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EGYPTIAN MAINTENANCE STUDY

PREPARED FOR  
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INTERNATIONAL DEVELOPMENT

SUBMITTED BY  
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## EXECUTIVE SUMMARY

Keeping the governorates fleet of vehicles and construction equipment in good repair and available for work is critical to the support of the infrastructure and essential public services. This study has examined the many facets of establishing a viable maintenance system to optimize the availability of vehicles and equipment and protect the large investment in such equipment. In essence, a "Blueprint" for making major improvements to vehicle and equipment maintenance is presented. Very briefly summarized, the actions detailed are:

- Remove all obsolete, non-repairable and inoperable vehicles and equipment as well as parts and components for such vehicles and equipment from garages and workshops.
- Improve facilities and working conditions at garages and workshops.
- Improve the supply system to assure that spare parts are made available when needed.
- Provide operator manuals, maintenance manuals, service manuals and parts catalogs to the personnel at the level where they are needed.
- Provide tools and shop equipment for garages to perform Level 1 maintenance.
- Use the experience and expertise of the private sector in the operation and management of governorate Maintenance Centers.
- Assure the spare parts procured as part of vehicle or equipment acquisition are those that will be used on a recurrent basis. Depend on the Egyptian representative for supply of seldom needed parts.
- High level governorate personnel demonstrate an interest in vehicle and equipment utilization by visiting garages and work sites.
- Appoint a Maintenance Coordinator in each governorate to assure that vehicles and equipment are properly maintained at both the garage level and in the Maintenance Centers.
- Formulate a continuing training program for all personnel responsible for operating, maintaining, and overseeing the use of vehicles and equipment.
- Establish Maintenance Centers in the governorates, managed and operated by well qualified private sector companies to perform Level II maintenance of vehicles and equipment.
- Establish central stores in each Maintenance Center to receive, store and issue spare parts to both the Maintenance Center and garages.
- Contract with Egyptian representatives of vehicle and equipment manufacturers for major repair and rebuild of vehicle, equipment and major components. Contract should be on an annual basis and be applicable for all governorates.
- Development of available maintenance program for wells and pumps requires detail study of current needs and resources.

The financial and economic evaluation of the Maintenance Centers are based on costs that would be incurred for a typical center and the revenues that would accrue from its operation. It is anticipated that the center will return a profit in the third year of full operations and the governorate will share in the profits.

The financial data obtained from the four governorates included in the study were chiefly the 1984/85 and 1985/86 budgets for the BAB II funds. As budgets do not necessarily reflect expenditures, it is rather difficult to determine the expenditures for the various departments and activities of the governorates. From these budgets plus other sources of information it was possible to develop sufficient data to present financial and economic analysis.

From a financial point of view it appears that the efficient operation of the Maintenance Center will eliminate the estimated short fall in maintenance funds. This is based on the following assumptions:

- The centers will be managed and operated by a private sector company.
- The improved maintenance practices will not only reduce the time that equipment is down, it will also add to the useful life.
- Governorates and local units will be expected to pay the same rates as the private sector does.
- It is estimated that in the first year of operation, 80% of the operational time of the centers will be expended on the governorate fleet with only 20% available to the private sector.
- By the third year of operation, it is estimated that 40% of the time would be available for the private sector.
- Net profits resulting from the operation of the center will be divided between the governorate and the private sector based on a mutually agreeable formula.
- It is anticipated that the governorate share of net profits will be used to reduce or eliminate the shortfall in the maintenance fund.

## SUMMARY-ROAD MAINTENANCE

Four specific governorates in different agricultural areas of Egypt were examined regarding their local road systems. The total lengths of road by surface type (paved and unpaved) are taken from published sources. They are described from limited field observations, and further classified as asphaltic-concrete paved, gravel, or sand/clay surfaced. Required maintenance activities for each type are discussed, and an assessment made of average maintenance quantities (patching rates, grading frequencies, etc.) and probable annual maintenance costs per kilometer.

This section briefly considers the relationships between vehicles, road surfaces, and types of maintenance, concluding that labor-intensive methods would not be satisfactory in Egypt and that the governorates now own most of the equipment varieties needed for mechanized maintenance. Work methods are discussed, and identification made of the equipment types which are normally involved.

Four categories of equipment care are described, from daily fueling and oil checks to the infrequent rebuilding of engines or whole machines.

Assignments of responsibilities for the four echelons of equipment upkeep are discussed, with special attention to mechanical repair, where the degree of involvement of the governorates will be a critical question.

The space requirements for proposed work centers, or maintenance yards, in governorates are assessed in general terms but related only to road maintenance equipment. Other physical needs, such as utilities and storage, are mentioned. Finally, the technical needs for such work centers are examined, touching on work space characteristics and basic shop equipment, but not including personnel or training requirements.

Some general observations and conclusions are as follows:

- . Lack of rain and Egypt's generally favorable soil and topography conditions result in less road Maintenance Requirements than normally required in most countries.
- . In spite of this, however, even minimally acceptable road maintenance is not generally being performed, nor equipment utilized in proper fashion.
- . Lack of maintenance, particularly not patching potholes, allowing shoulder erosion and not brushing back areas of limited visibility is resulting in high economic cost to commercial commodity movements and in unnecessary accidents and loss of life to both commercial and passenger traffic.
- . The road maintenance system, as presently practiced, needs a complete system restructuring to meet minimal acceptable targets of performance and economic efficiency.

## SECTION I

### General

The establishment of maintenance centers in the Governorates is a highly desirable and important step towards the decentralization of governmental activity. It is not, however, a development that can be accomplished overnight. If it is a majority opinion that the task must be spread over several years (five perhaps) then it would seem reasonable to believe that the establishment of the centers would be successful. It should not be expected that such an accomplishment is without serious but not insurmountable obstacles. In essence one must learn to walk before one starts to run.

There are a number of management decisions that must be made in order for the centers to operate successfully. Many of these decisions can be solved over time by:

- Staff attrition.
- Training at all levels of operations and management.
- Setting up arrangements for assuring a regular flow of spare parts.
- Limiting outside interference, and
- supervision by top level management and authorities.

The key to the solution of these decisions is the phrase "over time". One approach to these management decisions is to set up a three-year rolling program. This allows the center operators to establish an initial program and to revise it on an annual basis. As an example, the first program would include years 1, 2, 3. The second program would include years 2,3,4 with projects unfinished in the first year moved into year 2 and years 3 and 4 adjusted accordingly. Thus there would always be a current three-year program and the attainment of goals can be assessed more easily.

Another important aspect of the maintenance center operation is, in the first years, to keep written reporting procedures at the lower levels to a minimum and to rely heavily on inspection and review by middle and upper management. An overly complex reporting and evaluation system would be self-defeating.

The ability of the Governorates to finance the operation of the centers is the key determinate of the program success. It is axiomatic that the operation must be technically sound, well managed, and highly efficient. If the private sector is to manage the center, it is well understood that it will be interested in the bottom line i.e. profits. If some of the profits adhere to the Governorate, all well and good. If the governorate receives no profit but is not assessed for support of the center, it's gain will be much more efficient operating fleet of equipment and a resulting decrease in the costs of spare parts. The availability of equipment due to limiting the down time plus extending equipment service life and the accompanying reduction in capital investment are all measurable and tangible economic gains.

A. Technical Inspection of Vehicles, Construction Equipment,

A. Technical Inspection of Vehicles, Construction Equipment,  
Spare Parts and Materials

Garages and workshops visited were uniformly crowded with inoperable vehicles and construction equipment as well as obsolete and used parts and components. In many cases the facility was so packed with such items as to make any effort at maintenance difficult if not impossible. The disorder caused by the garages and workshops retaining such items extended to the supply and spare parts storage. Spare parts and supplies required to meet current needs were mixed with used items and items that had obviously been in storage for a considerable period of time.

A successful maintenance program must begin at the level at which the vehicles and equipment are operated and garaged. Removal of inoperable and obsolete equipment, vehicles and components from the garages and workshops will free up space so a maintenance program at such facilities can be established. The garages and workshops at this level will need assistance to equip them with tools and equipment to perform at least level one maintenance.

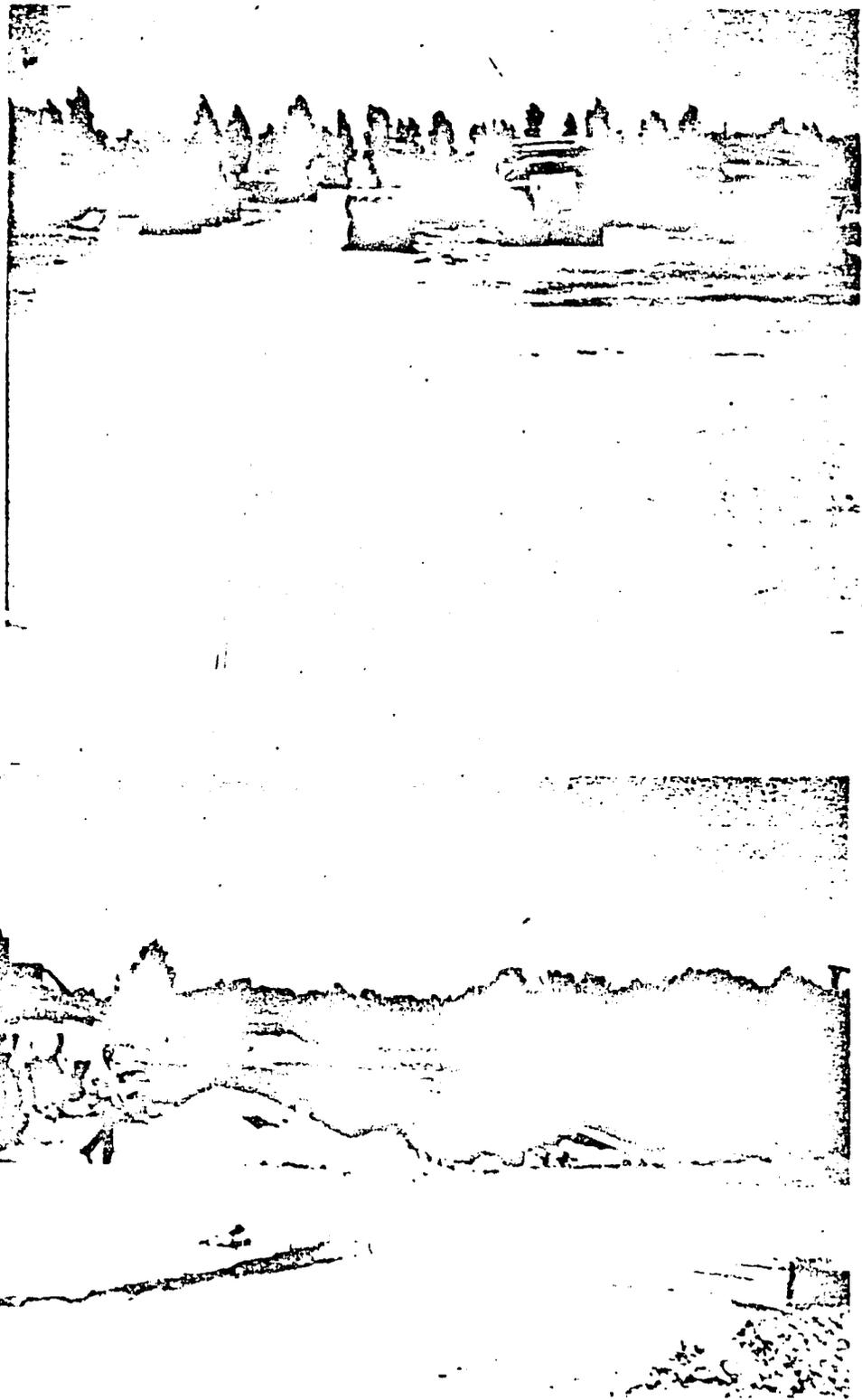
As a preliminary step in establishing a viable maintenance system in the rural governorates, such inoperable, obsolete and damaged vehicles, equipment and materials must be removed from the garages and workshops. To accomplish this step a Technical Inspection Team can be formed in the Governorate. The Team should include engineers competent to evaluate vehicle and construction equipment repair requirements and personnel familiar with Egyptian Law and procedures for disposal of government property. The team will inspect each vehicle and piece of equipment and classify it into such categories as servicable, repairable, not economically repairable, obsolete, or salvage. Parts and components can be inspected and classified in a similar manner. All vehicles, equipment, parts and components classified as not economically repairable, obsolete or salvage should be moved to a central holding area away from the garages and workshops and subsequently sold in accordance with Egyptian law and procedures.

B. Garages and Workshops

In each of the four governorates several garages and workshops at the governorate, markaz and village level were visited. Some findings are common to all sites visited.

Garages for fire fighting equipment (fire stations) are in good condition, well maintained and almost free of inoperable vehicles and equipment. They have a spare parts room with a variety of parts on hand. Equipment is clean and appears well maintained.

Garages and workshops for water departments at the governorate level are generally adequate in size and have



Road Department Garage

Kena Governorate

Fig. 1

workshops with machine tools, i.e. lathes, drill presses, welders, etc. Stockage of pumps, casing, well points and other components appears adequate. While parts rooms were usually small, crowded and with improvised bins and shelving, the spare parts on hand appeared representative of their needs. Water Department workshops at the markaz level had some machine tools but few if any spare parts. Water points at the village level had a minimum of tools and no spare parts. The markaz workshops support the villages but generally depend on the village council for the purchase of spare parts. The governorate Water Departments do have vehicles, some with tools and spare parts, to service the wells and pumps of the villages.

Facilities of the governorates Road Department are very poor, although improvements are being made in Qena and Assuit Governorates. Prevalent conditions affecting equipment and vehicle maintenance are:

- \* Obsolete and unservicable vehicles and equipment are stored on the site which is so crowded with such "junk" that servicable vehicles and equipment must be parked in the street. The few sheds that could be used for maintenance or storage of servicable equipment were usually taken up with unservicable equipment and discarded components and parts. In one case it was observed that such unservicable equipment was parked over the lubrication pit thus precluding its use.

There is little or no paving in the garages and no defined parking areas and drive ways.

- \* While most garages have lubrication pits they are not provided with drains. Some have water standing in the pits which would indicate they have not been used in recent times. None observed had steps so the person doing the lubrication could conveniently enter and leave the pit.

- \* Covered areas that could be used for servicing equipment were few or none existent, although some were being constructed in Qena Governorate.

- \* None of the garages have facilities for washing and cleaning the vehicles and equipment.

- \* Storerooms and spare parts rooms are inadequate in size, and do not have the bins and racks for proper storage. New tires were observed stored in the open where they are subject to deterioration due to sun, heat and blowing sand and dust. Gaskets that should be stored flat were hung or bent out of shape. Parts of the same type were stored in different rooms. CONEX containers that had little or no ventilation were diverted to storage. Store rooms and spare parts rooms do not have a stock record system although some of the supply rooms did have a rudimentary bin card system. None of the spare parts/store rooms had a locator card system. None of the spare parts rooms had a spare parts book for the DSF equipment. Items stocked were not

identified by make, model and parts number.

\* None of the garages had spare parts books for the DSF equipment.

\* Tools and service equipment were few and in poor condition at some sites that had new tools, the tools were locked up and had never been used.

\* In some locations a maintenance manual was available for specific pieces of equipment; however, the service manuals were not found at any locations. The only scheduled maintenance found at any location was oil and oil filter changes, otherwise repairs were made or attempted for breakdowns only.

Conditions at the municipal garages are similar to those described for the governorates Road Department. No efforts at improving conditions were noted.

Garages for other departments such as Health, Education, Social Services, etc. were not observed.

In general the conditions in the garages do not encourage any type of periodic maintenance or use of spare parts that are available. Drivers are drivers only and don't exhibit any concern for the equipment they are driving or operating.

At some locations there did seem to be some supervision and an attempt to have an organization. In all cases these efforts were frustrated by inadequate space, lack of resources and inept personnel.

#### C. Private Sector Involvement In Maintenance and Repair of Vehicles and Construction Equipment

In each of the four governorates designated to receive a Maintenance Center inquiry was made as to what extent the private sector was currently involved in repair of vehicles and construction equipment. The reply was similar in each case. The garage or workshop with basic responsibility for the item determined the part or component that was defective. The part or component is removed by mechanics of that garage or workshop and taken to a workshop in the private sector to be repaired. The repaired part is then replaced on the vehicle or equipment by mechanics of the governorate garage or workshop.

Inquiry was made in each governorate as to the actual expenditures to the private sector for such repairs. No definitive answers were obtained but such statements as "90% of all repairs" were given. Observation of tools, shop equipment and facilities at the garages and workshops give support to such statements. When supervisory persons were asked why so many repairs were sent out to the private sector the reply was that they did not have the skilled mechanics to perform such work nor did they have the tools and special shop equipment.

In two instances specific problems were identified.

\* The Road Department in El Sharkeya Governorate had a road grader of British manufacture repaired. The cost of repairs was L.E. 17,000. The garage supervisor stated that the wrong oil pump had been installed on the grader and it broke down on the return trip to the garage. There was no information available as to action being taken to have the private sector workshop correct their defective work.

\* In the Road department of Assuit Governorate the transmission of a Caterpillar Grader furnished under a US ID program had been removed and sent to the private sector for repairs. The grader was parked in the open subject to wind blown dust, sand and debris of the desert surroundings. The hoses and tubes where the transmission had been removed were not capped or plugged thus permitting dust and sand to enter tubes and hoses. It can be anticipated that when the repaired transmission is received it will be connected without the hoses and tubes being purged of any dust or sand. Such contamination could and probably will result in the premature failure of the transmission. While the private sector workshop performing the repairs will probably be faulted for an early failure it is just as likely to be the result of the failure of the Road Department mechanics to cap or plug the tubes and hoses.

- Private sector workshops were visited in each of the four governorates.

\* In general the shops are small and much of the work is performed in the street or in open spaces immediately adjacent to the workshop.

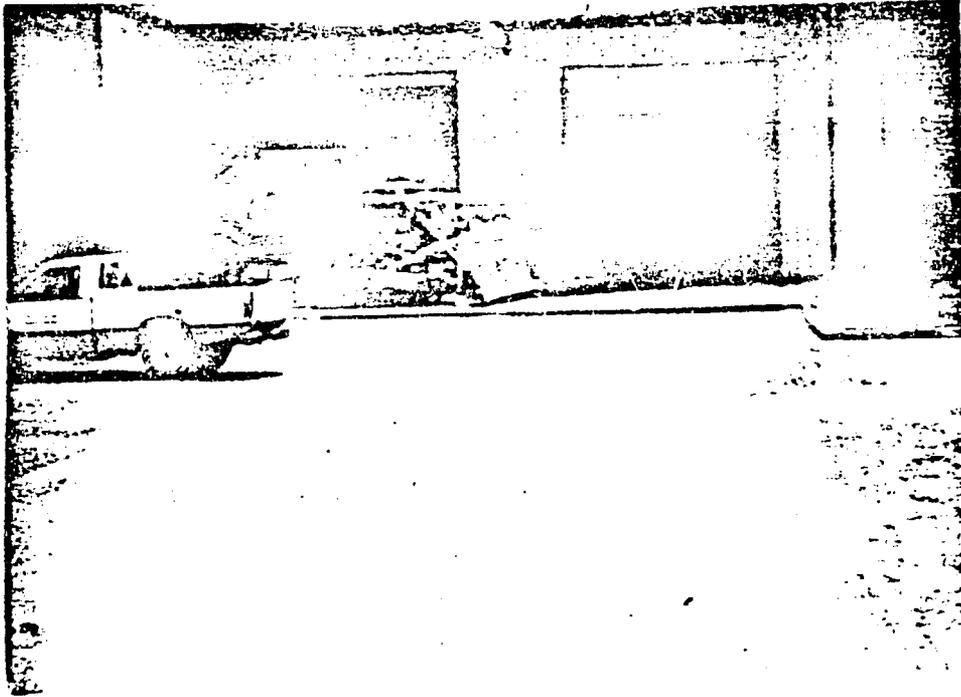
\* Tools and equipment are generally limited but some modern test equipment was observed.

\* A workshop with excellent tools, machines and equipment for repair and rebuild of diesel engines was visited in Assuit Governorate. The workshop had no space or facilities for storage of construction equipment or vehicles. Only engines and components could be handled by the shop.

\* There are numerous small shops capable of various levels of repair to gasoline and diesel engines, agriculture equipment and pumps located even in the villages. These shops show considerable resourcefulness and ingenuity in effecting repairs to small engines and equipment.

\* These small shops accomplish much of the repairs to Governorate vehicles and equipment that is performed by the private sector.

- Contact was made with Egyptian representatives of American vehicle and equipment manufacturers.



PRE - ENGINEERED BUILDING  
MANTRAC SHOPS

Fig. 2

\* Mantrac, representing Caterpillar. The concept of the Governorate maintenance Centers was explained to the Mantrac representatives. Mantrac currently performs considerable major repairs on Caterpillar equipment for the Governorates. They expressed an interest in managing and operating such Maintenance Centers if the IFB was equitable and offered an opportunity for a profit.

\* Carlin Middle East representing Detroit Diesel, Allison Transmissions, General Motors, Eaton Equipment and Fuller Transmissions. Carlin currently provides maintenance and repair services to the various Governorates. The concept of the Maintenance Centers was explained to Mr. Hady Tarrab, President of Carlin Middle East. Mr. Tarrab suggested that consideration be given to the governorates making an annual contract with the equipment dealers for major repair and rebuilding of the various components. Such a contract would fix the prices for specific work items and assure the Governorates of prompt repairs at a predetermined cost. The contract could be on a national basis. Mr. Tarrab expressed an interest in managing and operating the Maintenance Centers but commented that the terms of the contract offered would be the determining factor.

\* Industrial Engineering Company (ICON) representing John Deere, Grove Crane, Dynapack, Hyster and Euclid. ICON currently performs repairs to Governorate equipment. The company is building a new shop facility in Helwan. Representatives expressed a mild interest in managing and operating the Maintenance Center but expressed considerable concern as to the terms of a contract that might be offered.

\* Elecktessadia representing International Harvester, Cummins Diesel, Case, Dodge, Champion Motor Grader and Elgin Sweepers. Elecktessadia currently performs considerable major repairs to Governorate vehicles and equipment. Management representatives detailed some problems they were experiencing in clearing spare parts through Egyptian Customs and extra costs incidental to obtaining spare parts. When the concept of the Maintenance Centers was explained they expressed an interest in managing and operating one or more centers but noted that the conditions in the contract offered would be the determining factor.

\* Aswan National Company for Agriculture Mechanization located in Kom Ombo, Aswan Governorate was visited. The company has complete maintenance facilities for both heavy construction equipment and vehicles. The shop is in support of the companies main function of preparing land for sugar cane farmers and reclaiming land for the cultivation of sugar cane. The vast majority of the equipment maintained as well as the shop equipment is of Japanese manufacture. Mr. Ahmed Taha Hessein conducted a tour of the workshop and warehouse. The workshop was exceptionally well managed.

+ All tools and equipment were in good operating condition and clean.

+ There was a tool room for special tools and test equipment. A check-out/check-in system was used in the tool room.

+ A highly organized training system was in place. All employees must undergo an initial training period. All technicians and engineers are in a continuing education training program. The facility includes a training room with cut-away engines and components, charts, manufacturers manuals and parts books and other training aids. The Company conducts training for outside organizations.

+ The warehouse (parts room) is adequate in size with adequate bins, shelves and racks for the proper storage of parts and materials. There is a well organized supply management system in operation. A stock record card used by the company is shown in Fig 3 & 3A. The stock record card could be used in conjunction with a bin card as used in Central Supply of Menoufeya Governorate, see Fig 4 & 4A.

+ While Mr. Hessein was not questioned as to his companies interest in managing and operating Maintenance Centers for the Governorates, the company is certainly a candidates for such a function.

#### D. Spare Parts Furnished With Equipment:

Equipment furnished to the Governorates included a load of spare parts to be shipped with the equipment or to arrive shortly after the equipment is delivered. The spare parts furnished in general were those that were recommended by the equipment manufacturer. In some instances there are large numbers of items that may not be used for several years, if ever.

Future parts orders should not include such items as cylinder heads, crankshafts, injection pumps, transmissions, axles, short blocks, complete engines and major body components; these parts orders should be limited to those fast moving items that would be utilized in the 1st or 2nd levels or preventative maintenance. Items such as oil and air filter, belts, hoses, points, spark plugs, gaskets, lamps and bulbs, etc. should be included in the initial order of parts.

The local dealer or manufacturers representative receives a commission on each unit that is delivered in country. This commission is paid to help defray the cost of maintaining a service facility and spare parts inventory in country. The local representative should be required to maintain a supply of major components and parts needed for rebuild of engines, transmissions, final drives, track frames, etc. This should be spelled out in the purchase contract.

Egyptian representatives of American equipment manufacturers have stated in meeting with USAID and IA contractor personnel that they would be willing to work with persons preparing

procurement documents in determining the spare parts to be furnished as part of the equipment order.

Any parts list supplied by the manufacturer or the local representative should be scrutinized very thoroughly to make certain it does not include large quantities of slow moving items taking up space in the manufacturer supply facility.

Stock Record Card

Store Name: \_\_\_\_\_

Serial No.		Part No.		Part Name		Location		Max: Average Stock: Min:			
Date	Order No:	In	Out	Balance	Remarks	Date	Order No:	In	Out	Balance	Remarks

Fig. 3



Local Unit.

Shebin El Kom City and Markaz.

Storage Department.

Part No. \_\_\_\_

Part Name:

Balance :

In	Date	Out	Date

BIN CARD .

Fig.4



## SECTION II

### Design of Maintenance System

#### A. Governorate Involvement:

Any successful maintenance system requires the guidance, supervision, interest and participation of the authorities that are recognized as the "decision makers" within the governorate.

##### 1. Executive Interest

There is a truth to the statement that "people do well what the boss will check". Occasional visits to the garages by the Governor, Secretary General and/or City Chief will do much to improve morale of the garage personnel, promote better performance of supervisors, operators and mechanics as well as give the executive first hand knowledge of the condition and utilization of a very high value capital resources.

##### 2. Maintenance Coordinator

While occasional visits by top governorate and city officials will provide an oversight of the efficiency and effectiveness of the maintenance system there must be an official to supervise, monitor and coordinate the total maintenance program within the governorate. The designated "Maintenance Coordinator" must be provided the staff and resources to make the program fully effective. The "Maintenance Coordinator" must have the necessary authority and resources to carry out the following duties and responsibilities.

- Monitor the private sector company managing and operating the Maintenance Center to assure:

- \*The terms of the contract are fulfilled by both parties.
- \*Governorate equipment and vehicles receive service in a timely manner.
- \*Only work authorized by proper authority is performed.
- \*Work performed meets quality standards.
- \*Charges for work performed are in accordance with terms of the contract.
- \*Governorate furnished facilities, tools and shop equipment are kept in good condition, safeguarded from loss and abuse and used only in accordance with the terms of the contract.
- \*Assure accounting records of the private sector company managing and operating the Maintenance Center are sufficient to correctly credit the governorate with the proper share of profits earned for work performed for the private sector.

- Supervise garages of the governorate, markez and villages as necessary to assure that vehicles and equipment are provided all scheduled maintenance. Scheduled maintenance may be either at the garage or at the Maintenance Center, as detailed in this study. The Maintenance Coordinator must have the authority to order the various departments to perform the scheduled maintenance or deliver the vehicle or

equipment to the Maintenance Center for the scheduled maintenance. Authority must also extend to ordering the garages to deliver the vehicle or equipment to the Maintenance Center for repairs. These requirements presume that adequate service and utilization records are maintained at the garages. The following two reports will serve as excellent guides in setting up a maintenance system and records system.

- \* Preventive Maintenance Manual for District Service Vehicles and Equipment, prepared for the United States Agency for International Development by Wilbur Smith and Associates in Association with Public Administration service and Engineering and Geological Consulting Office as a part of the Neighborhood Urban Services Project.
- \* Recommended Equipment Maintenance Program Improvements for Shoubra El Kheima city, prepared for the United States Agency for International Development by Wilbur Smith and Associates in Association with Public Administration Services and Engineering and Geological Consulting Office as a part of the Neighborhood Urban Services Project.

Staff for the Maintenance Coordinator should include:

- Mechanical engineers to assure work quality standards in both the garages and Maintenance Center.
- Personnel with legal training to interpret the terms of the contract and to assure they are carried out by both parties.
- Accountants to maintain records and to review accounts of the private company managing and operating the Maintenance Center.
- Technicians and clerks to assist the professional personnel.

### 3. Training:

While there have been training programs conducted by equipment suppliers for operation and maintenance of vehicles and equipment, such training has failed to meet the needs of the governorates. Observation of equipment as well as garage facilities and operations indicate a need for initial as well as continuing training in the following areas:

- Training of operators of specific pieces of equipment.
- Operator maintenance of specific pieces of equipment.
- Preventive maintenance of specific pieces of equipment, to include lubrication, adjustments and tune-ups.
- Skill proficiency training of mechanics.
- Training of supervisors in personnel management.

- Garage and fleet management.
- Supply management to include organization and administration of spare parts supply, storage, issue and utilization.
- Establishing, maintaining and utilizing a library of operator manuals, maintenance manuals, service manual and parts catalogs for each make, model and type of equipment in the inventory. Such a library should be at the level at which the equipment is operated and garaged as well as at the Maintenance Center. The Central Supply facility must have a copy of the parts catalogs if it is to assure the correct replacement parts are issued to mechanics, technicians and engineers.
- Executive training of Maintenance Coordinator.
- Training of equipment repair inspectors. Work performed by any organization must be reviewed by competent persons to assure it meets quality, quantity and cost standards. Inspection on a random bases is usually adequate but may be increased if performance problems are encountered.

Experience on other USAID sponsored projects as well as observations and visits made in the various governorates makes it clear that most of the needed training is available in country. The U.S. training required by this IQC will provide the executive training for the Maintenance Coordinators as well as some garages and fleet managers. There are vocational and industrial schools in the major cities in the governorates that have facilities and staff to conduct training for equipment operators and mechanics. The Aswan National Company for Agriculture Mechanization in Kom Ombo, Aswan Governorate would be an excellent source of "hands-on" training for mechanics, machinests and supply management personnel. High level supervisory, management and executive personnel could benefit by a visit to see how a well run maintenance center should be operated and managed. There is nothing out-standing about the physical plant of the maintenance center but the equipment, supply and training programs are exceptional.

#### B. Maintenance by Equipment Operators, Vehicle Drivers and garage Personnel.

Any improvement in the maintenance of equipment and vehicles must begin with the operators, drivers and garage personnel. The driver/operator must be required to perform prescribed checks and adjustments before starting the vehicle or equipment and additional checks after starting but before operating the vehicles or equipment. Specific checks to be made by the driver/operator will depend on the Specific vehicle or equipment. The Preventive Maintenance Manual Previously referred to will serve as a guide for establishing the checks to be made and the driver/operator responsibility. Required checks should be in writing and the driver/operator instructed on the proper way to

make the checks, instruments or tools to be use and action the driver/operator must take.

The garage must have the physical plant, shop equipment, tools and staff to perform certain scheduled maintenance, lubrication, adjustments, replacements and minor repairs. To perform such functions efficiently and effectively the typical garage must be upgraded by removal of obsolete, and non-repairable vehicles and equipment as well as other non-usable parts and debris and provided with the facilities, tools and shop equipment detailed in subsequent paragraphs.

The driver/operator maintenance as well as the quality of maintenance at the garage level must be improved if the Maintenance Center is to operate efficiently and effectively and the capital invested in vehicles and equipment is to be protected.

1. Level of Maintenance Performed at Garages:

a. Vehicles: Reference should be made to the manufacturer's operator's and maintenance manuals in performing the following checks, adjustments and scheduled maintenance.

- Prior to starting:

- \* Check all fluid levels and bring to the correct level any that are incorrect.
- \* Check for fluid leaks. Repair if minor or send to the Maintenance Center for necessary corrective measures.
- \* Check tire pressure and bring to correct pressure if necessary.
- \* Inspect tires for bumps, cuts, abrasions or other defects. Replace or repair as necessary.
- \* Check battery for electrolyte level and corrosion as well as loose connections and frayed cables. Repair or replace as necessary.
- \* Check hoses and belts for cuts or damage. Repairs if necessary are to be made by the Maintenance Center.

- After starting engine and prior to moving:

- \* Check gauges to make sure all systems are operating properly. Should improper operation be detected, repair or have Maintenance Center make repairs.
- \* Check lights and signals to make certain they are functioning. Replace bulbs or make repairs if trouble is found.

Check breaks, service and parking. Adjust if necessary or have repairs made by the Maintenance Center.

- During Operations:

Be alert for anything that is not normal. Anything noticed should be reported to the garage supervisor so repairs can be made and breakdowns eliminated. In case there is a loss of oil pressure, immediate shutdown of the engine should be made until the cause is determined and corrective action taken.

After Operating:

- \* Clean the vehicle of dust, mud and trash.
- \* Lubricate the vehicle in accordance with the schedule recommended by the vehicle manufacturer.
- \* Change oil and filters in accordance with the schedule recommended by the vehicle manufacturer.
- \* Clean or change the air filter in accordance with the schedule recommended by the vehicle manufacturer.

- b. Construction Equipment: General and specific preventive maintenance and operator Maintenance will vary considerably for each piece of equipment. Manufacturer's operator's and maintenance manuals should be used in preparing level I procedures for each piece of equipment.

2. Organization, Staffing and Training:

a. Organization and Staffing

Garages and workshops for the governorates, marakez and villages have varying types and numbers of vehicles and equipment. The specific organization and staffing would have to be based on the fleet and equipment size and composition and such determination is not within the scope of this study. The staff for the garages should include the following repair specialists:

- Mechanical (Diesel)
- Mechanical (Gasoline)
- Battery
- Tires
- Electrical
- Lubrication
- Body work

b. Training

The skill levels of current repair personnel were reported and observed to be low. This is due to a large degree to low salary levels. The disparity in wages between public and private sector employees will make it extremely difficult to recruit and retain highly skilled employees. Training to improve existing skill levels is necessary. Equipment suppliers and manufacturers will provide short training courses on their equipment free of charge or at a nominal fee. The possibility of attending training courses at vocational and industrial schools within the governorates

or at private or public sector companies within the governorate or in other governorates should be investigated.

### 3. Record Keeping:

To effectively manage the operations and maintenance of an equipment fleet, record keeping must be organized to provide managers and officials with properly formatted information. As a minimum a record should be made for each vehicle and piece of equipment to reflect all scheduled maintenance and repairs performed. Such records are maintained in some of the garages. Overtime other reports similar to those presented in the report on Recommended Equipment Maintenance Program for Shoubra El Kheima City, previously referred to, can be implemented.

### 4. Tools and Equipment:

Tools and equipment available at the garages vary widely but are deficient in some or all of the tools and equipment necessary to perform the garage level maintenance recommended above. Each garage should be provided with the tools and equipment listed below. A cost estimate is shown for each item listed. Tools and equipment recommended are based on level of maintenance performed at the garages and not on fleet size. Quantities may be varied based on fleet size.

Item	Est. Cost
----	-----
Air Compressor, 2 - Stage, 5 H.P, Minimum 20 gal. Tank.	\$ 2,000
Tire Service, Equipment, Light Vehicle Only	1,500
Bench Grinder, Min. 1 H.P, Snap-on BG -1000G, Pg. 203	500
Battery Charger Similar to Snap-on YA - 165A, Pg. 266	200
Lubrication Equipment, Power Operated, Similar to Snap-on YA - 715 Maxi Lube, eg, 281	800
10 Ton Service Jack, Similar to Snap-on YA-660, Pg. 240	1,900
20 Ton Hydraulic Bottle Jack, Similar to Snap-on YA 233, Pg. 240	220
3 Ton Hydraulic Bottle Jack Similar to Snap-on YA-226, Pg. 240	75

Item -----	Est. Cost -----
Individual Mechanics Tools Set Similar to Snap-on CAT-2049-AB	680
Tool set for Shop Use, Metric, Similar to Snap-on 720B MB, Pg. 13	3,200
Total	11,075

#### 5. Physical Plant:

Existing physical plant of the garages vary widely, even within the same governorate. As noted previously, some construction is in progress on the Road Department garages in Qena and Assuit Governorates. Some improvements in garages is necessary to accommodate the tools and equipment recommended above. Improvements to the physical plant should be a condition for the USAID to provide the tools and equipment listed above. Each garage needs a small parts storage and tool room. The room should have the necessary shelves, bins and racks to store spare parts used at the garage such as oil filters, air filters, batteries, tires and miscellaneous supplies. The parts - tool room must be secured.

#### C. Maintenance Centers:

Several factors will affect the design of the Maintenance Centers among which are:

- Fleet size and composition.
- Site size and configuration.
- Terrain.
- Buildings and utilities on or adjacent to the site.
- Future expansion potential.
- Management organization; governmental, public or private.
- Type construction selected; pre-engineered buildings or conventional Egyptian materials and design.

In selecting a management organization a comparison must be made between what is observable in the governorate garages as now operating and maintenance centers managed and operated by the private sector. Conditions in governorate garages have been previously detailed in this study and the interest of private sector companies stated. To make a significant improvement in maintenance the organizational and management skills of the private sector must be applied to the governorate Maintenance Centers. In selecting a management organization, the private sector offers several advantages.

By being able to pay higher wages, the skill level of employees can be set at the level necessary to perform the work to a set quality standard in an efficient and

effective manner.

- Private sector management, being profit oriented, will constantly seek ways to improve service and reduce costs. Labor required to meet work requirements will be set at the optimum number.
- Personnel with the necessary education, training and experience for managing the center can be placed in charge. The manager is in a position where he must satisfy the governorate on the cost, quality and quantity of work and satisfy his company on profit produced.
- The opportunity to perform work for the private sector in the Maintenance Center with the governorate sharing in any profit, will reduce the overall cost to the governorate for maintenance of vehicles and equipment.
- Depending on the volume of work performed, for both the governorate and private sector, the contractor may make capital investments (tools, equipment and facilities) in the Maintenance Center that will have benefits accruing to the governorate.

Use of pre-engineered buildings for the maintenance centers will permit more rapid construction and simply design. A cost comparison has not been made, to compare pre-engineered buildings with local conventional construction, but experience on other projects of similar type would indicate a probable lower cost. Pre-engineered buildings and structures are available from both local and import sources, some of which are:

Encorp. 117 Thawra St., Heliopolis, Cairo.  
Kirby. 9 Salah Salem St., Heliopolis.  
Prefabco Hegazi. 14 El Negah St., El Oroba Connor, Heliopolis.  
Skyline Versatile Building System. 3 Shagaret El Dor, Zamalek.  
Maria. El Abbasia Industrial Area, From Abdo Basha Sq.  
Acro Misr. Arab Contractors.  
EY Shark Steel Co. Geziret El Dehab.  
Soule Building systems (PICO), 6 Dar El Shefa St., Garden-City.

The companies listed may or may not have standard designs for shop facilities. Any company selected to supply and erect the maintenance Center should have a minimum of five years experience in the fabrication and erection of shop type buildings. Pre-qualification of the companies should include a requirement that they list a minimum of five projects on which they fabricated and erected shop type buildings similar to those required for the Maintenance Centers.

Design of the Maintenance Centers should be performed by competent Architect-Engineering firms with experience in

maintenance center design. Any such firm retained should be fully responsible for all surveys, design, construction drawing preparation, preparation of bills of materials, preparation of building documents, assist in evaluation of bids and proposals, inspection of construction and approval of in progress and final payments to the construction contractor.

#### 1. Level of Maintenance

The Maintenance Centers must be equipped and staffed to perform all level I checks and adjustments in addition to the level II maintenance. The Maintenance Center must have the physical plant, staff, shop equipment, tools and spare parts to perform all maintenance and repair of vehicles and equipment except desassembly and rebuild of major components such as engines, transmissions, final drives and track frames. Each vehicle should be scheduled for a preventive maintenance check each 500 hours of operation or quarterly whichever comes first.

#### - Vehicle Preventive Maintenance Checks and Adjustments:

- \* Chassis. Inspect for worn or loose tie-rod ends, drag links and pitman arm saddle bolts and bushings; check drive-line U-joints and pinions for free play; check center bearings; clean vents on axle housing and gear box.
- \* Springs. Inspect for breaks, sheared tie-bolts, loose or missing rebound clips; tighten U-bolts.
- \* Brakes. Inspect brake fluid lines for looseness and leaks; inspect safety and shutoff valves; blow out air tanks; check for excessive oil or grease; adjust brakes.
- \* Exhaust Assembly. Check clamps and hangers, inspect exhaust pipe, muffler and tail pipe; repair or replace.
- \* Wheels and Tires. Tighten all lugs and note broken studs or loose rims; check that tires on dual wheels match; replace defective valve cores; replace missing valve caps.
- \* Body. Check for accident damage, rust, broken or missing reflectors.
- \* Transmission and clutch. Check lever action, pedal free travel, declutching, vibration, chatter, slippage and noise.
- \* Steering. Check for bind, wandering, shimmy, side pull, freeplay.
- \* Engine. Check idle acceleration, power and noise.
- \* Radiator. Check for leaks and core for obstructions, check pressure cap.
- \* Wiring. Inspect secondary and primary wires for bad insulation and loose terminals.

- \* Distributer. Remove cap, and check condition of points, inspect all rubber nipples.
- \* Spark Plugs. Wipe porcelain clean, inspect for cracks, tighten terminals.
- \* Engine Timing. Set to manufacturer's specifications.
- \* Carburetor. Service fuel filter, adjust idle speed, tighten all screws and bolts, lubricate linkage, check governor setting and show R.P.M.
- \* Fluid levels. Check steering and transmission fluid levels and lubricate distributor staff.
- \* Diesel Engine Injectors. Check and adjust to manufacturer's recommended pressure, hot and cold.
- \* After cleaning the radiator core run the engine to an operating temperature of 82 C.
  - + Check valves and adjust settings to correct intake hot and exhaust cold.
  - + Change oil and replace filter.
  - + Replace fuel and water filters.
  - + Check alternator and regulator.
  - + Check universal joints.
  - + Check motor mounts.
  - + Check load pads.
  - + Check walking beams.
  - + Check spindle pins.
  - + Check alignment.

- Construction Equipment Preventive Maintenance:

Using the manufacturer's maintenance manual, a preventative maintenance program must be established for each piece of construction equipment. The program will vary for each piece of equipment and ~~be based on the number of hours of operation.~~ hours of operation.

- Injection Pumps and Hydraulic Pumps:

Diesel injection pumps and hydraulic pumps are to be removed and sent to a qualified service center to be calibrated and timed after each 1000 hours of operation or annually, whichever comes first.

2. Spare Parts:

Information obtained from the checks and repairs can be used in determining the stock levels of spare parts to be kept in the Maintenance Center and in the Center Stores.

3. Maintenance Limitations:

The Maintenance Center is to have the capability to remove components from vehicles and equipment. The components may be replaced with new or rebuilt items. The Maintenance Center is to have the capability to remove major components such as engines, transmissions, final drives and track frames but such components are to be sent to the manufacturer's representative for repairs unless the Maintenance Center operator can clearly demonstrate that he has the necessary tools, test-equipment, service manuals and skilled mechanics as well as spare parts on hand at the Maintenance Center to satisfactorily and economically perform the work.

4. Organization and staffing:

Organization and staffing of the Maintenance Center will depend entirely on the private sector company managing and operating the center. It is anticipated that initially the contractor will employ some government employees for a trial period to determine if they have the skills and desire to work that will contribute to the successful operation of the center. Some he will retain and some he will discharge. Based on data obtained at Mantrac it is expected that at about the third year of operation the staff of the Maintenance Center will be approximately as follows:

<u>Staff</u>	<u>Number</u>
Management, Administration and Technical	7
Mechanics Light Vehicle	8
Heavy Construction Equipment	3
Helpers Light Vehicles	2
Heavy Construction Equipment	3
Wash Area	2
Lubrication Area	3
Specialized Skills	5
Tool Keepers	2

<u>Staff</u>	<u>Number</u>
Parts Room Keeper	1
Library and Training	1
Janitors or Cleaners	5
Guards	2
	<u>44</u>
TOTAL	

### 5. Shop Equipment and Tools:

For Level II maintenance, as previously described, the following shop equipment and tools should be provided.

<u>Item</u>	<u>Est. Cost</u>
	\$
Arc Welding Equipment, motor generator type, 400 amp.	4,500
Gas Welding Equipment, 2 stage Similar to Snap-on WE 250, pg. 287	450
Air Compressor, 2 stage, with minimum 40 gal. reservoir, 10 H.P., 3 phase	5,000
Lubrication Equipment, power operated Similar to Snap-on YA 915 Maxi Lube with kits YA 900 Automatic and YA 901 Heavy Equipment, pg. 281	1,350
Hydraulic Jacks and Heavy Lift Equipment	6,025
- 10 Ton service Jack Similar to Snap-on YA 660, pg. 240	
- 20 Ton Hydraulic Bottle Jack Similar to Snap-on YA 233, pg. 240	
- 3 Ton Hydraulic Bottle Jack Similar to Snap-on YA 226, pg. 240	
- 1 Ton Hydraulic Transmission Jack Similar to Snap-on YA 717, pg. 240	
- 10 Ton Jack Stand Similar to Snap-on YA 522, Pg. 240	
- 2 Ton Crane/Engine Lifter Similar to Snap-on YA 705, pg. 240	
Tire Service Equipment, Light Duty Vehicle air operated, with bench grinder, Snap-on BG 1000 G, pg. 203	3,750

Item	Est. Cost
Battery Charger, Similar to Snap on YA 165A, pg. 266 with service tools similar to those on pg. 268 Snap-on catalogue	\$ 200
Parts Washing and Cleaning Unit, Similar to Snap-on PBC-34, pg. 286	2,220
Auto and Heavy Equipment Test Equipment, Electric Circuits, Similar to Snap-on MT 540 D, pg. 331 and Armature Growler MT 326 C, pg. 259	1,240
High Pressure Washing Equipment, for Cleaning equipment prior to servicing	1,335
Break Servicing Equipment, Similar to Snap-on YA 281, pg. 270	5,530
Master Mechanic Tool Set, both English and Metric-Similar to Snap-on 8600 GSB, pg. 11 and 7300 GMB, pg. 13	18,220
Heavy Equipment Tool Set for Mechanics, Similar to Snap-on CAT 2049 AB.	680
TOTAL	\$ 50,500

Notes: Snap-on numbers are from the 1987 catalogue and are given for purposes of identification only.

All items requiring electric service should give voltage, phase and cycle in specifications.

No large truck or earthmoving equipment tire service equipment is listed. This type work can be better handled in the private sector.

#### 6. Mobile Equipment:

- The Maintenance Coordinator should be provided with a vehicle for travel to and from the center, garages and work areas. A small pick-up truck or all wheel drive jeep type vehicle will be adequate for the purpose. Cost would be approximately \$ 10,000.
- The Maintenance Center should have at least one field service truck, minimum one ton capacity. The truck should be equipped with locking compartments and contain mechanic tool set (English and Metric), battery service tools, jacks, electric test meters, lubrication equipment, air compressor and battery chargers. Cost, including tools and

equipment, would be approximately \$ 35,000.

- It is desirable that the Maintenance Center have a truck tractor and a low bed trailer, 30 ton capacity. The trailer should be equipped with ramps, chains and hold down binders in quantities to permit the operator to fasten down the largest and most complex piece of equipment needing transport. The truck tractor should be of sufficient capacity to tow the trailer with it fully loaded. The truck tractor should be equipped with a rear mounted winch to enable the operator to load a piece of disabled equipment. The truck tractor and low bed trailer will be used to transport inoperative equipment to the Maintenance Center and to move heavy equipment between job sites when over the road movement is not practical. Approximate cost of the truck tractor and low bed is \$ 70,000.

## 7. Central Stores:

A building for Central Stores should be provided at each Maintenance Center. An adequate building exists at the Assuit site. The Central Stores should be approximately 200 m2 with the storage area sprated from issue. The storage area is to be equipped with shelving, bins and racks, preferably of a prefabricated type that can be modified as needs change. The storeroom needs a clear area where crates, cartons and packages can be received and inventoried before being placed in stock. The storage area should be separated from the issue area by a counter and records area. The Central Stores must have a good stock record system and locator system to assure parts can be identified and made available when needed.

Only parts to meet Level I maintenance needs should issued to the garages. The Central Stores should be co-located with the Maintenance Center so parts are readily available to that operation. Parts with a recurrent requirement should be issued to the Maintenance Center based on a 30 day use experience.

The Central Stores should be provided on industrial vacuum cleaner and a small rough terrain fork lift. The industrial vaccum cleaner will cost approximately \$ 200 and the fork lift approximately \$ 10,000.

## 8. Major Maintenance, Overhall and Rebuild:

The Maintenance Center proposed in this study does not include the shop equipment, tools and skilled personnel to disassemble and rebuild major components such as engines, transmission, final drives and track frames. If the private sector contractor managing and operating the Maintenance Center adds the necessary shop equipment, tools and skilled mechanics at his own expense, such work could be performed at the Center. This study is based on the premise that such work will be performed by the Egyptian distributor of the equipment or component to be repaired.

Since the kinds, types and manufacture of vehicles and equipment furnished under the DSF program are common to all governorates, annual contracts at negotiated prices applicable to all governorates would be beneficial. The vehicle and equipment manufacturers publish standard times for performing specific repairs and cost of parts. These standards and price lists can be used in negotiating the contracts. Copies of the contracts could be furnished to each governorate so they would be aware of such costs before the component is sent for repairs.

Such annual contracts were discussed with some vehicle and equipment distributors and they were agreeable.

SECTION III

MAINTENANCE CENTER - QENA GOVERNORATE

A. Fleet Size and Composition:

Information available on fleet size and composition was evaluated and allowances made for incomplete data and future acquisitions. The scope of the project for Qena Governorate is based on the following fleet size and composition.

<u>Type of Equipment</u>	<u>Quantity</u>
Scraper	2
Dozer	1
Grader	6
Road Roller	2
Asphalt Finisher	2
Dump Truck	50
Sprinkler Truck	22
Loader	4
Asphalt Mixers	2
Bucket Truck	2
Sewage Truck	32
1/4 Ton Truck	55
Agriculture Tractor	31
Refuse Truck	30
Excavator	5
Crane	1
Landrover	1
Ambulance	2
TOTAL	<u>250</u>

B. Requirements for Physical Plant:

Improved maintenance programs at the garage level and in the Maintenance Center will produce an availability rate of between 75% and 85% when both programs are functioning properly. At these availability rates between 37 and 62 vehicles or equipment will be out of service either at the garages or at the Maintenance Center.

The physical plant for the Maintenance Center is based on 35 vehicles being at, on the way to the center or returning to the garage at any given time.

The physical plant should include:

- Wash area for high pressure cleaning prior to servicing.
- Lubrication and oil change pit for wheeled vehicles.
- Hard stand for lubrication of tracked equipment and certain other pieces that can not be serviced over a lubrication pit.
- Eight covered work areas for servicing wheeled vehicles,

- with reinforced concrete floors.
- Three covered work areas for servicing construction equipment, with reinforced concrete floors.
- Secure enclosed area for service equipment such as brake service equipment, battery charger, welding equipment, parts washing equipment, bench grinder, electrical test equipment and tire service equipment.
- Secure enclosed area for spare parts of the Maintenance Center.
- Secure enclosed area for governorate Central Stores.
- Secure enclosed area, with ventilation, to be used as a library for various manufacturer's publications such as operator's manuals, maintenance manuals, service manuals and parts catalogs. The space is to be sized and designed for use as training classroom.
- Secure enclosed administrative space to be used by the contractor managing and operating the center.
- Secure enclosed space to be used as an office by the Maintenance Coordinator.
- Secure enclosed space for staff locker-wash room, located away from shops and offices.
- W.C. for staff, located away from shops and offices.
- Covered parking area for personal vehicles of the staff members. Providing this facility will preclude the use of service bays for staff parking.
- Defined parking areas for vehicles and equipment awaiting servicing and vehicles and equipment awaiting pick-up by the garages. The areas are to be sufficiently secure to prevent vandalism or theft.
- Access road and gate into the Center must be such that a large low bed trailer with a large piece of equipment can enter or leave without difficulty. There should be no overhead obstruction at the gate to prevent large cranes or drag lines from entering or exiting.
- Covered service bays for servicing wheeled vehicles should have four meters clearance from floor to overhead obstruction.
- Covered service bays for servicing construction equipment should have five meters clearance from floor to overhead obstruction.
- Air compressor is to be located centrally and lines installed to all service bays, shop areas, wash area and lubrication area.
- Secure enclosed tool room with sufficient space to store all special tools and test equipment plus the tools of the individual mechanics. Locate the tool room centrally with easy access to all service areas.
- Finish floor of the service bays to be reinforced concrete without joints or obstructions so tool carts, portable jacks and mobile service equipment can be moved from one service area to another with a minimum of effort. Aprons around the service area should be constructed in the same manner.
- Provide drains for the wash areas and lubrication pit. Provide drains with sediment trap and oil and grease separators.

- Wash area and lubrication area to be reinforced concrete hard stand.
- Pave entire area in and around the shops with asphaltic concrete over a firmly compacted base course.
- Fence the entire area. Provide gate and gate house.

C. Estimated Cost:

A programming estimate for the Maintenance Center is shown in Table 1 Proposed Site Plan is shown in figure 5.

Summary of estimated costs are:

- Physical Plant	L.E. 1,040,000
- Tools and shop Equipment \$50,500 plus 20% Transportation and Acquisition Costs = \$60,000 or @ L.E. 0.83 to the dollar	L.E. 73,012
- Mobile Equipment \$115,000 plus 20% Transportation & Acquisition Cost = \$138,000 or @ L.E. 0.83 to the dollar	L.E. 166,265
- Central Stores Equipment \$10,200 plus 20% Transportation and Acquisition = 12,240 or @ L.E. 0.83 to the dollar	L.E. 14,747
Total L.E. Cost	1,294,024
Round to L.E.	1,300,000

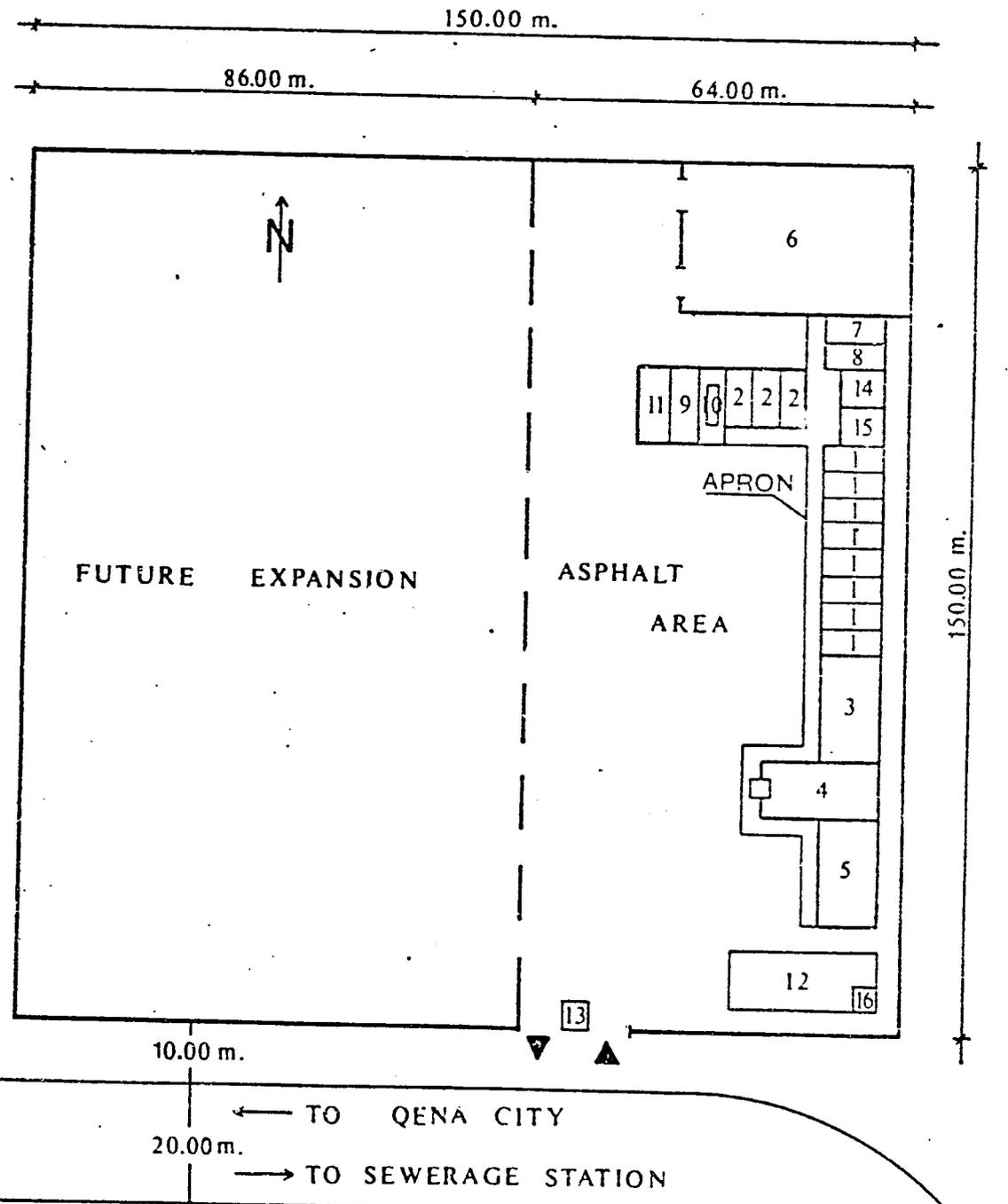
A firm written commitment should be obtained for the site prior to proceeding with the design.

Table 1  
Bena Governorate  
Physical Plant Requirements and Estimated Cost

Description	Requirements	No.	Total	L.E. Unit Cost
Light Vehicle Service Bay	10m x 4.5m	8	360 m2	200
Construction Equip. Service Bay	10m x 4.5m	3	135 m2	210
Shop Area for Service Equip	10m x 20m	1	200 m2	300
Administrative Library, Training Coordinator Office	10m x 20m 2 story	1	400 m2	300
Governorate Central Stores	10m x 20m	1	200 m2	300
Hardstand, Holding	10m x 4.5m	24	1080 m2	50
Wash & Locker room & N.C	10m x 4.5m	1	45 m2	430
Lunch & Tea room	10m x 4.5m	1	45 m2	300
Lubrication Hard Stand	12m x 4.5m	1	45 m2	250
Lubrication Pit Area	12m x 4.5m	1	45 m2	300
Wash Rack	12m x 4.5m	1	45 m2	250
Covered Parking Area	10m x 25m	1	250 m2	120
Gate House	4m x 4m	1	16 m2	300
Tool room	7m x 6.5m	1	45.5 m2	300
Spare Parts room	7m x 6.5m	1	45.5 m2	300
Fence	430 l.m.	-	4301 m	150
Concrete Apron	390 m2	-	390 m2	30
Asphaltic Concrete Pavement (Incl.base)	6,400 m2	-	6,400 m2	20
Water Pumps	1	1	1	20,000
Sewerage Connection	1	1	1	10,000
Electrical Services	1	1	1	15,000

Sub-Total  
Architect Engineer Service 18%  
Contingency 15%

TOTAL  
Round to L.E.



- 45
- 1 - Light Vehicle Service Bays.
  - 2 - Construction Equipment Service Bays.
  - 3 - Shop Area for Service Equipment.
  - 4 - 2 Story Structure Consists of:
    - a. Administrative Area.
    - b. Coordinator Space.
    - c. Library and Training Facility.
  - 5 - Spare Parts Facility Governorate.
  - 6 - Paved Holding Spaces for receiving and Dispatching equipment to owner.
  - 7 - Wash Room, Locker Room and Toilet Facility.
  - 8 - Lunch and Tea Room.
  - 9 - Lubrication Hard Stand for Heavy Equipment.
  - 10 - Lube Pit Area.
  - 11 - Wash Area.
  - 12 - Staff Parking Area.
  - 13 - Gate House.
  - 14 - Tool Room.
  - 15 - Spare Parts Room.
  - 16 - Transformer Room.

FIG. 5

SCALE  
1/1000

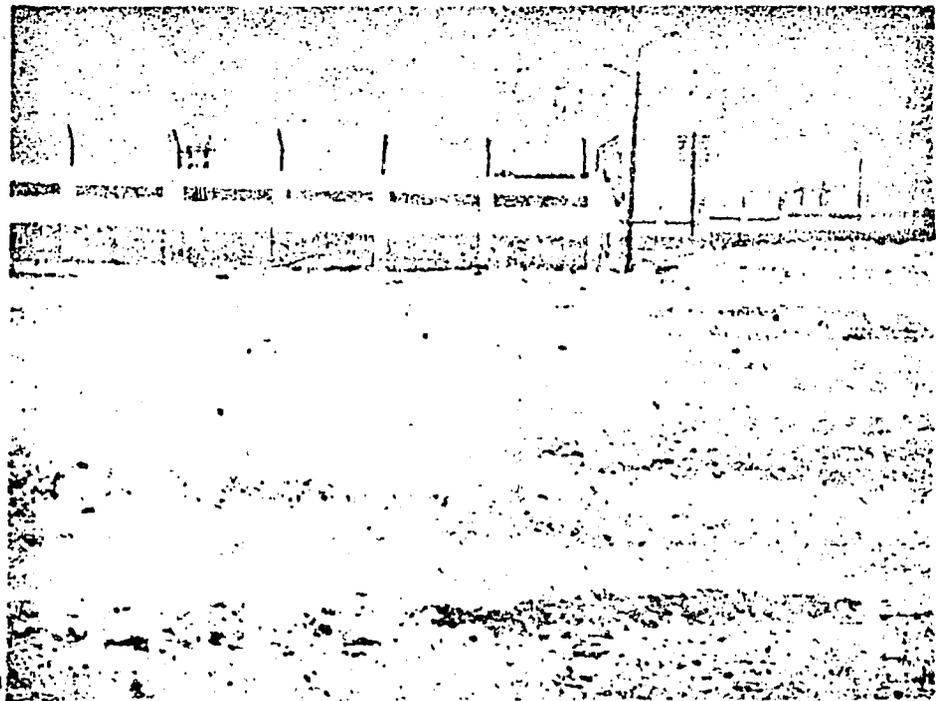
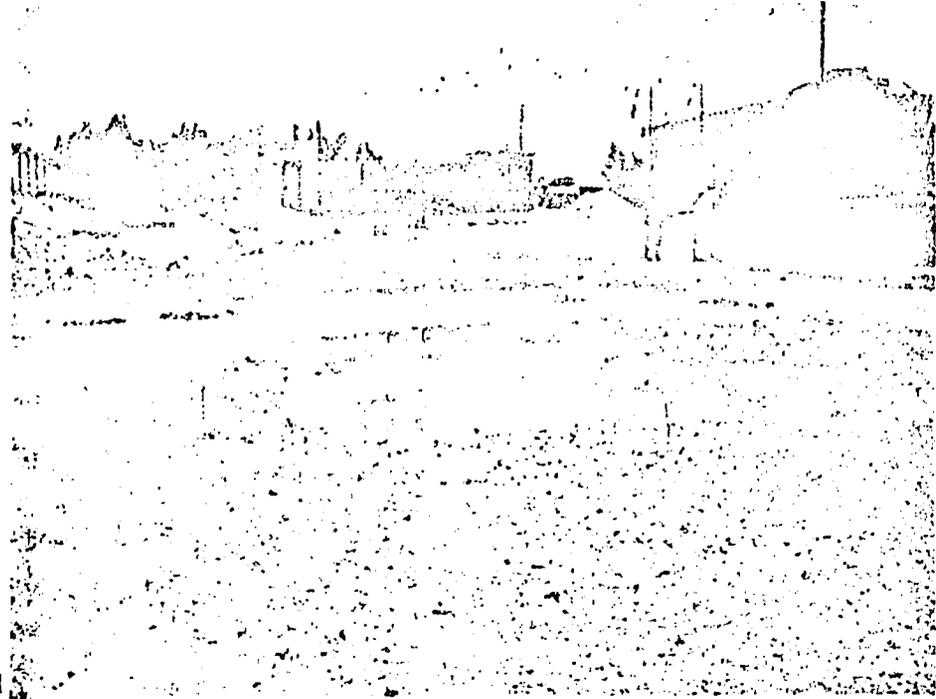
Electrical Power ○



Proposed Site of Maintenance Center  
Kona Governorate

SECTION IV  
MAINTENANCE CENTER - ASSUIT GOVERNORATE

A Maintenance Center similar to that proposed for Qena Governorate would be suitable for the Assuit Governorate site. Costs for the physical plant would be somewhat less since a Central Stores, Gate House and Fence would not be required. Elimination of these items would reduce the estimated cost of the physical plant to approximately L.E. 870,000 and total cost to approximately L.E. 1,111,000. A firm written commitment should be obtained for the site before proceeding with a design.



PROPOSED MAINTENANCE CENTER SITE  
ASSUIT GOVERNORATE

SECTION V  
MAINTENANCE CENTERS - EL SHARKEYA AND MENOUEFYA GOVERNORATES

Data available on the sites in El Sharkeya and Menoufeya Governorates is not sufficiently well defined to permit development of a site plan and cost estimates. Since there was some uncertainty as to the areas available for the Maintenance Centers no design effort should be made until it is certain that sites of adequate size and location have been set aside. Firm written commitments should be obtained for the sites before proceeding with design.

## SECTION VI WELLS AND PUMPS

Water departments and water points were visited in each of the four governorates. No package water purification or desalination units were observed. Water departments generally had better physical plant, spare parts stocks and maintenance tools and equipment than other departments. Marakez visited had shop equipment and tools such as lathes and pullers for maintenance of pumps. Water department shops were observed making bushings for the pumps.

Water department authorities stated that they had vehicles assigned to marakez to service the wells. One such truck was observed in Deyarb Negm Markaz of El Sharkeya. In other marakez information was received that BVS funds had been used to purchase vehicles to service wells and water points.

In Qena Governorate one instance was observed where the pumps were pumping directly into the distribution system and there was no surge tank or elevated storage tank on the system. Pump motor life can be expected to very short in such a situation.

Observation made and data obtained during the period May 9 to July 26 were not sufficient to permit the forming of any meaningful conclusions and developing recommendations. Development of available maintenance program for rural water systems should be undertaken as a separate action.

## SECTION VII

### Financial And Economic Analysis

A broad picture can be presented for the financial and economic aspects of the proposed maintenance centers but the look at basic and specific inputs makes a detailed analysis somewhat suspect. It is important that the analysis, both financial and economic, be conducted even if limited in scope.

The financial analysis will attempt to measure the total maintenance and operation funds needed in the Governorates for the LD II and LD III programs and to estimate the source and magnitude of the funds available for maintenance and operation. The economic analysis will present the costs and benefits accruing to the operation of the center over its estimated life.

- A. Financial Analysis: The financial evaluation of the proposed center is, of course, dependent on the size of the equipment fleet it is supposed to service and the efficiency of operation. Under the proposed maintenance center plan included in this report the center and equipment is estimated to cost L.E.1,300,000. The equipment fleet to be serviced is estimated to total 250. It is estimated that 35 vehicles will be out of service at any one time. Using these assumptions then there will be a fairly consistent work load at the center. Obviously, there will be high and low spots in the work load but this can be alleviated by careful scheduling.

The capital investment of constructing the center has been amortized over 30 years at a capital recovery rate of 15 percent. In other words, the replacement costs required on annual basis are included in the financial analysis.

1. The Local Development II Program: The local Development II (LD II) Program, just getting underway, envisions the expenditure of US \$228 million over the 5-year period 1986-1990 inclusive with the major portion (98.1 percent) being programmed for the first three years. The LD II program is designed to tie the earlier DSS Program to the future (LD III) Program scheduled for the years 1988-1992. Funding of the program is provided by USAID US\$ 156.0 million and US\$ 72.2 million by the GOE. The funds for maintenance, provided by the GOE, will total US\$ 53.2 million over the fiscal year 1986-1988,

inclusive, approximately US\$ 17.73 million per year. The estimated expenditures for the principal items in LD II are:

U.S.\$ Millions	
-----	
Block Grant Fund	134.96
Maintenance Fund	53.20
PVD Grant Fund	16.38
Staff Support	5.67
Other	18.01
	-----
	228.22

Several studies have been conducted since the advent of the USAID program in 1978. It is quite well documented that the capital investment program undertaken by the governorates and local units were needed and appeared to be a good application of economic resources. It is quite possible and has been strongly suggested that too much emphasis has been placed on the investment of capital and not enough on maintenance and operation.

The studies have unanimously pointed out that maintenance and operation programs are poor, under-financed and almost non-existent in many governmental units. The BAB II funds allocated by the GOE are so small as to be inconsequential in attempting to properly maintain the investments generated by the DSS Program.

It is believed that the maintenance fund included in LD II and the use of block grant funds to construct and equip maintenance centers will go far towards meeting maintenance and operating fund shortfalls. At the present time the governorates and local units are using BAB III funds, local funds and the 10 percent GOE funds to augment BAB II funds for maintenance and operation purposes. In some governorates, equipment is leased to private contractors in an effort to partially offset inadequate maintenance funds.

The principal weakness, and both the Ministry of finance and USAID are aware of this, is the inadequate budgeting and expenditure programs for maintenance and operation at the governorates and local level. No satisfactory maintenance and operation budget can be

prepared unless there is available the detailed expenditures for previous years. It would also be helpful to prepare two-or-three year maintenance and operation budgets and update them annually. With this information available management will have a clear picture of progress and of the future work programs and possible problem areas.

It can safely be stated that unless the reporting, programming and expenditure operations are conducted on a sound management basis the ultimate success of LD II is problematical. As noted earlier, both the Ministry of Finance and USAID are well aware of this situation, and are taking positive remedial action in the conduct of LD II program.

- a. Maintenance Funding: The program paper prepared for laying the groundwork for the LD II Program included a tabulation showing the estimated shortfall in BAB II maintenance funds. 1) In preparing the estimates, the capital investment in equipment and projects was totaled and an annual cost of 10 percent was calculated for the equipment and 5 percent for the projects. Under these assumptions, it was estimated that the 1984/1985 maintenance needs were L.E. 23.9 million while the BAB II funds totaled only L.E. 8.7 million, a shortfall of L.E. 15.2 million.

In order to estimate the future shortfall in maintenance funding during LD II Program an annual inflation factor of 15 percent has been applied to the 1984-1985 value of L.E. 23.9 million for the years 1986-1988. The resulting values in L.E. millions are shown below. The L.E. 14.7 million represents the GOE contribution for maintenance in the LD II Program.

Fiscal Year	BAB II Funds	GOE LD II Funds	M+O Needs	Short Fall
1985/86	8.7	14.7	27.5	4.1
1986/87	8.7	14.7	31.6	8.2
1987/88	8.7	14.7	36.3	12.9
Total	26.1	44.1	95.4	25.2

1) Local Development II Program paper, an Egyptian-American Cooperative Program, USAID/Cairo and Ministry of Local Government, August 1985. Page 10/1

Although the preceding tabulation does show a substantial shortfall by the end of the LD II Program, two rather offsetting developments are not included. (1) If the maintenance centers fulfill their planned role in the maintenance and operation program it is believed that increased operational efficiency could materially offset the inflationary trend of rising costs. (2) By the end of LD II some of the earlier capital investment programs will be requiring funds. A third development, and this could well be the key to reducing the estimated shortfall in maintenance funds, is the profits from the operation of the maintenance centers which would occur, in part, to the governorates.

Both GOE and USAID are hopeful that either by providing the local units with some means of generating revenues or by dedicating the profits generated by the maintenance centers to the maintenance effort that the projected shortfall can be in the substantially reduced or eliminated. This was discussed in the report previously cited and the following was excerpted from it.

The GOE Maintenance Fund contribution would be provided from central sources. The Ministry of Finance would make a direct allocation to each governorate to cover maintenance requirements. This allocation would be made through the GOE BAB II recurrent cost budget. Overtime, it is hoped that local units would have the authority to assume responsibility for financing a greater portion of recurrent costs in their jurisdiction. 2)

2. Maintenance Center Costs- It is part of the plan for LD II to establish maintenance centers in the Governorates. This is a highly desirable program as it is patently obvious that the maintenance of capital improvement projects completed under the BVS program is unsatisfactory and that the utilization of equipment and spare parts provided under the DSF program leaves much to be desired. The stated aim of the maintenance centers is to provide a level (second level) of equipment maintenance above the operating level of governorate, village and market garages. This aim, if coordinated, will eliminate substantial overlapping of effort, equipment, and spare parts.

-----  
2)  
Opcit, Page 67.

The following illustrative material gives some indication of the financial magnitude of such an establishment. Although it is quite desirable to conduct benefit/cost evaluations for capital investments of this magnitude, it is the stated intention of the LD II program to construct and equip maintenance centers in all Governorates from the block grant funds included in the LD II program. Therefore, the determination of the benefit/cost values could be considered academic insofar as the construction of the centers and support facilities are concerned. The position taken in this analysis is that they should be included.

a. Construction Costs- The cost of building the maintenance center and support facilities is estimated at L.E. 1,040,000. Cost of equipment required to operate the facilities are estimated at L.E. 260,000.

(1) Annual Costs- The annual cost in L.E. of constructing the maintenance centers and equipment is estimated as follows:

(a) Construction Cost	L.E. 1,040,000
-----	
Estimated Life	30 years
Estimated salvage	L.E. 500,000
Rate of interest	15 percent

$$(1,040,000 - 500,000) (0.15230) + 500,000 \times 0.15$$


---

2,400 hours

$$= \frac{82,242}{2,400} + \frac{75,000}{2,400} = \frac{157,242}{2,400} = \text{L.E. } 65.52 \text{ per hour}$$

(b) Tools and Shop Equipment Costs = L.E. 73,000

---

Estimated Life	5 years
Estimated salvage	0
Rate of interest	15 percent

$$= \frac{(73,000) (0.29832)}{2,400} = \frac{21,777}{2,400} = \text{L.E. } 9.07 \text{ per hour}$$

(c) Mobile Equipment Costs:

-----	LE 167,000
Estimated life	10 year
Estimated salvage	0
Rate of interest	15 percent

$$\frac{(167,000) (0.19925)}{2,400} = \frac{33,266}{2,400} = \text{L.E. 13.86 per hour}$$

- b. Staffing- The staffing requirements are, of course, dependent on the size and complexity of the equipment fleet and its condition. Because the center is a new concept it is highly probable that the first year or so the staff would be somewhat small. It is assumed that a staff size would increase overtime to the desired level. An estimate of staff requirements are shown below:

# Of Personnel -----	1 st Year -----	2 nd Year -----	3 rd Year -----
Management	3	3	3
Supervisory	6	5	4
Mechanic	7	9	11
Support staff	18	22	26
	---	---	---
Total	34	39	44

The cost of the staffing requirements is estimated as follows:

Personnel -----	1 st Year ----- L.E.	2 nd Year ----- L.E.	3 rd Year ----- L.E.
Management	12,000	15,000	18,000
Supervisory	18,000	20,000	20,000
Mechanic	14,000	27,000	44,000
Support Staff	18,000	33,000	52,000
	-----	-----	-----
Total	62,000	95,000	134,000
per hour	25.83	39.58	55.83

The above costs were estimated using the following annual salaries in L.E.

Personnel -----	1 st Year ----	2 nd Year -----	3 rd Year -----
Management	4,000	5,000	6,000
Supervisory	3,000	4,000	5,000
Mechanics	2,000	3,000	4,000
Support Staff	1,000	1,500	2,000

The estimated staff cost, can assume to be constant from the third year on, disregarding the effects of inflation.

A summary of the estimated hourly cost of building, equipping and staffing the maintenance center is as follows:

Construction	65.52
Equipment	22.93
Staffing (3rd year)	55.83
	-----
Total L.E.	144.28

The estimated cost per hour of L.E. 144.28 appears to be quite large but the center is equipped with eight bays for servicing trucks and similar equipment plus three hard stands for heavy equipment. As it is estimated that there will be, on the average, 35 vehicles out of service at any one time, the center should be operating at near capacity most of the time. The tabulation showing the cost of owning and operating a motor grader gives an indication of the economic loss involved if the equipment is out of service.

- C. Cost of Owning and Operating Equipment: As an example of the cost of owning and operating heavy equipment is shown in Table 2. This motor grader would have an estimated hourly owning and operating cost of L.E. 21.55.

This rate seems quite low in relation to the estimated cost of running the center but it must be borne in mind that the center will be providing service to a fleet of 250 vehicles and will have 8 bays for ordinary vehicles and 3 for heavy equipment.

Table 2

Cost of Owning & Operating Equipment

Machine Designation		Motor Grader 140G
		-----
Estimated life		6 years
Estimated Usage (hours/year)		1,800
Ownership Usage		10,800
Owing Costs		
		-----
1. Delivered Price		\$ 80,000
2. Residual Value		-
3.a. Value to be recovered thru works		\$ 80,000
b. Cost per hour		
Value	\$80,000	
Hours	10,800	
		\$ 7.41 P.H.
4. Interest Costs		
	$N+1 \times \text{Price} \times \text{Int. Rate}$	
	---	
	$2N$	
	-----	
	Hours per year	
	$N = \text{No. of years}$	
	$\frac{7}{12}$	
	$\times 80,000 \times 15\%$	
	$= \$ 3.89$	P.H.
	-----	
	1800	
5. Insurance		\$ 0.26 P.H.
		-----
Total hourly owning costs		\$11.56 P.H.
		L.E. 9.60

Operating Costs

1.	Fuel	1.00 x 5	\$ 5.00	P.H.
2.	Lube sits etc		0.40	P.H.
3.	Repair reserve	1 x 4	4.00	P.H.
	Total Operating costs		\$ 9.40	P.H.
			L.E. 7.80	
	Total Owning and Operating Costs		\$ 20.96	P.H.
	Operators Hourly Wage		5.00	P.H.
			L.E. 4.15	
	Grand Total		US\$ 25.96	P.H.
			L.E. 21.55	

Therefore, if operating at 60-75 percent capacity, the revenues generated should provide a good margin of profit. Furthermore, if operated by the private sector it can be assumed that any idle capacity will be utilized to service the private sector.

3. Operating Revenues: The mix of vehicles in the equipment fleet and the rather complex task of determining an equitable charge per hour for labor make it difficult to select an hourly charge that would be commensurate to the work being done. There are also other charges such as utilities that must be considered. Therefore in this study repair costs per hour have been set at L.E. 25. An assumption has been made that the center will be operating at 80 percent of capacity. The revenues generated by these assumption are:

$$25 \times 11 \times 0.80 \times 2400 \text{ hours} = \text{L.E. } 528,000 \text{ per year}$$

The annual operating costs are estimated at L.E. 346,272 (L.E. 144.28 x 2400), thus providing an annual net profit of L.E. 181,728.

The net profits generated by the maintenance center operations will be divided between the private operator and the Governorate on a mutually agreed basis. If such profits were divided evenly, the Governorate would receive L.E. 90,864 annually. This would also provide the private sector with a net profit ratio of 0.68 (L.E. 90,864 / L.E. 134,000) as the only costs incurred are those for the staff. The division of net profits is subject to negotiation.

If the L.E. 14.7 million in maintenance funds shown in the LD II program were divided equally between the Governorates each would receive L.E. 700,000 for the years, 1986-1988. According to the previously cited report "Local Development Program Papers" (page 10/4) the Qena Governorate had a shortfall of L.E. 1,350,000 (L.E. 1,760,000 - 410,000) in 1984/85 maintenance needs.

The distribution of GOE maintenance funds (L.E. 14,100,000) for the three years of LD II is expected to be distributed to the Governorates based on needs. Although noted repeatedly in this report, it bears emphasizing again that the equitable distribution of funds has to be carefully done and the needs estimated based on established criteria. Using the estimated maintenance needs noted in the previous paragraph divided by the total of such needs (L.E. 26,500,000) Qena's share of the GOE funds would be 6.63 percent or L.E. 934,800 per year for the three years of the LD II program. The following tabulation provides an

approximation of what the maintenance needs and expected funding might be in the future.

Needs have been inflated by 15 percent for the years 1986 through 1988, by 10 percent for 1989 and held constant in 1990, and for the years thereafter.

It can be observed that the available funds even with a substantial increase in GOE funds will not eliminate the shortfall. If inflation is ignored i.e. needs at the 1985 level of L.E. 1,760,000 from 1989 on a very slight deficit of funds would occur.

Fiscal Year	Maintenance Needs	Available Funds			Short Fall
		BAB	GOE	Profits	
-----					
Million L.E.					
1986	2.02	0.41	0.94	-	0.67
1987	2.32	0.41	0.94	-	0.97
1988	2.67	0.41	0.94	-	1.32
1989	2.94	0.41	1.20	0.10	1.23
1990	2.94	0.41	1.20	0.10	1.23

A calculation of the net present value of the anticipated construction, operation and revenues shows that at a discounted rate of 10 percent over a 30-year period the facility will have a net present value of L.E. 23,575 and an estimated internal rate of return of about 10.5 percent. This illustration does present a very sound financial picture.

#### 4. Ten Percent BVS Maintenance Funds

The ten percent BVS maintenance funds have their origin in the BVS Project Grant Agreement in which USAID provided the funding of capital investment projects and the GOE provided 10 percent of the total capital costs for maintenance of the completed projects. The funds were to be allocated by the governorates to the villages and such funds were to be deposited in interest bearing accounts in village banks. The village, in turn, were to transfer funds to the markez so that the markez maintenance centers could provide maintenance services to the villages. Lastly, the villages were to use the remaining funds to establish and equip village maintenance workshops and to pay for recurring material of maintenance costs.

A survey covering nine governorates conducted by Chemonics/Cairo indicated a rather diverse pattern of distribution and expenditure of the funds. Chemonics/Cairo had this to say about the disposition of the funds.

"It was suspected that the concept of systematic preventive maintenance had not yet "Caught on" and most governorate officials still thought of maintenance as identical with repair. It was also suspected that spending might be overly oriented to items superficially indicative of "development" such as permanent material with high initial investment costs, with few or no funds being used for the recurrent costs associated with preventive maintenance, such as maintenance and repair services, replacement parts, lubricants, etc." 1)

The data used in this section was extracted from the referenced study by Chemonics/Cairo.

In the Chemonics study, nine governorates were included in the survey and although not indicative, the interest earned on deposited funds varied from 11.45 percent on the funds received by Fayoum to 0.0 by Qena. Three of the four governorates included in this study, Menoufeya, Qena and El Sharkeya - were also included in the Chemonics study. The interest earned on their deposits was 4.61, 0.00 and 2.48, respectively.

The three governorates showed quite different expenditure patterns. Menoufeya had 57.3 percent of the funds in their closing balance and reported a relatively low expenditure for expendable material. This latter item indicates a lesser effort on the conduct of recurring maintenance activities. Qena earned no interest on the funds as they were held in governorate accounts. The Governorate purchased all tools and equipment for the markez and villages. Identical sets of tools, equipment and spare parts were distributed to each village regardless of the size of the BVS allocation.

The funds available to the El Sharekeya Governorate for maintenance were, to a large extent, retained by the Governorate as 71 percent (L.E.506,550) were still unexpended.

It must be concluded that the three governorates were somewhat lax in following both the guidelines and the purpose of the GOE funding effort. There is no question that the maintenance funds were needed and that a high degree of cooperative and coordinated effort would be involved.

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1) BVS Maintenance Fund Study  
prepared by Chemonics/Cairo June 1986, p.4

5. Operating Efficiency: The illustration costs of owning and operating equipment and the construction, equipping and staffing of the maintenance center should be considered as "order of magnitude" estimates. The values do emphasize, however, that the maintenance of equipment, the orderly flow of spare parts and the importance of what might be designated "first level" operating maintenance function are primary requisites if the centers are to fulfill their designated part of the maintenance program. For example, if the motor grader (Table 2) downtime can be significantly reduced it can clearly be seen that the economic savings are to substantial magnitude. It should be borne in mind that the costs of owning the machine (L.E. 9.60 per hour) continue whether or not the machine is idle and unproductive and quite possibly the operator would have to be retained at an hourly rate of L.E. 4.15. The reduction of "downtime" is a key item in attaining operating efficiency.

In the conduct of the LD II program, there will be a substantial number of capital investment programs. It should be a requirement that the governmental units involved propose, along with the justification of the capital investment projects, an estimate of the future maintenance needs. This procedure will enable all participants in the program to estimate future equipment and staffing requirements. If conducted properly, such a procedure might well reduce the number of capital investment projects.

- B. Economic Analysis: The evaluation of the economic benefits emanating from the operation of the maintenance centers and supporting facilities are quite real and measurable once the facilities are constructed and operating. The overall benefits can be generally categorized as the best use of economic resources. This generalization does not, however, provide values from which benefit/cost comparisons can be made. The benefits can be identified but their magnitude is difficult to assess. The beneficiaries can also be identified although spread across a large spectrum of society. Improvement in the operational efficiency of the equipment fleet, i.e. less downtime and extended service life, should result overtime in the reduction of fleet size, elimination of redundancy in spare parts stock, overall operating efficiency, and a reduction of the need for recurring capital investment. The reduction of capital investments is an important and vital factor when economic resources are limited.

As it is expected that the maintenance centers will operate on a commercial basis, the evaluation of financial operations is much more relevant to them than relative economic costs. It was noted previously that the estimated

costs and revenues of the facility discounted at 10 percent show a positive net present value. The evaluation is, however, quite sensitive to changes in the labor charge per hour. The calculation employed in this illustration was  $25 \times 11 \times 0.80 \times 2400 = \text{L.E. } 528,000$ . If the rate per hour is lowered to L.E. 20 per hour, the resultant revenues would generate only L.E. 422,400. A shift in the capacity being used is not so sensitive.

- C. Assuit Governorate: The budget allocation of BAB II funds for the fiscal years 1984/85 and 1985/86 were obtained from the Governorate, and represents the extent of finance data made available. In reply to an inquiry as to the availability of expenditures of the BAB II funds Governorate representatives stated that it would take a month to get them. This is a rather unusual situation as it would seem that the governmental body preparing the budget would need to know how such funds had been expended in the past. The above budgets represent the total body of financial data obtained.

Although budget allocations provide some measure of governmental activity, there is no mandate that such allocations be expended for the proposed budgeted items or, for that matter, expended in part or at all. A budget is primarily a management guidance tool and reflects only the proposed fiscal year program. If administrators have a firm grip on the activities of the several departments, then expenditures will closely follow budget allocations. This particular point could not be determined.

1984/85 budget, Table 3:- About 18 percent of the total funds of L.E. 852,005 were budgeted for spare parts. The distribution varied from 10.4 percent (usually low) for roads and transportation to 43.5 percent for personnel. Governorate and Local Councils, and Health, representing the bulk (67.9 percent) of the allocation for spare parts, budgeted about a quarter of their funds for this item. The Department of Education, although having the largest budgeted total, allocated quite a small percentage (7.9) of their total funds to spare parts. (see Table 3P (1)).

Table 3P (2) shows the percentage distribution by department. The Governorate and Local Councils, Education and Health collectively were allocated 86.4 percent of the total spare parts budget, 91.0 percent of the maintenance funds and 90.3 percent of the total budget allocation. Totals for the remaining seven departments varied from 3.0 percent for Housing and Construction and Agriculture down to 0.1 percent for two other departments. (see Table 3P (2)).

As can be noted in footnote 2 of Table 3P (2), the maintenance allocation is budgeted for such a wide variety of activities that it defies analysis.

Table 3

Governorate of Assiut - budget allocation of BAB II funds by department and expenditure item, Fiscal Year 1984 - 1985.

Department	Spare Parts 1)	Maintenance 2)	Total
The Governorate And Local Councils	54,000	150,000	204,000
Education	28,110	341,450	369,560
Health	49,000	146,700	195,700
Housing & Construction	6,200	19,400	25,600
Social Affairs	1,100	1,800	2,900
Food Supply	400	2,180	2,580
Agriculture	9,400	15,835	25,235
Personnel	500	650	1,150
Road & Transportation	2,500	21,610	24,110
Youth and Sports	450	720	1,170
3) Tax	-	-	-
3) O & M	-	-	-
Total	151,660	700,345	852,005

1) Includes spare parts and other.

2) Includes buildings, roads and bridges, infrastructure, tools and equipment, transportation and other.

3) Not included in budget document.

Table 3F (1)

Governorate of Assiut - percentage distribution by expenditure item-budget allocation of BAB II funds, Fiscal Year 1984 - 1985.

Departments	Spare Parts 1)	Maintenance 1)	Total
(P E R C E N T )			
The Governorate And Local Councils	26.5	73.5	100.0
Education	7.6	92.4	100.0
Health	25.0	75.0	100.0
Housing & Construction	24.2	75.8	100.0
Social Affairs	37.9	62.1	100.0
Food Supply	15.5	84.5	100.0
Agriculture	37.2	62.8	100.0
Personnel	43.5	56.5	100.0
Road & Transportation	10.4	89.6	100.0
Youth and Sports	38.5	61.5	100.0
3) Tax	-	-	-
3) O & M	-	-	-
Total	17.8	82.2	100.0

1) Include spare parts and other .

2) Includes buildings, roads and bridges, infrastructure, tools and equipemnt, transportation and other.

3) Not included in budget document

Table 3F (2)

Governorate of Assiut - percentage distribution by department budget allocation of BAB II funding, Fiscal Year 1984 - 1985.

Departments	Spare Parts 1)	Maintenance 2)	Total
( P E R C E N T )			
The Governorate And Local Councils	35.6	21.4	25.9
Education	18.5	48.7	43.4
Health	32.3	20.9	23.0
Housing & Construction	4.1	2.8	3.0
Social Affairs	0.7	0.3	0.4
Food Supply	0.3	0.3	0.3
Agriculture	6.2	2.3	3.0
Personnel	0.3	0.1	0.1
Road & Transportation	1.7	3.1	2.8
Youth and Sports	0.3	0.1	0.1
3) Tax	-	-	-
3) D & M	-	-	-
Total	100.0	100.0	100.0

1) Include spare parts and other

2) Includes buildings, roads and bridges, infrastructure, tools and equipemnt, transportation and other.

3) Not included in budget document

1985/86 budget, Table 4: BAB 11 funds budgeted for the 1985/86 fiscal year totaled L.E. 786,844, down L.E. 65,161, or 7.6 percent from the previous year. Education decreased by L.E. 46,783 chiefly in the maintenance function. Governorate and Local Councils budget funds decreased by L.E. 12,640 and Health by L.E. 7,335. The three departments noted above accounted for 90.3 percent of the budget total, 32.3 percent of the spare parts total and 91.0 percent of the maintenance total. As might be expected, the percentage distribution for the three departments does not vary significantly. (see Table 4P (2) ).

Table 4

Governorate of Assiut - budget allocation of BAB II funds by department and expenditure item, Fiscal Year 1985 - 1986.

Departments	Spare Parts 1)	Maintenance 2)	Total
(EGYPTIAN POUNDS)			
The Governorate And Local Councils	50,000	141,360	191,360
Education	30,000	292,777	322,777
Health	49,000	139,365	188,365
Housing & Construction	6,600	18,705	25,305
Social Affairs	1,200	1,500	2,700
Food Supply	400	3,000	3,400
Agriculture	9,192	15,835	25,027
Personnel	500	450	950
Road & Transportation	2,500	20,800	23,300
Youth and Sports	500	720	1,220
Tax	700	640	1,340
O & M	600	500	1,100
<b>Total</b>	<b>151,192</b>	<b>635,652</b>	<b>786,844</b>

1) Include spare parts and other

2) Includes buildings, roads and bridges, infrastructure, tools and equipemnt, furniture and other.

Table 4P (1)

Governorate of Assiut - percentage distribution by expenditure item-budget allocation of BAB II funds, Fiscal Year 1985 - 1986.

Departments	Spare Parts 1)	Maintenance 2)	Total
( P E R C E N T )			
The Governorate And Local Councils	26.1	73.9	100.0
Education	9.3	90.7	100.0
Health	26.0	74.0	100.0
Housing & Construction	26.1	73.9	100.0
Social Affairs	44.4	55.6	100.0
Food Supply	11.8	88.2	100.0
Agriculture	36.7	63.3	100.0
Personnel	52.6	47.4	100.0
Road & Transportation	10.7	89.3	100.0
Youth and Sports	41.0	59.0	100.0
Tax	52.2	47.8	100.0
O & M	54.5	45.5	100.0
<b>Total</b>	<b>19.2</b>	<b>80.8</b>	<b>100.0</b>

1) Includes spare parts and other

2) Includes buildings, roads and bridges, infrastructure, tools and equipemnt, transportation , furniture and other.

Table 4F (2)

Governorate of Assiut - percentage distribution by department budget allocation of BAB II funds, Fiscal Year 1985 - 1986.

Departments	Spare Parts 1)	Maintenance 2)	Total
( P E R C E N T )			
The Governorate And Local Councils	33.1	22.2	24.3
Education	19.8	46.1	41.0
Health	32.4	21.9	24.0
Housing & Construction	4.4	2.9	3.2
Social Affairs	0.9	0.2	0.3
Food Supply	0.3	0.5	0.4
Agriculture	6.1	2.5	3.2
Personnel	0.3	0.1	0.1
Road & Transportation	1.6	3.3	3.0
Youth and Sports	0.3	0.1	0.2
Tax	0.5	0.1	0.2
O & M	0.4	0.1	0.1
Total	100.0	100.0	100.0

1) Include spare parts and other

2) Includes buildings, roads and bridges, infrastructure, tools and equipemnt, transportation , furniture and other.

Summary- As previously noted, it is rather difficult to determine the expenditure patterns or degree of effort put forth by the Governorate, local councils, and market from the fiscal information provided. Missing are the expenditures (or budgets) for the BAB III funds as well as the 10% maintenance funds provided by the GOE. It is quite obvious that the budget information provided fails to reflect the complete fiscal patterns for some functions. The budgeted funds for roads and transportation are a case in point. In the two years shown, budgeted amounts for this function totaled only 2.2 and 3.0 percent respectively. From the data available, it is not possible to evaluate the ability of the Governorate to finance an efficient and effective Maintenance Center. The foregoing statement does not imply that the Governorate is not financially capable of operating the Maintenance Center but the lack of data precludes the determination of such capacity.

D. Menoufeya Governorate- The Governorate provided the 1984/85 and 1985/86 budget allocation for BAB II funds. In the fiscal year 1984/85 the budget total was L.E. 1,192,748 while the 1985/86 fiscal year totaled L.E. 1,434,671, up L.E. 241,923, or 26.3 percent over 1984/85. The largest change in the two years in the amount budgeted for spare parts by the Governorate and local councils. In 1984/85 the budeted amount was L.E. 94,000; in 1985/86 L.E. 358,000. Other than that the differences in the budgets both by department or by item varied but slightly for the two years indicating little if any change in the budgeting process or needs of the several departments.

1984-1985 Budget, Table 5: As noted in the other Governorate budgets, the maintenance funds budgeted for education was substantially greater than that for other departments. Eighty eight percent of the total budget for the department was designated for maintenance. The Health department budgeted the next largest amount for maintenance, L.E. 120,000 or 64.3 percent of the department total. (Table 5A (1) ).

Of the total funds budgeted for spare parts, five departments - the Governorate and Local Councils, Education, Health, Housing and Construction and Agriculture accounted for 92.6 percent of the maintenance funds budgeted.

Table 6F (2) includes the percentage distribution of budgeted funds for spare parts and maintenance by department. Governorate and Local Councils, Education, Health and Agriculture accounted for 88.3 percent of the total spare parts budget with that of Housing and Construciton accounting for another 7.8 percent.

The budgeted maintenance funds for the Governorate and Local Councils, Education and Health totaled L.E. 765,000 and 93.6 percent of total amount. (Table 5F (2) ).

1985-1986 Budget, Table 6: As noted above, the budget at the Governorate and Local Councils for spare parts was quite large representing 79.1 percent of their total expenditures. On the other hand the Department of Education budgeted 87.0 percent of its total for maintenance. This would be expected as the care of buildings would be the departments major maintenance function. The spare parts budgeted (L.E. 637,003) constituted 44.4 percent of the total BAB funds budgeted with 55.6 percent budgeted for maintenance of a variety of items. (Table 6F (1) )

Table 5

## GOVERNORATE OF MENOUEFYA

Budget allocation of BAB II funds by department and expenditures item, Fiscal Year 1984 - 1985.

Departments	Spare Parts 1)	Maintenance 2)	Total
( P E R C E N T )			
The Governorate And Local Councils	94,000	95,000	189,000
Education	72,613	550,000	622,613
Health	66,700	120,000	186,700
Housing & Construction	52,800	20,600	73,400
Social Affairs	3,600	1,280	4,880
Food Supply	8,635	2,130	10,765
Agriculture	61,600	17,000	78,600
Personnel	1,050	690	1,740
Road & Transportation	11,000	9,500	20,500
Youth and Sports	3,550	1,000	4,550
3) Tax	--	--	--
3) O & M	--	--	--
<b>Total</b>	<b>375,548</b>	<b>817,200</b>	<b>1,192,748</b>

1) Include spare parts and other

2) Includes buildings, roads and bridges, infrastructure, tools and equipemnt, transportation and other.

3) Not included in budget document

Table 5P (1)

## GOVERNORATE OF MENOUEFYA

Percentage distribution of BAB II budget by expenditure item,  
Fiscal year 1984 - 1985.

Departments	Spare Parts 1)	Maintenance 2)	Total
The Governorate And Local Councils	49.7	50.3	100.0
Education	11.7	88.3	100.0
Health	35.7	64.3	100.0
Housing & Construction	71.9	28.1	100.0
Social Affairs	73.8	26.2	100.0
Food Supply	80.2	19.8	100.0
Agriculture	78.4	21.6	100.0
Personnel	60.3	39.7	100.0
Road & Transportation	53.7	46.3	100.0
Youth and Sports	78.0	22.0	100.0
3) Tax	-	-	-
3) O & M	-	-	-
Total	31.5	68.5	100.0

1) Include spare parts and other

2) Includes buildings, roads and bridges, infrastructure, tools  
and equipemnt, transportation and other.

3) Not included in budget document

Table 5P (2)

## GOVERNORATE OF MENOUEFEYA

Percentage distribution of BAB II- budget fund by department, fiscal year 1984 - 1985.

Departments	Spare Parts 1)	Maintenance 2)	Total
The Governorate And Local Councils	25.0	11.6	15.8
Education	19.3	67.3	52.2
Health	17.8	14.7	15.7
Housing & Construction	14.1	2.5	6.2
Social Affairs	1.0	0.1	0.4
Food Supply	2.3	0.3	0.9
Agriculture	16.4	2.1	6.6
Personnel	0.3	0.1	0.1
Road & Transportation	2.9	1.2	1.7
Youth and Sports	0.9	0.1	0.4
3) Tax	-	-	-
3) O & M	-	-	-
Total	100.0	100.0	100.0

1) Include spare parts and other.

2) Includes buildings, roads and bridges, infrastructure, tools and equipemnt, transportation and other.

3) Not included in budget document

Table 6

## GOVERNORATE OF MENOUEFEYA

Budget allocation of BAB II funds by department and expenditure item, fiscal year 1985 - 1986

Departments	Spare Parts 1)	Maintenance 2)	Total
The Governorate And Local Councils	358,000	94,700	452,700
Education	78,500	526,635	605,135
Health	67,000	121,898	188,898
Housing & Construction	49,500	23,115	72,615
Social Affairs	3,600	980	4,580
Food Supply	8,150	2,000	10,150
Agriculture	59,203	17,250	76,453
Personnel	1,050	790	1,840
Road & Transportation	7,000	9,000	16,000
Youth and Sports	4,200	1,000	5,200
Tax	300	200	500
D & M	500	100	600
<b>Total</b>	<b>637,003</b>	<b>797,668</b>	<b>1,434,671</b>

1) Include spare parts and other

2) Includes buildings, roads and bridges, infrastructure, tools and equipemnt, transportation and other.

Table 6P (1)

## GOVERNORATE OF MENOUEFYA

Percentage distribution of BAB II budget funds by expenditure item, fiscal year 1985-1986.

Departments	Spare Parts 1)	Maintenance 2)	Total
The Governorate And Local Councils	79.1	20.9	100.0
Education	13.0	87.0	100.0
Health	35.5	64.5	100.0
Housing & Construction	68.2	31.8	100.0
Social Affairs	78.6	21.4	100.0
Food Supply	80.3	19.7	100.0
Agriculture	77.4	22.6	100.0
Personnel	57.1	42.9	100.0
Road & Transportation	43.8	56.2	100.0
Youth and Sports	80.8	19.2	100.0
Tax	60.0	40.0	100.0
O & M	83.3	16.7	100.0
Total	44.4	55.6	100.0

1) Include spare parts and other

2) Includes buildings, roads and bridges, infrastructure, tools and equipemnt, transportation and other.

Table 6P (2)

## GOVERNORATE OF MENOUEFEYA

Percentage distribution of BAB II budget funds by department, fiscal year 1985 - 1986

Departments	Spare Parts 1)	Maintenance 2)	Total
The Governorate And Local Councils	56.2	11.9	31.6
Education	12.3	66.0	42.2
Health	10.5	15.3	13.2
Housing & Construction	7.8	2.9	5.1
Social Affairs	0.6	0.1	0.3
Food Supply	1.3	0.3	0.7
Agriculture	9.3	2.2	5.3
Personnel	0.2	0.1	0.1
Road & Transportation	1.1	1.1	1.1
Youth and Sports	0.6	0.1	0.4
3) Tax	-	-	-
3) O & M	-	-	-
Total	100.0	100.0	100.0

1) Include spare parts and other

2) Includes buildings, roads and bridges, infrastructure, tools and equipemnt, transportation and other.

3) Less than one half of 0.1 percent

- E. El Sharkeya Governorate- Similar to the Governorate of Assuit and Menoufeya, the BAB II budget document for the years 1984/85 and 1985/86 does not change materially except for the funds for spare parts budgeted by the Governorate and Local Councils in the 1985/86 fiscal year.

1984 - 1985 Budget, Table 7:

Almost 19 percent of the total funds available was budgeted for spare parts. Five departments (Governorate and Local Councils, Education, Health, Housing and Construction and Agriculture) accounted for 96.4 percent of the spare parts budget. The Education maintenance budget accounted for 91.6 percent of the total budgeted for the department and 57.0 percent of the total maintenance funds budgeted. Three departments (Governorate and Local Governments, Education, Health) accounted for 91.9 percent of the funds budgeted for maintenance.

1985 - 1986 Budget, Table 8-

Except for the large increase in spare parts budgeted for the Governorate and Local Councils, the remaining spare parts budget is quite similar to the amount budgeted for 1984/85. In fact six departments budgeted identical amounts. The total amount budgeted for spare parts (L.E. 185,550) accounted for 43.2 percent of the total BAB II budget.

Similar to other Governorates, the budget for maintenance for Education was by far the largest, being more than three times greater than the next highest-Health. Overall funds budgeted for maintenance were L.E. 33,126 less than for 1984/85. Fifty six and eight tenths percent of the total BAB II funds were budgeted for maintenance with Education providing the most.

Ninety six percent of the total funds budgeted for spare parts were budgeted by the Governorate and Local Councils, Education, Health and Housing and Construction. Over half of the maintenance budget was earmarked for Education which together with the Governorate and Local Councils and Health accounted 91.2 percent of the total maintenance funds. The three departments accounted for the same percent of the total funds budgeted for the year.

Table 7

## GOVERNORATE OF EI SHARKEYA

Budget allocation of BAB II funds by department and expenditure item, Fiscal Year 1984 - 1985.

Departments	Spare Parts 1)	Maintenance 2)	Total
The Governorate And Local Councils	42,000	130,000	172,000
Education	42,000	460,000	502,000
Health	51,250	152,000	203,250
Housing & Construction	28,000	25,000	53,000
Social Affairs	1,400	1,500	2,900
Food Supply	1,000	2,000	3,000
Agriculture	15,700	13,000	28,700
Personnel	500	900	1,400
Road & Transportation	2,200	21,000	23,200
Youth and Sports	1,500	1,400	2,900
<b>Total</b>	<b>185,550</b>	<b>806,800</b>	<b>992,350</b>

1) Include spare parts and other

2) Includes buildings, roads and bridges, infrastructure, tools and equipemnt, transportation and other.

Table 7P (1)

## GOVERNORATE OF EI SHARKEYA

Budget Distribution of BAB II funds by expenditure item, Fiscal Year 1984 - 1985

Departments	Spare Parts 1)	Maintenance 2)	Total
The Governorate And Local Councils	24.4	75.6	100.0
Education	8.4	91.6	100.0
Health	25.2	74.8	100.0
Housing & Construction	52.8	47.2	100.0
Social Affairs	48.3	51.7	100.0
Food Supply	33.3	66.7	100.0
Agriculture	54.7	45.3	100.0
Personnel	35.7	64.3	100.0
Road & Transportation	9.5	90.5	100.0
Youth and Sports	51.7	48.3	100.0
Total	18.7	81.3	100.0

1) Include spare parts and other

2) Includes buildings, roads and bridges, infrastructure, tools and equipemnt, transportation and other.

Table 7P (2)

## GOVERNORATE OF EL SHARKEYA

Percentage distribution of BAB II budget funds by department,  
Fiscal Year 1984 - 1985

Departments	Spare Parts 1)	Maintenance 2)	Total
The Governorate And Local Councils	22.6	16.1	17.3
Education	22.6	57.0	50.6
Health	27.6	18.8	20.5
Housing & Construction	15.1	3.1	5.4
Social Affairs	0.8	0.2	0.3
Food Supply	0.5	0.3	0.3
Agriculture	8.5	1.6	2.9
Personnel	0.3	0.1	0.1
Road & Transportation	1.2	2.6	2.3
Youth and Sports	0.8	0.2	0.3
Total	100.0	100.0	100.0

1) Include spare parts and other

2) Includes buildings, roads and bridges, infrastructure, tools and equipment, transportation and other.

Table 8

## GOVERNORATE OF EI SHARKEYA

Budget allocation of BAB II funds by department and expenditure item, Fiscal Year 1985 - 1986

Departments	Spare Parts 1)	Maintenance 2)	Total
The Governorate And Local Councils	444,000	136,993	580,993
Education	42,000	434,776	476,776
Health	51,250	133,860	185,110
Housing & Construction	28,000	24,420	52,420
Social Affairs	1,400	2,050	3,450
Food Supply	1,000	1,800	2,800
Agriculture	16,500	16,250	32,750
Personnel	500	1,000	1,500
Road & Transportation	2,500	21,175	23,675
Youth and Sports	1,500	1,400	2,900
<b>Total</b>	<b>588,650</b>	<b>773,724</b>	<b>1,362,324</b>

1) Include spare parts and other

2) Includes buildings, roads and bridges, infrastructure, tools and equipment, transportation and other.

Table 8P (1)

## GOVERNORATE OF EI SHARKEYA

Budget distribution of BAB II funds by expenditure item, Fiscal Year 1985 - 1986

Departments	Spare Parts 1)	Maintenance 2)	Total
The Governorate And Local Councils	76.4	23.6	100.0
Education	8.8	91.2	100.0
Health	27.7	72.3	100.0
Housing & Construction	53.4	46.6	100.0
Social Affairs	40.6	59.4	100.0
Food Supply	35.7	64.3	100.0
Agriculture	50.4	49.6	100.0
Personnel	33.3	66.7	100.0
Road & Transportation	10.6	89.4	100.0
Youth and Sports	51.7	48.3	100.0
Total	43.2	56.8	100.0

1) Include spare parts and other

2) Includes buildings, roads and bridges, infrastructure, tools and equipment, transportation and other.

Table 8P (2)

## GOVERNORATE OF EL SHARKEYA

Budget distribution of BAB II funds by department, Fiscal Year  
1985 - 1986

Departments	Spare Parts 1)	Maintenance 2)	Total
The Governorate And Local Councils	75.4	17.7	42.6
Education	7.1	56.2	35.0
Health	8.7	17.3	13.6
Housing & Construction	4.8	3.2	3.9
Social Affairs	0.2	0.3	0.3
Food Supply	0.2	0.2	0.2
Agriculture	2.8	2.1	2.4
Personnel	0.1	0.1	0.1
Road & Transportation	0.4	2.7	1.7
Youth and Sports	0.3	0.2	0.2
Total	100.0	100.0	100.0

1) Include spare parts and other

2) Includes buildings, roads and bridges, infrastructure, tools  
and equipment, transportation and other.

F. Qena Governorate: The 1982 - 1983 budget information for BAB III funds in Qena Governorate reveals a wide range of capital projects being undertaken. It should also be noted that the 10 percent maintenance fund allocation (L.E. 345,000) is included in Table 9.

As would be expected, budgeting for projects related to the expansion of agriculture or activities related to the production of food were allocated a large share (34.7 percent) of the total budgeted amount of L.E. 8,934,000. Highway paving of L.E. 1,550,000 accounted for 17.3 percent of the total. A substantial amount (L.E. 1,727,000) was allocated to capital investments in major facilities i.e. Luxor plant and Governorate buildings. In retrospect, the budget reflects a well rounded and substantial capital investment program.

The BAB III budgets for 1983/84 and 1984/85 (Tables 10 and 11) show identical totals L.E. 9,455,000. With the completion of the Luxor and UNISEF Water Plants, budget funds were shifted to water projects and an increased amount for food processing. As noted in discussing the 1982/83 budget, the Governorate appears to be vigorously pursuing a well rounded program.

The Governorate also submitted a very detailed and extensive account of expenditures from BAB II funds. In fact, the expenditures as shown in Table 12 exceed the BAB funds by a considerable margin, indicating a substantial transfer of funds from other sources. It further indicates that the BAB II funds fall short of meeting needs. The rather large increase in the 1984 - 1985 utilities expenditure was attributed to electric lighting and the increase in transportation and communication was caused by a substantial and unusual expenditure for telephone bills.

The BAB II expenditure tabulations have a rather large item identified only as budget in both years submitted. These amounts accounted for 60.1 and 40.6 percent, respectively, for the 1983/84 and 1984/85 fiscal years.

The governorate provided the study with considerably more financial data than other Governorates included in the study and the data made it much easier for an analysis of the financial activities of the Qena Governorate.

Table 9  
GOVERNORATE OF QENA

Budget of the BAB III Investment funds for the Fiscal Year 1982 - 1983

I T E M	Amount L.E.	Percent
1) Food Processing	3,100,000	34.7
Electricity - network expansion	463,000	5.2
2) Transport	1,550,000	17.3
<u>Utilities</u>		
Public Sanitation	195,000	2.2
3) City Planning	60,000	0.7
4) Small Highway Vehicles	74,000	0.8
Public Buildings	100,000	1.1
Water Projects	870,000	9.7
BVS (maintenance fund-AID agreement)	345,000	3.9
Sub-Total	1,644,000	18.4
Luxor water plant	416,000	4.7
<u>Buildings</u>		
Regional Planning	600,000	6.7
Governorate	500,000	5.6
Youth	211,000	2.3
Sub-Total	1,311,000	14.6
Fire fighting & Traffic Control	275,000	3.1
Feasibility Studies	25,000	0.3
Maintenance Fund (AID for DFS)	150,000	1.7
Total	8,934,000	100.0

1) Includes dairy plants, dairy cows, poultry food plants, land reclamation and food-related projects.

2) Paving rural and urban highways

3) Purchase of right-of-way

4) Include pickups, minibuses, etc.

Table 10  
GOVERNORATE OF QENA

Budget of the BAB III Investment funds for the Fiscal Year 1983 - 1984

I T E M	Amount L.E.	Percent
1)		
Food Processing	2,915,000	30.8
Electricity - network expansion	700,000	7.4
Transport 2)	1,500,000	15.9
<u>Utilities</u>		
Public Sanitation	300,000	3.2
City Planning 3)	100,000	1.0
Small Highway Vehicles 4)	150,000	1.6
Public Buildings	150,000	1.6
Water Projects	500,000	5.3
BVS (maintenance fund-AID agreement)		
Sub-Total	1,200,000	12.7
Luxor and UNISEF water plants	755,000	8.0
<u>Buildings</u>		
Regional Planning	540,000	5.7
Governorate	550,000	5.8
Youth	225,000	2.4
BVS Maintenance	345,000	3.6
Sub-Total	1,660,000	17.5
Fire fighting & Traffic Control	350,000	3.7
Feasibility Studies	25,000	0.3
Maintenance Fund (AID for DFS)	350,000	3.7
Total	9,455,000	100.0

1) Includes dairy plants, dairy cows, poultry food plants, land reclamation and food-related projects.

2) Paving rural and urban highways

3) Purchase of right-of-way

4) Include pickups, minibuses, etc.

Table 11  
GOVERNORATE OF QENA

Budget of the BAB III Investment funds for the Fiscal Year 1984 - 1985

I T E M	Amount L.E.	Percent
1)		
Food Processing	3,778,000	40.0
Electricity - network expansion	990,000	10.5
Transport 2)	1,500,000	15.9
<u>Utilities</u>		
Public Sanitation	277,000	2.9
City Planning 3)	105,000	1.1
Small Highway Vehicles 4)	200,000	2.1
Public Buildings	200,000	2.1
Water Projects	1,200,000	12.7
BVS (maintenance fund-AID agreement)	-	-
Sub-Total	1,982,000	20.9
Luxor water plant	-	-
<u>Buildings</u>		
Regional Planning	400,000	4.2
Governorate	400,000	4.2
Youth	150,000	1.6
Sub-Total	950,000	10.0
Fire fighting & Traffic Control	230,000	2.5
Feasibility Studies	25,000	0.2
Maintenance Fund (AID for DFS)	-	-
Total	9,455,000	100.0

- 1) Includes dairy plants, dairy cows, poultry food plants, land reclamation and food-related projects.
- 2) Paving rural and urban highways
- 3) Purchase of right-of-way
- 4) Include pickups, minibuses, etc.

Table 12  
GOVERNORATE OF QENA

Expenditure of BAB II funds, Fiscal Years 1983 - 1984, 1984 - 1985.

I T E M	F/Y 1983/1984	F/Y 1984/185
Materials	71,553	77,629
Fuel and Oils	77,371	52,841
Spare Parts	46,288	41,497
Office Supplies	37,704	41,481
Utilities	834,504	1,768,745
Equipment	88,965	50,777
Maintenance	73,368	65,188
Advertising	19,455	16,542
Printing	12,874	16,012
Transportation & Communication	870,832	1,211,907
Current Exchange	50,896	544,657
Miscellaneous	61,874	88,972
Interest	96,041	76,776
Budget.	<u>3,518,348</u>	<u>2,765,895</u>
Total	5,860,073	6,818,919

G. Conclusions: As noted previously in this section the economic and financial implications of the maintenance center program are rather complex. Economic evaluations are difficult to come by because there is no reliable historic procedures for the basic input required, nor is there any future listing of projects and their magnitude to be undertaken in the LD II program. Furthermore, the listings of available equipment at the governorate and local governmental units are far from complete, and the information concerning the inventories of spare parts and their disposition are negligible in some cases. Lastly, financial data are scarce and lacking in detail. Economic analysis based on so many assumptions and interpretations would obviously be open to critical reviews and observations. Therefore, the position can be taken that, assuming the maintenance center program progresses satisfactorily, the benefits accruing to society would be substantial. There is no question that the successful attainment of the projected maintenance centers program would be a highly desirable goal.

The financial problems facing the establishment of the centers can probably be surmounted as LD II funds will be available for constructing and equipping them. The principal problems will be providing adequate management and staff.

As the operation of the centers is expected to be on a commercial basis, net profits are anticipated. Nevertheless, governorates and local units must be prepared to finance the costs incurred in maintaining and repairing their own equipment. This is a planning and budgetary process that has been rather neglected in the decentralization programs to date.

SECTION VIII  
ROAD MAINTENANCE

A. ROAD MAINTENANCE

1. GENERAL

The report is concerned only with the four governorates of Menoufeya, El Sharkeya, Assuit and Kena. The capital cities of the first two are, respectively, Shibin El Kom and Zagazig. In the other two, the capital city has the same name as the governorate itself. All four are in farm areas, two in the Delta region and two, Assuit and Kena, in the relatively narrow Nile valley to the south. The governorates are generally areas of dense rural population with extensive local road systems serving mixed economic activities, agriculture predominating. Principal highways through the governorates are under the jurisdiction of the National Roads and Bridges Authority (RBA), as in the rest of Egypt.

An inventory of all Egyptian roads was made in 1977 as part of the National Transport Study (NTS, Phase II, 1981), reporting totals of 14,922 km of paved highways and 13,644 km of unpaved. The figures for the governorates of interest were:

Governorate	Length of Paved Roads (km)		Length of Unpaved Roads (km)	
	RBA	Other Agencies	RBA	Other Agencies
Menoufeya	193	128	-	852
Sharkeya	351	205	-	1,386
Assuit	237	15	-	605
Kena	362	125	2	741

A later inventory of Menoufeya roads only, made under the AID-financed Basic Village Services (BVS) program, showed 150.5 km of paved road and 814 km unpaved, (1) indicating fairly close agreement on total kilometers of governorate-maintained roads, and the probable upgrading of some 22 km between the two inventories.

Although the BVS program has been underway for several years and has provided assistance to various governorates, it covers other infrastructure in addition to roads, and maintenance plans, with detailed local road lists, have been made for only two other areas (Beni Suef and New Valley).

(1) "BVS Pilot Maintenance Program, Maintenance plan for Menoufeya Governorate," Prepared by Menoufeya Engineering Department/Chemonics Engineering Section, April, 1985.

#### a. COMMON ROAD FEATURES.

Essentially all the governorate roads are in level terrain, and in irrigated farm areas (short sections are within population centers). Therefore, they have certain common characteristics related to maintenance which are almost always present:

- a. The subsoils are fine-grained silts, mixed with clays.
- b. The sub-surface water tables are high, due to irrigation and topography.
- c. The roads are on raised embankments.
- d. There are no gravels or other stabilizing materials near the roads.
- e. The adjacent lands are cultivated or otherwise developed, and have a high value.
- f. Road cross-drainage is fixed and controlled. There is no longitudinal drainage, and therefore no side ditches, except as related to active irrigation.
- g. Vegetation is abundant but is controlled or cropped by animals, and does not usually present a problem on the roads.
- h. The climate is dry, with annual rainfall from 13.8 mm to zero.

On the negative side, these common factors indicate that the embankments will be subject to consolidation and distortion over time. The cost of maintaining a good paved surface will rise rapidly a few years after construction, because of settlements and moisture in the subgrades, and pavement useful life will be relatively short before rehabilitation is necessary. One favorable effect is that culvert and ditch maintenance is reduced to a minimum.

The upkeep of gravel surfaces would present fewer problems, since differential settlements would be adjusted automatically in the course of periodic gradings. This would be offset by the comparatively high cost of importing material for spot-regraveling and for re-surfacing at intervals of several years. (In Menoufeya it was stated that pavement and base aggregates are brought from the Giza area; the other three governorates have closer sources).

#### b. SURFACE TYPES.

All road surfaces are commonly classified as paved, gravel or earth. Apparently, there is very little gravel road in the farm areas of the governorates of interest. A few examples were observed in field trips, but may have been in delayed preparation for paving.

##### (1) Paved:

In the four governorates and, in fact, in Egypt overall, "paved" means asphalt surfaced. The amount of rigid pavement (cement concrete) is insignificant. Furthermore, the asphalt pavements are always asphaltic concrete, that is, plant hot-mix, machine-laid. There apparently are no asphalt surface treatments, emulsion mixes, or other intermediate types. This is somewhat surprising, since the lighter pavements could presumably be built at lower cost and, if properly designed and constructed, should be satisfactory for medium traffic volumes.

The asphaltic concrete (A.C.) roads observed in the governorates were two-lane, generally six and seven meters in width, and usually with unpaved (soil) shoulders. Most were in fair condition and appeared to be less than 10 years old. Some isolated sections were more deteriorated, and in need of heavy maintenance or rehabilitation. Very little surface maintenance was noted. There were no seal-coated surfaces seen in these limited field trips, although one governorate road engineer said that he has done seal-coating, and with stone chips (not sand cover).

Distortions of the A.C. pavements were often present, obviously caused by uneven settlement of the embankments. From a maintenance point of view it is apparent that such costly surfaces should not be placed on poor subgrades, because the only satisfactory way to keep a good running surface as warping occurs is by placing asphalt leveling overlays which may average four or six centimeters in thickness. These will cost as much as a new wearing course but will not strengthen the pavement for additional heavy traffic, since there is no reinforcement over the high spots. Neither will the leveling overlays cure the problem permanently, until all significant settlement has taken place. Before base and pavement layers are built, basement soils and roadway prisms should be adequately compacted for the full width, including sufficient shoulder width, if later maintenance costs are to be kept within normal limits.

#### (2) Gravel:

Although not much in evidence, this type of surface should be mentioned because it is a standard type which has its place in all road systems. Good natural gravels should be available within reasonable haul distances of three of the governorates of interest, though not, perhaps, for Menoufeya. Gravel surfacing will withstand truck loads much better than earth roads, and are a good compromise in areas where truck access is important but asphalt paving is not economically justified. Even when eventual paving is planned, gravel can serve as an interim surface for several years while embankment consolidation takes place, although this is not a substitute for adequate compaction.

#### (3) Earth:

Most of the natural-surfaced roads observed were silt-clay or fine sand-clay combinations, either natural or blended. These can be expected to develop looseness and powder holes in some circumstances, for example when the clay content is low and the roads are used by heavy trucks, and carts or wagons with narrow wheels. Nevertheless, these roads provide limited access for trucks, if wide enough and, in the unusual climate/groundwater conditions which prevail, may offer much better utility than is normal for the type. Sands and clays should always be available for maintaining fairly good admixtures, and water is at hand everywhere to aid in mixing and shaping the surfaces. Since rainfall is infrequent, they will seldom suffer the great disadvantage of earth roads elsewhere, that they become impassable when soaked because of slipperiness and/or deep rutting.

## 2. MAINTENANCE ACTIVITIES

All roads require maintenance, once they are constructed, to keep them as smooth as is practical for use, and to preserve the investment which has been made. The work which is necessary is related to:

- The travelway
- The shoulders
- Drainage elements
- Embankment slopes
- Bridges and Box culverts
- Traffic service (Mostly signs and pavement striping)
- Emergency maintenance

The special interest of this portion of the IQC report is to identify maintenance activities on the governorate roads which will require mechanized equipment, which will in turn require service and repair, thereby imposing a need for work centers which can do part of this service and repair on equipment.

Some maintenance activities are common to all kinds of roads, for example, the care of the drainage facilities, bridges, and other elements. In identifying activities by different surface types these will only be repeated when necessary.

### a. PAVED ROAD MAINTENANCE:

#### (1) Travelway.

The most important work for all classes of roads is the care of the travelway. For asphalt pavements, this usually consists of patching holes, placing short overlays over deteriorated sections, sealing over all such repairs to prevent raveling, and periodic seal-coating over the whole width and length to renew the surface (at intervals of several years). Reconstruction of short sections (up to 300 meters) may sometimes be needed, as maintenance. Long reconstructions should be engineering projects. If, after several years of use, an asphalt pavement becomes badly warped and uneven, it may be necessary to level up the surface with asphalt (hot mix or cold mix). This is a maintenance operation. If the grade line and cross-section are still satisfactory but the pavement needs reinforcement because of slight cracking or displacement in the wheel paths, then a full-length overlay of uniform thickness (usually 5 cm) can be placed on the whole surface. Such an overlay can also be placed over the leveling of a distorted pavement in a full rehabilitation, but in both cases the uniform-thickness overlay is usually classed as additional investment, not as maintenance.

#### (2) Shoulders (paved roads only).

If the shoulder areas are also paved with asphalt, then their maintenance is about the same as for the travelway. When the shoulder areas are of gravel or earth, it is important that they be graded, about every two years. The main reason for this is to have an even, well-compacted support for the pavement edge, to prevent breakage of the

edge. Other reasons are to keep the shoulder area useful for emergency parking and for avoiding collisions. This is especially important along narrow pavements. The shoulder should be graded to drain away from the pavement edge even in very dry climates, so that water from irrigation, spills or occasional rainfall will not be trapped alongside the paving.

Vegetation may sometimes have to be trimmed or cut from the shoulders and adjacent areas to prevent encroachment on the travelway or the blocking of visibility at junctions.

#### (3) Drainage.

This normally consists of ditch-maintenance and the checking and cleaning of culverts. Under the existing conditions in the four governorates of interest, this activity will be minimal, although some work may be needed at irrigation cross-drainages and other sites.

#### (4) Embankment slope maintenance.

The need here is to preserve the stability of the roadway prism. In general, the side slopes appear to be too steep for the characteristics of the embankment soils, which will probably cause gradual subsidence of the prism and distortion of the roadway surface. Considerable maintenance effort is justified in minimizing these problems on paved routes. Bulk soil and lateral support are removed from the side slopes by:

- (a) Cultivation crowded against the slope.
- (b) Removal of soil for irrigation dikes, walkways and other farm uses.
- (c) Slope failure and settlement.
- (d) Erosion by flow in irrigation ditches and canals.
- (e) Channel cleaning in these waterways, by irrigation authorities and farmers.

The settlement and loss is often so gradual, and so obscured by vegetation, that it is not noted until the roadway surface is affected. It is important to replace material and maintain stable slope angles by whatever methods are available. Pushing up with a crawler tractor is best, where it is possible. Hand methods may be necessary in most cases, but compaction is critical. Loose material dumped on the slopes produces little benefit. When required, slope angles should be maintained by the use of retaining walls, slope facings, channel lining, and other measures.

#### (5) Bridges and Box culverts.

Modern structures of reinforced concrete need little maintenance, except for occasional masonry work and the repair of metal railings. Any wood bridges on minor roads will require new decking at intervals of several years.

(6) Traffic service.

Three classes of signs are helpful or necessary to road use. These are informational (destinations, distances, etc.), cautionary (curve, narrow bridge, etc.) and control (stop, speed limit, and so on). They are less important on minor roads used mostly by local residents, but where they exist they require painting, straightening, and eventual replacement. On major routes with substantial traffic volumes the maintenance of required signs can be a significant cost.

On pavement six meters or more in width, a centering stripe is of great benefit in reducing accidents, particularly at night. Such striping needs to be repainted every two or three years, depending on traffic and other conditions.

(7) Emergency maintenance.

This is mentioned only in passing since there are few circumstances in the governorates which would cause road emergencies. However, from time to time there may be collapsed bridges, flooding from blocked irrigation conduits, severe accidents requiring clearing of the roadway, and other problems. Road maintenance forces and their equipment are often called on to help in these circumstances.

b. GRAVEL ROAD MAINTENANCE:

(1) Travelway.

Grading is required to remove corrugations and rutting, and to redistribute coarse material thrown to the sides and, on wider roadways, to the center. On routes carrying around 100 vehicles per day (AADT) this should be done about every four to eight weeks. In the subject governorates, watering prior to grading will improve results. On gravel roads not scheduled for future paving, the fines lost through the action of traffic and wind should be replaced every two or three years, using silty-clays to bind the coarser gravel particles in place. The re-mixing will be aided if the grader is equipped with scarifier teeth, and compaction with a roller gives a better surface. Under normal conditions, the gravel mixture is lost at a rate of one or more centimeters per year, and must be replaced (added to) at intervals of several years, in lifts of 10 cm to 15 cm.

(2) Shoulders.

Gravel and earth roads are not usually considered to have shoulders, even though most traffic avoids the outer edges of the embankment and establishes a "travelway" in the middle portion. In grading, material is first pulled in from the edges and then crowned slightly in the center.

### (3) Other activities.

The maintenance work for the care of drainage, embankment slopes, bridges, signs and in emergencies is about as described for paved roads, normally in lesser amounts.

### c. EARTH ROAD MAINTENANCE.

#### (1) Travelway.

Grading is again required, to re-shape the surface for traffic. For AADT volumes of 30 to 50, grading should be done every three or four months. A normal minimum would be twice per year. Careful watering will be helpful in reworking and crowning the roadway, as in the case of gravel, but rolling would not be justified or advisable. Very narrow earth roads (four meters or less) might present problems even for graders, and agricultural tractors with front blades or drag blades might be preferable for working such roads.

Earth surfacing is also lost to traffic and wind, and will have to be added to periodically. This should be selected (sand-clay proportion) to give the best practical stability when dry.

#### (2) Other activities.

Drainage, slope, bridge and sign maintenance will again be necessary, in declining amounts. Embankments may be lower than for paved and gravel roads, requiring less attention. Bridges and signs may be absent altogether.

### 3. MAINTENANCE QUANTITIES AND COSTS.

Specific maintenance programs can only be drawn up when there are good inventories of the existing roads, including lengths and widths by surface type and the age and condition of pavements. Other data is also needed on traffic, sources of materials, and so on. However, generalized average annual costs per kilometer can be estimated.

#### a. ASPHALTIC CONCRETE PAVED ROADS.

##### (1) Travelway.

These high-type surfaces will normally show little distress in the initial years of use. After four or five years, increasing amounts of hole patching and short, leveling overlays will be needed, rising rapidly after about ten years. Assuming an average age of eight years, and keeping in mind the physical conditions and probable standards of construction in the governorates, it is believed that the annual rate of hole patching should be about 0.09% of the travelway area, and the rate for leveling overlay about 1.50%. If the average pavement width is 6.5 m, this will result in 5.85 m<sup>2</sup> of hole patching and 97.5 m<sup>2</sup> of leveling overlay per kilometer per year.

Hand methods are indicated for this modest amount of hole patching, using hot mix or cold mix patching material. The cost is estimated to be about 8.00 Egyptian pounds (L.E.8.00) per m<sup>2</sup>, or L.E. 46.80 per km per year. (2)

All patches and short overlays areas should be sealed over with a hot bitumen and crushed stone chips, to prevent raveling, within a few days or weeks after the repair. Usually, the area of hand sealing over hole patches should be about 50% larger than the area of the patch and the sealing over the short overlays about 5% larger than the overlay area, to insure covering the edges and ends of the overlays. It is assumed that the bitumen will be shot with an asphalt distributor truck or an asphalt heating kettle with a spray bar on the overlays. The average seal areas for the two types would then be 8.78 m<sup>2</sup> and 102.38 m<sup>2</sup> per km. At a uniform estimated cost of L.E.1.50 per m<sup>2</sup>, the annual cost would be L.E.166.74 per km.

Regarding periodic, full-width seal coating, or surface dressing, there is some question of whether this maintenance activity is justified in the dry-climate areas of Egypt, since one of its primary purposes, to seal against water penetration, is not pertinent. It is not a regular practice of RBA at present. However, seal coating also helps to prevent loss of pavement thickness due to wear and to reduce accidents by providing a better non-skid surface. Therefore, it is recommended that the work be included for the paved roads of the governorates.

The formal policy of RBA (3) states that seal coating "...may become necessary in intervals of 6-10 years...". This is in agreement with normal practice for similar conditions. If a cycle of eight years is assumed for a group of pavements of varying age, then the cost can be pro-rated at one eighth per year. The seal area should be about 2% greater than pavement area, to make sure that the edges are covered by a normal triple-lap nozzle spacing on a spray bar. This would give 6,630 m<sup>2</sup> per km for an average width of 6.5 m, or 828.75 m<sup>2</sup> per year pro-rated. The work is estimated to cost L.E.0.75 per m<sup>2</sup>, or L.E.621.56 per km annually.

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(2) All prices are financial costs (not economic costs) and are estimated as of May, 1985.

(3) "Maintenance policy", Ministry of Transport, Authority of Roads and Bridges, July, 1985.

As stated previously, the maintenance reconstruction of short sections may sometimes be necessary in the later years of pavement life, but a quantification of such work will not be estimated here, nor that of general rehabilitation after 10 or 15 years.

(2) Shoulders.

By observations, the shoulders along paved routes in the governorates are usually earth or gravel. Grading is assumed to be necessary every two years, adding about 6m<sup>3</sup> per km of soil to make up material lost to shoulder traffic of different kinds. It is estimated that a work crew can reshape the shoulders (both sides) on about 3 km per day, at a cost of around L.E.615 per crew day. (4) Most of the cost is for 8 hours of grader time at L.E.35 per hour, 8 hours use of a small dump truck at L.E. 15 per hour, and 4 hours water truck time, also at L.E.15 per hour. The grader operator (8 hours) and truck drivers (12 hours total) are assumed to earn about L.E. 1.04 per hour each, and two laborers L.E.0.33 per hour. The soil is estimated to cost L.E.0.70 per m<sup>3</sup>, loaded, from some convenient source.

Dividing the L.E.615 by 3 (km per day) and further by two (for the 2-year cycle) indicates L.E. 102.50 per km annually.

(3) Drainage maintenance.

A small labor crew with a pickup truck and driver/crew-leader should do all necessary culvert and ditch care on five km of road length per day:

8 hours pickup truck	@ L.E. 5.00	= L.E. 40.00
8 hours driver	@ L.E. 1.04	= L.E. 8.32
32 hours labor	@ L.E. 0.33	= L.E. 10.56
		-----
	Subtotal	58.88
	Overhead @ 25%	= L.E. 14.72
		-----
	Total	= L.E. 73.60
Annual, per km (x 0.2)		= L.E. 14.72

- 4) All crew-day costs, and unit prices in general, are intended to include overhead costs equalling 25% of other costs, to cover maintenance inspections, engineering services, and other administrative.

(4) Embankment maintenance.

Whether the work consists of restoring earth slopes, or repairs to rip-rap, walls or other, it is assumed that one crew-day per km annually will be adequate for this activity:

8 hours small dump truck @ L.E. 15.00 =	L.E. 120.00
8 hours driver @ L.E. 1.04 =	L.E. 8.32
8 hours Mason/Foreman @ L.E. 0.83 =	L.E. 6.64
48 hours Labor @ L.E. 0.33 =	L.E. 15.84
5 m <sup>3</sup> soil (or equivalent value, other matls) @ L.E. 0.70 =	L.E. 3.50
	-----
Subtotal =	L.E. 154.30
Overhead @ 25% =	L.E. 38.58
	-----
Annual, per km, Total =	L.E. 192.88

(5) Repair of bridges and other structures.

Assuming one structure in every 10 km and one crew-day per km on each once a year, the approximate cost would be:

8 hours pickup truck @ L.E. 5.00 =	L.E. 40.00
8 hours driver @ L.E. 1.04 =	L.E. 8.32
8 hours Mason or Welder @ L.E. 0.83 =	L.E. 6.64
32 hours labor @ L.E. 0.33 =	L.E. 10.56
Lump sum materials	10.00
	-----
Subtotal =	L.E. 75.52
Overhead @ 25% =	L.E. 18.88
	-----
Total =	L.E. 94.40
Annual, per km (x 0.10)	= L.E. 9.44

(6) Traffic services.

- (1) From examination of the numbers and costs of signs typical for Egyptian secondary roads, it is believed that upkeep and replacement of signs on the paved roads of the governorates will cost about L.E. 90 per km annually.
- (2) Centerline striping (every third year) is also estimated as a lump sum per km per year. Using cost information from the Cairo-Assuit Feasibility Study the figure adopted is L.E. 80.00
- (3) Total annual per km for traffic services = L.E. 170
- (7) Emergency maintenance.  
Not estimated for this report.

(8) Summary, governorate paved road maintenance.

Travelway	L.E. 1,078.85
Unpaved shoulders	102.50
Drainage maintenance	14.72
Embankment	192.88
Structures	9.44
Traffic services	170.00
	-----
Total	L.E. 1,568.39
Total annual maintenance, cost per km, rounded	L.E. 1,570.00

b. GRAVEL ROAD MAINTENANCE.

(1) Travelway.

The activities are assumed to be grading every six weeks (9 times per year), and the addition of 15 cm (compacted thickness) of replacement gravel every 10 years, with the latter pro-rated to an annual cost. The total roadway width is taken to be seven meters, requiring five passes in normal grading and the completion of about six km per day. The regravelling quantity would be 1,050 m<sup>3</sup> per km, and a work crew with a grader, loader, roller, water truck and 5 small dump trucks should place about 125 m<sup>3</sup> per day (compacted), requiring 8.4 crew-days per km every 10 years.

(a) Grading.

8 hours grader	@ L.E. 35.00 = L.E. 280.00
8 hours water truck	@ L.E. 15.00 = L.E. 120.00
8 hours grader operator	@ L.E. 1.04 = L.E. 8.32
8 hours driver	@ L.E. 1.04 = L.E. 8.32
8 hours labor	@ L.E. 0.33 = L.E. 2.64

Subtotal = L.E. 419.28  
 Overhead @ 25% = L.E. 104.82

Total L.E. 524.10  
 L.E. 786.15

Annual per km = 9/6 or x 1.5 =

(b) Periodic regravelling.

8 hours grader	@ L.E. 35.00 = L.E. 280.00
8 hours loader	@ L.E. 50.00 = L.E. 400.00
8 hours roller	@ L.E. 20.00 = L.E. 160.00
40 hours dump trucks	@ L.E. 15.00 = L.E. 600.00
8 hours water truck	@ L.E. 15.00 = L.E. 120.00
72 hours operators/drivers	@ L.E. 1.04 = L.E. 74.88
16 hours labor	@ L.E. 0.33 = L.E. 5.28
144 m <sup>3</sup> pit-run gravel (loose)	@ L.E. 6.00 = L.E. 864.00

Sub total L.E. 2,504.16  
 Overhead @ 25% = L.E. 626.04

Total = L.E. 3,130.20  
 L.E. 2,629.37

Annual per km = 8.4/10 or x 0.84 =

(2) Other activities.

Drainage care is assumed to cost about the same on gravel roads as for paved routes, embankment maintenance about two thirds because of lower fills, bridge repairs one half of that for paved, and sign maintenance maybe L.E. 60 per km.

(3) Summary, gravel road maintenance.

Travelway	L.E. 3,415.52
Drainage	14.72
Embankment	128.65
Structures	4.72
Signs	60.00
	-----
	L.E. 3,623.61

Total annual maintenance cost  
per km, rounded L.E. 3,620

c. EARTH ROAD.

(1) Travelway.

The activities are taken to be grading three times each year, and adding soil or clay every third year to maintain reasonable stability, again pro-rated to annual. The width is assumed to be five meters, requiring only three passes with a grader, but the yield is still only about seven km per day because of poor alignments and other difficulties. The addition of new material every third year is assumed to average 2 cm or 100 m<sup>3</sup> per km, added where needed and mixed into the top ten centimet of the roadbed. A work crew should complete about one km of road length day.

(a) Grading earth surface.

8 hours grader	@ L.E. 35.00 =	L.E. 280.00
8 hours water truck	@ L.E. 15.00 =	L.E. 120.00
8 hours grader operator	@ L.E. 1.04 =	L.E. 9.32
8 hours truck driver	@ L.E. 1.04 =	L.E. 9.32
8 hours labor	@ L.E. 0.33 =	L.E. 2.64
		-----
	Subtotal =	L.E. 419.28
	Overhead @ 25% =	L.E. 104.82
		-----
	Total	L.E. 524.10
Annual per km = 3/7, or x 0.43 =		L.E. 225.36

(b) Addition of material.

8 hours grader	@ L.E. 35.00 =	L.E. 280.00
8 hours water truck	@ L.E. 15.00 =	L.E. 120.00
24 hours dump trucks	@ L.E. 15.00 =	L.E. 360.00
40 hours operators/drivers	@ L.E. 1.04 =	L.E. 41.60
16 hours labor	@ L.E. 0.33 =	L.E. 5.28
100 m <sup>3</sup> sand/clay (loaded)	@ L.E. 0.70 =	L.E. 70.00
		-----
	Subtotal =	L.E. 876.88
	Overhead @ 25% =	L.E. 219.22
		-----
	Total	L.E. 1,096.10
Annual per km = x 0.33 =		L.E. 361.71

(2) Other activities.

Drainage care should cost less than that for higher-type roads, perhaps one-half, embankment maintenance around one-third that for paved routes, bridge repairs one-quarter, and sign upkeep again one-third.

(3) Summary, earth road maintenance.

Travelway	L.E. 587.07
Drainage	7.36
Embankment	64.29
Structures	2.36
Signs	30.00
	-----
	L.E. 691.08

Total maintenance cost per km, rounded, L.E. 690

d. COMMENTS:

It should be understood that the foregoing estimates of maintenance costs are based on incomplete information and are, therefore, approximate. Real costs will also vary according to traffic volumes, road standards, and other factors. It is believed that all major items of cost have been taken into account.

It should also be apparent that funds may not be available for adequate maintenance of the governorate roads. That circumstance is fairly common. When roads are constructed but not well-maintained they deteriorate, usually becoming rougher, and some part of the expense, or perhaps a multiple of it, is transferred to the general economy in the form of higher vehicle operating costs and interruptions in traffic.

## R. MAINTENANCE METHODS AND EQUIPMENT.

### 1. Vehicle and road development.

The first 50 years of the motorized vehicle showed constant increases in size, weight, power and speed. This was true for passenger cars and was even more pronounced for trucks. Happily, the trend for car size and speed moderated somewhat in the last two decades, but still the value of time impels people to drive their vehicles as fast as conditions will permit.

Faster speed caused the development of better highway and street surfaces. The improvement was achieved not by introducing new materials (although some of the old ones were abandoned) but by changing construction methods. Better preparation and mixing of paving materials helped, but the most important factor was the invention of machines to lay pavements in a continuous ribbon, for greater smoothness.

### 2. Labor-intensive maintenance versus mechanized.

Maintenance of the surfaces has followed the lead of construction in trying to preserve smoothness. It is demanded by the users of highways and streets, and it is important in minimizing vehicle operating costs, closely related to tariffs, fares, and fuel consumption.

These observations seem almost completely unrelated to the maintenance of roads in four governorates of Egypt, but they are related. The highly-developed vehicles that have led to the improved construction and maintenance methods operate on most of the road systems of the world, including Egypt's. In fact, it is difficult to buy vehicles that are suited to poorer roads and slower speeds. Those that are suited, such as military units, generally carry a high price for purchase and use. There is a need for maintenance standards to be in step with the characteristics of the vehicles which use the roads.

This presents some hard choices for developing countries. When population growth is strong there is often a surplus of labor, and a need to employ it productively. Labor-intensive methods have to be considered in all economic activities, and public sector employment is a special target. However, when hand methods are chosen to increase labor utilization and reduce the foreign component of costs there is often a trade-off in product quality. This applies to road maintenance as much as to textile finishing or steel-making.

There are nations today where the pressure of unskilled labor is so great that road maintenance is done almost entirely by hand, at least on the secondary road systems, but including the maintenance of asphalt pavements. Gravel and earth roads are graded by manual labor, sometimes using templates to guide the work. Stone aggregates for base repairs, patching mixes and surface dressings are broken and screened by hand. Bitumens are heated in half-drumms over open fires and poured from smaller vessels, or mixed with aggregates in batches of half a cubic meter or less. Other pavement types like brick or cobble are also used because they not only can be built and repaired by hand, but must be.

It is astonishing to see what can be done by these methods, and the results are certainly adequate for basic access and transportation. However, they are not equal in either smoothness or durability to surfaces constructed by machine methods. The comparative roughness is evident even at very moderate driving speeds, and the imperfections in construction, the variations from meter to meter along the road, lead to earlier maintenance and more maintenance. No matter how much care is taken in hand-grading unpaved surfaces, the results are never as good as those obtained by a modern grader with its long wheel base and its weight and power. Seal coats made by pouring bitumen and casting stone chips are not as uniform as those placed with good mechanized equipment, and they have to be repeated more often. It is worth nothing that the quantities of materials used each time are the same or even higher for the hand methods.

The degree of mechanization to be used in road maintenance is a matter for government decision. Work descriptions and standards can be written for either mode or any combination. Nevertheless, the only way to achieve surface smoothness and strength consonant with the cars and trucks in use today, in Egypt as elsewhere, is by employing the equipment developed for this purpose. The four governorates of interest have, in fact, already acquired many, perhaps most, of the machines necessary for road maintenance, and have access to other machines through rental or contract work. It is presumed here that labor methods should be used to the greatest practical extent, but that the maintenance of governorate roads will be generally mechanized in its methods, and therefore will be equipment-intensive. This implies that the best possible use of equipment is important, and that facilities should be provided for the service, adjustment and repair of the machines, in addition to training in their operation.

### 3. Equipment identification.

#### a. Asphalt pavement maintenance:

- (1) The patching of potholes is a manual operation. It consists of trimming away the failed pavement to sound edges, and excavating any base material which is unstable. If the pothole has been caused by water seepage or some other obvious cause, then that condition has to be corrected before proceeding. Naturally, this hole preparation is much easier with an air compressor and an air driven paving breaker (not a jack hammer) with the ordinary insert tools; cutting spade, moil point and tamping foot. The tamper also saves much labor in constructing the patch as this lifts of base material (if needed) and the final patching mix are compacted in place. However, most hole preparation around the world is done with pick and shovel, and the patches hand-tamped. Compressors are not used except when labor costs are high and the work is concentrated; that is, when there are many potholes close together.

Whether trimmed by hand or with air tools, there is no advantage in cutting the holes to a rectangular shape, a common but mistaken practice. Trimming square holes takes more time, more material is required for the patch, and compaction is more difficult in the square corners.

There are mobile units available to speed the patching process; truck-mounted packages with small compressors and materials storage, small portable hot-mixing plants, special units to shoot emulsion-aggregate mixes into the holes, and others. None seem to have any wide acceptance. A better strategy in pavement maintenance is to patch small holes quickly, within a few days after they appear, and not wait for the development of concentrations of work. If the holes are few and far apart there is no justification for driving or pulling special units or compressors long distances to make occasional small repairs. For the limited paved roads of the governorates, hand methods will be best. When the need for limited patching is identified by frequent maintenance inspections, two men with a pickup truck, hand tools and small quantities of tacking bitumen and patching mix can do the work adequately, without special equipment.

There is a question of how patching mix should be prepared for maintenance; whether small plants are necessary for this task. According to the NTS inventory of 1981, the governorates of interest have from 15 to 205 km of pavement each. If the 205 km in Sharkeya have the average rate of hole development estimated earlier (0.09%) and the 6.5 m average width, then the total annual patching area will only be about 1,200m<sup>2</sup>. Assuming a thickness of 8 cm (before compaction) this would require 96m<sup>3</sup> of patching mix. Even adding the larger quantity for short maintenance overlays (discussed below) with a loose average thickness of around 5 cm, or  $6500 \times 205 \times 0.015 \times 0.05 = 999\text{m}^3$ , the total annual requirement is only 1,095m<sup>3</sup>. The quantity for the 15 km of pavement inventoried in Kena governorate would be 80m<sup>3</sup>. It is doubtful whether even the 1,095m<sup>3</sup> would justify the acquisition of any size plant, for maintenance alone, since the work would be spread through-out the year. Quantities of this order should be obtained from REA plants, or contractors.

The foregoing assumes that hot-mix would be used for all surface repairs. Hot-mix is generally preferable, despite its limited working time before cooling, but cold mixes made with liquid bitumens (medium-curing or slow curing cutbacks) are satisfactory for the work, and can be stock-piled for weeks or even months. They offer greater freedom in scheduling work, and can be mixed in most plants (with care and adjustment) in pugmills, on grader circles or, in small quantities, with a loader.

It was mentioned earlier that short maintenance overlays are best done with a grader. In fact, graders are needed in various activities and should be on any list of basic maintenance equipment. Steel-drum rollers are also required in different maintenance operations. Even when labor-intensive methods are dominant, rollers have to be provided for the compaction and finishing of road materials. Pneumatic (rubber-tired) rollers have advantages in some circumstances, but are not absolutely essential. Steel-wheel rollers cannot be dispensed with. If such rollers have a vibratory capacity they will speed up some operations but, in most maintenance work, they will be operated in the static mode. Small walk-behind

but motor-driven rollers are useful when there are large amounts of hand patching to be done, but are probably not justified for any governorate.

- (2) Hand sealing over patches requires a hot bitumen sprayed, or poured and spread, over and beyond the patch, plus a hand-cast cover aggregate of stone chips (or coarse sand), and tamping. Providing the hot bitumen is a problem for scattered work. When justified by the quantity of patching, the usual solution is the trailer-mounted asphalt heating kettle with kerosene burners and a small gasoline engine with pump to supply pressure for a single hose and hand spray-nozzle. These kettles have a rather narrow range of uses and are not really suitable for sealing areas of any size, such as leveling overlays, but are often used for the purpose in the absence of anything better. Hand-casting the cover material with shovels is not a problem even for sizeable areas.

Setting the aggregate by hand-tamping is normal for patches, or by rolling with truck tires for slightly larger areas. These methods are tedious for overlays, but often preferable to moving a roller long distances between separated work sites.

- (3) Periodic seal coating:

The only satisfactory way of doing full-width sealing for long distances is by the use of an asphalt distributor truck and a mechanical aggregate spreader. The work is moderately expensive and unless good results are assured the expense is wasted or, worse, can result in streaked or bleeding pavement surfaces. Rolling is necessary immediately after the cover material is spread. Power-brooming is often needed as preparation. Because sealing is only done at intervals of several years it will be better for the governorates, with their limited paved networks, to contract this work rather than own the special equipment. Alternatives would be to have sealing done by RBA, if feasible, or for two or more governorates to share the cost and use of a distributor truck. Self-propelled chip spreaders are probably not warranted even for a regional work group. The push-box type which attaches to a dump truck should be satisfactory.

- (4) Shoulder grading:

This applies only to unpaved shoulders along paved travelways. The equipment needed consists of a grader, a water truck in some circumstances, a small dump truck (5m<sup>3</sup>) to haul make-up material if required, and a roller, at times. Normally, the grader tires will give adequate compaction at the pavement edge, where it is most necessary.

- (5) Centerline striping:

Hand painting is not satisfactory for lengths of more than a few meters. A wide variety of special machines are manufactured for this work, of all sizes. Again, contracting, or arranging the work with RBA, or a regional grouping for ownership may be the best choices. Otherwise, acquisition should be limited to the walk-behind types of striping machines, or the smallest and simplest self-powered units.

#### b. Embankment maintenance:

As mentioned, slope repairs on rural highways are often done with dozers, but that is probably not a feasible method in the intensely farmed areas of Egypt. Working the slopes from the top will involve hand labor, with a dump truck for bringing in new slope material. For small areas this material can be placed and tamped by hand. In larger amounts (several m<sup>3</sup>) compaction will be faster and better if done with a vibrating-plate tamper. Various models and sizes are available. They are hard to hold on slopes, but rope slings can be used.

If plate tampers are a part of governorate equipment, they are also very useful for compacting asphalt patches, setting seal coat cover materials on small areas, and so on. Gasoline-engined tampers, or "jumping jack" compactors, also have their uses, especially for tamping back-fill in holes and trenches.

When slopes are held with mortared stone facings or retaining walls, their repair may involve the use of powered mortar or cement mixers.

#### c. Drainage upkeep:

This is almost entirely hand work, shoveling out silt deposits or replacing lost materials around headwalls, etc. Once again, repairing masonry or concrete facilities may, if there are large quantities of work, be made easier by using mortar and cement mixers.

#### d. Bridges and other structures:

The decks of concrete structures sometimes develop spalls, or suffer damage to curbsings, and need to be repaired with concrete. More frequently, similar work is needed around piers and abutments. Damage to metal railings is common, requiring acetylene torches for straightening or removing bent sections, and arc welders for joining new pieces in place.

#### e. Signs in general:

All classes of road require at least some signs. The maintenance of these involves cleaning, straightening and repainting sign faces (and posts), and replacing these when necessary. For the governorates, this will usually be hand labor. Ovens for baking on reflective facings and letters might be justified for regional groupings of governorates.

#### f. Grading gravel and earth roads:

This is mostly work for graders, assisted when necessary by water trucks, dump trucks, loaders, and rollers. The nature of the work is obvious, as is the equipment needed.

#### g. General listing of equipment:

The basic tools of road maintenance are the grader, dump truck, rubber-tired loader and steel-drum roller. They are used for shaping surfaces, for loading, hauling, laying out and compacting materials, for mixing combinations of materials, and for special jobs in paving maintenance. Loaders of the 1 m<sup>3</sup>. to 3 m<sup>3</sup> size are a constant necessity. It is true that most cold loose materials can be loaded by hand, but the resulting delays to work crews are often intolerable. Only a limited number of men with shovels can work around a truck bed, and this determines loading time.

In the second rank of essential equipment are pickups, water trucks, agricultural tractors with attachments, and the large flatbed truck or truck-tractor with trailer for moving other equipment to distant work sites, or to haul disabled machines to repair shops. Crawler tractors are needed in pit operations and for other purposes.

Fourth in normal use can be listed the small machines such as welders, water pumps, small compactors, cement mixers, and fork lifts. Behind these come special units like pneumatic rollers, asphalt kettles, chip spreaders, asphalt distributors, mixing plants, striping machines, and so on.

All of the mentioned equipment, and other types as well, can be found in ordinary maintenance fleets. Most of them are already owned by one or more of the governorates of interest. It is a matter of fundamental concern to keep them serviced and in good operating condition.

#### C. EQUIPMENT CARE.

There are various ways of subdividing the different kinds of maintenance needed to keep machines going. one categorization is:

- The supply of fuels, lubricants, tires and other consumed items.
- Servicing and adjustment.
- The repair of components.
- Rebuilding.

##### 1. Consumed supplies:

- (a) Fuels and lubricants have to be available for the operation of most equipment, and other petroleum products as well. This includes gasoline of the proper grade, diesel fuel, oils, greases, kerosene, hydraulic fluid, and special fluids for brake systems, transmissions, and power steering. Glycol coolants may be required. Manufacturers specifications are important. All of these must be kept free from contamination, mixing and loss. Fuels especially have to be stored so that condensation water can be removed.
- (b) Tires are a normal wear item. Most maintenance organizations will keep the most-used sizes on hand, and depend on commercial suppliers for the others. Ordering well in advance of need may be necessary.

(c) Wear parts.

Graders, loaders, dozers and some other machines have replaceable cutting edges, and often corner bits as well. The most used items should be kept in stock; grader edges wear rapidly in some conditions and, if not replaced in time, the wear will continue into the moldboard itself, removing the support for the replaceable edge and finally requiring an entire new moldboard, at high cost.

(d) Naturally, there are other items which are also consumed, e.g. brake linings, but most are considered under other kinds of equipment maintenance.

2. Service and adjustment:

This includes the changing of oils, transmission fluids, etc., and especially the servicing or replacement of filter elements intended to remove contaminants from fluids, dust and sand from air intake systems, and abrasive particles caused by metal wear in engines. Dry filter elements are sometimes expensive and there are numerous types and sizes which have to be stocked, but attention to this according to fixed schedules is critical.

Adjustments can usually be done with hand tools, though some of the tools may be special. Items requiring adjustment include clutch and brake clearances, steering, throttle linkages, hydraulic pressures and many others.

3. Repair of components:

In the machines of an ordinary maintenance fleet there are literally thousands of parts which can wear out, break, or become damaged. It is this category which occupies most of the time of mechanics. Engines, drive trains, frames, electrical, hydraulic, water and air systems all wear, fail and rupture. For a mixed fleet of equipment, there are hundreds of thousands of specially designed and fabricated parts which have to be in a stock bin somewhere, if the machines are to work out their useful lives. This is a huge problem, one which exists even in developed countries where equipment is manufactured. The problem simply has to be accepted. Parts are normally held at three or four different levels: the point of use of the machines, field offices of the fabricators or their sales representatives, and home and regional warehouses of the manufacturers, which can also draw from the fabricators of sub-assemblies. These arrangements work fairly well for highly standardized items such as wheels, and for certain popular engines in wide use. Even bearing assemblies, in their great variety, are made by a limited number of companies and built into many different types and makes of machines. The difficulty lies in the special components like one-company transmissions, ancillary drives and controls, pumps, valves, and a great variety of heavy sub-assemblies and small special parts.

A common practice has been to import, with each machine, spare parts amounting to 20% or 25% of the machine cost. This has been helpful, but not generally satisfactory. It results, universally, in parts being lost while waiting for use (sometimes years), and in warehouses full of dead parts which must be stored, carried on books or lists for long periods, and finally disposed of when they have no resale value. A better system would be to hold a major part of the funds for the purchase of specific parts when needed. It is recognized that there would be serious complexities in such a system, like holding the funds unmixed for long periods and in arranging for customs clearances when the parts are needed.

Equipment managers and mechanics often long for the days when machines were simpler and, as an example, a gear-type transmission could be taken apart in almost any shop, inspected, and re-assembled with a couple of new gears or perhaps only some standard bearings or lathe-turned bushings. Maintenance of equipment was certainly easier when the machines were less complex but, in fact, the growth in complexity has almost always made the machines more useful in their work. The increase in work efficiency of instant-shift torque converter transmissions over old manual gear boxes is astounding when viewed in operations. Hydraulic systems have revolutionized graders, power shovels and other machines, and have led to the development of highly useful equipment which didn't exist before.

The repair of components is the key to equipment maintenance, and spare parts are the key to repair. Of course, machines also consist of frames, mountings, and simple shafts and housings which can be welded, straightened, or modified by mechanics with ordinary facilities. Increasingly, however, successful repair depends on the use of specific spare parts from the manufacturer. "Remove and Replace" used to be a derogatory term among mechanics but, more and more, repair consists of replacing sealed pumps, regulators, multiple valve blocks, and large or small assemblies which must be either discarded because of any internal defect, or sent to special shops with tools and facilities for working with close tolerances, high pressures, exotic welding and other uncommon techniques, plus means for rigorous testing before an assembly is returned for use.

#### 4. Rebuilding:

It has always been true that the general renewal of whole machines or major sub-parts was a matter for large shops. The classic example is engine rebuild. Grinding valves in middle-sized gasoline engines is feasible even for field shops. Re-boring the cylinders of such engines is no big problem. Regrinding crankshafts is another matter entirely, and the rebuilding of large diesel engines is only possible in major shops with the right facilities. The same is true for crawler tracks, grader circles, and other major parts or whole machines. It is often economical to rebuild rather than acquire new equipment, but it is usually necessary to have the work done by central shops at state or national level, or by a commercial service of a manufacturer.

#### D. ASSIGNMENT OF EQUIPMENT CARE:

##### 1. Fuels, lubricants and other consumed supplies:

It is obvious that fueling equipment and adding make-up lubricants should be under the control of the entity which uses the equipment. Even if commercial outlets are the source of some fuels and other supplies there must be administrative arrangements through which they can be bought without delays. Tires of small and medium size should be stocked and changed when necessary by the operating agency, although mounting large tires, as on loaders and graders, may have to be done by others. The using agency should have grader cutting edges and the necessary plow bolts on hand, plus some other wear parts, and replace them in their own yards when possible.

##### 2. Service and adjustment:

This should also be in the hands of the operating agency, since it is an almost daily requirement. Minimum stocks of filter elements should be on hand. Mechanics have to be available, with the hand tools necessary, for normal, frequent adjustments. Equipment operators need to have a few basic tools, plus grease guns for any daily lubrication which is needed at the sites of work.

##### 3. Repair of components:

It is desirable to have the highest feasible repair capability under the control of the operating agency. Here it is necessary to compromise with reality, because the costs of having mechanics, parts, shops and tools constantly available is high. The provision of repair facilities has to be adjusted to the numbers of equipment units and the importance of the work they do. Nevertheless, all modern equipment is expensive, and down time means that no benefit is being obtained from the investment. Furthermore, the machines often work in teams (load, haul and place) and one unit out of service may stop all the rest. Considerable effort and expense is justified to insure that equipment is repaired early and put back in use. If good repair services can not be provided at the primary (operating) level, it is to be hoped that skills, parts and auxiliary needs will be within reach when major pieces of equipment are out of service.

##### 4. Rebuilding:

This, obviously, is work to be assigned to central shops or equipment suppliers. Nevertheless, in the interest of economy in owning and using road maintenance equipment, rebuilding services have to be back there somewhere in the chain of equipment repair.

#### E. GOVERNORATE WORK CENTERS.

As a pilot program, it is proposed to furnish work centers in the four governorates of interest, with modest initial facilities for the maintenance of road equipment, water supply systems, and other

infrastructure. This paper has discussed the kinds of equipment normally used in partially mechanized road conservation, and the care of such road equipment. It remains to consider the physical and technical requirements of governorate work centers, related only to the road maintenance equipment.

#### 1. Space and Other Physical Needs.

a. A first consideration is location and access. Naturally, it is desirable to have the operating equipment parked at or near the administrative center which schedules the actual work of the men and equipment. This managerial access should be as good as possible, but it is often impossible to provide enough space near general government offices. A reasonable alternative is good telephone service and an acceptably short driving distance for written messages, signed documents, and so on. Work centers should be on principal paved roads, and preferably somewhere near the centroid of the road system to be maintained, or at least well-connected to all parts of it. The direct entrance to the work center site, from the public road or street, must be reasonably level and wide enough so that graders and other long or towed vehicles can turn in without serious traffic conflicts. Walls or fences on the front line of the site should be beyond the radius of such turns, and the gate opening wide enough for large vehicles or loads. Steep grades up on to the public street or road should be avoided, and sight distances left and right must be good enough so that heavy equipment leaving the yard can enter traffic without danger.

#### b. Total Size.

An obvious need within the site, facing the entrance, is room for the largest vehicles or combinations to turn around, either in one movement or, if necessary, by maneuver. On the periphery of this turning space should be fuel storage or pumps which can be reached by all vehicles. The mechanic's work area should also be accessible to equipment. In addition, the requirements for extra space include:

- a. Parking for all equipment likely to be in the yard at one time.
- b. Storage for stockpiles of maintenance materials (gravel, asphalt, lumber, culvert pipe, etc.)
- c. Enclosed storage for high-value items like spare parts, tires and batteries.
- d. Space for a minimum amount of disabled equipment.
- e. Space for cleaning large machines, regularly and prior to major repair, at least by hosing and scrubbing. This area should drain away from other work space.

The minimum size to provide for all of these uses is probably 8,000 to 10,000 square meters. Work center responsibilities for other infrastructure might add to the space needs. Room for future expansion should be obtained if possible.

APPENDIX A  
Equipment Lists

Assuit Governorate

Menoufeya Governorate

El Sharkeya Governorate

Qena Governorate

### c. Other Physical requirements.

Telephone service was mentioned as a part of access considerations. Electricity is also essential, plus potable water, and bulk water for several uses.

#### 2. Technical requirements:

If the resources provided to the governorate work centers are intended only for fueling, oil changes, filter changes and mechanical adjustments, then hand tools and simple facilities will be sufficient for most circumstances. On the other hand, in the very broad range of activities called for under component repair, there is an almost unlimited list of tools, shop equipment and facilities which might be needed. They are listed in some detail below without any implication that they should all be acquired by the governorates, now or in the future, or that they constitute a recommended list for shops at any level. It should be noted, however, that if modern road maintenance equipment, such as that now owned by the governorates, is to be kept in good working order, then most of the items discussed below will have to exist, somewhere, at least in primitive form.

1. Covered work space, lighted, and with provision for portable work lights.
2. Strong, smooth, hard floors in at least part of the work space.
3. Access openings and ceilings high enough for grader cabs and raised dump beds.
4. Strong, metal-surfaced work tables and some work stands.
5. A means for lifting engines and other heavy components out of machines. This can be simple "A" frames and chain blocks.
6. Dollies on which transmissions, bell housings and other heavy items can be lowered and rolled out from under vehicles.
7. Heavy hydraulic jacks for lifting, including rolling jacks for positioning transmissions, etc.
8. Some provision for cleaning parts.
9. Hand tools, in great variety.
10. Shop tools, including drill press, grinder, hydraulic press, vises, bearing pullers, torque wrench, and on and on.
11. Acetylene heating and cutting torches.
12. Electric arc welding equipment.
13. Brake drum lathe.

ASSIUT GOVERNORATE

List of Equipment

Equipment	Markaz and City	Governorate				Assiut				Dirof				Koseia				Manfalot				Abu Teeg				Safa			
		Condition				Condition				Condition				Condition				Condition				Condition							
		O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T
1.	Street Flusher TR.					3	-	3	6	1	-	-	1																
2.	Agriculture TR.					6	4	4	14	6	-	-	6	4	-	-	4	5	-	-	5	4	-	-	4	1	3	-	4
3.	Trailers					4	1	3	8	6	1	-	7	3	-	-	3	4	-	-	4								
4.	Water SPR. TR.					2	-	-	2	3	-	-	3	2	-	-	2	-	4	-	4	4	-	-	4	3	-	-	3
5.	Refuse TR.					18	-	-	18	4	-	-	4	2	-	-	2	3	-	-	3	8	-	-	8	5	-	-	5
6.	Heavy Equipment (G./R.)					1	-	1	2	1	-	-	1					1	-	-	1	1	1	-	2				
7.	Sewage TR.					13	5	6	24	5	1	-	6	4	1	-	5	3	1	-	4	4	1	-	5	3	-	-	3
8.	Ford Jet					4	1	-	5																				
9.	Bucket TR.					3	-	-	3																				
10.	Crane					1	-	-	1																				
11.	Loader					1	-	-	1																				
12.	Heavy Trucks	4	-	-	4	3	2	-	5					1	-	-	1					1	-	-	1				
13.	½ Trucks					9	3	-	12	3	1	-	4					3	-	-	3	2	-	1	3	2	-	-	2
14.	¼ Trucks	9	-	-	9									1	-	-	1												
15.	Passenger Cars	14	-	-	14	2	-	-	2	1	-	-	1	1	-	-	1	1	-	-	1	1	-	-	1	1	-	-	1
16.	Mini Bus	4	1	-	5																								
17.	Jeep	3	-	-	3																								
18.	Fire Trucks																	2	-	-	2					1	-	-	1
19.	Refrigerator																												
20.	Finisher																												
21.	Asphalt Mixers																												
22.	Dozer																												
23.	Dump TR.																												

O = In Operation

U = Under repair

S = Scrapped

T = Total No.

ASSIUT GOVERNORATE

List of Equipment

Equipment	Markaz and City	Sahel Selim				Abnob				Ghenaïem				El Badary				Paving Proj.				Roads&Trans. Department				Housing											
		Condition				Condition				Condition				Condition				Condition				Condition															
		O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T								
1. Street Flusher TR.																																					
2. Agriculture TR.		5	-	-	5	4	2	-	6	1	-	3	4	3	2	-	5	2	-	-	2	1	2	-	3												
3. Trailers						4	-	-	4					3	-	-	3																				
4. Water SPR. TR.		2	-	-	2	4	-	-	4	1	-	2	3	2	-	1	3																				
5. Refuse TR.		8	-	-	8	3	-	-	3	3	-	-	3	2	-	-	2																				
6. Heavy Equipment (G./R.)						1	-	-	1									2	1	-	3	1	2	-	3												
7. Sewage TR.		4	-	-	4	4	-	-	4	2	-	-	2	2	1	-	3																				
8. Ford Jet																																					
9. Bucket TR.																																					
10. Crane																																					
11. Loader																		2	-	-	2	1	-	-	1												
12. Heavy Trucks														1	-	-	1	6	1	-	7	4	-	-	4	2	-	-	2								
13. ½ Trucks		1	-	-	1	4	-	-	4	1	-	1	2					3	-	-	3					14	-	-	14								
14. ¼ Trucks														2	1	-	3																				
15. Passenger Cars		1	-	-	1	1	-	-	1	1	-	-	1	1	-	-	1													4	-	-	4				
16. Mini Bus																																					
17. Jeep						1	-	-	1																												
18. Fire Trucks																																					
19. Refregerator										2	-	-	2																								
20. Finisher																		1	-	-	1																
21. Asphalt Mixers																		1	-	-	1																
22. Dozer																						-	1	-	1												
23. Dump TR.																																					

O = In Operation

U = Under repair

S = Scrapped

T = Total No.

ASSIUT GOVERNORATE

List of Equipment

Equipment	Markaz and City	Live Stock Production				Marketing Department				Quarry				Poultry Production				Total					
		Condition				Condition				Condition				Condition				Condition					
		O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T		
1. Street Flusher TR.																							
2. Agriculture TR.		27	-	-	27																		
3. Trailers		21	-	-	21																		
4. Water SPE. TR.																							
5. Refuse TR.																							
6. Heavy Equipment (G./R.)																							
7. Sewage TR.		1	-	-	1																		
8. Ford Jet																							
9. Bucket TR.																							
10. Crane																							
11. Loader										1	1	3	5										
12. Heavy Trucks		7	2	1	10	7	-	1	8					2	1	-	3						
13. 4 Trucks		13	1	-	14									4	-	-	4						
14. 3 Trucks														7	-	-	7						
15. Passenger Cars		2	1	-	3	1	-	-	1					1	-	-	1						
16. Mini Bus										1	-	2	3										
17. Jeep																							
18. Fire Trucks																							
19. Refregerator		2	-	-	2																		
20. Finisher																							
21. Asphalt Mixers																							
22. Dozer										1	-	-	1										
23. Dump TR.										2	-		2										
Grand Total																				437	50	34	521

O = In Operation

U = Under repair

S = Scrapped

T = Total No.

List of Equipment

Equipment	Markaz and City	Berket El Sabh				El Bagor				El Shohada				Menouf				Talla				Ashmoon				Sers Elian			
		Condition				Condition				Condition				Condition				Condition				Condition							
		O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T
1.	Street Flusher TR.																												
2.	Agriculture TR.	2	-	-	2					2	-	-	2	5	-	-	5	5	-	-	5	5	-	-	5	1	-	-	2
3.	Trailers																												
4.	Water SPR. TR.	2	-	-	2	2	-	-	2	2	-	-	2	3	-	-	3	1	-	-	1	3	-	-	3	2	-	-	2
5.	Refuse TR.	4	-	-	4	2	-	-	2	2	-	-	2	3	-	-	3	1	-	-	1					1	-	-	1
6.	Heavy Equipment (G./R.)	1	-	-	1	1	-	-	1	1	-	-	1	2	-	-	2					2	-	-	2				
7.	Sewage TR.	5	-	-	5	7	-	-	7	5	-	-	5	7	-	-	7	4	-	-	4	8	-	-	8	3	-	-	3
8.	Ford Jet																												
9.	Bucket TR.																												
10.	Crane																												
11.	Loader													1	-	-	1												
12.	Heavy Trucks																												
13.	½ Trucks	3	-	-	3	1	-	-	1	6	-	-	6	7	-	-	7					3	-	-	3	5	-	-	6
14.	¼ Trucks																												
15.	Passenger Cars	4	-	-	4	7	-	-	7	5	-	-	5	7	-	-	7	7	-	-	7	11	-	-	11	4	-	-	4
16.	Mini Bus	1	-	-	1	1	-	-	1	1	-	-	1	1	-	-	1												
17.	Jeep																												
18.	Fire Trucks																												
19.	Refrigerator																												
20.	Finisher																												
21.	Asphalt Mixers																												
22.	Dozer																												
23.	Dump TR.	1	-	-	1	2	-	-	2	3	-	-	3	6	-	-	6	4	-	-	4	9	-	-	9	1	-	-	1

O = In Operation

U = Under repair

S = Scrapped

T = Total No.

List of Equipment

Equipment	Markaz and City				Quesna				Sheben ElKom				Road				Agriculture				Youth				Supply				Totals			
	Condition				Condition				Condition				Condition				Condition				Condition				Condition							
	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T
1. Street Flusher TR.					1	-	-	1																					1	-	-	1
2. Agriculture TR.	3	-	-	3	2	-	-	2	5	-	-	5					1	-	-	1									31	-	-	32
3. Trailers																																
4. Water SPR. TR.					3	-	-	3																					18	-	-	18
5. Refuse TR.					4	-	-	4																					17	-	-	17
6. Heavy Equipment (G./R.)	1	-	-	1	1	-	-	1	9	-	-	9																	18	-	-	18
7. Sewage TR.					10	-	-	10																					56	-	-	56
8. Ford Jet					2	-	-	2																					2	-	-	2
9. Bucket TR.																																
10. Crane					1	-	-	1																					1	-	-	1
11. Loader					1	-	-	1	2	-	-	2	1	-	-	1													5	-	-	5
12. Heavy Trucks																																
13. 1/2 Trucks	1	-	-	1	4	-	-	4	3	-	-	3	17	2	-	19	5	-	-	5	5	1	-	6	60	3	1	64				
14. 1/2 Trucks																																
15. Passenger Cars	4	1	-	5	35	-	-	35	3	-	-	3	7	-	-	7	1	-	-	1					95	1	-	96				
16. Mini Bus													8	-	-	8	1	-	-	1	4	1	-	5	16	1	-	17				
17. Jeep					1	-	-	1																					1	-	-	1
18. Fire Trucks																																
19. Refregerator																																
20. Finisher									2	-	-	2																	2	-	-	2
21. Asphalt Mixers																																
22. Dozer																																
23. Dump TR.	23	-	-	23	3	-	-	3	7	-	-	7	35	-	-	35													94	-	-	94

O = In Operation

U = Under repair

S = Scrapped

T = Total No.

Grand Total 417 5 2 424



EL SHARKEYA GOVERNORATE

List of Equipment

Equipment	Markaz and City	El Ebrahim-eya.				Dyarb Negm				Abu Hamad				Menya El Kamh				Civil Defe-nce.				Road Depart				Paving Proj.			
		Condition				Condition				Condition				Condition				Condition				Condition							
		O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T
1.	Street Flusher TR.					1	-	-	1																				
2.	Agriculture TR.																					2	-	-	2	6	-	-	6
3.	Trailers																									2	-	-	2
4.	Water SPR. TR.	1	-	-	1																					8	-	-	8
5.	Refuse TR.																												
6.	Heavy Equipment (G./R.)																					9	-	-	9	43	-	-	43
7.	Sewage TR.									2	-	-	2	2	-	-	2												
8.	Ford Jet																												
9.	Bucket TR.																												
10.	Crane																									3	-	-	3
11.	Loader					1	-	-	1													1	-	-	1	8	-	-	8
12.	Heavy Trucks																									3	-	-	3
13.	½ Trucks																									13	-	-	13
14.	¼ Trucks																												
15.	Passenger Cars																									10	-	-	10
16.	Mini Bus																												
17.	Jeep																												
18.	Fire Trucks																	12	-	-	12								
19.	Refregerator																												
20.	Finisher																									7	-	-	7
21.	Asphalt Mixers																									6	-	-	6
22.	Dozer																					1	-	-	1	4	-	-	4
23.	Dump TR.									2	-	-	2													47	-	-	47

O = In Operation

U = Under repair

S = Scrapped

T = Total No.

List of Equipment

Equipment	Markaz and City	Quarry Proj.				Distribut- ion Proj.				Transporta- tion Proj.								Total							
		Condition				Condition				Condition				Condition				Condition							
		O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T
1. Street Flusher TR.																					2	-	-	2	
2. Agriculture TR.		12	-	-	12					1	-	-	1												
3. Trailers																					2	-	-	2	
4. Water SPR. TR.																					12	-	-	12	
5. Refuse TR.																					7	-	-	7	
6. Heavy Equipment (G./R.)		1	-	-	1																	60	-	-	60
7. Sewage TR.																					11	-	-	11	
8. Ford Jet																					2	-	-	2	
9. Bucket TR.		1	-	-	1																	1	-	-	1
10. Crane																					3	-	-	3	
11. Loader		19	-	-	19																	31	-	-	31
12. Heavy Trucks						10	-	-	10	85	-	-	85									98	-	-	98
13. ½ Trucks		21	-	-	21	10	-	-	10													44	-	-	44
14. ½ Trucks																					-	-	-	-	
15. Passenger Cars		3	-	-	3	5	-	-	5													18	-	-	18
16. Mini Bus										172	-	-	172									172	-	-	172
17. Jeep																					-	-	-	-	
18. Fire Trucks																					12	-	-	12	
19. Refregerator																					1	-	-	1	
20. Finisher																					7	-	-	7	
21. Asphalt Mixers																					6	-	-	6	
22. Dozer		5	-	-	5																	10	-	-	10
23. Dump TR.		13	-	-	13																	67	-	-	67
																					Grand Total	587	-	-	587

O = In Operation

U = Under repair

S = Scrapped

T = Total No.

QENA GOVERNORATE  
List of Equipment

Equipment	Markaz and City				Road Dept.				Qena Municipal																Total							
	Condition				Condition				Condition				Condition				Condition				Condition				Condition							
	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T	O	U	S	T
1. Street Flusher TR.																																
2. Agriculture TR.									9	-	-	9																	9	-	-	9
3. Trailers									7	-	-	7																	7	-	-	7
4. Water SPR. TR.	3	-	-	3	1	2	-	3																					4	2	-	6
5. Refuse TR.					1	-	-	1																					1	-	-	1
6. Heavy Equipment (G./R.)	7	-	-	7	1	-	-	1																					8	-	-	8
7. Sewage TR.					8	6	-	14																					8	6	-	14
8. Ford Jet																																
9. Bucket TR.					1	-	-	1																					1	-	-	1
10. Crane																																
11. Loader	3	-	-	3	1	-	-	1																					4	-	-	4
12. Heavy Trucks																																
13. ¼ Trucks					6	1	-	7																					6	1	-	7
14. ½ Trucks																																
15. Passenger Cars																																
16. Scraper	2	-	-	2																									2	-	-	2
17. Excavator					1	-	-	1																					1	-	-	1
18. Fire Trucks																																
19. Refregerator																																
20. Finisher	2	-	-	2																									2	-	-	2
21. Asphalt Mixers	1	-	-	1																									1	-	-	1
22. Dozer	1	-	-	1																									1	-	-	1
23. Dump TR.	12	-	-	12	1	1	-	2																					13	1	-	14
Grand Total																								58	10	-	78					

O = In Operation      U = Under repair  
S = Scrapped          T = Total No.

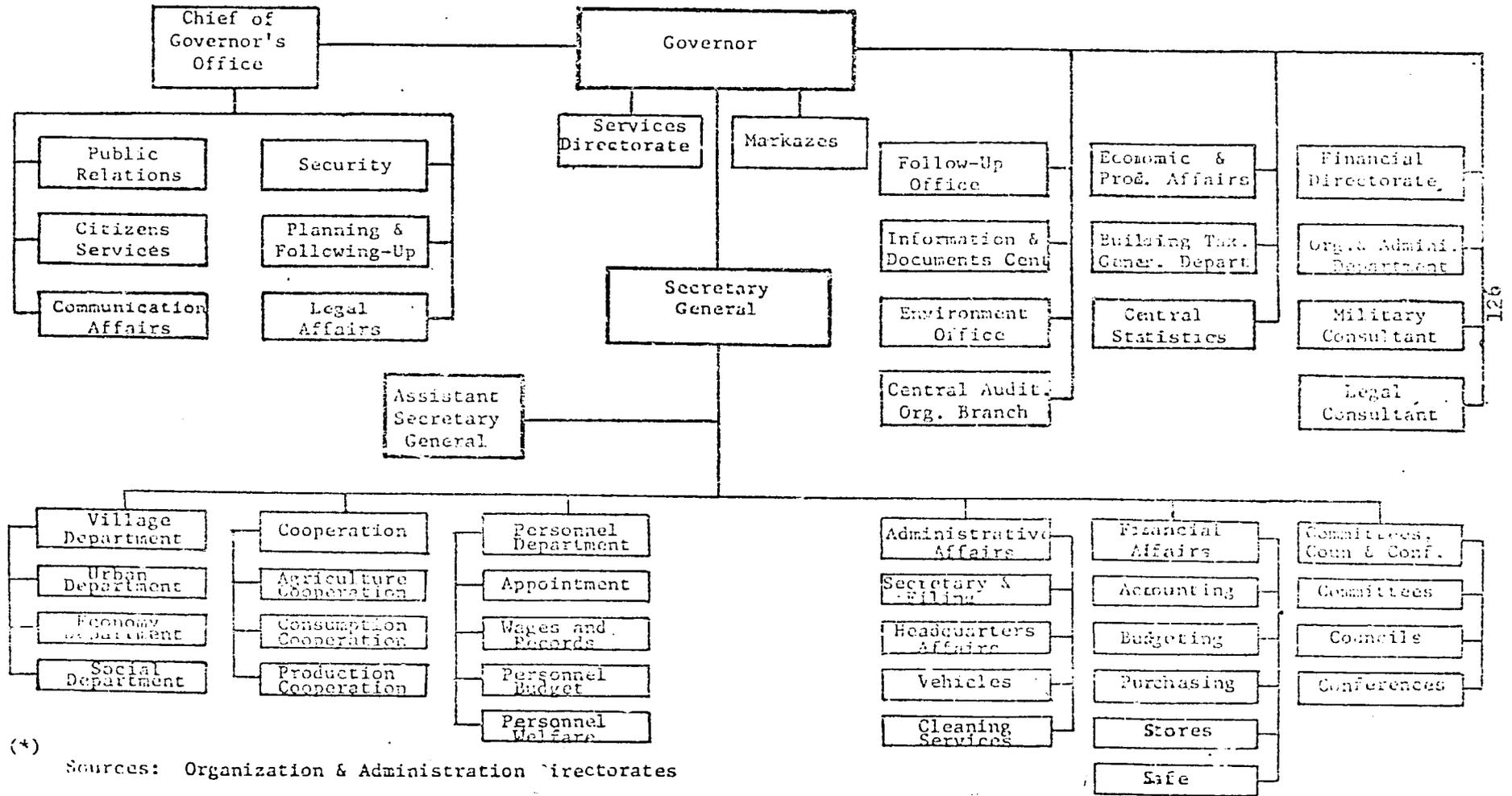
APPENDIX B  
Organization Charts  
of Governorates

Menoufeya Governorate

Sharkeya Governorate

Directorate Chart for Menoufeya Governorate

ORGANIZATION CHART FOR MONCUFEYA GOVERNORATE

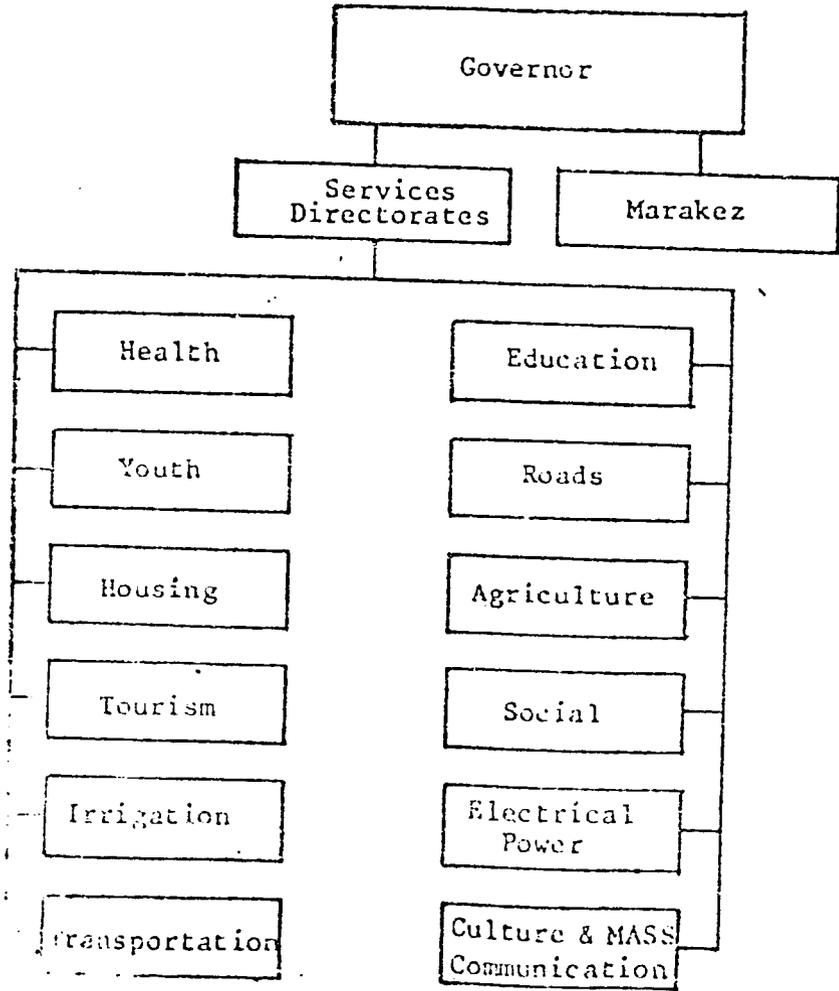


(\*)

Sources: Organization & Administration Directorates



DIRECTORATE CHART FOR MONOUFEYA GOVERNORATE.



Notes: Similar for other Governorates.

APPENDIX C

List of Persons Contacted

Qena Governorate

Assuit Governorate

Menoufeya Governorate

Sharkeya Governorate

QENA GOVERNORATE

Major General/Abdel Moneim Awad	Secretary Genera.
Mr. Yehia Mohamed El Khatib	Deputy Director Planning Dept.
Eng./Nabil El Hefny Mahmoud	Assistant Business Manager Housing Department
Mr. Makram Farid	Director of Road Department
Mr. Abdel Moneim Ibrahim	Director of Mech. Fleet Qena City and Markaz
Mr. Abuel Kheir Adib Salib	Store Keeper- Road Dept.
Mr. El Sharkawy Dardir Ahmed	Deputy Director- Main Govt. Stores
Mr. Abdel Sabour Awadallah	City Chief Qus City and Markaz
Mr. Shoukry Habib	Deputy Director Mechanical Fleet Qus City and Markaz
Major Gamal	Fire Dept. Director

ASSUIT GOVERNORATE

Mr. Sami Khodeir	Governor
Mr. Fekry El Far	Secretary General
Mr. Salah Abdel Hafez	Assit. Sec. General
Mr. Farouk Nassif Wahby	Director of Budgeting Dept.
Eng. Mourad Fares	Director of Road Dept.
Eng. Yosry	Director of Water Dept.
Eng. Youssef	Water Dept.

MENOUFEYA GOVERNORATE

Mr. Hamdy El Hakim	The Governor
Mr. Yaseen Salem Abdel Hafez	Sec. General
Mr. Talaat El Desouky	Assist. Sec. General
Mr. Kamal Mohamed Badawy	Governor's Office Director
Eng. Mohamed Tahoun	Director of Housing Dept.
Eng. Mohamed Sabry	Eng. of Housing Dept.
Eng. Mohamed Morsy	Eng. of Housing Dept.
Eng. Abdel Fattah Salem	Director of Road Dept.
Eng. Sobhy Hassouna	Deputy of Road Dept.
Eng. Ade. Aly El Shenawy	Mechanical Eng.
Eng. Yehia	Director of Maint. Center for Water Plant
Eng. Ibrahim El Beheary	Garage
Eng. Mohamed Abdel Halim	Garage
Eng. Mohamed El Ghrabawy	Garage
Mr. Mohamed Gabaliah	Direct. of Develop. Dept.
Mr. Sobhy Sorskok Yousef	Director of Plann. Dept.
Mr. Fathy Zedan	Director of Budget Dept.

Mr. Mena Zaki

Director of  
Financing and  
Management Road  
Dept.

Mr. Abdel Moneim Sakrr

Store Keeper in the  
Governorate

SHAREKEYA GOVERNORATE

Gen./Mohamed Amin Metkees	The Governor
Gen./Mohamed Ibrahim El Tokhy	Sec.General
Eng./Henry Fahmy	Deputy of Housing Dept.
Eng./Galal El Halawany	Housing Dept.
Eng./Ahmed Kamel	Direct.of Public Utilities
Eng./Mohamed Samy El Basha	Direct.of Public Affairs
Mr. Mohamed Lasheen	Director quarry Projects
Eng. Mohamed Samy	Road Dept. Maintenance
Mr. Ibrahim Hassan	Direct.of Translation Dept
Mrs Farida Mohamed	Translator
Dr. Sayed Sayed Ahmed	Direct. in Faculty of Eng.
Mr. Mohamed Said El Azezy	Basic Services Project Respon.
Mr. Ezzat Tantawy	Direct. of Devel. in Dyarhb Negm
Mr. Ahmed Bedier	Chief of Local Unit at El Asayed
Mr. Metwally Ibrahim	Chief of Local Unit at Saft Zoreek
Mr. Boreay Mohamed	Direct. of Finance at the Governorate
Mr. Mounir Mansour	Purchasing and Market. Dept.
Mr. Mohamed Rashad	Village Develop. Director

APPENDIX D

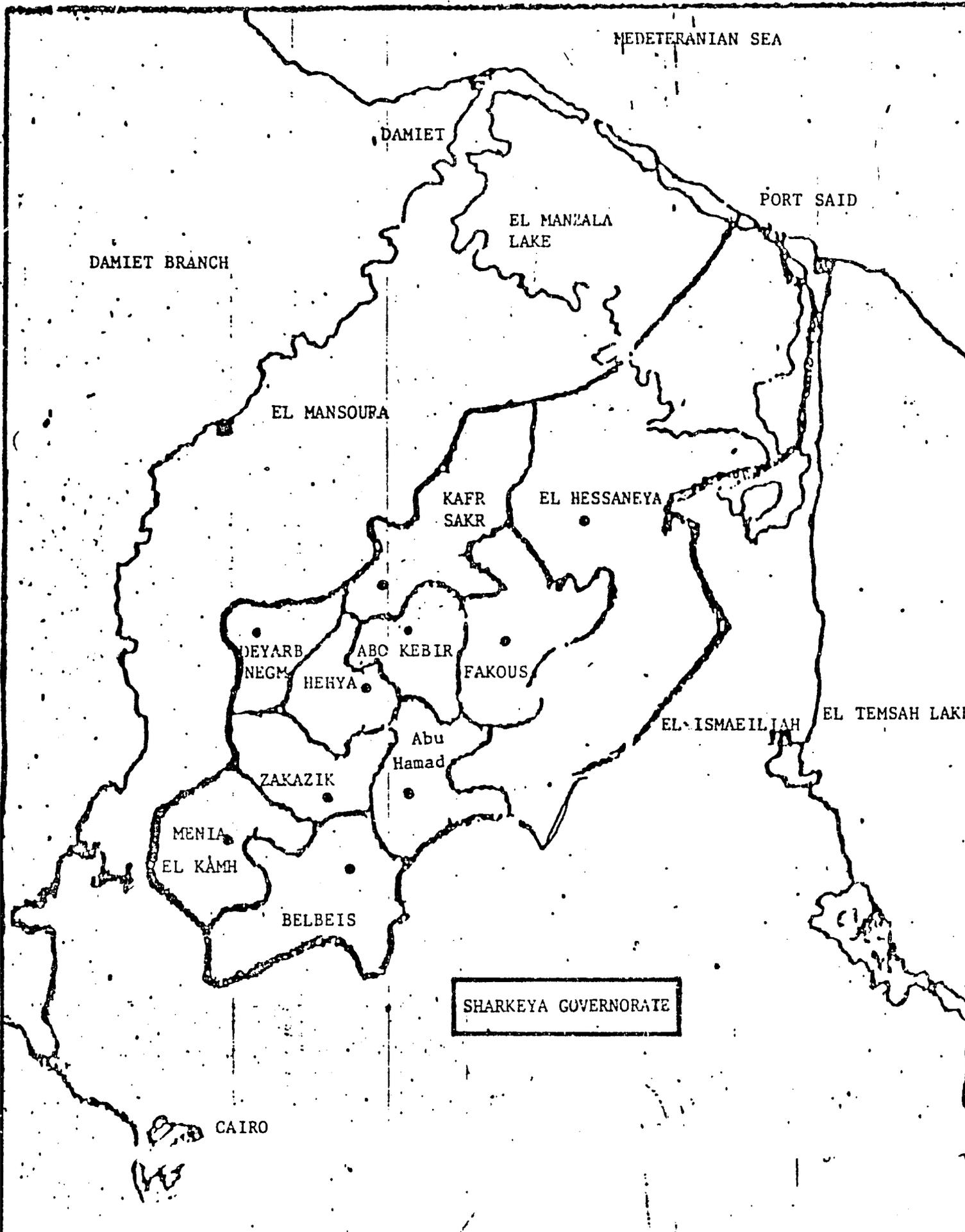
Sketch Maps of Governorates

Sharkeya Governorate

Assuit Governorate

Menoufeya Governorate

Qena Governorate



MEDETERANIAN SEA

DAMIET

PORT SAID

EL MANZALA LAKE

DAMIET BRANCH

EL MANSOURA

KAFR SAKR

EL HESSANEYA

BEYARB NEGM

ABO KEBIR

FAKOUS

HEHYA

Abu Hamad

EL ISMAELIAH

EL TEMSAH LAKE

ZAKAZIK

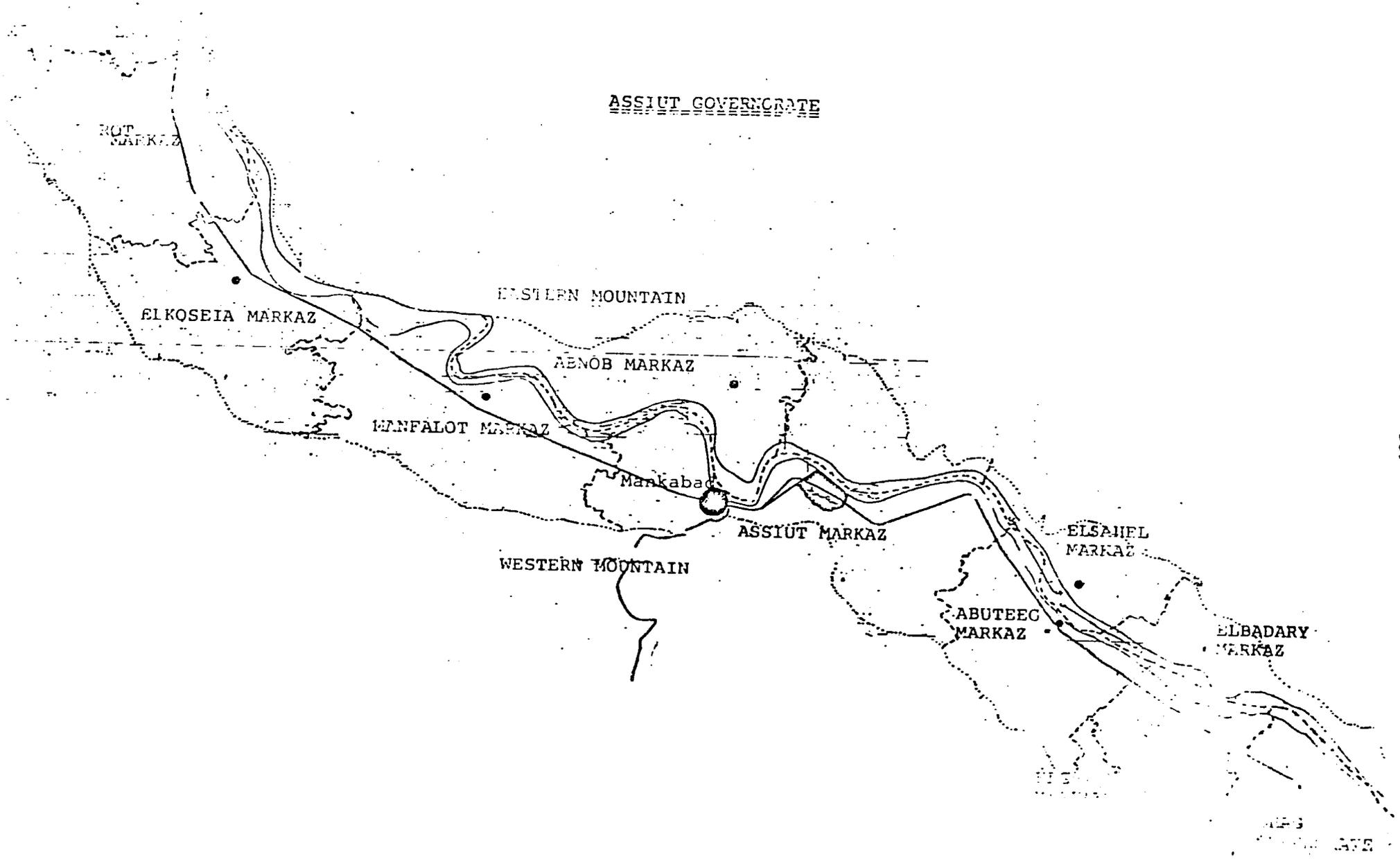
MENIA EL KAMH

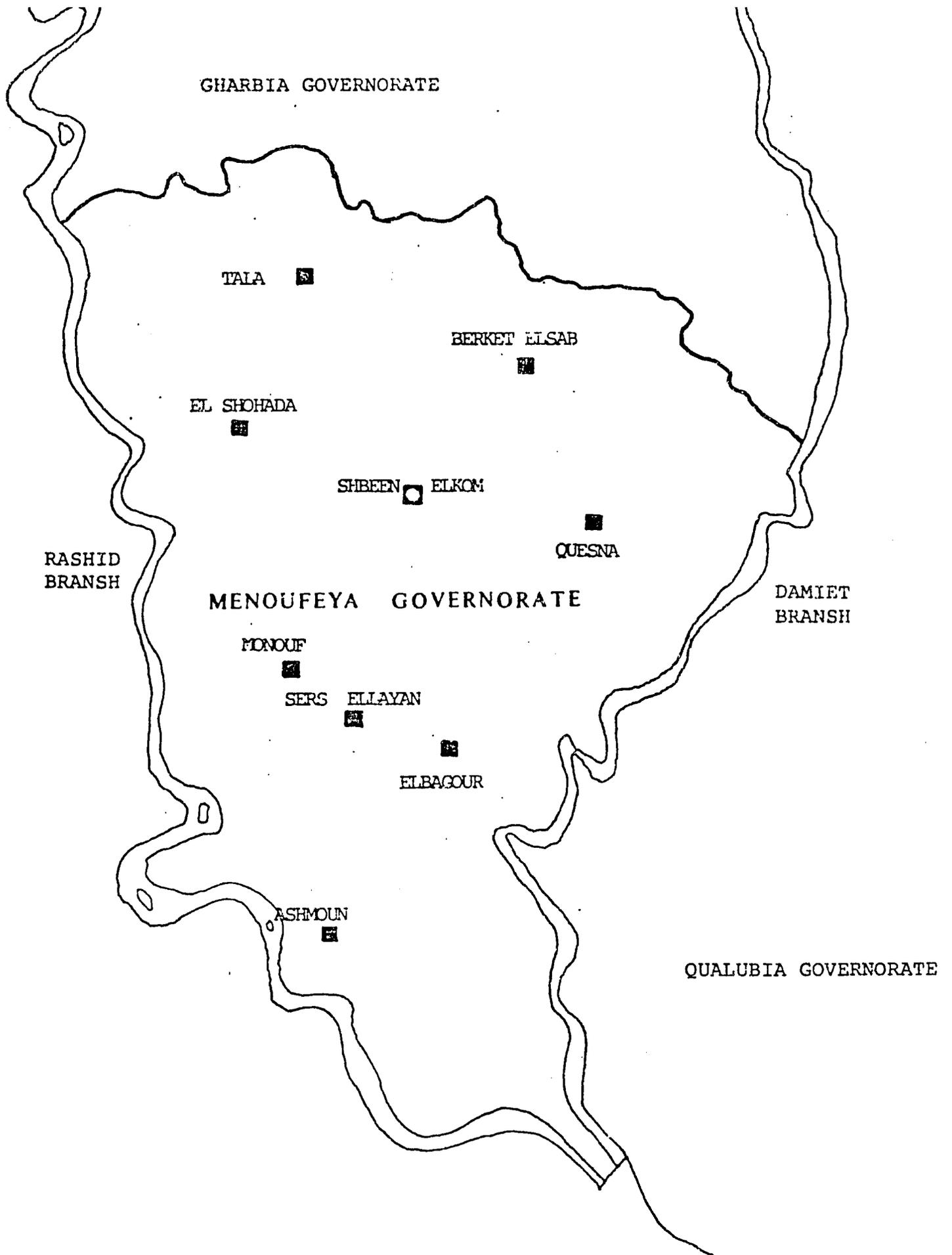
BELBEIS

SHARKEYA GOVERNORATE

CAIRO

ASSIUT GOVERNORATE





GHARBIA GOVERNORATE

TALA

BERKET ELSAB

EL SHOHADA

SHBEEN ELKOM

QUESNA

RASHID  
BRANSH

MENOUFEYA GOVERNORATE

DAMIET  
BRANSH

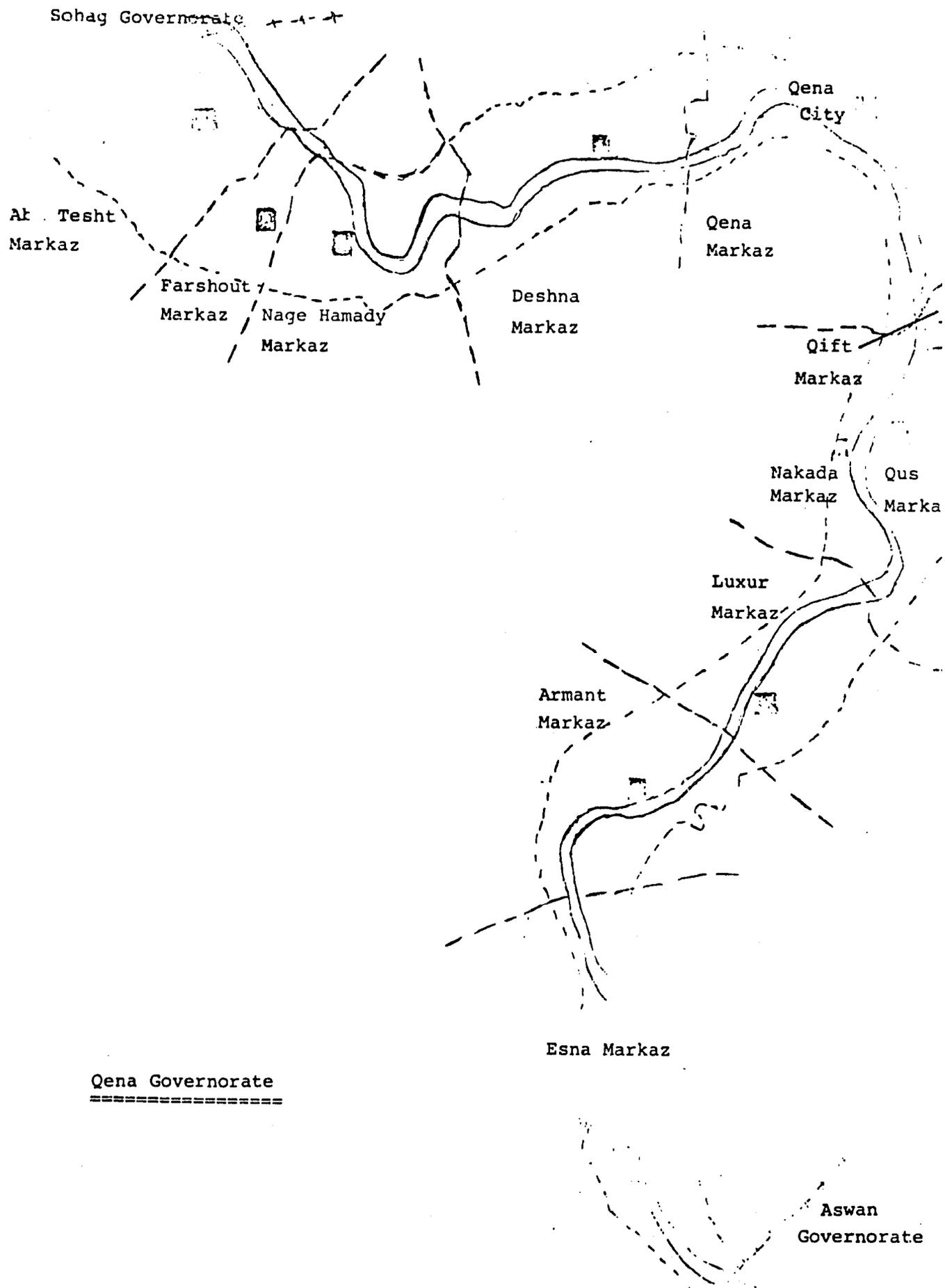
MONOUF

SERS ELLAYAN

ELBAGOUR

ASHMOUN

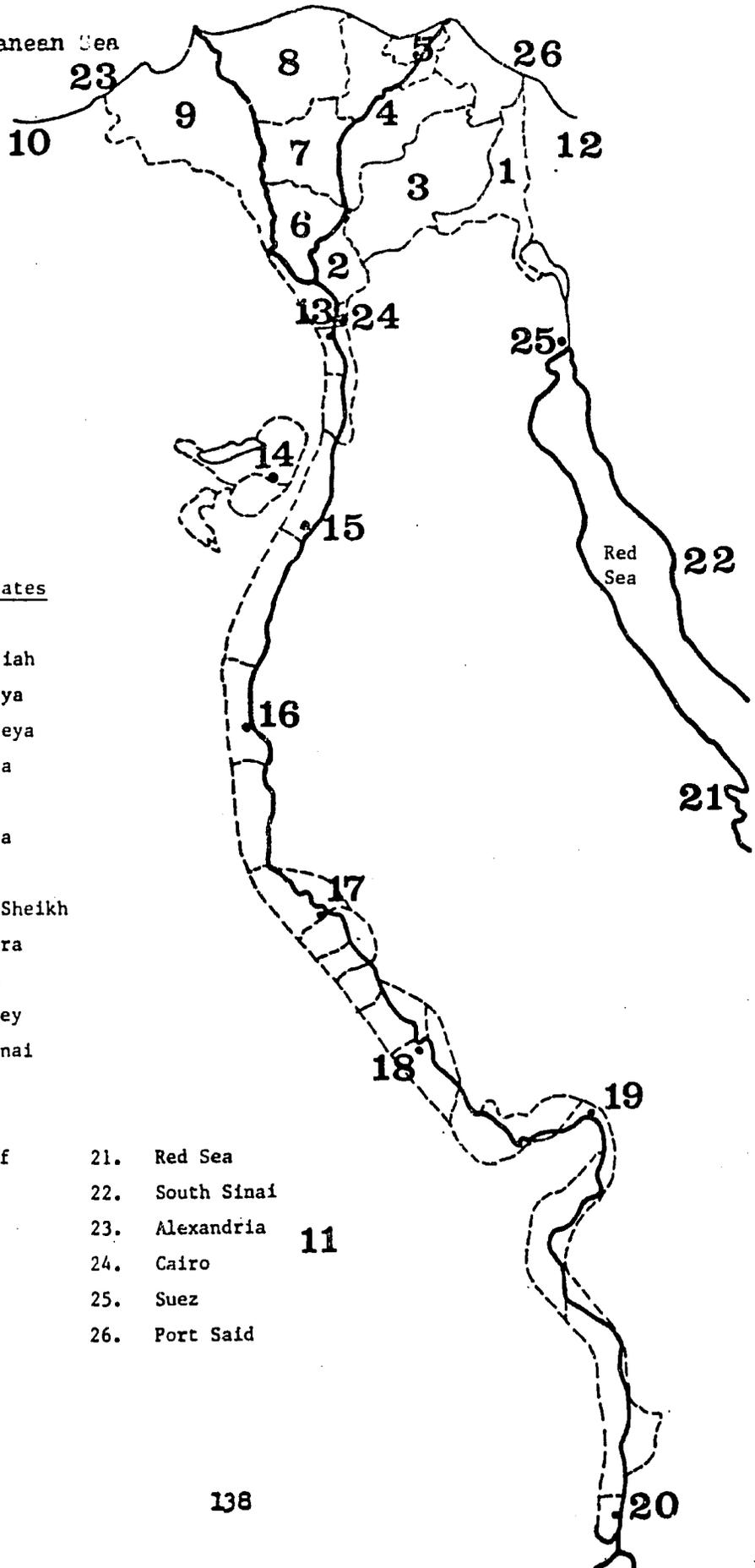
QUALUBIA GOVERNORATE



APPENDIX E

Sketch Map of Egypt  
Showing Governorates

Mediterranean Sea



EGYPT

LDF's Governorates

- |                   |                 |
|-------------------|-----------------|
| 1. Ismaeilliah    |                 |
| 2. Kalyoubeya     |                 |
| 3. El Sharkeya    |                 |
| 4. Dakahleya      |                 |
| 5. Domiat         |                 |
| 6. Menoufeya      |                 |
| 7. Gharbeya       |                 |
| 8. Kafr El Sheikh |                 |
| 9. El Beheira     |                 |
| 10. Mattrouh      |                 |
| 11. New Valley    |                 |
| 12. North Sinai   |                 |
| 13. El Giza       |                 |
| 14. Fayoum        |                 |
| 15. Beni Suef     | 21. Red Sea     |
| 16. El Menya      | 22. South Sinai |
| 17. Assyout       | 23. Alexandria  |
| 18. Sohag         | 24. Cairo       |
| 19. Qena          | 25. Suez        |
| 20. Aswan         | 26. Port Said   |