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INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT
INTERNATIONAL DEVELOPMENT ASSOCIATION

APPRAISAL OF
A FIRST HIGHWAY PROJECT
JORDAN

May 21, 1971

Transportation Projects Department

Currency Equivalentents:

Currency Unit - Jordan Dinar (JD)
US\$1 = JD 0.357 (fils 357)
JD 1 (fils 1,000) = US\$2.80
JD 1 million = US\$2.8 million

Fiscal Year: January 1 - December 31

System of Weights and Measures: Metric

<u>Metric</u>	<u>British/US</u>
1 meter (m)	= 3.28 feet (ft)
1 kilometer (km)	= 0.62 miles (mi)
1 square kilometer (km ²)	= 0.386 square miles (sq mi)
1 hectare (ha)	= 2.47 acres (ac)
1 liter (l)	= 0.22 British gallons (imp gal)
	= 0.26 US gallons (gal)
1 metric ton (m ton)	= 0.98 long tons (lg ton)
	= 1.1 US short tons (sh ton)

Abbreviations and Acronyms:

US A.I.D. = United States Agency for
International Development
JDB = Jordan Development Board
BPR = Bureau of Public Roads
(United States)
vpd = vehicles per day
vph = vehicles per hour

JORDAN

APPRAISAL OF A FIRST HIGHWAY PROJECT

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This report was prepared by Messrs. R. Mulligan (Engineer) and H. Schlechtriem (Economist) on the basis of a preappraisal mission to Jordan in October 1969, followed by an appraisal mission in April/May 1970. It was edited by Mrs. P. Valad.

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CHART

Ministry of Public Works

MAP

Jordan First Highway Project

JORDAN

APPRAISAL OF A FIRST HIGHWAY PROJECT

SUMMARY AND CONCLUSIONS

- i. This report appraises the first project in the transport sector of Jordan proposed for Bank Group assistance. The project includes: construction of the new four-lane highway between Amman and Zarqa (18 km), including supervision by consultants; purchases of road maintenance equipment; technical assistance, if needed, to the Ministry of Public Works; and an urban transportation study of Amman.
- ii. The Amman-Zarqa road links the country's two largest population centers east of the Jordan River. After the 1967 Arab-Israeli War, the population of these two cities and of the corridor between them expanded rapidly due to a large influx of refugees from the territory west of the river. The resulting increase in traffic, coupled with unplanned ribbon development, has brought the existing road to its capacity much earlier than had been foreseen. Construction of a new highway is clearly of high priority. Investment in this new road is expected to yield a rate of return of 17%.
- iii. In Zarqa the new road will terminate in a four-lane city street, with sufficient capacity to handle the forecast traffic. At the Amman end, the Municipality proposes a four-lane limited access extension of the new road to an intersection in the center of Amman where better traffic distribution can be obtained. However, some urban planning aspects of this proposal require further investigation. On the basis of available data, the capacity of the six-lane city street, to which the new road will be initially connected, will be reached about 1978, when additional facilities will be required. In the interim, the requisite planning studies can be made and, on the basis of their findings, construction of the most suitable solution for traffic distribution should be undertaken.
- iv. The mechanical equipment and the possible technical assistance included in the project will help the Government improve the standard of road maintenance in the country, at present considered as only fair. By increasing the effectiveness of personnel and equipment, improvements in maintenance services can be made without significantly increasing maintenance expenditures.
- v. The total project cost, including contingencies, is US\$8.7 million, including a foreign exchange component of US\$6.0 million to be financed by the Association. The award of the construction contract and the procurement of mechanical equipment will be based on international competitive bidding. Construction supervision and the other expert services will be carried out by consultants. The Ministry of Public Works will be responsible for execution of the road project.

vi. The cost of the construction element of the project is based on actual bids received April 24, 1971 and this element accounts for about 80% of the total cost. The overall rate of return for the project will be very close to the 17% calculated for the Amman-Zarqa road. It constitutes a suitable basis for an IDA credit of US\$6.0 million equivalent to the Government of Jordan on the usual terms.

JORDAN

APPRAISAL OF A FIRST HIGHWAY PROJECT

I. INTRODUCTION

1.01 The Government of Jordan has requested a credit from the Association to finance a highway project consisting of: (a) construction of a new four-lane highway between Amman and Zarqa (18 km), including supervision by consultants; (b) purchases of road maintenance equipment identified by consultants; (c) technical assistance, if needed, to the Ministry of Public Works for improving administration and methods of road maintenance; and (d) an urban transportation study, by consultants, to determine the best solution for distributing traffic from the project road into downtown Amman.

1.02 This is the Bank Group's first project in Jordan's transport sector. The highway selected for construction by the Government is clearly of high priority in the sector, serving two of the largest population centers on the territories east of the Jordan River (East Bank). The need for additional road capacity in the corridor between these two centers has been accelerated by the rapid expansion of the area's population and the steep growth in traffic volumes after the 1967 Arab-Israeli War.

1.03 The United States Agency for International Development (US A.I.D.) is financing a road maintenance study by a United States consultant, Miller-Warden-Western/Frederic Harris, presently engaged on other US A.I.D.-sponsored work in Jordan. The results of this study are expected early in 1972, and the Government assured the Association that it will implement the study's agreed findings.

1.04 This report was prepared by Messrs. R. Mulligan (Engineer) and H. Schlechtriem (Economist) on the basis of a preappraisal mission to Jordan in October 1969, followed by an appraisal mission in April/May 1970. It was edited by Mrs. P. Valad.

II. BACKGROUND

A. General

2.01 The Hashemite Kingdom of Jordan, with an area of about 97,000 km² (38,000 sq mi), is about the size of Portugal or the State of Virginia. Except for a short coastline on the Gulf of Aqaba, it is landlocked; its neighbors are Syria on the north, Iraq on the northeast, and Saudi Arabia on the east and south. A 600 km truce line separates it from the State of Israel on the west. Jordan's total population is 2.3 million, including about 900,000 refugees, and it is increasing about 3% p.a.

2.02 Natural resources are scarce, therefore, Jordan relies heavily on foreign trade and assistance. Only about 7% of its area is cultivated and the remainder is arid. A small part of this productive area is irrigated, but for the most part agriculture (vegetables, fruits, wheat, and olives) depends on rainfall. Two phosphate mines, a petroleum refinery, a cement plant, and a variety of small factories producing consumer goods form the industrial sector. Various sites of historical and religious interest, and, to a lesser extent, some recreational resorts are the basis of the country's tourist industry.

2.03 Supported by foreign assistance, the economy grew at almost 10% p.a. up to 1967 when per capita income reached a level of JD 93 (US\$260 equivalent). The June 1967 Arab-Israeli War, which resulted in the occupation by Israel of the territories west of the Jordan River (West Bank), the influx of new refugees from the West to the East Bank, and the closure of the Suez Canal, disrupted this promising development. The subsequent process of recovery and adaptation to the changed situation on the East Bank was interrupted by the September 1970 Civil War, which again brought the economy to a standstill. Before the Civil War, per capita income of the 1.4 million Jordanians living on the East Bank was about JD 75 (US\$200 equivalent). Future economic development depends to a great extent on the settlement of the Arab-Israeli conflict.

B. Transportation

(a) General

2.04 The major centers of population and domestic production are relatively close to each other (Map) and, therefore, only limited domestic transportation is required. The situation is quite different for imports and exports, which generally have to be transported long distances. Jordan's only access to the sea, the port of Aqaba on an arm of the Red Sea, is some 300 km south of Amman. Since the Suez Canal has been closed, most trade with western countries has been through Beirut (Lebanon), about an equal distance north of Amman through Syria. The transport needs are, in general, adequately served by a comprehensive network of national and feeder roads and also, to a limited extent, by the railroad. Air transport is significant only for international passenger traffic. Road transport is by far the dominant mode for both goods and passengers.

(b) Highways

2.05 At the end of 1969, Jordan's highway network comprised about 2,800 km; in 1968, the last year for which data are available, the motor vehicle fleet numbered some 25,900 units, of which 15,200 were private passenger cars and taxis. Details of the highway sector are given in Chapter 3.

(c) Railroads

2.06 Jordan's railroad was built in the early years of this century as part of the Turkish Hedjaz railroad, which connected Damascus (Syria) with Medina (Saudi Arabia) before it was partially destroyed in World War I. Now, 366 km of 1.05 m gauge track are in operation by Jordan, linking Dera'a at the Syrian border via Amman to Ras en Naqb, 70 km north of the Port of Aqaba. Traffic on the northern link was about 100,000 m tons in 1969, the major commodity being phosphate from Ruseifa which was diverted from Aqaba to Beirut. The volume of exports that can be carried on this route is fixed by international agreement because of the limited capacity of the "rack-railroad" in Lebanon. ^{1/} Also in 1969, about 16,000 passengers traveled on the northern link between Amman and Damascus. Traffic on the southern link fell from about 100,000 m tons in 1966 to 36,000 m tons (mainly Government goods) in 1969. Revenues from traffic declined from JD 159,000 (US\$445,000) in 1966 to JD 94,000 (US\$263,000) in 1969; the railroad is understood to receive an annual Government subsidy of about JD 50,000 (US\$140,000).

2.07 Two major railroad developments now are underway. Following a 1963 agreement between Syria, Jordan, and Saudi Arabia, the Hedjaz railroad to Medina is being rebuilt. Works on the Ma'an-Mudawwara section in Jordan were recently completed, but those on the section in Saudi Arabia are temporarily halted. The main purpose of this new railroad will be to handle part of the 500,000 pilgrims to and from Mecca each year during the two-month pilgrimage season. Since a new road parallel to this railroad is now under construction, the railroad will probably have serious competition as soon as it opens. The second development is the construction of a 142 km branch line from Hattiya (between Ma'an and the Saudi border) to Aqaba, for which West German financial assistance is expected. It is planned that the new line will be operated by a separate organization (the Aqaba Railroad Authority), and will cater mainly to phosphate exports, now carried by road from El Hassa. The project was fully prepared for implementation, but the 1967 events drastically changed the traffic expectations for this link. The Government has decided to have consultants reassess the feasibility of the project before undertaking construction.

(d) Ports and Shipping

2.08 In 1966 the Port of Aqaba reached its highest traffic -- about 600,000 m tons of exports and imports. The closure of the Suez Canal had the greatest effect on import volumes, which dropped to 160,000 m tons in 1968. The volume of exports, mainly phosphate, continued to rise slowly, largely because of the Government's policy of fostering trade with Asian countries. The port capacity of 800,000 m tons p.a. for general cargo and over 2 million m tons for phosphate, now is not fully used, and even under normal conditions would be adequate for many years.

^{1/} The Chemin de Fer du Liban uses rack and pignon (cog wheel) to surmount the mountain range between Damascus and Beirut.

(e) Air Transport

2.09 In 1966, before the Arab-Israeli War, Jordan's two main airports, Amman and Jerusalem (90 km apart), handled a total volume of 340,000 passenger movements. An airport feasibility study for the entire country was carried out by the Batelle Memorial Institute (United States) in 1966/67. In view of the rapid increase in air travel and with particular regard to the requirements of tourist traffic, the study recommended, among other things, a new international airport near Jericho in the western Jordan valley and a small airport at Aqaba. The Jericho proposal is no longer practicable, but the Aqaba project is under construction with British financial assistance. The events of 1967 have had little effect on traffic at Amman airport, where the volume of passenger movements continued to increase from about 137,000 in 1966 to 176,000 in 1968, and some improvements would probably be justified. However, the Government now proposes to construct the first stage of a new airport 30 km south of the capital, reportedly to better accommodate two Boeing 707 aircraft which are being added to the national airline (ALIA) fleet.

(f) Pipelines

2.10 Two pipelines pass through Jordan: the Iraq Petroleum Company (IPC) line and the Trans-Arabian Pipeline (TAP). The former was shut down in 1949 and abandoned in 1964. The TAP is considered as an external facility and not a part of Jordan's transport system, although it is the source of crude oil for the Jordan Refinery.

C. Transport Planning and Coordination

2.11 The responsibility for administering the transport system is divided between two Ministries: the Ministry of Public Works, responsible for the national road network and, recently, also for the village or feeder road network; and the Ministry of Transport responsible for railroads, Aqaba port, and aviation. Investments in transport, as in other sectors, are coordinated by the Jordan Development Board (JDB). The most recent planning document is the Seven-Year Program for Economic Development of Jordan (1964-1970), which allocated 23% of total public investments (JD 145.7 million or US\$408 million) to transport. The major objectives in the transport sector were to promote exports by reduced transport costs on improved road, rail, and port facilities and to improve airport facilities so as not to hamper the growth of tourism. Feasibility studies have been made of the projects and it appears that most were well-conceived and economically viable; an exception might be reconstruction of the Hedjaz railroad (para. 2.07), which is religiously motivated.

2.12 The events of 1967 have changed the scene from that existing at the beginning of the plan. Some investments made in its early years cannot be utilized fully, e.g., the expansion of port facilities in Aqaba; others have been suspended, e.g., construction of the Aqaba-Safi road, which was

halted when 25% complete because of hostilities in the area. Still other investment plans, particularly those concerning tourism development, have had to be reconceived, and new needs have suddenly arisen, e.g., the proposed Amman-Zarqa road construction, which is the main element of this project. A new plan is needed to meet the requirements of the changed situation, but under present conditions the Government intends to proceed with short-term planning.

2.13 Planning in Jordan is generally adequate, but some problems exist in project evaluation and selection. The staff at a working level in the JDB are not fully capable of supervising, coordinating, and, finally, evaluating the various studies carried out by consultants. Decisions are generally made at a higher level and more on an intuitive basis than by a detailed analysis of the economic advantages and disadvantages of the proposal. The Government is aware of these deficiencies and has informed the Association that, among other measures, it intends to employ a qualified and experienced transport economist to improve planning and coordination of transport investments as well as to review salient transport policy issues.

2.14 There is little regulation of goods' movements in the transport market; both the railroad and the trucking industry are free to set rates and adapt market policies. The expanding road industry has attracted most of the general traffic from the railroad. So far the railroad has been able to compete successfully for the transport of phosphate; for shipments between Ruseifa and Beirut it now charges slightly less than the trucking rate of JD 1.6 per m ton. On its southern link, pending construction of the Aqaba branch line, the railroad has completely lost this traffic as a result of a boycott by the road industry, which refused to carry the phosphate from the rail terminal at Ras en Naqb to Aqaba. The railroad's rates are understood to cover all operational costs, including track maintenance and a track depreciation charge. Estimates of revenues from road-user taxes during the past few years covered expenditures on the network (para. 3.09). The taxation structure favors heavy vehicles, but it is unlikely that a higher taxation of trucks would have any major impact on the distribution of traffic between road and rail.

III. THE HIGHWAY SECTOR

A. The Highway Network

3.01 The Ministry of Public Works is responsible for Jordan's national highway system, which comprises 1,760 km of primary roads (1,460 km or 83% paved) and 1,040 km of secondary roads (690 km or 66% paved). The network has grown at about 4% p.a., with a reduction in 1967 due to the loss of the West Bank territories. Table 1 shows the changes in lengths of these categories resulting from new construction and improvements. Village or feeder roads were under the jurisdiction of the Ministry of the Interior's

Department for Municipal and Rural Affairs until 1970 when they were transferred back to the Ministry. The length maintained in 1969 was 1,715 km, of which 1,110 km (65%) were paved.

3.02 In general, this highway system (Map) adequately connects all populated parts of the country. Surfaced roads lead from Amman to Aqaba and the borders of Syria and Iraq. In the seven-year plan (para. 2.11) which allocated about 50% of the highway funds to improvements of the existing network, only two new construction projects were planned: the Aqaba-Safi road to serve the Dead Sea potash development project near Safi (para. 2.12), and the Ma'an-Mudawwara road to provide a link with southern Saudi Arabia (para. 2.07). The latter was completed in 1970. The list of highway projects has since been extended and priorities have changed. Emphasis is now on expanding the network in the Amman area and improving road connections with Syria and Iraq, and the newly-built road system in northern Saudi Arabia.

3.03 Adequate regulations are in force governing the maximum dimensions and axle loading of vehicles. Weighing stations at Ramtha on the Syrian border, the Port of Aqaba, and the phosphate mines at El Hassa and Ruseifa ensure that vehicles using the major haulage routes are not overloaded. In addition, the truckers' association (para. 3.08) polices its members to ensure that no operator deprives another of livelihood by overloading his vehicles; this control is exercised most effectively. During credit negotiations, the Government gave an assurance that it will continue to enforce regulations controlling the dimensions and axle loading of vehicles.

B. Characteristics and Growth of Road Traffic

3.04 Jordan's motor vehicle fleet (Table 2) grew at an average annual rate of about 10%, from 12,770 vehicles in 1960 to 24,500 in 1967. Passenger cars increased at the comparatively high rate of 15% p.a. over this period, and represented 42% of the fleet in 1967. In 1968 there were about 25,900 vehicles in Jordan, more than two-thirds of which were registered in the Amman district. During the 1967 war, many vehicles on the West Bank were transferred to the East Bank. Statistics on the fleet for the years after 1968 are not reliable.

3.05 The Ministry of Economy regulates motor vehicle importation by issuing import licenses. These licenses have so far been granted freely and are therefore not a means of restriction; import charges amount to about 100% of the vehicle's c.i.f. value. Growth of the commercial fleet is controlled by the number of transport licences established annually by the Traffic Council, in accordance with demand. This Council comprises representatives from the Ministries of Economy, Interior, Finance, and Public Works, as well as delegates from the interest groups concerned. Licenses are transferable to allow for renewal of equipment.

3.06 The highest traffic is on the access roads to Amman (8,000-10,000 vpd) and the main road to Syria and Lebanon (2,000-5,000 vpd). Other main roads carry less than 2,000 vpd; most secondary roads, less than 500 vpd. A small amount of traffic still passes to and from the West Bank. Traffic growth over the last five years has been irregular, and has varied widely from road to road; the general range has been about 10% to 15% p.a., roughly in line with the increase in fuel consumption (23% for gasoline and 11% for gas-oil -- Table 3). The higher growth in gasoline consumption reflects the steeper increase in the number and usage of passenger cars (para. 3.04).

3.07 Cheap and efficient public passenger transport is provided by taxis and buses, which serve all towns and major villages in Jordan as well as the main centers in neighboring countries. Fares for taxis, which are restricted by their licenses to a particular route, are about double those for buses. Bus fares are Government controlled and vary between fils 1.5 to 2.5 per km (US¢0.7 - 1.1 per mi).

3.08 Jordan's trucking industry consists of 20 companies with fleets of more than 10 vehicles, and a large number of small operators. A strong truckers' association controls about 40% (2,500 vehicles) of the country's truck fleet; it negotiates and enters into contracts with clients, and allocates the resulting haulage work among its members. It maintains firm control over the traffic to and from the ports of Aqaba and Beirut. Despite its rather monopolistic position, freight rates on the average (fils 6 - 9 per ton-km or US¢2.7 - 4 per ton-mi) are not excessive. Private trucking is confined mainly to specialized transport; only the Jordan refinery and the phosphate mines have sizeable fleets, although the operation of the latter is subcontracted.

3.09 No firm data on receipts from road-user charges exists. Based on available material, the Association estimates the average annual revenue from taxes on the use and ownership of vehicles (excluding import charges) during the last four years at JD 2.4 million (US\$6.7 million). Annual expenditures (capital and recurrent) on the national highway network during that same four-year period averaged JD 2.2 million (US\$6.2 million).

C. Highway Administration

3.10 The Ministry of Public Works is responsible for the construction and maintenance of roads and public buildings. The Under-Secretary for Public Works is the senior coordinating official to whom the Directors of Highways and Buildings report (Chart). The highways headquarters is adequately staffed and functions effectively, although it has some minor deficiencies, such as inadequate cost accounting procedures, where worthwhile improvements could be made and are proposed under this project (para. 4.06). For the purposes of the Ministry's work, Jordan is divided into eight districts, three of which are on the West Bank. Each is under the control of a district engineer, whose duties include responsibility for all road works in his district. The district organizations operate effectively.

D. Highway Maintenance

3.11 Maintenance of Jordan's national highway system is the responsibility of the Ministry's highway department. Mechanized methods are used predominantly; the foundations for them were laid by the United States Bureau of Public Roads (BPR). This agency, under US A.I.D. financing, was responsible for technical assistance in the construction and maintenance of roads by equipment intensive means during the years 1953-1965. It set up training programs for operators, mechanics, technicians, materials laboratory personnel, etc., and assisted in purchases of road construction and maintenance equipment (the maintenance equipment cost about US\$1.5 million) financed by US A.I.D. This equipment is held in a central pool in Amman and is issued on hire as required. The Ministry still conducts the training schemes for mechanics and equipment operators, although in the latter case there now are no suitable instructors for field training, a situation which this project seeks to remedy (para. 4.06).

3.12 Excellent central workshop facilities in Amman, constructed on the advice of the BPR under US A.I.D. financing, are more than adequate for the needs of the Ministry's equipment fleet. Distances in Jordan are relatively short and little time is lost by sending equipment from the provinces to Amman for major repair; consequently, district workshops handle only minor repairs, and are adequately equipped for this service.

3.13 The Ministry normally undertakes maintenance works using its departmental forces, but operations such as asphaltic paving, some resurfacing, and the supply of crushed stone, are provided by contract. Thus, the Ministry avoids purchase and maintenance of expensive equipment, such as asphalt plants, pavers, and quarry machinery, and takes advantage of competitive rates offered by the contracting industry.

3.14 The present standard of road maintenance is fair. Maintenance of the riding surface is generally good, but shoulder and side drain maintenance, normally a mechanized operation, is poor. The main reason for these present conditions is the lack of skilled equipment operators; many who were trained in the BPR programs have left Jordan for Saudi Arabia and the Gulf States where higher wages are paid. This drain of skilled manpower is understood to have diminished, but a reinforcement of training methods to include more practical, on-the-job training in equipment operations is now required for present and future staff.

3.15 Funds allocated for road maintenance over the period 1966-70 inclusive are shown in Table 4 and currently provide an average of JD 100 per km (US\$280 per km) for the costs of labor, equipment (excluding depreciation), and materials, but exclude the costs of administration and periodically recurring maintenance tasks, such as asphalt paving and surfacing. Clearly, this provision will not finance routine maintenance at its present level; some funds provided in the budget for administration and periodically recurring maintenance are spent on routine maintenance, but the amounts involved cannot be ascertained.

3.16 A practical approach to raising the standard of maintenance is to improve the use of present manpower and equipment resources; for this reason a general review of the maintenance organization by a consultant is being financed by US A.I.D. The study (para. 4.06) will supplement the excellent background work of BPR in this field and is being executed by a consultant (Miller-Warden-Western/Frederic Harris, United States) already commissioned for highway feasibility studies in Jordan under US A.I.D. sponsorship. During credit negotiations, the Government agreed to implement those recommendations of the consultant agreed between the Association and the Borrower in accordance with a timetable mutually acceptable to the Association and the Government.

E. Highway Engineering and Construction

3.17 The Director of Highways is responsible for executing road projects; his headquarters organization is adequately staffed with engineers to fulfill this function (most senior engineers trained with the BPR). His department undertakes necessary surveys and design, advertises construction contracts, awards contracts according to standard Government procedures, and supervises construction. Consultants, mostly foreign, are often employed to provide some of these services, although local consulting firms are becoming more experienced in road works and can be expected to play a larger role in future.

3.18 Highway design standards in Jordan were recommended by BPR and are reasonable. Pavement design is based on Jordan's legal maximum axle loading of 12 m tons, which takes into account the high proportion of heavy vehicles in the country.

3.19 Each year the department conducts systematic traffic counts at key points in the highway network. The resulting traffic figures are used to a limited extent in the selection of road works. The proposed transportation economist (para. 2.13) could assist the Government in better use of these data. During credit negotiations, the Government confirmed its intention to continue collecting and collating traffic data on a regular and systematic basis.

3.20 Highway construction is normally executed under unit price contracts awarded after competitive bidding. The domestic contracting industry is small but active; more than a dozen contractors are registered with the Government to undertake works of up to US\$750,000 each (for contracts in excess of this value, separate prequalification is required), but only one is of a size capable of undertaking on his own the construction in this project. On average, these contractors have about US\$500,000 invested in construction equipment, and, as a group, provide an annual contractual capacity of about US\$5 million. About 30 smaller contractors exist, with total work potential of about US\$3 million p.a. The Ministry undertakes some construction by force account; these operations are usually restricted to minor improvements, limited road widening, and similar operations which do not lend themselves conveniently to execution by contract.

F. Financing

3.21 Budget proposals submitted by the ministries are reviewed by the Ministry of Finance and the JDB; after the Government budget is approved, funds are released to the ministries. During the fiscal year, the JDB can provide the ministries with additional funds from its own unallocated reserve. Besides being the coordinating agency, the JDB is responsible for all foreign assistance. The 1966-1970 expenditures on the national highway system, which form the major part of the Ministry's budget, are given in Table 4.

3.22 Before 1967, expenditures on (routine) maintenance were fairly constant at about JD 300,000 (US\$840,000) p.a. Almost in proportion to the reduction in network length after the loss of the West Bank in 1967, expenditures dropped to about JD 250,000 (US\$700,000) in 1968 and 1969. Although there is a 10% increase in the 1970 maintenance allocation, maintenance expenditures in general are unrelated to the increase in usage and the changes in the standards of the road network. However, as budgetary allocations for maintenance are to be reviewed by the maintenance consultant (paras. 3.16 and 4.06), the 1970 allocation is adequate for the present. During credit negotiations, the Government gave an assurance that it will allocate adequate funds annually for proper highway maintenance.

3.23 Annual highway expenditures other than for routine maintenance and administration during 1966-1969 averaged JD 1.9 million (US\$5.3 million). An estimated 60% of these expenditures were from foreign aid and loans. Local funds financed the remaining 40% and were used principally on force account works.

3.24 It is difficult to predict the future pattern of highway expenditures. Excluding the Amman-Zarqa road construction and force account improvement works, projects now being considered total some JD 10 million (US\$28 million). Financing for most is unresolved, and feasibility studies remain to be done. Considering the Government's investment needs in other sectors and the present commitments of bilateral lending agencies to Jordan, it is unlikely that annual highway investments will exceed JD 2 million (US\$5.6 million) in the next few years.

IV. THE PROJECT

A. General Description

4.01 The proposed project consists of:

- (a) construction of a new road, about 18 km long, between Amman and Zarqa, including supervision by consultants;

- (b) purchase of road maintenance equipment;
- (c) assistance, if required, by consultants in implementing the agreed findings of the US A.I.D.-sponsored maintenance study;
- (d) advice, by consultants, on requirements for purchases of road maintenance equipment and preparation of specifications for its procurement; and
- (e) an urban transportation study of metropolitan Amman by consultants.

The United Nations Development Programme is interested in financing (c) above, if required, and US A.I.D. has included provision for (d) above in the terms of reference for the maintenance consultant.

B. Amman-Zarqa Highway (18 km)

4.02 The existing paved road from Amman to Zarqa is inadequate for present traffic needs. The first 4 km from Amman is a narrow congested four-lane section and the remainder is two-lane. Alignment of the first few kilometers is characterized by steep gradients and poor sight distances; urban development precludes any major improvements. A pattern of unplanned ribbon development throughout the remainder of the road limits its capacity and makes improvements unduly expensive.

4.03 After a study which compared two other alignments and an improved existing alignment, the Government's consultants (De Leuw Cather International/Jouzy and Partners, United States/Lebanon) proposed a new four-lane divided highway to the standards indicated in Table 5, which are satisfactory. The possibility of stage construction was investigated, but found to be impracticable. The new alignment crosses the existing road only once, and a traffic interchange will be constructed at that point. At-grade intersections with other roads are expected to carry only small traffic volumes. On the outskirts of Zarqa, the project road joins a street which is being widened to four-lanes, and is capable of handling the forecast traffic. All land needed for road construction has been obtained.

4.04 The Municipality of Amman is planning a four-lane limited access continuation of the project road to an intersection near the center of the city, where traffic may disperse more satisfactorily, but this may not be the best long-term solution. To provide access until completion of the necessary planning studies and construction of the most desirable traffic distributor (para. 4.07), the project road will be connected initially with an existing six-lane city street which will meet traffic requirements for about five years after the new road will have been opened.

C. Road Maintenance Equipment

4.05 Much of the present maintenance equipment, which was purchased from US A.I.D. funds on the advice of BPR, is now between six and sixteen years old and many items should be replaced. Replacement value of equipment in use is about US\$3 million, with annual renewal costs of about US\$0.3 million. An equipment renewal fund, financed from rentals, is in operation, but is under-financed because allowances for depreciation are inadequate. During credit negotiations, the Government agreed to institute such better arrangements for financing the renewal of road maintenance equipment as would be defined by the agreed findings of the maintenance study. The Government has submitted to the Association a list of the most urgently needed equipment items, totaling about US\$0.5 million, for purchase under the proposed Credit (Table 6). The maintenance consultant, whose services are being financed by US A.I.D. (para. 4.06), will verify these requirements before the Government purchases the agreed items under international competitive bidding.

D. Maintenance Consultants' Services

4.06 To assist the Government by identifying possible shortcomings in its maintenance organization, US A.I.D. is financing consultants whose terms of reference include a brief review of the maintenance department with recommendations for needed improvements and other matters, such as establishing an adequate cost accounting system, and an equipment replacement program, and proposals for improvement of training programs. During credit negotiations, the Government agreed to implement those findings of the consultant as will be mutually agreeable to the Association and the Borrower.

E. Urban Transportation Study

4.07 The most appropriate method for distributing traffic from the project road in Amman should be based on a limited study of the city's future land use and related transport patterns with a more detailed study of the access corridor of the project road. Accordingly, an allowance of US\$0.4 million has been made in the project for the necessary studies, which would be undertaken by a consultant. The findings of the study are expected by mid-1973, allowing ample time for construction of the recommended solution to be completed before the end of 1978 when additional facilities will be needed to allow the full capacity of the Amman-Zarqa road to be utilized. During negotiations, the Government gave assurances that it will:

- (a) undertake the necessary urban planning studies without delay and complete them before July 31, 1974; and
- (b) provide the Association, no later than December 31, 1974 with a timetable for construction of the additional traffic facilities required in the Amman area, as agreed with the Association.

F. Cost Estimate and Foreign Exchange Component

4.08 The total cost of the project is estimated at US\$8.7 million equivalent, including contingency allowances. A summary of the project cost and the Association's participation follows:

	<u>JD thousand</u>			<u>US\$ thousand</u>			<u>%</u>
	<u>Local</u>	<u>Foreign</u>	<u>Total</u>	<u>Local</u>	<u>Foreign</u>	<u>Total</u>	<u>Foreign Exchange Component</u>
1. Construction of Amman-Zarqa road	770	1,430	2,200	2,170	4,030	6,200	65
2. Road maintenance equipment, including initial spare parts	<u>a/</u>	180	180	<u>a/</u>	500	500	100
3. Consultants' services for:							
(a) construction supervision; and	60	150	210	170	420	590	70
(b) an urban transportation study of Amman	30	110	140	80	320	400	80
4. Contingency allowance	100	260	360	280	730	1,010	
(a) Physical (10% of items 1 and 3)							
(b) Price (5% of item 1, 4% of item 2)							
	<u>960</u>	<u>2,130</u>	<u>3,090</u>	<u>2,700</u>	<u>6,000</u>	<u>8,700</u>	

a/ A small amount for local handling, transport, and assembly.

4.09 The construction costs shown are based on the evaluation of eight bids received in Amman on April 24, 1971. Contractors from six countries participated, and the lowest bidder, to whom the contract award is recommended, is a British/Jordanian joint venture. The unusual procedure of receiving bids for the project road construction before presentation of the project to the Board of Executive Directors was adopted because the effect on bidding of recent events in Jordan and the Middle East could not be forecast.

4.10 The foreign exchange component of construction costs is estimated at 65%; this is consistent with execution of the contract by a foreign/local joint venture contractor. Supervision of construction by the Ministry's foreign consultants is estimated to have a 70% foreign cost; execution of the Amman urban transportation study is estimated to have an 80% foreign

exchange component. The cost of maintenance equipment is shown in the summary at 100% of its c.i.f. landed value. The local assembly and delivery costs are assumed to be nominal.

4.11 The contingency allowances are reasonable. The 5% for construction price escalation is the average estimated price increase over the period from receipt of bids to completion of construction. A 10% contingency allowance has been made to cover possible quantity increases during construction. Equal increases are expected in local and foreign costs on the basis of available information. The 4% allowance for maintenance equipment is assessed on a similar basis for the two-year period between the preparation of estimates and the anticipated procurement. The 10% allowance for consultants' services is to cover possible increases in the man-months of work required.

G. Project Financing and Execution

4.12 The proposed credit would be to the Government of Jordan. The local costs would be met by the Government from funds earmarked for this project in its development budget; no difficulties in providing these funds are foreseen. The executing agency would be the Ministry of Public Works, assisted by qualified consultants under terms and conditions satisfactory to the Association. Agreement was obtained from the Government during credit negotiations that it will promptly retain consultants for construction supervision and for other expert services provided in the project (paras. 4.06 and 4.07).

4.13 The construction contract has been tendered on the basis of unit prices after international competitive bidding, and in accordance with the Association's "Guidelines on Procurement". The contract will be awarded in June 1971, and on this basis, construction should be completed by the end of 1973. The consultant for the urban studies of Amman should complete his work by the end of 1973.

H. Disbursements

4.14 Credit funds will be disbursed as follows:

Highway construction - 65% of payments to construction contractors.

Road maintenance equipment - 100% of the c.i.f. landed cost.

Consultant's services - the foreign exchange cost of payments to consultants.

Any surplus funds remaining in the Credit Account on completion of the project will be cancelled. A schedule of cumulative quarterly credit disbursements is shown in Annex A.

V. ECONOMIC JUSTIFICATION

A. Amman-Zarqa Highway

5.01 The proposed 18 km four-lane highway between Amman and Zarqa will relieve traffic congestion on the existing road (para. 4.02). The road is one of the most vital traffic arteries in Jordan's highway network; it links the two largest cities on the East Bank and is part of the main routes from Amman to Jordan's northern and eastern neighbors. Failure to provide additional road capacity could have serious implications on the development of the Amman-Zarqa corridor and the country.

5.02 The Amman-Zarqa road serves about 700,000 people, approximately one-third of Jordan's total population. Amman has about 400,000 inhabitants, and Zarqa, 150,000. Population growth is above average because of a continuing influx of refugees and immigration from rural areas which is stimulated by employment opportunities in the industries concentrated in the corridor. More than 90% of all sizeable industrial establishments on Jordan's East Bank are located in the Amman District (which includes Zarqa). Fifty-six industrial plants are located along the Amman-Zarqa road; these employ a labor force of about 4,000 and have an annual production of about 1 million m tons. The largest plants are those of the phosphate mines in Ruseifa (annual output 500,000 m tons) and the Jordan Refinery near the Zarqa terminal (annual output 400,000 m tons). Military establishments near Zarqa create some traffic on the road, however, the volume of this traffic was identified in the counts and omitted from the economic analysis.

5.03 The majority of vehicles using the road travel the full distance between Amman and Zarqa, and for this traffic there is no alternative route. A lightly trafficked branch road leads from Ruseifa to Suweileh and the construction of another from west of Ruseifa to the Desert Road (southern by-pass) is being considered by the Government. Both would involve considerable detours for traffic to and from Amman. The railroad, which parallels the road, is an insignificant factor in the carriage of passenger or freight traffic between the two towns.

5.04 The present traffic volume on the existing road is 10,400 vpd (Table 7), 59% of which are passenger cars and taxis. The savings in vehicle operating costs and time for the 75% of total traffic expected to use the new highway are fils 6.1 per km (US¢2.7 per mi) for passenger cars, fils 3.6 (US¢1.6 per mi) for taxis, fils 9.3 (US¢4.2 per mi) for buses, and fils 3.8 (US¢1.7 per mi) for trucks. These savings represent between 10% and 27% of present operating costs (Table 8). Further detail on traffic and benefits is given in Annex B.

5.05 The proposed investment, conservatively estimated, would yield a rate of return of 17% over an assumed 20-year life. If the time value of passengers, which has been evaluated at JD 0.37 (US\$1.03) per hour for private cars, JD 0.07 (US\$0.20) for taxis, and JD 0.48 (US\$1.35) for buses, is

excluded from the benefits, the rate of return would be 10%. The sensitivity of the rate of return was tested by reducing the benefits and the assumed traffic growth by 25% and simultaneously increasing the costs of construction (including contingencies) and land acquisition by 10%. Even with these extreme assumptions, the rate of return would be 10%, which is acceptable. Because of uncertainties about the future, a further test was made to determine the annual average growth rate of traffic which would be required for a rate of return of 12%. The resulting rate is 5%, which is lower than actual past increases and would certainly be exceeded under stable conditions in the country and a modest overall growth of the economy.

B. Road Maintenance Equipment

5.07 The US\$500,000 for maintenance equipment proposed in this project would meet urgent replacement needs in the existing equipment fleet. The maintenance consultant (para 4.06) will review the Government's request for equipment (Table 6) on the basis of an assessment of overall equipment needs and will recommend how maintenance practices, and the use of equipment in particular, can be improved.

5.08 The average age of the equipment proposed for replacement is 10 to 12 years. The available data do not lend themselves to comprehensive cost analyses from which optimum replacement ages could be derived. However, the items being considered are certainly well beyond such optimum ages. Their "repair and oil" costs in 1968 and 1969 were 70-100% higher and their effective working time 40-50% lower than for comparable machinery about five years old. Therefore, purchase of new equipment is justified on the basis of excessive running expenses and decreased availability for use of the existing items. To make up for shortages of equipment for present maintenance operations, the Government has often been obliged to rent machinery from private sources at higher costs.

VI. RECOMMENDATIONS

6.01 During credit negotiations, the Government gave a number of assurances, the most important of which are that it will: implement, in accordance with an agreed timetable, the agreed findings of the maintenance consultant (para. 3.16); undertake, without delay, the necessary urban studies to identify arrangements for distributing traffic from the Amman-Zarqa road (para. 4.07); and provide the Association, by December 31, 1974, with a timetable for the construction of additional traffic facilities required in the Amman area, as agreed with the Association (para. 4.07).

6.02 The proposed project constitutes a suitable basis for an IDA credit of US\$6.0 million equivalent to the Government of Jordan on the usual terms.

JORDAN
FIRST HIGHWAY PROJECT

Estimated Schedule of Disbursements

<u>IDA Fiscal Year and Quarter</u>	<u>Cumulative Disbursement at end of Quarter</u>
	(US\$ thousand)
<u>1971/72</u>	
September 30, 1971	200
December 31, 1971	600
March 31, 1972	1,200
June 30, 1972	1,800
<u>1972/73</u>	
September 30, 1972	2,800
December 31, 1972	3,500
March 31, 1973	4,400
June 30, 1973	4,900
<u>1973/74</u>	
September 30, 1973	5,550
December 31, 1973	5,750
March 31, 1974	6,000

Source: Association

March 5, 1971

JORDANAPPRAISAL OF A FIRST HIGHWAY PROJECTFurther Information on Traffic and Benefits

1. Traffic volume on the existing Amman-Zarqa road is highest at the Mahatta end in Amman (16,000 vpd), and falls to about 10,000 vpd in Marka, 4 km from Amman; from this point it remains fairly constant to Zarqa. Private passenger cars and taxis represent 59% of total traffic; trucks, 19%; buses, 6%; and vehicles of military and para-military organizations, 16%. Civilian traffic declined radically after 1967. Between 1961 and 1967, annual growth rates averaged 8%; during 1968 and 1969 traffic increased nearly 25% p.a. This steep increase resulted from the 1967 influx of approximately 100,000 refugees, a great many of whom settled in the area adjoining the road, and from the change in the trade flow pattern (para. 2.04).
2. Forecasting future traffic with any degree of accuracy is difficult, if not impossible, under the present circumstances. For the project analysis, traffic has been assumed to grow, up to the fifth year of operation of the new road, at annual rates of 12% for private passenger cars, 10% for taxis and buses, and 8% for trucks; thereafter growth is assumed to continue at reduced rates of 8%, 6%, and 5%, respectively (Table 7). These rates have no "scientific" basis but they are in general agreement with the current state of development in the area. The traffic generating effect of the new highway has not been considered separately.
3. The main benefits of the proposed highway will be savings in vehicle operating costs and passenger time and due to relief in congestion and increase in operating speeds. The possible capacity of the major part of the existing road is some 900 vph; hourly traffic volumes now vary between 500 and 700 vehicles and travel speeds average 40 to 45 km/h (25 to 28 mph). With increasing traffic, speeds will further decrease and operating costs increase. For the calculation of benefits, travel speeds of 40 km/h (25 mph) for light vehicles and 35 km/h (22 mph) for heavy vehicles were used for the existing road and of 80 km/h (50 mph) and 60 km/h (37 mph) for the new highway. The speed assumptions for the existing road probably understate the conditions prevailing until the new highway is opened in 1974.
4. The estimates of vehicle operating costs on the existing road and on the new highway are given in Table 8. The estimated savings per km are fils 6.1 (US\$2.7 per mi) for private cars, fils 3.6 (US\$1.6 per mi) for taxis, fils 9.3 (US\$4.2 per mi) for buses, and fils 3.8 (US\$1.7 per mi) for trucks. Most savings in vehicle operating costs are from reductions in the costs of depreciation, interest, and wages. When determining the cost of depreciation and interest for trips on the new highway, it was assumed that only part of the travel time savings would lead to a higher vehicle utilization.

Since most passengers in private cars, taxis, and buses are either on business trips or on trips to and from work, it is appropriate to include in the analysis an evaluation of their time. In line with the results of studies made in other countries ^{1/} on how transport users evaluate reductions in travel time, one-third of their earning rate was applied. Taking account of the average vehicle occupancies, the total value of passenger time savings resulted in JD 0.37 (US\$1.03) per hour for private cars, JD 0.07 (US\$0.20) for taxis, and JD 0.48 (US\$1.35) for buses.

5. Benefits were calculated only for the 75% of total traffic which will divert to the new highway (Table 8). The benefits from reduced congestion to traffic continuing to use the existing road, which are about 20% of the assessed benefits in the opening year and then will decrease again, have been disregarded. Further, benefits from a probable reduction in traffic accidents (390 in 1968, including 20 fatalities and 284 injuries) have not been quantified.

^{1/} For a detailed discussion see: "Evaluation of Travelling Time", C.J. Oort, Journal of Transport Economics and Policy, September 1969.

JORDAN
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Total Lengths of Primary and Secondary Roads, 1965-1969
(km)

<u>Year</u>	<u>Primary</u>		<u>Secondary</u>	
	<u>Total</u>	<u>Paved</u>	<u>Total</u>	<u>Paved</u>
1965	1,645	980 (60%)	1,575	860 (55%)
1966	1,715	1,235 (72%)	1,600	1,222 (76%)
1967	1,790	1,413 (79%)	1,620	1,280 (79%)
1968 <u>1/</u>	1,660	1,337 (81%)	1,038	648 (63%)
1969 <u>1/</u>	1,759	1,457 (83%)	1,038	689 (66%)

1/ Excludes lengths of road on West Bank.

Source: Ministry of Public Works

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JORDAN
FIRST HIGHWAY PROJECT

Motor Vehicle Fleet

<u>Year</u>	<u>Private Cars</u>	<u>Taxis</u>	<u>Trucks</u>	<u>Buses</u>	<u>Government and Other Authorities</u>	<u>Total</u>
1960	3,785	2,655	3,734	902	1,695	12,771
1961	4,130	2,649	3,679	916	1,888	13,262
1962	4,789	2,654	3,714	916	2,174	14,247
1963	5,607	2,641	3,917	920	2,337	15,422
1964	6,919	2,655	4,133	933	2,610	17,250
1965	7,926	2,725	4,384	968	2,760	18,763
1966	8,741	3,305	5,160	1,043	2,359	20,608
1967 ^{1/}	10,232	4,089	5,668	1,075	3,422	24,486
1968 ^{1/}	11,138	4,055	5,478	1,111	4,112	25,894

^{1/} Estimates.

Source: Highway Department, Ministry of Public Works

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JORDAN
FIRST HIGHWAY PROJECT

Fuel Consumption, 1964-1969
(thousand liters)

<u>Year</u>	<u>Gasoline</u>		<u>Gas Oil</u> ^{1/} ^{2/}	
	<u>Jordan</u>	<u>Amman District</u>	<u>Jordan</u>	<u>Amman District</u>
1964	51,040	22,054	128,753	51,440
1965	60,138	27,336	148,348	70,393
1966	73,357	33,964	148,245	56,502
1967 ^{3/}	70,933	42,851	141,537	64,600
1968 ^{3/}	74,935	52,477	143,738	78,751
1969 ^{3/4/}	88,330	62,065	135,179 ^{5/}	77,379

1/ Total consumption.

2/ Statistics for 1964-1968 were given in tons and converted at 1,160 liters per ton.

3/ The "Jordan" figures quoted exclude fuel consumed on the West Bank after June 1967

4/ Preliminary.

5/ Consumption on roads is estimated at 60% of total.

Source: Department of Statistics

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JORDAN
FIRST HIGHWAY PROJECT

Expenditures on National Highway Network, 1966-1970
(JD)

<u>Year</u>	<u>Administration</u>	<u>Maintenance</u>	<u>Construction</u>	<u>Total</u>
1966 (9 months only)	160,148	206,156	956,754	1,323,058
1967	184,990	317,743	1,933,048	2,435,781
1968	145,849	244,296	1,552,815	1,942,960
1969	154,580 ^{1/}	249,600 ^{1/}	2,838,191 ^{2/}	3,242,371
1970 ^{3/}	163,680	280,000	1,165,000	1,608,680

^{1/} Ministry's estimated expenditure.

^{2/} Includes JD 318,895 carried over from 1968.

^{3/} Budget allocation.

Source: Ministry of Public Works

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JORDAN
FIRST HIGHWAY PROJECT

Design Standards for Project Road

	<u>Unit</u>	<u>Rolling Terrain</u>			<u>All Areas</u>
		<u>Rural</u>	<u>Semi-Urban</u>	<u>Urban</u>	
Design speed	km/h	120	100	80	
Minimum radius of curvature	m	530	350	230	
Minimum stopping sight distance	m	225	170	125	
Minimum passing sight distance	m	850	700	550	
Maximum gradient	%				6
Traffic lane width	m				3.5
Shoulder width (outside)	m				2.5
Shoulder width (inside)	m				1.5
Right of way width	m	40		30	
Design axle load	m tons				12
Design loading, structures					H20-S16-44

Source: Ministry of Public Works

March 5, 1971

JORDAN
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Mechanical Equipment Purchases Proposed by the Government

<u>Description</u>	<u>No.</u>	<u>Estimated Cost</u> ^{1/} (US\$)
Motor Graders	4	72,000
Steel Rollers (10-12 ton)	5	40,000
Pneumatic Rollers	2	16,000
Dump Trucks (5-7 ton)	10	60,000
Pick-ups	5	15,000
Front End Loader	5	90,000
Asphalt Trailers	3	60,000
Asphalt Sprayers	2	40,000
Low Loader	1	25,000
Mobile Greasing Unit	2	11,000
Cat D4 Bulldozer (or equiv.)	2	36,000
Spares	-	<u>35,000</u>
Total		<u>500,000</u>

^{1/} c.i.f. Amman.

Source: Ministry of Public Works

March 5, 1971

JORDAN
FIRST HIGHWAY PROJECT

Projected Average Daily Traffic, 1969-1993

<u>Year</u>	<u>Private Cars</u>	<u>Taxis</u>	<u>Trucks</u>	<u>Buses</u>	<u>Others</u> ^{1/}	<u>Total</u>
1969 ^{2/}	2,400	3,710	1,970	620	1,720	10,420
1973 ^{3/}	3,430	3,807	2,326	454	860	10,877
1978	6,045	6,131	3,418	731	860	17,185
1983	8,883	8,204	4,363	978	860	23,288
1988	13,051	10,979	5,568	1,309	860	31,767
1993	19,175	14,693	7,106	1,752	860	43,586

1/ Mostly military traffic, which was disregarded in the benefit calculation.

2/ Actual volumes on existing road.

3/ For 1973 and later, traffic expected on new highway.

Source: Ministry of Public Works, Consultants, and Association

March 5, 1971

JORDAN
FIRST HIGHWAY PROJECT

Motor Vehicle Operating Costs and Savings
(JD per 100 km, excluding taxes)

	<u>Private Cars</u>	<u>Taxis</u>	<u>Buses</u>	<u>Trucks</u>
<u>Existing Road</u> ^{1/}				
Fuel, oil, and lubricants	0.230	0.230	0.667	0.780
Tires	0.026	0.026	0.212	0.265
Repair	0.114	0.114	0.366	0.468
Depreciation and interest	0.930	0.516	0.967	1.213
Insurance	0.020	0.170	0.600	0.200
Driver and assistant	-	0.313	0.511	0.715
Sub-total	<u>1.350</u>	<u>1.399</u>	<u>3.323</u>	<u>3.641</u>
Passengers' time	<u>0.921</u>	<u>0.184</u>	<u>1.365</u>	-
Total	<u>2.271</u>	<u>1.583</u>	<u>4.688</u>	<u>3.641</u>
US¢ per mi	10.2	7.1	21.0	16.4
<u>New Highway</u> ^{2/}				
Fuel, oil, and lubricants	0.205	0.205	0.453	0.529
Tires	0.049	0.049	0.368	0.460
Repair	0.164	0.164	0.423	0.550
Depreciation and interest	0.762	0.386	0.828	1.115
Insurance	0.020	0.170	0.600	0.200
Driver and assistant	-	0.156	0.292	0.408
Sub-total	<u>1.200</u>	<u>1.130</u>	<u>2.964</u>	<u>3.264</u>
Passengers' time	<u>0.461</u>	<u>0.092</u>	<u>0.797</u>	-
Total	<u>1.661</u>	<u>1.222</u>	<u>3.761</u>	<u>3.262</u>
US¢ per mi	7.5	5.5	16.9	14.7
<u>Savings</u>				
Vehicle operation	0.150	0.269	0.359	0.379
Passengers' time	<u>0.460</u>	<u>0.092</u>	<u>0.568</u>	-
Total	<u>0.610</u>	<u>0.361</u>	<u>0.927</u>	<u>0.379</u>
%	27	23	20	10

1/ Passenger cars and taxis: 40 km/h; trucks and buses: 35 km/h.

2/ Passenger cars and taxis: 80 km/h; trucks and buses: 60 km/h.

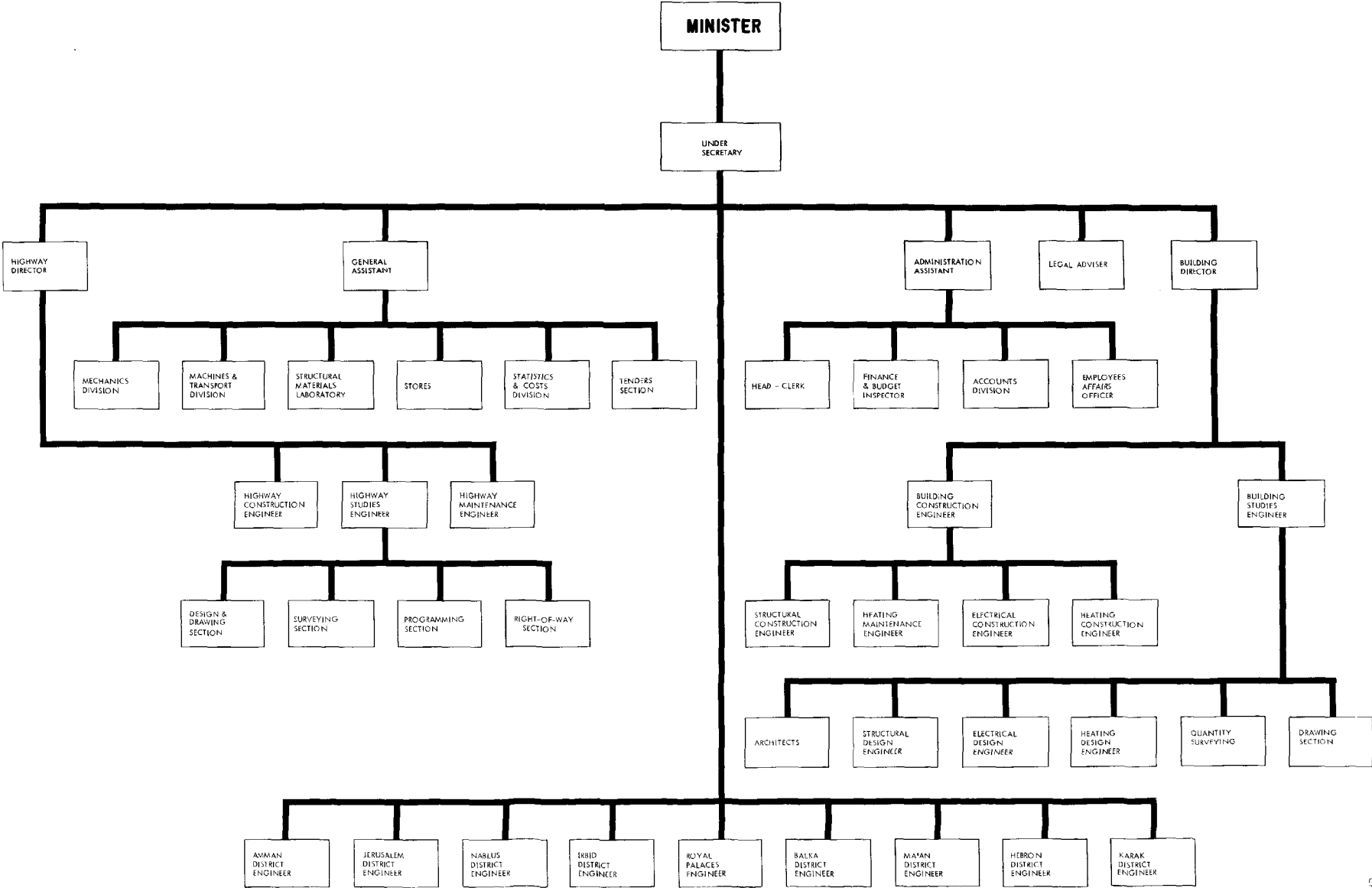
Source: Consultants and Association

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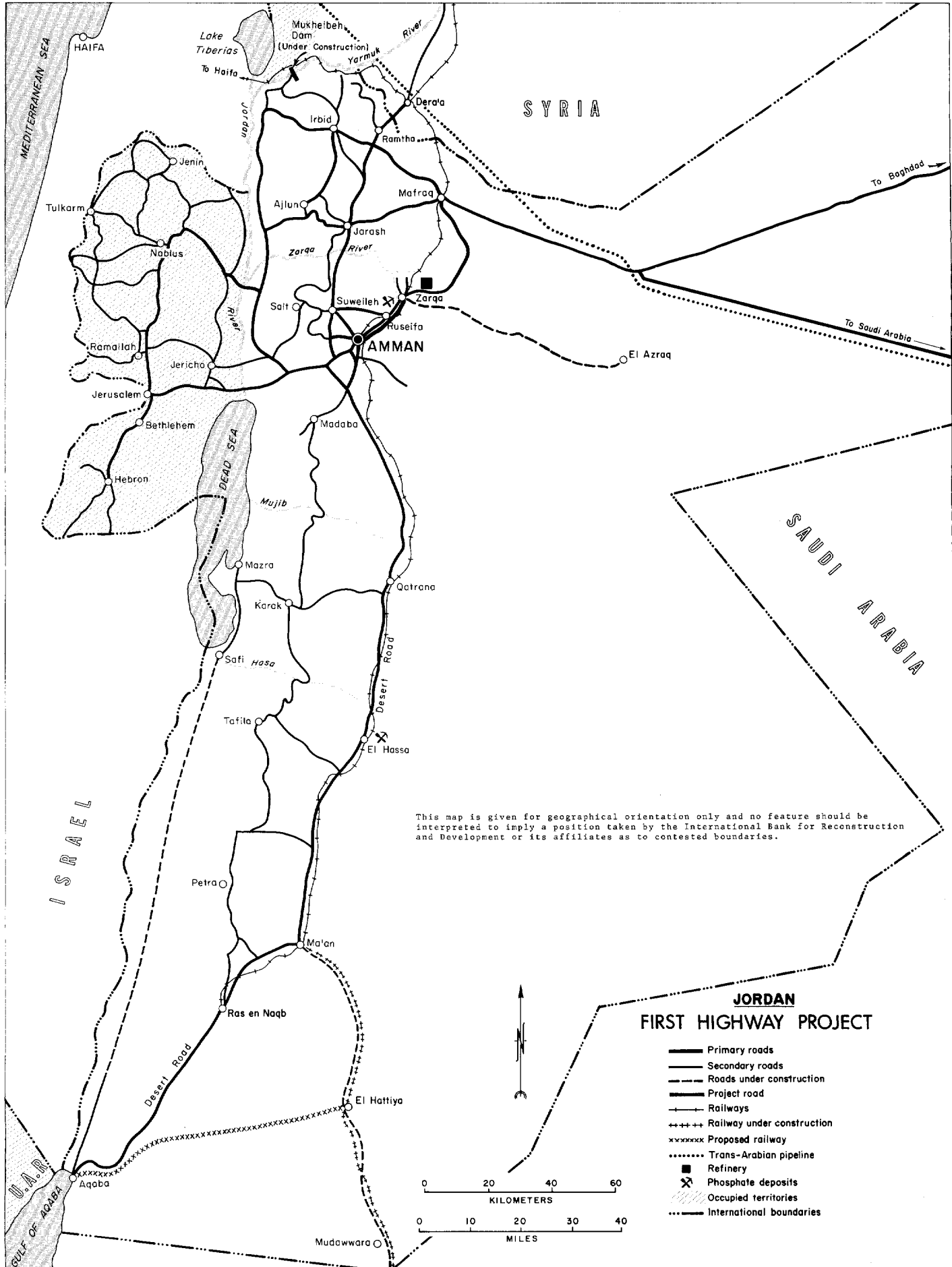
JORDAN: FIRST HIGHWAY PROJECT

MINISTRY OF PUBLIC WORKS

ORGANIZATION CHART



CHART



This map is given for geographical orientation only and no feature should be interpreted to imply a position taken by the International Bank for Reconstruction and Development or its affiliates as to contested boundaries.

JORDAN
FIRST HIGHWAY PROJECT

- Primary roads
- - - Secondary roads
- - - Roads under construction
- Project road
- Railways
- - - - - Railway under construction
- xxxxx Proposed railway
- Trans-Arabian pipeline
- Refinery
- ⊗ Phosphate deposits
- Occupied territories
- International boundaries