	100	216	150	504	1,624	2,494	51	119	170	98	482	708	1,458	3,952
Ismailiya	128	61	189	239	327	456	1,211	-	52	52	62	207	202	523	1,734
Qalubiya	37	37	74	81	336	421	912	-	5	5	52	237	273	567	1,479
<b>Subtotal East Delta</b>	<b>407</b>	<b>304</b>	<b>711</b>	<b>728</b>	<b>2,224</b>	<b>3,128</b>	<b>6,791</b>	<b>115</b>	<b>290</b>	<b>405</b>	<b>338</b>	<b>1,995</b>	<b>1,301</b>	<b>4,039</b>	<b>10,830</b>
<b>Middle Egypt</b>															
Giza	42	109	151	127	408	721	1,407	-	103	103	72	50	584	809	2,216
El Fayoum	-	72	72	161	429	731	1,393	-	-	-	68	120	819	1,007	2,400
Beni Suof	58	27	82	157	184	1,167	1,560	-	23	23	101	188	894	1,176	2,738
El Minya West	118	107	225	86	198	830	1,339	-	-	-	15	62	347	424	1,763
El-Minya East	-	-	-	56	381	771	1,208	-	33	33	32	145	264	474	1,682
<b>Subtotal Middle Egypt</b>	<b>215</b>	<b>315</b>	<b>530</b>	<b>587</b>	<b>1,570</b>	<b>4,220</b>	<b>6,907</b>	<b>-</b>	<b>159</b>	<b>159</b>	<b>288</b>	<b>535</b>	<b>2,908</b>	<b>3,890</b>	<b>10,797</b>
<b>Upper Egypt</b>															
Assuit	61	95	156	162	905	511	1,734	-	-	-	27	28	133	188	1,922
Sohag	-	224	224	182	873	563	1,842	-	-	-	112	128	156	396	2,238
Qena	-	274	274	149	1,481	300	2,204	-	-	-	40	230	345	615	2,819
Aswan	-	30	30	68	629	166	893	-	-	-	73	290	75	438	1,331
<b>Subtotal Upper Egypt</b>	<b>61</b>	<b>623</b>	<b>684</b>	<b>561</b>	<b>3,888</b>	<b>1,540</b>	<b>6,673</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>252</b>	<b>676</b>	<b>709</b>	<b>1,637</b>	<b>8,310</b>
<b>TOTAL</b>	<b>1,371</b>	<b>1,884</b>	<b>3,255</b>	<b>2,880</b>	<b>10,638</b>	<b>14,409</b>	<b>31,182</b>	<b>169</b>	<b>672</b>	<b>841</b>	<b>1,457</b>	<b>5,751</b>	<b>8,637</b>	<b>16,686</b>	<b>47,868</b>

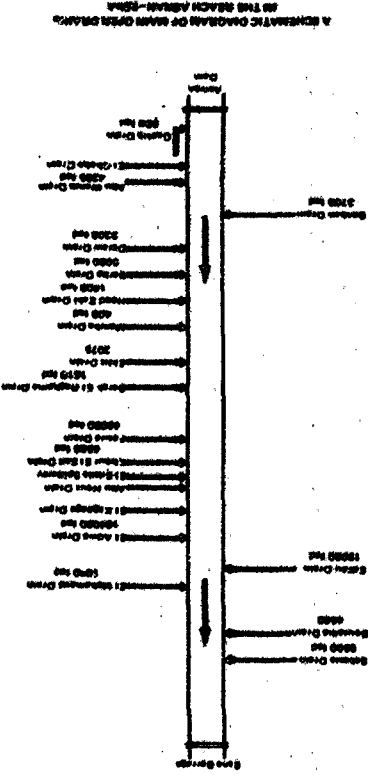
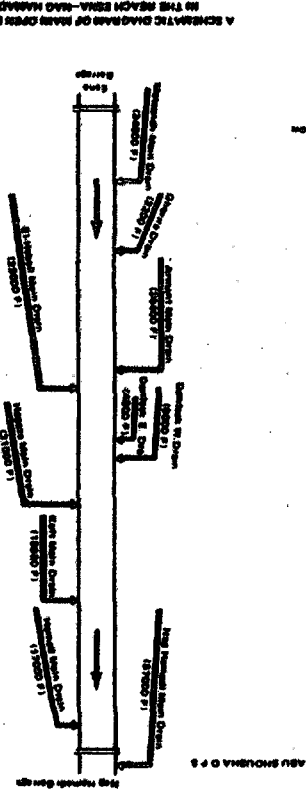
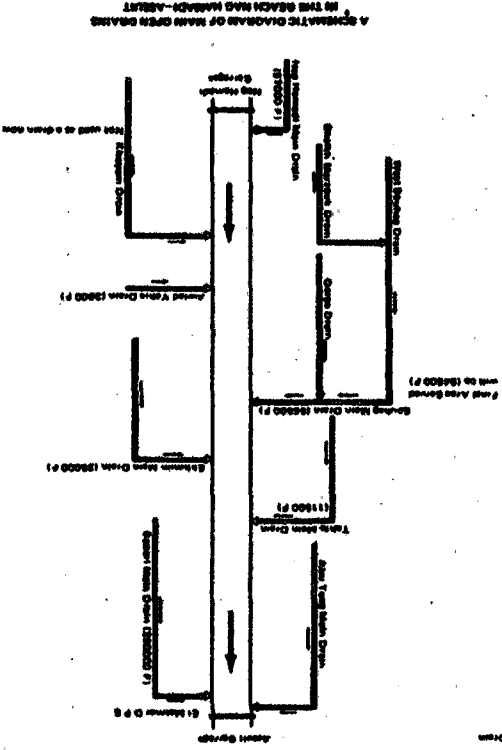
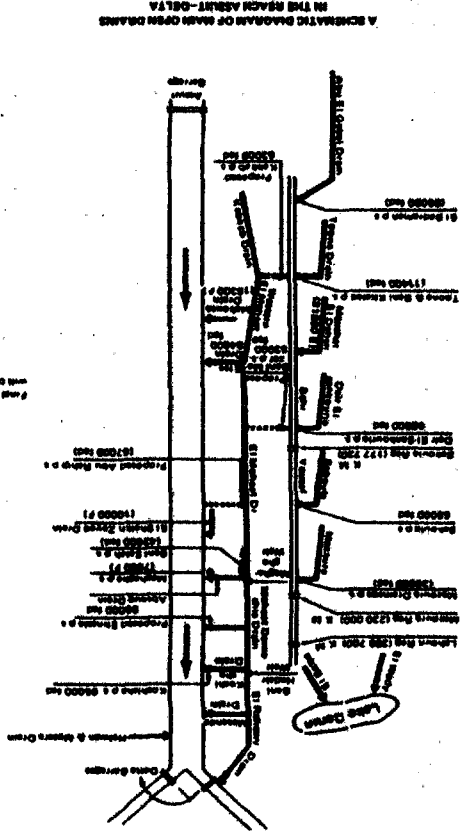
1/ Data provided by MOI with updating of drain lengths by FAO/CP mission, May 1985.

### ARAB REPUBLIC OF EGYPT CHANNEL MAINTENANCE PROJECT Schematic Diagram of Irrigation System



- LEGEND:**
- ▽ Reservoirs
  - ▽ Regulators/Barrages
  - Gaging Stations
  - Drainage Pumps
  - Irrigation Pumps
  - Main Canals
  - Open Drains

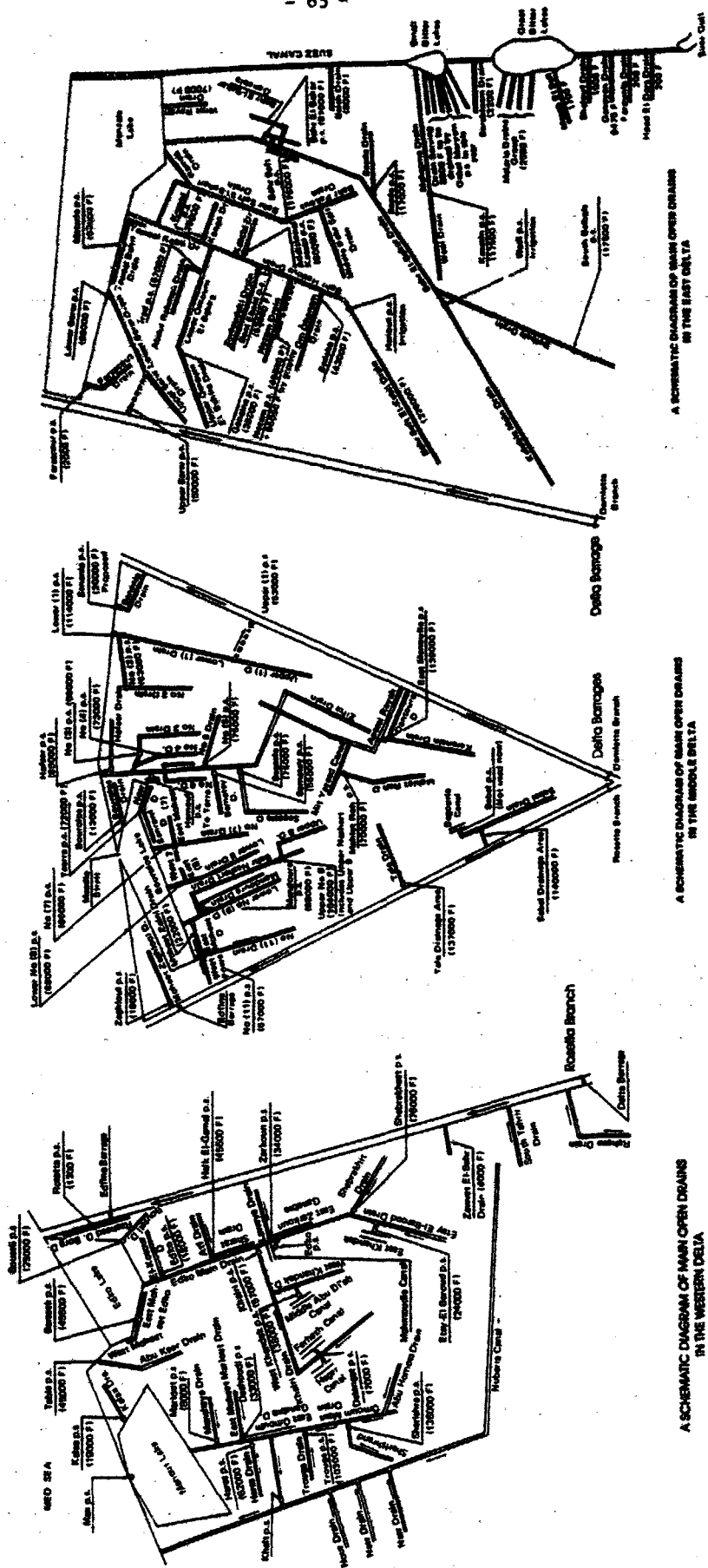
ARAB REPUBLIC OF EGYPT  
 CHANNEL MAINTENANCE PROJECT  
 Drainage Systems in Upper Egypt  
 Schematic Diagrams



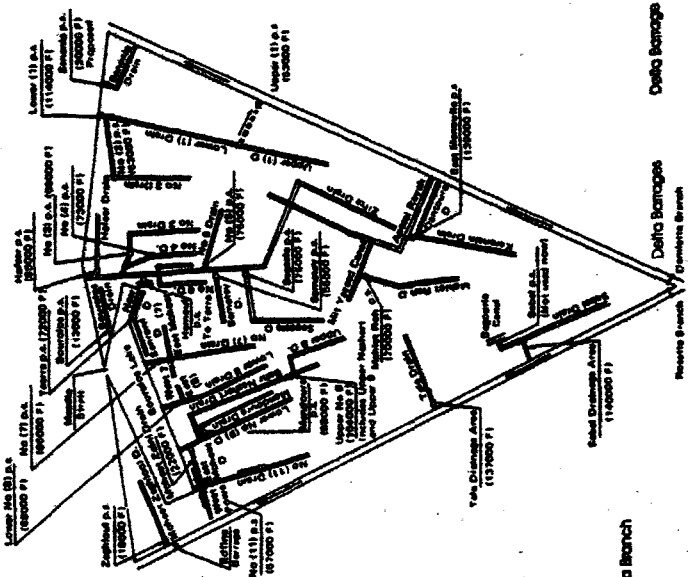
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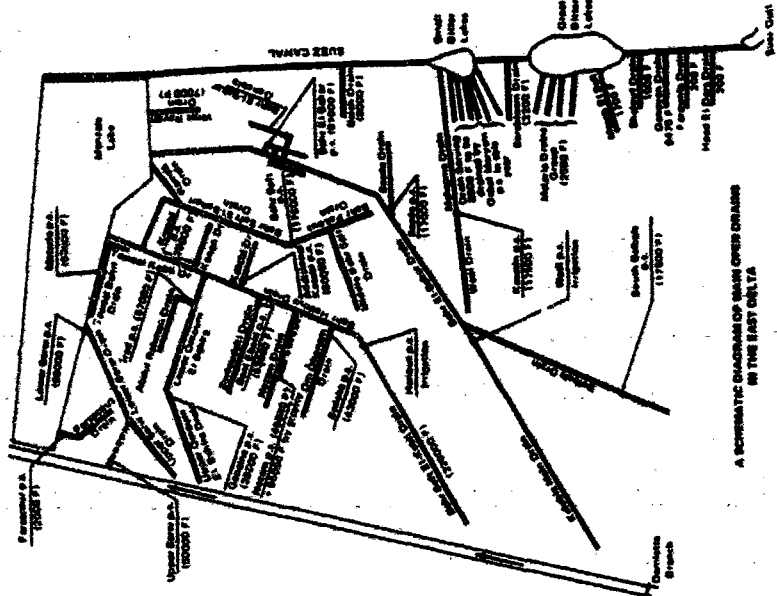
ARAB REPUBLIC OF EGYPT  
CHANNEL MAINTENANCE PROJECT  
Drainage Systems in Lower Egypt  
Schematic Diagrams



A SCHEMATIC DIAGRAM OF MAIN OPEN DRAINS  
IN THE WESTERN DELTA



A SCHEMATIC DIAGRAM OF MAIN OPEN DRAINS  
IN THE MIDDLE DELTA



A SCHEMATIC DIAGRAM OF MAIN OPEN DRAINS  
IN THE EAST DELTA

World Bank-301466

ARAB REPUBLIC OF EGYPT  
CHANNEL MAINTENANCE PROJECT

Chemical Weed Control

1. The Ministry of Irrigation (MOI) has used herbicides—mainly Acrolein and Ametrine—for aquatic weed management in channel maintenance for many years. Total use of these chemicals in 1984 amounted respectively to 307 tons and 91 tons. The Drainage Authority reports relatively minor use of the herbicides Dalapon, Ametrole, and "2,4-D" on a few channel banks. In 1985, the newer herbicide, Glysohate (Lancer) has also been used on an experimental basis for the control of ditchbank weeds.
2. Herbicides proposed for use in the project include Ametrine and Diquat for a directed spray for water hyacinth control and other floating aquatics. Ametrine, although less effective than herbicides such as 2,4-D has low levels of animal toxicity. Diquat, also a contact herbicide, is proposed as an alternate for water hyacinth control. Restrictions apply for use of both herbicides near potable water intakes. Neither herbicide would be applied directly into the water, but only sprayed on the floating plants resulting in negligible residues.
3. Acrolein, or Magnacide H, would continue to be introduced into the water 2-4 times per year for submersed weed control in channels of 5 m bed-width and larger. Routine use of this material was established by the MOI in 1975, with restrictions against application near potable water intakes, and against human contact with treated water. Fish are killed by the material, but because of the use of molluscicides for Bilharzia control and irrigation rotation, fish resources are already very limited in the irrigation and drain systems.
4. Emersed and ditchbank weeds are considered as one type for the purposes of herbicide use proposed in this project. Both types of plants are represented as growing mainly from the channel banks and encroach into the wetted perimeter of the canals and drains reducing carrying capacity.
5. Two herbicides are proposed for application following mowing cycles to control re-growth and causing an eventual reduction in the continued extensive need for mechanical removal. These herbicides will be used for spot spraying of re-growth in the integrated maintenance plan. Glysohate, or Lancer, is outstandingly effective on terrestrial and emersed aquatic weeds. It is suitable for use on ditchbanks, has low levels of animal toxicities, and has no restrictions on use in or around water. Although very active on plants—and care must be taken in application near crops—it is considered to be one of the safer available herbicides. Dalapon is the second herbicide

proposed for use on emerged/ditchbank weeds. It too is approved for use on ditchbanks and has very few restrictions around water. Dalapon is selective for grass plants and, consequently, has no effectiveness on broad-leaf species, hence the need for two different products.

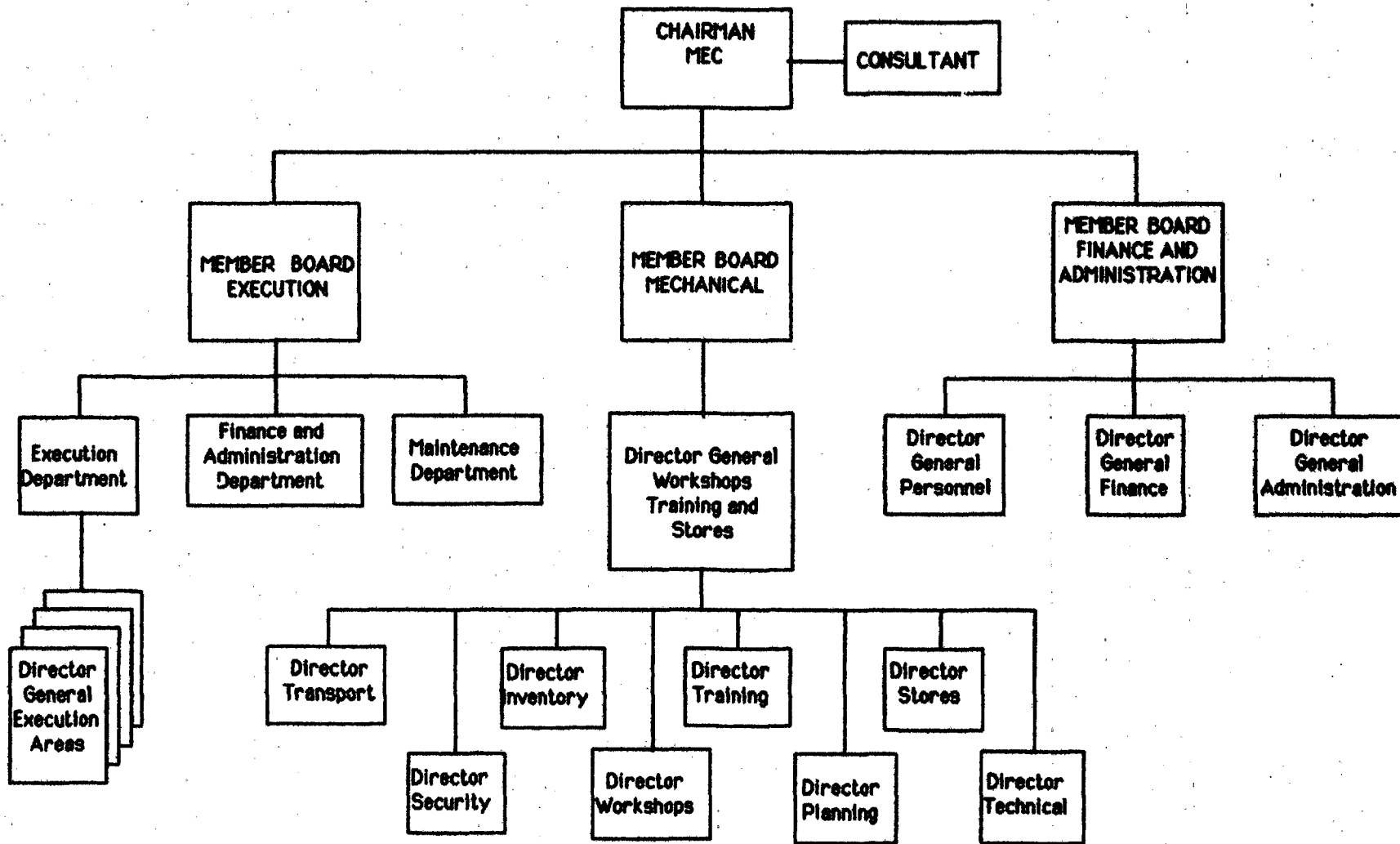
6. For maximum effectiveness, herbicide application to floating, emerged and ditchbank weeds requires additives that improve wetting of leaves and herbicide penetration. The additive proposed for Diquat and Glyphosate is Ortho X-77, and for Dalapon, a non-ionic emulsifier similar to Morax. These products are considered environmentally safe.

7. Herbicide application equipment will be made by hand held boom sprayers calibrated to apply high volume, low pressure delivery to ensure good wetting of plants, with minimal spray drift. The spray tractors will be self-contained, equipped to provide uniform forward speed to ensure good coverage. All ditchbank spraying will be made up-stream with no more than 1/2 meter over spray of the surface of a canal to reduce herbicide residues concentration in canal and drain water. Spraying from boats is to be discouraged except for access to large floating aquatic weed mats in the river or larger channels. All spray crews must be adequately trained and routinely supervised in handling of herbicides, spraying and disposal of unused materials and empty containers. All of the herbicides, with the exception of Acrolein, are approved for use in and around irrigation water in many West European countries, the United States, Australia and elsewhere. Acrolein is approved for use in canals of the Western U.S. and Australia, and has been used since 1960s.

ARAB REPUBLIC OF EGYPT

CHANNEL MAINTENANCE PROJECT

Organization Chart -- Mechanical Excavation Company (MEC)



ARAB REPUBLIC OF EGYPT

CHANNEL MAINTENANCE PROJECT

Equipment Available for Channel Maintenance and  
Other Works Within the PECS 1/  
(October 1985)

Equipment	Egyptian Dredging Company	Mechanical Excavation Company	Upper Egypt Dredging Company	Irrigation and Drainage Company	Total
<b>I. Main Equipment</b>					
-Draglines >15 yr.	15	231	-	-	246
-Draglines <15 yr.	205	111	74	10	400
-Hydraulic Excavators	129	173	53	19	374
-Amph. Hydraulic Excavator	2	-	-	-	2
-Suction Dredgers	32	-	-	-	32
-W. Tractor (side boom)	30	36	14	-	80
-Mowing Buckets	21	23	6	-	50
-Bulldozers	21	12	4	4	41
-Elev. Scrapers	7	7	-	-	14
-Dumptruck	-	-	-	4	4
-Wheel Loaders	-	-	-	2	2
<b>Total Main Equipment</b>	<b>462</b>	<b>593</b>	<b>151</b>	<b>39</b>	<b>1,245</b>
<b>II. Supporting Equipment</b>					
-Low Loaders	20	17	13	3	53
-Lorries	15	13	11	16	55
-Pick-ups	45	78	24	22	169
-Fuel Trucks	-	7	1	-	8
-Lubricating Trucks	7	7	-	-	14
-Mobile Workshops	9	8	4	3	24
-Mobile Cranes	-	3	5	-	8
-Forklifts	3	3	1	1	8
<b>III. Vehicles</b>					
-Buses	18	10	1	-	29
-Cars	34	37	12	12	95
<b>Total Supporting Equipment and Vehicles</b>	<b>151</b>	<b>183</b>	<b>72</b>	<b>57</b>	<b>463</b>

1/ Four companies involved in channel maintenance operate under the jurisdiction of the Ministry of Irrigation.

**ARAB REPUBLIC OF EGYPT**  
**CHANNEL MAINTENANCE PROJECT**

**PECs Personnel and Ratio to Equipment**

	<u>Egyptian Dredging Company</u>	<u>Mechanical Excavation Company</u>	<u>Upper Egypt Dredging Company</u>	<u>Irrigation &amp; Drainage Company</u>	<u>Total</u>
<b>I. Background</b>					
Established (year)	1885	1975	1977	1975	-
Location Main Office 1/	Cairo	Delta Barrage	Nag- Hamadi	Assutt	-
Location Main Workshop 2/	Abu Zaabal	Delta Barrage	-	-	-
<b>II. Staffing Status 2/</b>					
Management & Administrative Staff	114	117	44	56	331
Technical and Execution Staff 3/	1,740	2,268	686	96	4,790
Ratio of Technical and Execution Staff/Production Equipment	5.0	6.4	5.4	3.3	4.7
-Support Staff	<u>857</u>	<u>418</u>	<u>193</u>	<u>132</u>	<u>1,600</u>
	<u>2,711</u>	<u>2,803</u>	<u>923</u>	<u>284</u>	<u>6,721</u>

1/ See Map, IBRD 19446 for field offices and workshops of each PEC.

2/ As of October 1985.

3/ Includes field engineers, workshop staff, machine operators and mechanics.

**ARAB REPUBLIC OF EGYPT**  
**CHANNEL MAINTENANCE PROJECT**

**Summary of Training Program and Technical Assistance for PECs**

	Unit	86/87	87/88	88/89	89/90	90/91	91/92	92/93	Total
<b>Public Excavation Companies</b>									
<b>I. Manpower Development</b>									
<b>(a) Special Training 1/</b>									
Manpower Development Coordinators 2/	month	-	5	-	-	-	-	-	5
Corporate Planners 3/	month	-	5	-	-	-	-	-	5
PEC's Workshop Engineers	3-week	-	4	-	-	-	-	-	4
<b>(b) Local Manpower Development for Mechanical and Chemical Maintenance</b>									
PEC's Field Engineers 4/	2-week	-	125	12	12	12	12	12	185
PEC's Machine Operators 5/	1-week	-	100	150	150	150	50	50	650
PEC's Field Mechanics 6/	1-week	-	50	75	75	50	25	25	300
PEC's Workshop Engineers	2-week	-	35	5	5	5	5	5	60
PEC's Workshop Foremen 6/	2-week	-	35	35	35	10	10	10	135
Mobile Sprayers Crews, Operators 6/	1-week	-	15	15	15	5	5	5	60
Mobile Sprayers Crews, Sprayers 6/	1-week	-	30	30	30	10	10	10	120
Mobile Sprayers Crews, Mechanics 6/	1-week	-	15	15	15	5	5	5	60
<b>(c) Local Manpower Development for Administration and Accounting</b>									
Cost Accounting Methods	month	-	9	1	1	1	1	1	14
Inventory Control Systems	month	-	9	1	1	1	1	1	14
Budgetary Planning Procedures	month	-	9	1	1	1	1	1	14
Micro-computer	2-week	-	38	4	4	4	4	4	58
<b>II. Technical Assistance</b>									
<b>(a) Operating Areas 7/</b>									
Manpower Development Specialist	month	-	3	-	1	-	-	-	4
Corporate Planning Specialist	month	-	6	-	1	-	-	-	7
Workshop Operations Specialist	month	-	4	-	2	-	1	-	7
Management Information Systems Specialist	month	-	4	-	1	-	-	-	5
Equipment Specialist	month	-	2	-	1	-	1	-	4
<b>(b) Financial Management 8/</b>									
Cost Accounting Specialist	month	-	13	-	1	-	-	-	14
Inventory Control Specialist	month	-	13	-	1	-	-	-	14
Budgetary Planning Specialist	month	-	8	-	1	-	-	-	9
Micro-Computer Specialist	month	-	8	5	1	-	-	-	14

1/ Estimated on the basis of overseas study tours.

2/ Includes one manpower development specialist from each company and IPSA for one month.

3/ Includes one corporate planner from each company and IPSA for one month.

4/ Includes one field engineer per 5 machines for the 2nd year and 10% thereof for the following years to account for staff turnover (partly by equipment suppliers' technicians).

5/ Includes 550 machine operators from the 2nd to 5th year, and 10% for each following year for staff turnover.

6/ Partly by machine suppliers' technicians.

7/ Estimate based on expatriate experts.

8/ Assumes one local firm to ensure compatibility of all systems.

ARAB REPUBLIC OF EGYPT

CHANNEL MAINTENANCE PROJECT

Selected Documents and Data Available in the Project File

I. Ministry of Irrigation

1. Project Preparation Department. Channel Maintenance Plan - Draft Final Report, September 1985.
2. N. E. Otto for the Project Preparation Department. Final Report on Aquatic Weed Control for Open Channel Maintenance in Egypt, September 1984.
3. Project Preparation Department. Channel Maintenance Plan - Inception Report, July 1984
4. Guidelines for the Safe Handling of Pesticides during their Formulation, Packing, Storage and Transport.
5. Ilaco for Ministry of Irrigation. Aquatic Weed Control - Final Report, September 1978.

II. FAO/CP

1. Egypt - Channel Maintenance Project, Preparation Report 92/85 CP-EGY34, July 1985.
2. Detailed Cost Tables, 7-Year Channel Maintenance Project, July 1985.
3. Detailed Cost Tables, 12-Year Channel Maintenance Plan, July 1985.
4. Egypt - Channel Maintenance Plan, Identification Report 31/85 CP-EGY33, March 1985

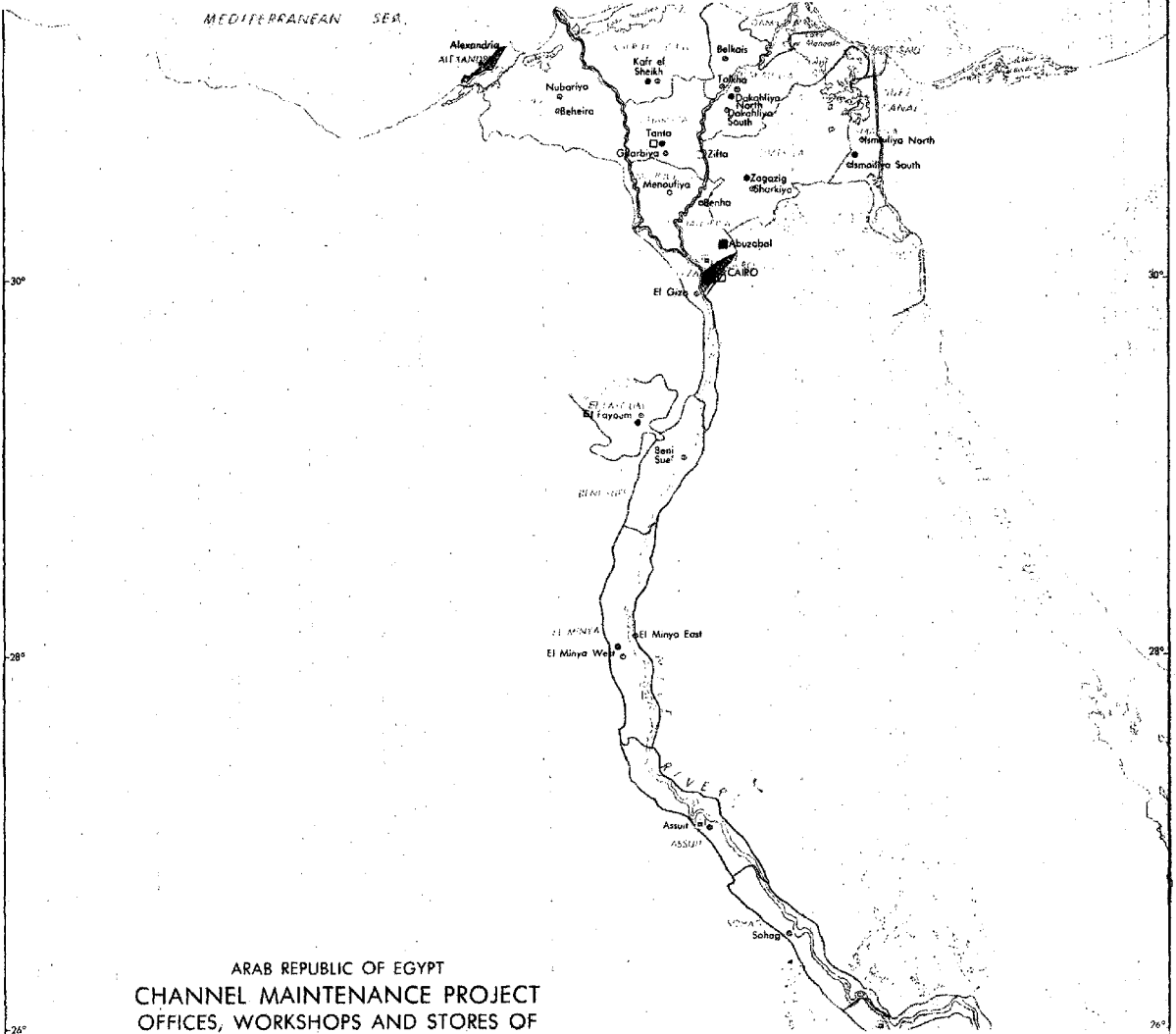
III. USAID

1. Mid-term Report of the Irrigation Management System Project, September 1985.
2. Evaluation of the Structural Replacement Project, December 1984.
3. Evaluation of Canal Maintenance Project, March 1984.
4. Project Paper "Egypt, Agricultural Canal Reconstruction and Maintenance" Project, 1977.

IV. Project Documents

1. Channel Maintenance Project, Detailed Cost Tables, February 1986.
2. -Chemical Weed Control, Working Paper.  
-Public Excavation Companies, Working Paper.  
-Assessment of Equipment and Plant Operating Costs.  
-Terms of Reference for Specialists.

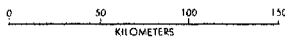
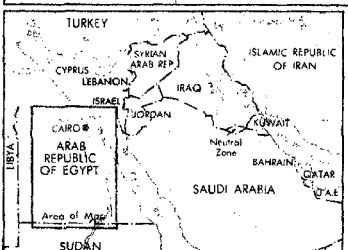
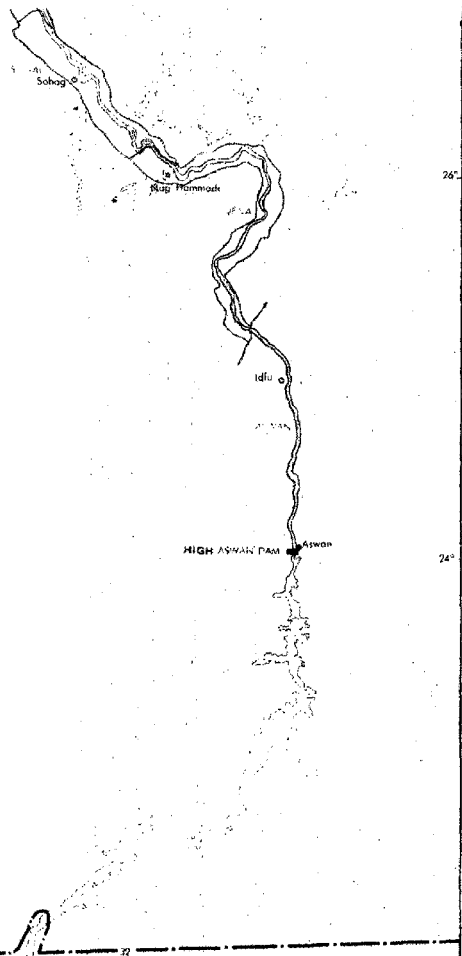




ARAB REPUBLIC OF EGYPT  
CHANNEL MAINTENANCE PROJECT  
OFFICES, WORKSHOPS AND STORES OF










ARAB REPUBLIC OF EGYPT  
CHANNEL MAINTENANCE PROJECT  
OFFICES, WORKSHOPS AND STORES OF  
PUBLIC COMPANIES FOR CHANNEL MAINTENANCE

- |                           |                               |                              |                                 |                                 |
|---------------------------|-------------------------------|------------------------------|---------------------------------|---------------------------------|
| EGYPTIAN DREDGING COMPANY | MECHANICAL EXCAVATION COMPANY | UPPER EGYPT DREDGING COMPANY | IRRIGATION AND DRAINAGE COMPANY | COMPANIES UNDER THE PROJECT     |
| ■                         | □                             | □                            | □                               | MAIN OFFICE                     |
| ■                         | □                             | □                            | □                               | MAIN OFFICES AND MAIN WORKSHOPS |
| □                         | □                             | □                            | □                               | MAIN WORKSHOPS                  |
| ●                         | ●                             | ●                            | ●                               | SUPPORT WORKSHOPS               |
| ●                         | ●                             | ●                            | ●                               | FIELD OFFICES                   |
- 
- RIVERS
  - - - WADIS
  - NATIONAL CAPITAL
  - ▭ URBAN AREAS
  - - - APPROXIMATE GOVERNORATE BOUNDARIES
  - INTERNATIONAL BOUNDARIES



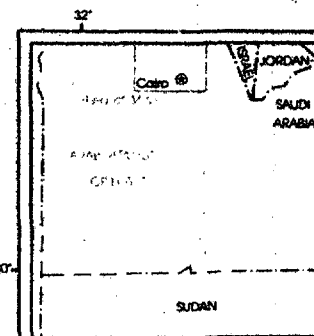
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# ARAB REPUBLIC OF EGYPT CHANNEL MAINTENANCE PROJECT LOWER EGYPT

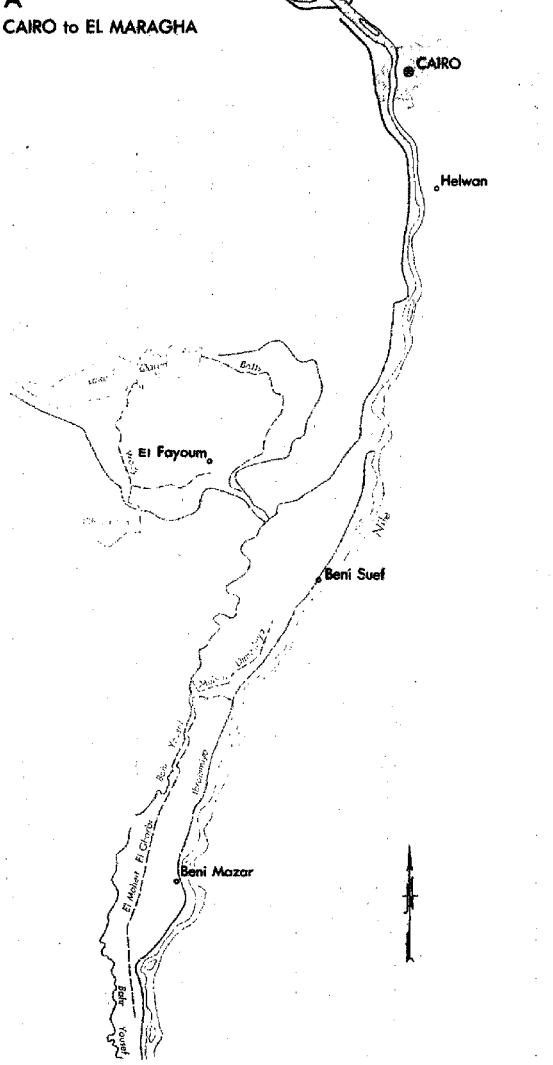
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-  Old Lands (Project)
  -  Areas Covered by Integrated Soil and Water Improvement Project (Canadian Project)
  -  Old-New Lands
  -  Main Canals
  -  Main Drains
  -  Towns and Villages
  -  Urban Areas
  -  National Capital
  -  International Boundaries

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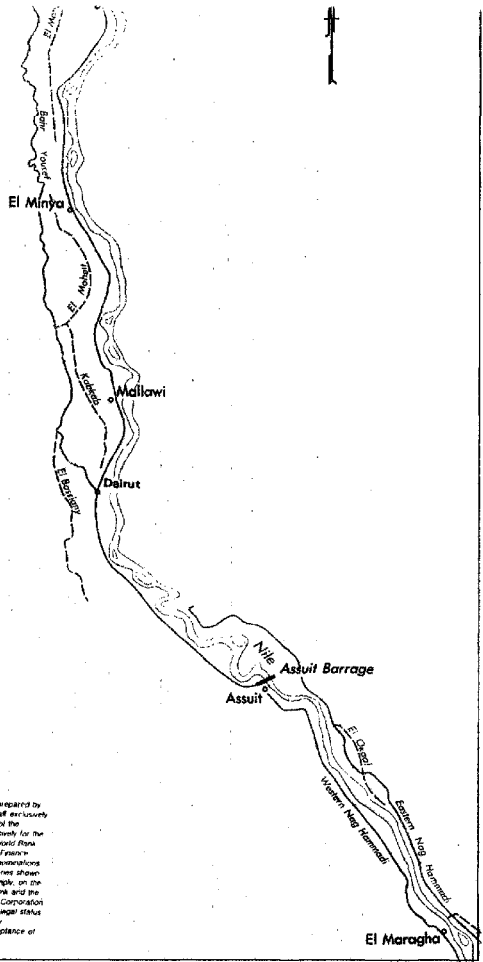
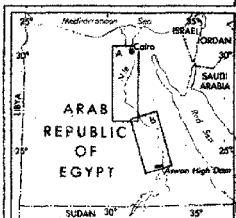
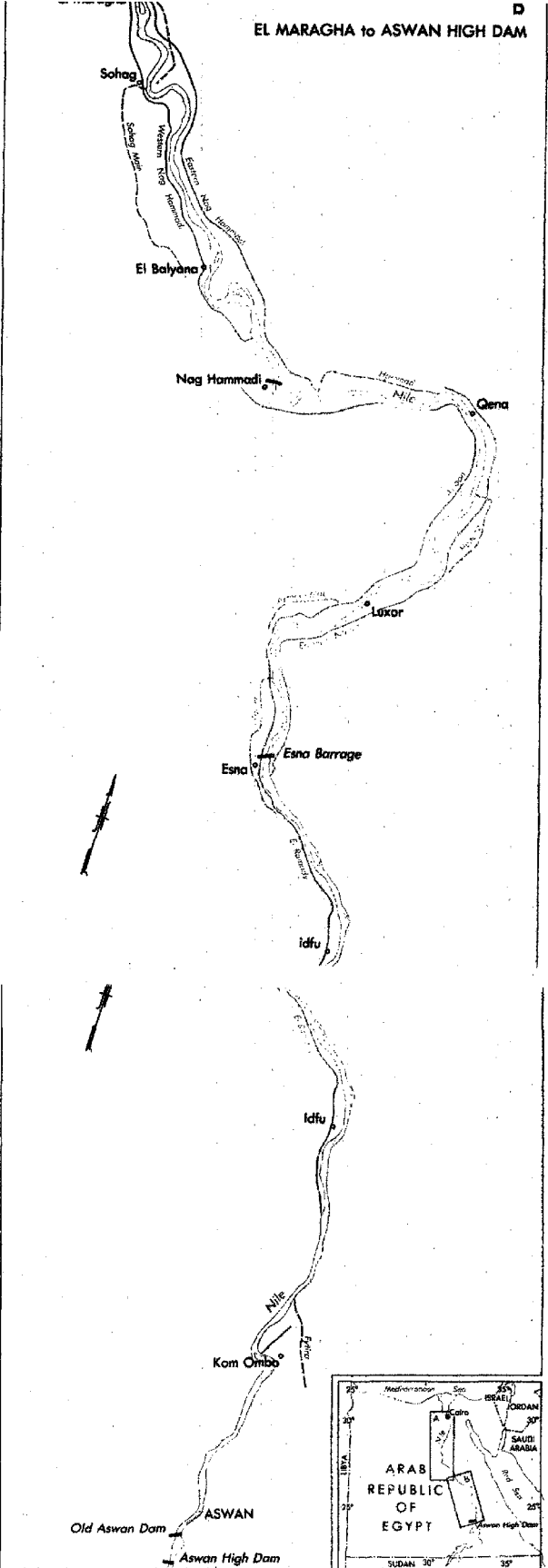
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KILOMETERS



**CAIRO to EL MARAGHA**

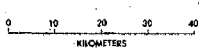


**EL MARAGHA to ASWAN HIGH DAM**



**ARAB REPUBLIC OF EGYPT  
CHANNEL MAINTENANCE PROJECT  
UPPER EGYPT**

- |                       |                                |
|-----------------------|--------------------------------|
| — Irrigated Areas:    | — Barrages and Dams            |
| — Old Lands (Project) | — Rivers                       |
| — Old-New Lands       | ● Urban Areas                  |
| — Main Canals         | ● Towns and Villages           |
| --- Main Drains       | ⊙ National Capital             |
|                       | - - - International Boundaries |



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