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SYRIAN ARAB REPUBLIC

AGRICULTURAL DEVELOPMENT OF THE AKKAR PLAIN

PART IV - SUMMARY

TIPTON AND KALMBACH-SCHICK INTERNATIONAL
DENVER SALT LAKE CITY

MARCH, 1979

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CONTENTS

PART IV - SUMMARY

	Page
THE DEVELOPMENT PLAN	1
Introduction	1
The Project Area	1
The Resources	3
Land	3
Surface Water	4
Groundwater	5
The Plan	6
Principal Features	6
Phase I	8
Phase II	8
Assumptions	11
Agricultural Benefits	12
Capital Costs	14
Annual Costs	15
Economic Analysis	15
Financial Analysis	15
CONCLUSIONS AND RECOMMENDATIONS	18
Feasibility	18
Technical Feasibility	18
Economic Feasibility	18
Financial Feasibility	19
Impact on the Economy	20
Change in Per Capita Income	20
Increase in Products Produced and Impact on Imports	21
Infrastructure Requirements	21
International Implications	23
Recommendations	24
Akkar Plain Authority	24
Additional Studies	25
Implementation	26
Janoubi River Channel Improvement	27
Drainage Improvement	27
Agricultural Service Center	27
Groundwater Development	27
Infrastructure Development	28
Surface Water Development	28

FIGURES

No.	Title	Following Page
1	Location Map	1
2	Project Area	1
3	Land Classification Map	4
4	Land Capability Classification	4
5	Drainage Plan	8
6	Rihaniyeh Reservoir and Irrigation System	9

THE DEVELOPMENT PLAN

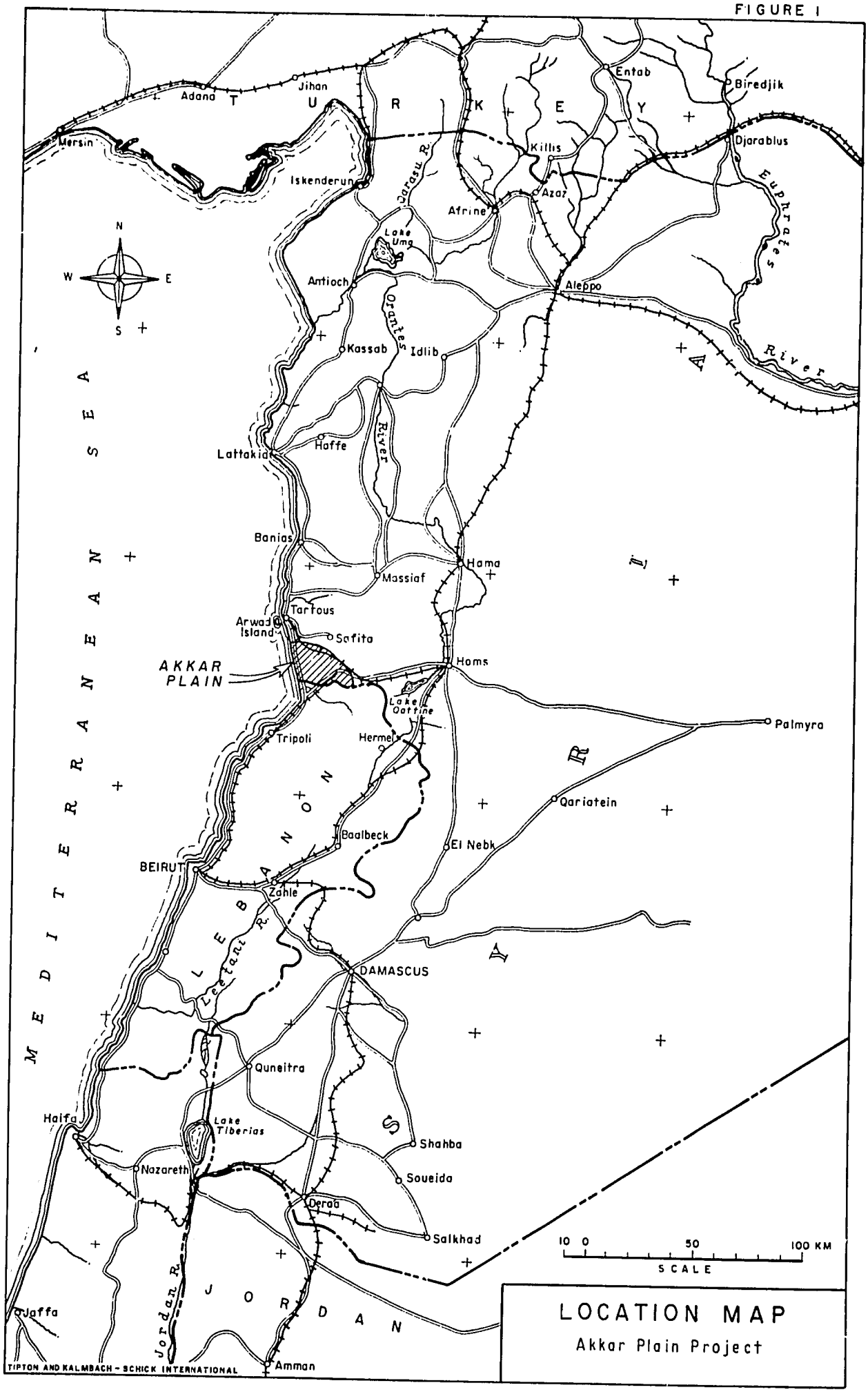
INTRODUCTION

The Akkar Plain is situated on the Mediterranean seacoast of Syria north of Lebanon as shown in Figures 1 and 2. While agriculture has been practiced for centuries on the Akkar Plain, the area has never reached its apparent potential. The Syrian Arab Republic Government (SARG), as part of an extensive program to develop the needed agricultural expansion throughout the country, commissioned a study of the area by the Public Administration Services, a United States consulting firm. It was concluded from the study that the potential exists for intense double-cropping irrigated agriculture on the Akkar Plain. A further study was therefore recommended to investigate the feasibility of the works required for such development. The United States Agency for International Development was requested by SARG to finance such a study, and AID in turn called upon the joint venture of Tipton and Kalmbach-Schick International to investigate the feasibility of agricultural development of the area by utilizing the existing water resources. The Ministry of Agriculture was designated by SARG as the cooperating agency and assigned the additional responsibilities of furnishing all counterpart and supporting staff, transportation, office space, and laboratory facilities. In October 1977, the studies were undertaken and have included: an inventory of the land resources; regional hydrology of the area including climate, runoff and occurrence of groundwater; existing agricultural restraints including drainage, fertility, pests and agronomic practices; the present condition of the agricultural infrastructure including transportation, communications, education, health and marketing; and the formulation of the Development Plan.

THE PROJECT AREA

The Project Area, consisting of approximately 23,000 hectares, is bounded by the Mediterranean Sea on the west, the Syrian Ansariye Mountains on the east, the international Syrian-Lebanon boundary at the Janoubi River on the south and an undefined limit on the north, arbitrarily set approximately four kilometers north

FIGURE 1



LOCATION MAP

Akkar Plain Project

FIG 2 -A

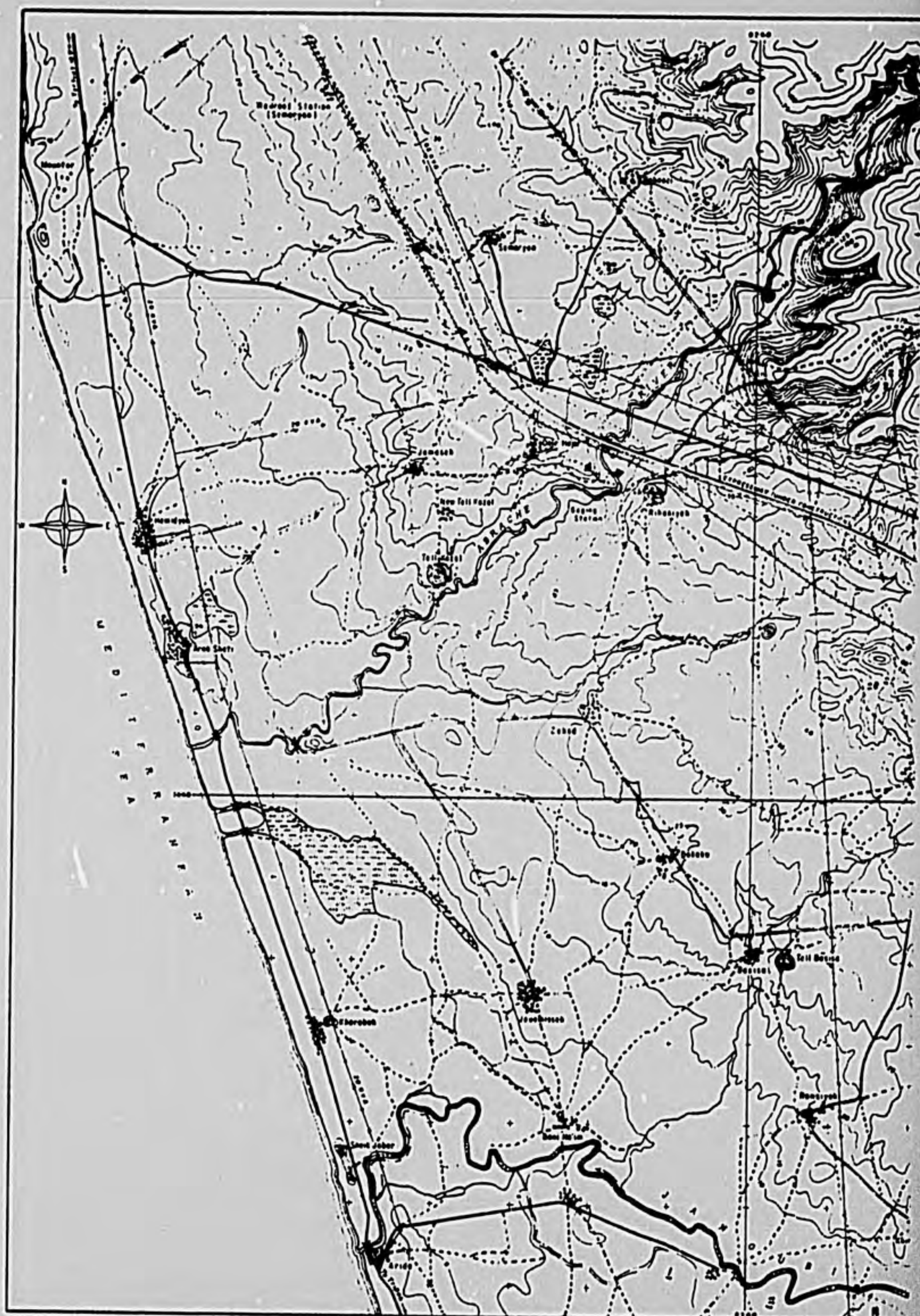


FIG. 2-B

FIGURE 2

of the Tartous-Homs highway. The principal city near the Project Area is the port city of Tartous. About 1,000 square kilometers of the Syrian Ansariye Mountains are drained through the area by the Janoubi and Abrache Rivers which flow across the Akkar Plain into the sea. The region is almost entirely agricultural today, as for centuries past. Dry land farming is presently carried out on the Plain on approximately 13,450 hectares and, in addition, approximately 3,550 hectares are irrigated from streams or wells. Grain crops are generally grown on the dry land area and vegetables, which are in great demand in Syria, are the chief crops in the irrigated area. Because of its Mediterranean climate; i.e., cool wet winters and mild dry summers, full agricultural development of the Plain cannot be achieved without storing the excess winter surface flows and making them available to the crops during the dry summer season.

The land area in the Akkar Plain is classified into four main areas or categories of ownership: private, reformed, cooperative, and government. Of the cultivated land, 67 percent is owned privately, 30 percent is reformed land being purchased by the farmers, 2 percent is government land rented to the farmer, and 1 percent is owned by the cooperatives. Land owned by a cooperative is operated by farmers on a share crop basis, or farmers can receive a salary plus a share of profits at the end of the year.

The government-sponsored redistribution program, Agrarian Reform, was initiated in 1958. The program distributed land from large-scale farmers to the small operators. This land is being paid for at a nominal rate over a 20-year period. Most of the farmers received some land as a result of the Agrarian Reform program. The land was allocated to landless peasants and small-scale operators according to shares with the shares being based on family size. The average farm operator has 8.4 hectares, including land rented for his own use.

Over fifty villages are presently within or adjacent to the Project Area. The population of the villages ranges from less than 50 to approximately 2,000 at Safsafeh. The total population of the Project Area was estimated at 18,000 persons in 1978, or a density of 81 persons per square kilometer.

In general, the present infrastructure of the Project Area, consisting of transportation system, communications network, power system, potable water supply, health facilities, educational facilities, marketing facilities, processing facilities, and storage facilities, is inadequate to meet the needs of the people. Both farmers and non-farmers living on the Akkar Plain must go to Tartous, Homs or other major cities to obtain many needed services.

Inadequate surface drainage and flooding of lands by flow from the Janoubi River are major problems to the farming community of the Akkar Plain. Most of the area is annually subjected to temporary inundation which limits root development of winter crops and causes delay of planting of spring crops until too late to make the best use of natural precipitation. In addition, about 850 hectares of arable land are flooded two out of three years by waters from the Janoubi River and one year out of ten years at least 1,300 hectares are flooded.

THE RESOURCES

An inventory was made of the land, surface water and groundwater resources of the Project Area as described in this section.

Land

With the application of sufficient water for irrigation and the necessary fertilizers to preserve their productivity, the better soils of the Akkar Plain are capable of producing high yields of vegetables and feed grains, and the poorer soils are capable of producing economic yields of forage and cereal grains for animal husbandry. Generally infertile, the soils have high cation exchange capacity and thus react well to fertilizers. The relatively shallow soils are predominately clay loams and clays and have high water-holding capacity. The following land areas were classified using basically the system of the U.S. Bureau of Reclamation:

Classification	Area (hectares)
1	971
2	9,574
3	6,981
5	2,450
Total - Arable	19,976
6	2,707
Total - Classified	22,683

The locations of the various classes of lands are shown on Figure 3.

The land capability, which is a combination of the physical factors expressed in the land classification considered together with the appropriate land use, was classified as follows:

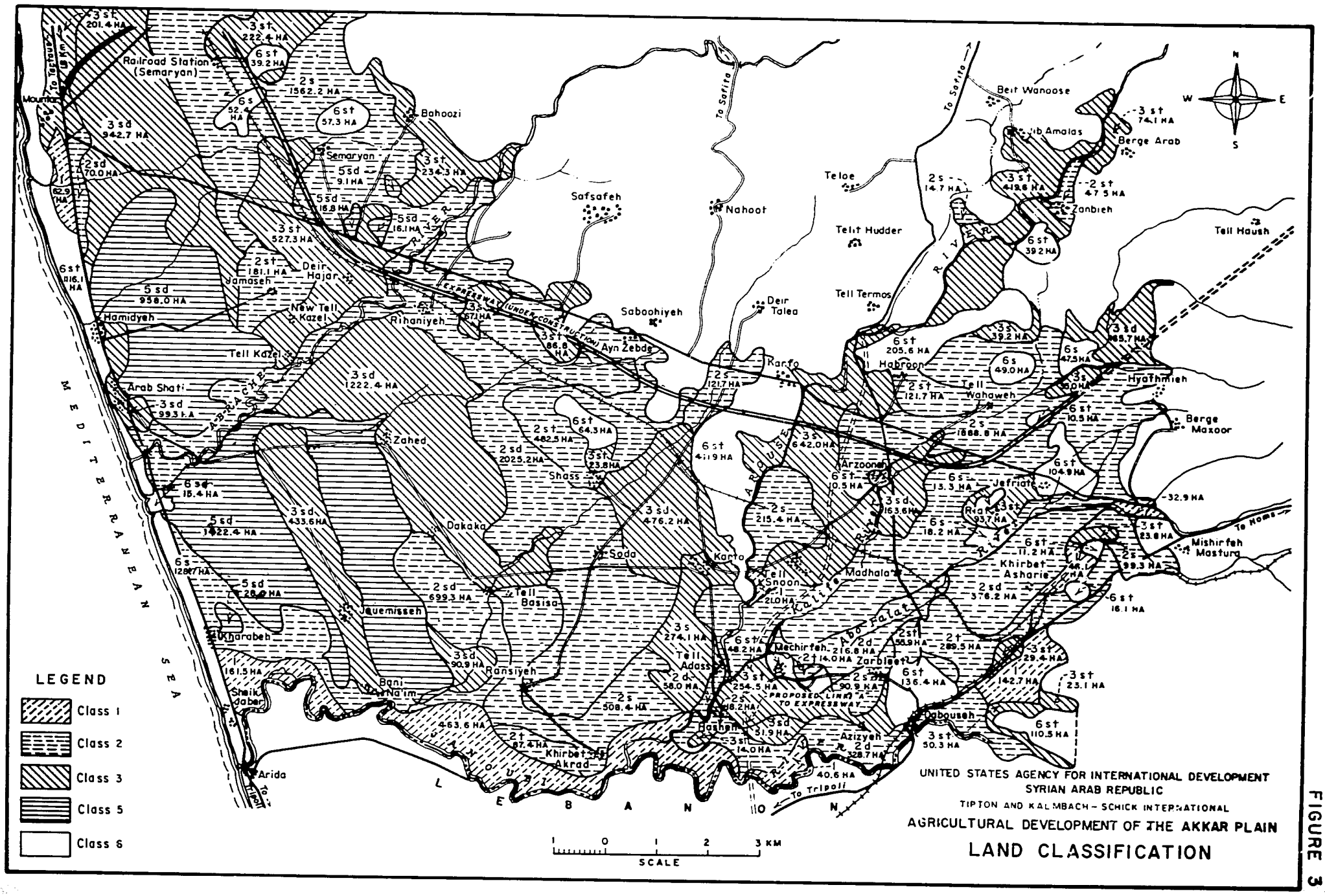
Capability Class	Area (hectares)
I	971
II	9,574
III	6,981
IV	2,450
VI	1,447
VIII	1,260
Total - Classified	22,683

The locations of the various land capability classes are shown on Figure 4.

Surface Water

The Project Area is transected by the Abrache, Arouse, Kalife and Abo Falat Rivers and the Janoubi River forms the southern boundary of the area. Short-term runoff records are available for the Abrache, Arouse, Kalife and Janoubi Rivers. The flows of the Abrache and Arouse Rivers, which vary from year to year and are virtually unused, could be used for irrigation of lands of the Akkar Plain. The average annual combined flow of the Abrache and Arouse Rivers during the period of 1965 to 1972 was 110 million cubic meters. The majority of runoff occurs during the six-month period of October through March.

12


LEGEND
Class 1
Class 2
Class 3
Class 5
Class 6
SCALE
1 0 1 2 3 KM
MEDITERRANEAN SEA
LEBANON
Railroad Station (Semaryan)
Bahoozi
Semaryan
Safsafeh
Nahoot
Teloe
Telit Hudder
Tell Termos
Deir Talea
Saboohiyeh
Ayn Zebde
Karto
Habroon
Tell Wahaweh
Arzooneh
Jefriate
Riaf
Madhala
Khirbet Asharie
Mishirfeh Masturq
Berge Maxoor
Hyathmieh
Berge Arab
Zanbieh
Beit Wanoose
Tell Haush
Tell Kazel
Arab Shati
Hamidyeh
New Tell Kazel
Deir Hajar
Jamaseh
Rihaniyeh
Zahed
Shass
Dakaka
Soda
Tell Basisa
Jouemisseh
Kharabeh
Sheik Jaber
Bani Na'im
Ransiyeh
Khirbet Akrad
Arida
Tell Adass
Mechirfeh
Zarbiset
Bashen
Azizyeh
Jabousseh
Tell Snoon
Abo Falat
PROPOSED LINK "A" TO EXPRESSWAY
EXPRESSWAY (UNDER CONSTRUCTION)
To Tripoli
To Safita
To Homs
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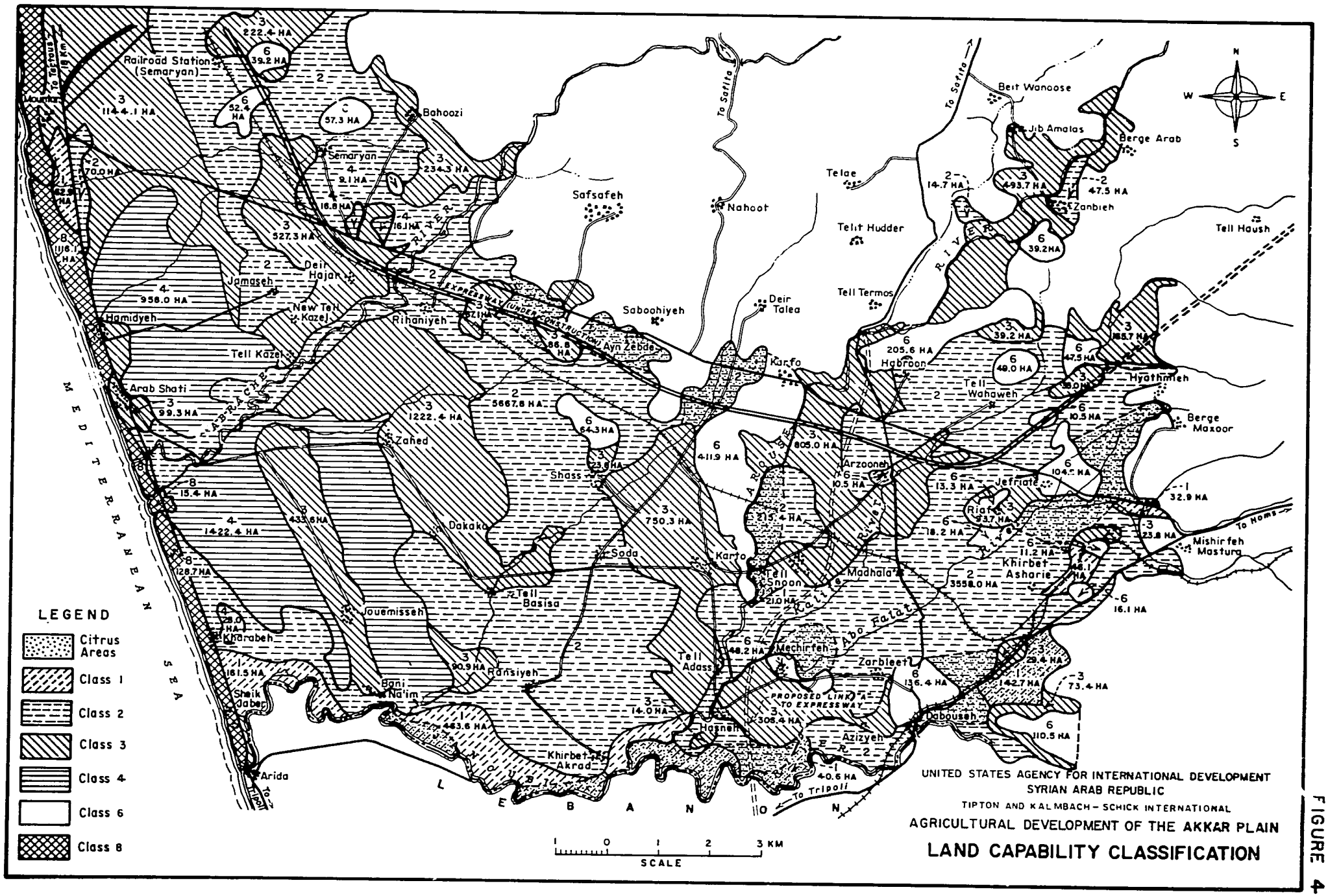
LAND CLASSIFICATION

FIGURE 3



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LAND CAPABILITY CLASSIFICATION

FIGURE 4

Groundwater

Groundwater occurs at relatively shallow depth throughout the Project Area. The Plain is underlain by Cretaceous limestone at depth over most of the area and at the surface in the northwest, northeast, and perhaps in the valley of the Arouse. Unconformably overlying the Cretaceous is a series of Tertiary deposits of extrusives and various facies of marine limestones, limey sandstones, and marls. Essentially the entire Plain area east of the Arouse River has basalt at the surface, and no wells visited were reported to have penetrated into limestone. West of the Abrache River most of the area has marine calcareous sediments at the surface, but basalt layers have been found at depth. Between the Abrache and Arouse, alternating limestones and basalts predominate, with the surficial rocks being largely basalt in the north and limestone in the south.

Productive wells have been found in nearly all types of formations, but no measured data are available to determine the horizons from which wells produce. Most of the drilled wells and some of the dug wells penetrate confined aquifers. It is believed that permeability is primarily in individual but discontinuous layers or beds with restricted and/or discontinuous vertical permeability. Permeability in the limestones probably is due largely to solution channels and fractures. In the basalts it is believed that permeability derives from cooling joints and from old weathered surfaces.

Pumping tests or recovery tests were carried out at 25 wells and the transmissivity of the aquifer was derived from the data. The transmissivity values so obtained varied from a few square meters per day to over 2,400 square meters per day. Specific capacity determinations were carried out at 69 wells. The specific capacity varied from less than 1 liter per second per meter to 53 liters per second per meter. Over two-thirds of the wells on which data are available have a specific capacity of less than 2 liters per second per meter. From inspection of specific capacity and discharge, it is apparent that many of the existing wells could produce more water than they presently produce.

Replenishment of the groundwater reservoir is derived from direct infiltration of rainfall, infiltration from stream beds and underflow originating in the mountains to the north. The infiltration of precipitation on the Project Area could be as much as 43 million cubic meters per year and the underflow originating in the mountains could be as much as 90 million cubic meters per year.

It is estimated that the present groundwater withdrawal of approximately 400 drilled wells and 150-200 dug wells irrigating 2,500 hectares on the Plain is on the order of 14 million cubic meters per year.

THE PLAN

The Development Plan is intended to describe the proposed project works which, when implemented, would assure the maximum integrated development of the water and land resources of the Akkar Plain. The program presented would be realistic of achievement with respect to timing and scheduling of project works, non-project works, corollary developments, and to the availability of the financial, physical, institutional, and human resources. These resources are required to implement the construction program and non-project activities that would be necessary to realize the potential economic benefits of the Development Plan.

Principal Features

The principal features recommended for development of the land and water resources of the Akkar Plain are:

1. Improvement of the Janoubi River channel to prevent flooding of croplands in the southwestern section of the Plain;

2. Improve existing surface drains and construct additional drains to control excessive precipitation runoff on the entire 23,000 hectares of the Plain and to reclaim the Ramit Laha swamp for agricultural use;

3. Utilization of the water from the Abrache and Arouse Rivers for irrigation. The Arouse River would be diverted into the Abrache River Basin and a storage dam would be constructed on the Abrache River to regulate the water resources of both rivers. Two damsites would be considered at Rihaniyeh and Yazdieh.

4. A canal system designed to convey water to 6,000 to 10,000 hectares of irrigable land on the Akkar Plain;

5. Drilled water wells in both the shallow and deep aquifers at locations on the Plain that have potential groundwater supplies;

6. Future extension of the canal system to transfer surface water replaced by the development of groundwater within the original area served from the Abrache River; and

7. Infrastructure facilities necessary to achieve full economic benefits from development of the water resources.

A plan to bring all seven principal features to completion would involve two phases of work with the second phase divided into two stages. Phasing the construction work would facilitate starting portions of the project which are not dependent upon other portions so that economic benefits would start to flow sooner than may occur if all of the development works were to be initiated together.

Implementation: An Akkar Plain Authority would be established as a separate department under the Ministry of Agriculture to implement the project as planned. The Authority would operate similarly, with its own financial budget and staff, to the relationship between the Minister of Agriculture and the present Department of Soils. After the Akkar Plain Development Plan is fully implemented and the various infrastructure features have accomplished their respective objectives, the Authority would begin phasing out by turning its responsibilities over to the relevant existing governmental departments. The Authority would be active for probably ten years or more following construction of Phases I and II.

Phase I

Under Phase I of the proposed plan of development, channel improvement and flood control works along the Janoubi River and surface drainage works benefiting the entire Project Area would be constructed. These features could be constructed quickly, would yield benefits in the first season following their construction, and the benefits are largely independent of other works. The proposed works are:

a. Sixty-three kilometers of new drains.

b. Eight kilometers of subsurface drains.

c. One hundred twenty kilometers of improved existing drains.

d. Ten kilometers of Janoubi River channel improvement.

The drainage works are shown on Figure 5.

Concurrent with the above construction, an Agricultural Service Center would be established to disseminate information and knowledge to the cultivators which will enable them to enhance their production under the existing agricultural structure. Land-smoothing will also be planned and supervised by the Center as part of the Phase I program as well as the construction of small grassed channels to convey surface water from private farmland to the main drainage channels constructed under this phase of the Plan.

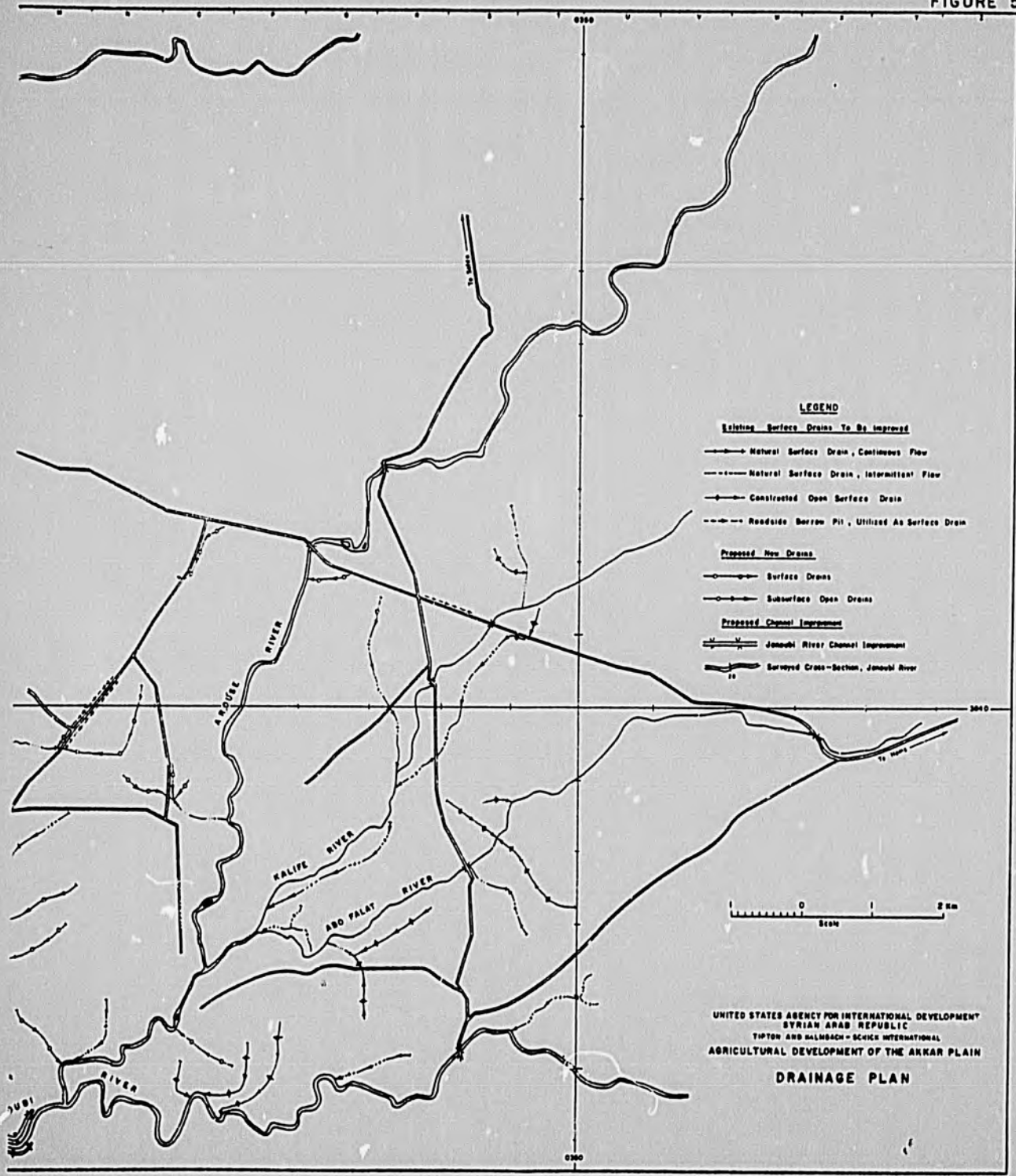
Phase II

Stage 1: Under Phase II, Stage 1, of the proposed plan of development, the surface irrigation system would be constructed. The proposed works are:

a. A diversion dam on the Arouse River at Berge Arab which would divert the flow of the Arouse River into the Abrache River Basin via the diversion structure and canal.

b. The Rihaniyeh Dam on the Abrache River which could create a storage reservoir having a total capacity of 77 million cubic meters and an estimated annual yield of 68 million cubic meters.

FIGURE 5 A


LEGEND
Existing Surface Drains To Be Improved
Natural Surface Drain, Continuous Flow
Natural Surface Drain, Intermittent Flow
Constructed Open Surface Drain
Roadside Borrow Pit, Utilized As Surface Drain
Proposed New Drains
Surface Drains
Subsurface Open Drains
Proposed Channel Improvement
Janoubi River Channel Improvement
Surveyed Cross-Section, Janoubi River
ARDUISE RIVER
KALIFE RIVER
ABO FALAT RIVER
JUBI RIVER
To Tripoli
0350
3040
0360
0
1
2 Km
Scale
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DRAINAGE PLAN

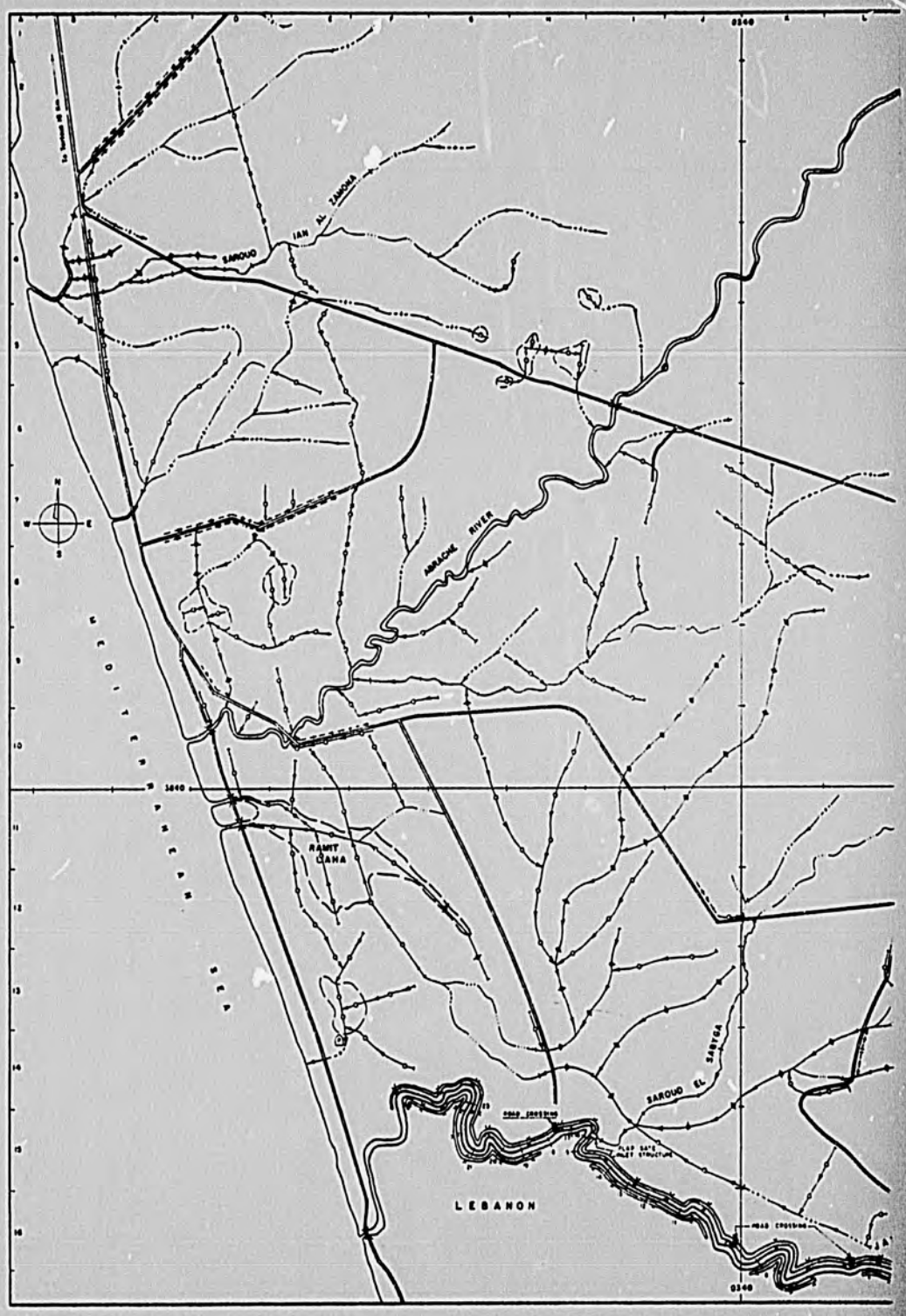

SAROUD
IAN AL ZAHRA
ABRACHE RIVER
RAMET
LAHA
SAROUD EL SABTIEH
LEBANON
MEDITERRANEAN SEA

Fig 5 B

c. A canal system from Rihaniyeh Dam to the irrigated area consisting of concrete-lined canals and appurtenant structures. A portion of the service area lies above the main canals and water would be pumped from the main canal into a secondary canal to serve this area. Approximately 97 kilometers of main and secondary canals are included in the system.

The irrigation system would command a gross farm area of 6,380 hectares and net irrigated area of 6,000 hectares of land of Land Capability Classes I, II and III. The annual water requirement at the head of the canal system is 65.2 million cubic meters. The Classes I and II lands will be double-cropped and produce primarily vegetables and some wheat, dry beans and vetch. The Class III lands will also be double-cropped and produce wheat, sorghum, maize, dry beans and vetch.

The investigation of storage sites in the Project Area was not included in the terms of reference of this study, and earlier investigations have not revealed an economic site. The Rihaniyeh site shown in this study has not been investigated, and the surface water system portion of the Development Plan cannot be finalized until further investigations are undertaken to determine the most economical storage site on the Abrache River.

The location of the Rihaniyeh Dam and its surface water irrigation system are shown on Figure 6.

In addition to the surface irrigation system, the following infrastructure facilities are included in Phase II, Stage 1:

1. Farm-to-Market Roads -- To improve existing roads and to construct new roads required for transporting products to market and for access to educational and other facilities.

2. Educational Facilities -- To upgrade existing schools and to construct new facilities to improve the standard of the school system.

3. Health Care Center -- To provide improved health facilities and care and thus increase the productivity of farm management and labor.

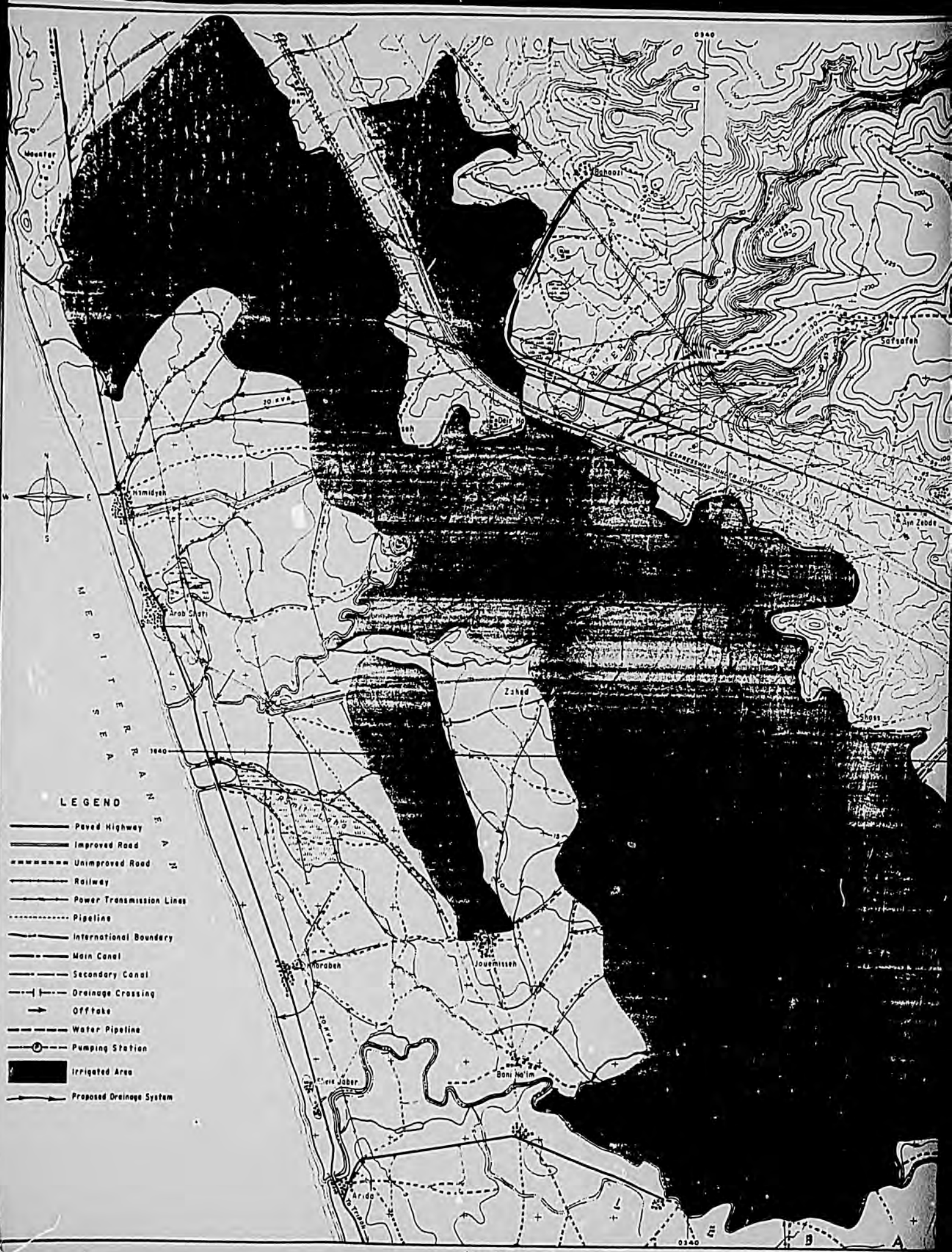
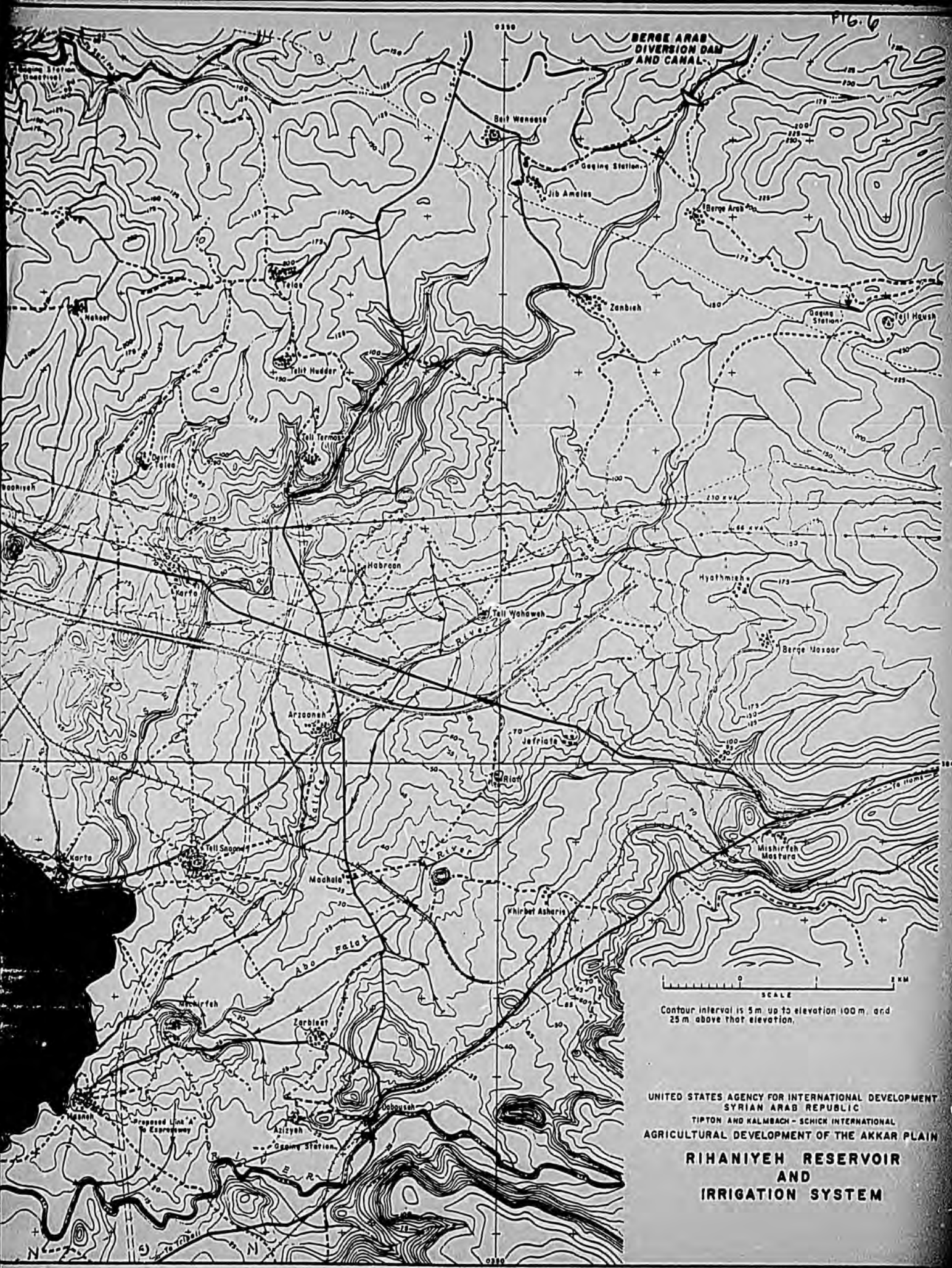

LEGEND
Paved Highway
Improved Road
Unimproved Road
Railway
Power Transmission Lines
Pipeline
International Boundary
Main Canal
Secondary Canal
Drainage Crossing
Offtake
Water Pipeline
Pumping Station
Irrigated Area
Proposed Drainage System
MEDITERRANEAN SEA
Mounter
Bahoosi
Safsafeh
Deir Ha
Himidyeh
Arab Shatt
Zahed
Shass
Ayn Zebde
Jouemisseh
Horabeh
Deir Jaber
Bani Na'im
Arida
20 KVA
0340
1040
A
B

FIG. 6A

FIG. 6



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RIHANIYEH RESERVOIR AND IRRIGATION SYSTEM

FIG. 6 B

4. Dairy -- To utilize production from Land Capability Class IV and improve the general diet of the people in the Project Area.

5. Processing Plants -- To process food, dairy products and livestock and thus obtain maximum return from products produced in the Project Area.

6. Grading and Packing Facilities -- To provide uniform grading and better packing of project products and thus improve their price structure.

7. Small Grain Storage -- To provide storage for the volume of small grains which will exceed the capacity of the on-farm storage.

The scope of activities of the Agricultural Service Center constructed under Phase I of the Plan would be increased as the area of intensive agriculture increases. Smaller irrigation and drainage works required to extend the systems to be constructed by the Government to individual farms and land-smoothing work would be carried out by the Center during Phase II of the Plan as well as continuing its role as the disseminator of agricultural information and knowledge.

Stage 2: Under Phase II, Stage 2, of the proposed plan of development, the groundwater irrigation system would be constructed. Although scheduled in Phase II, Stage 2, the further development of groundwater should be started in the early stages of the Development Plan. The works consist of re-equipping wells which are being operated below their potential; deepening existing wells; drilling new shallow wells by cable tool methods; and drilling new exploratory and production wells in the deep aquifers by rotary drilling methods.

The groundwater irrigation system as included in the Development Plan will command a gross farm area of 5,290 hectares and a net irrigated area of 4,970 hectares of land of Land Capability Classes I, II, and III. The annual gross pumping to serve this area is approximately 54.0 million cubic meters. The cropping pattern for this portion of the project is the same as the pattern of the surface water system.

The investigation of the groundwater resource was not included in the terms of reference of this study as it was understood that the resource had been identified in previous investigations. This was not the case and the total development of the groundwater resource cannot be planned until the resource is quantified. The groundwater development shown in the Development Plan utilizes only 40 percent of the preliminary estimate of the groundwater resource.

Assumptions

The foregoing listing of works embodied in the Development Plan is predicated on the assumption that certain supplemental explorations and investigations that have not yet been undertaken will substantiate the technical and economic feasibility of the several features of the plan. There are two areas in which further field investigations will have to be completed before the definitive plan of development can be finalized. Firstly, it is essential that sufficient mapping and exploratory drilling be undertaken at the Rihaniyeh site on the Abrache River to ascertain if it is technically and economically feasible to construct a major storage reservoir at that site and whether it would be more attractive than to attempt to develop the Yazdieh site which earlier was studied by Sofrelec. Secondly, it will be necessary to construct a number of test wells at various locations on the Plain to better define the extent and characteristics of the underlying shallow and deep aquifers to evaluate their water development potential.

It will be recalled that at the outset of this study it was assumed that investigations which had been carried out earlier would adequately define the best storage site and provide sufficient information to evaluate the potential yield of the groundwater resource. As it developed, this was not the case and further investigations will be necessary to define the best site for reservoir storage and the scope of the groundwater development program. Notwithstanding the uncertainties which cannot be resolved until the completion of the exploration program, to enable completion of the Report the assumption is made that provision of storage as well as the development of additional groundwater supplies to the extent envisaged herein will be found to be feasible.

Agricultural Benefits

The agricultural benefits of the Development Plan were quantified: firstly, to arrive at an estimate of the direct irrigation benefits which can be set against the project costs in the economic analysis of the project; and secondly, to establish a basis for estimating future repayment capacities of the irrigators; these, in turn, become factors in the financial analysis.

A common basis from which both the irrigation benefits and the repayment capacities can be derived is provided by the net farm income. This is defined as the gross value of agricultural production less the costs of all farm inputs, except the costs of irrigation water and family labor, but inclusive of the costs of on-farm land preparation for irrigation. In this analysis the opportunity cost of the farmer's investment in land, equipment, and operating capital is included in the costs of farm inputs. The farmer's investment is defined as the summation of the value of his land, farm irrigation structures, farm machinery, hand tools and operating capital. The annual opportunity cost is estimated to be 6 percent of the farmer's investment. According to the above definitions, the net farm income under future-without-project condition represents the return to family labor from dry farming or existing irrigation conditions. In the Akkar Plain area dry farming or limited irrigation farming is the only alternative to an irrigation project with regard to family labor, thus the opportunity cost of family labor is equivalent to the net farm income under future-without-project condition.

The net direct farm benefit used in the economic analysis is defined as the net farm income with-project development in excess of the net farm income without the project. Accordingly, in determining the irrigation benefit; i.e., the returns to irrigation water, family labor is valued at opportunity cost, and this is reflected by the returns under future-without-project development. The other farm inputs are valued at present costs, and agricultural products are valued at world market prices where applicable.

The payment capacity used in the financial analysis is the upper limit of the amount available by the farmer for payment of annual costs and for repayment of

capital costs of the irrigation project. In this analysis, the payment capacity is equivalent to the residual farm income, which is defined as the net farm income with project development less a family living allowance deduction. The family living allowance is intended to: compensate the operator and his family for their labor; provide the operator a fee for managing the farm; and reimburse the family for the farm products consumed in the home. In this analysis, the labor is compensated at a rate of SP 25 per man day; the management fee is 1 percent of the gross value of sales and the farm products are reimbursed at market prices. It is recognized that only a portion of the payment capacity can be returned to the project as a portion must be retained by the farmer to provide the necessary incentive for the increased labor and financial risks attendant upon intensive agriculture.

Net Farm Income: The net farm income per hectare of the various types of farm enterprises for the present condition, future-without-project and future-with-project is shown in the following table. The net farm income per hectare is determined by dividing the net farm income of the farm enterprise by the number of hectares of the farm enterprise including idle land.

Farm Type	Condition	Land Capability Class	Net Farm Income (Per Hectare) (SP)	(U.S. $)
General	Present	Composite	94.00	24.00
General	Future-Without	Composite	199.00	51.00
Vegetable	Future-With	Class I	9,769.00	2,505.00
Vegetable	Future-With	Class II	8,755.00	2,245.00
General	Future-With	Class III	811.00	208.00
Forage	Future-With	Class IV	316.00	81.00
Citrus	Future-With	Classes I & II	8,818.00	2,261.00
General (Drainage)	Future-With	Composite	406.00	104.00

Net Direct Farm Benefits: The net direct farm benefit, defined as the net farm income with project development in excess of the net farm income without the project, was determined for the several phases of the project as shown on the following table.

Project Phase	Segment	Annual Net Direct Farm Benefit (SP x 10^3)	(U.S.$ x 10^3)
I	Channel Improvement	397.8	102.0
I	Drainage System	3,549.0	910.0
I	Channel Improvement & Drainage	3,946.8	1,012.0
II	Stage 1, Surface Irrigation	28,002.0	7,180.0
II	Stage 2, Groundwater Irrigation	22,542.0	5,780.0
II	Stage 1 and Stage 2	50,544.0	12,960.0
I and II	Total Project	54,490.8	13,972.0

Payment Capacity: The payment capacity defined as the net farm income with project development less a family living allowance deduction was determined for Phase II of the Development Plan. Payment capacity will only be considered for the cultivators under the surface water and groundwater irrigation systems. The payment capacity of the irrigators of Phase II is shown in the following table.

Land Capability Class	Payment Capacity (Per Hectare) (U.S.$)	Area (ha)	Total Payment Capacity (U.S.$)
I	2,160.18	735	1,587,732
II	1,939.49	4,937	9,575,262
III	407.35	5,998	2,443,285
	Total	11,670	13,606,279
		Use U.S.$	13,606,000
		SP	53,063,000

Capital Costs

The capital cost of the physical works, facilities, equipment and services necessary for the implementation of the development plan is about SP 343.09 million as follows:

Feature	Estimated Capital Cost (SP x 10^6)
Phase I - Channel Improvement and Drainage System	11.38
Phase II, Stage 1 - Surface Irrigation System	276.90
Phase II, Stage 2 - Groundwater Irrigation System	22.62
Phases I and II - Infrastructure	32.19
Total Capital Costs	343.09

Approximately 47 percent of the capital costs of the project works and 15 percent of the capital costs of the infrastructure would be incurred in foreign currency.

Annual Costs

The estimated annual costs of operation and maintenance of the project works is about SP 4.14 million as follows:

Feature	Estimated Cost (SP x 10^6)
Phase I - Channel Improvement and Drainage System	0.02
Phase II, Stage 1 - Surface Irrigation System	1.25
Phase II, Stage 2 - Groundwater Irrigation System	2.87
Total Annual Cost	4.14

ECONOMIC ANALYSIS

Evaluation of project benefits was made for each segment of the project, for each phase of the project, and the total project, including the determination of the economic internal rates of return (EIRR) and the benefit-cost ratios. The summary of the analyses follows:

Project Phase	Segment	EIRR	Benefit-Cost Ratio @ 8% Discount Rate
I	Channel Improvement	12.0	1.5
I	Drainage System	32.8	4.6
I	Total Phase I	27.7	3.9
II	Stage 1, Surface Irrigation	8.1	1.0
II	Stage 2, Groundwater Irrigation	75.6	4.5
II	Stage 1 and Stage 2	12.4	1.5
I and II	Total Project	13.0	1.6

FINANCIAL ANALYSIS

A financial analysis was made of the project and to accomplish this study it was necessary to make a number of assumptions regarding sources of funds, interest rates,

repayment periods, water charges and related items. For this reason, the results of the financial analysis are only intended to illustrate a rational approach to financing of the irrigation development, it being recognized that governmental policies and decisions that may be made from time to time or alterations of some of the assumptions regarding funding will modify the results accordingly. The principal assumptions made in the study are:

1. Cash flow at all categories of project costs, including capital and operation, maintenance and replacement, for the project works are included. The cost of the Agricultural Service Center and its estimated operation and maintenance costs are included in the project costs. The capital, operation and maintenance costs of the remainder of the infrastructure shown in the Development Plan are assumed to be borne by other governmental agencies and are not included in the costs of the Akkar Plain Project.

2. The local currency requirements would be provided by SARG grants which are free of interest or other financial charges. Foreign currency requirements would be provided by loans from international lending institutions. The loans would carry interest inclusive of all financial charges at the rate of 7 percent per annum from time of disbursement. Repayment will be deferred until the third year following the final year of disbursement, after which the proceeds of the loan plus accrued interest will be amortized over a period of 30 years.

3. It is assumed that no irrigation charges will be levied as a result of the construction of the channel improvement and drainage system of Phase I. Irrigation charges will be made as a result of the construction of surface and groundwater facilities of Phase II. Levies against irrigators will be deferred through the initial development period until the eighth year of the project. The water charges to be levied are based on the payment capacity of the irrigators in the amount of 25 percent of the project's payment capacity

which is equivalent to annual water charge of SP 1137 per hectare of 11,670 hectares in the gross farm area served by the irrigation systems.

The summary of the financial analysis of Phase I and Phase II for a 54-year period is shown in the following table.

(All values in SP x 10^3)

Capital Expenditures			O & M and Replac.	Irrigation Revenues	Foreign Currency Loans		Surplus or (Deficit)
Local	Foreign	Total	Local		Disbursements	Debt Service	
166,067	146,052	312,119	241,715	623,502	146,052	491,730	(276,010)

The cumulative deficit over the 54-year period; i.e., gross irrigation revenues less the costs of local capital expenditures, operation, maintenance and replacement and debt service on foreign currency loans, is SP 276,010,000. To eliminate this deficit, an increase in water charges from SP 1137 per hectare to almost SP 1640 per hectare would be required beginning with Project Year 8. However, to project such an increase would be unrealistic in view of present water charge policy in Syria. Furthermore, it would be viewed as unrealistically high in highly developed agricultural areas, as for example in the United States.

The cumulative deficit over the 54-year period of analysis of SP 276,010,000 amounting to an average annual deficit of SP 5.1 million is manageable. The Government could assume the deficit as a general public obligation which is recovered from the indirect benefits of the project estimated to be SP 75 million per year at full development.

CONCLUSIONS AND RECOMMENDATIONS

Although no unusual risks, nor particularly difficult or hazardous problems, are involved in constructing the project works of the Akkar Plain Project, it is nevertheless a major undertaking for the Syrian Arab Republic Government. The conclusions expressed herein are based, in part, on the following assumptions:

1. Further investigations will confirm that a suitable storage site is available on the Abrache River for the storage of approximately 77 million cubic meters of water at a construction cost of approximately U.S. $53 million or less.

2. Further investigations of the groundwater resources will confirm that supplies are adequate to irrigate approximately 4,970 hectares by groundwater supplies.

The Development Plan, including the above assumptions, is feasible and is the only means of transforming a subsistence agricultural area into an important productive agricultural area.

FEASIBILITY

Technical Feasibility

The various works of the Development Plan present no unusual or difficult construction problems. The supplies, materials, equipment, manpower and technical knowledge required for the construction of the project are presently available in Syria or are readily available in the world market.

Economic Feasibility

Irrigation of the Akkar Plain clearly is feasible by the economic standards commonly applied to projects of this nature and magnitude, and according to the criteria which have been adopted in evaluating the direct benefits of the project.

In the latter connection, it should be emphasized that, although the projected yields of irrigated crops are high by local standards, they have already been exceeded in developed areas of the world; and they are not unreasonable according to contemporary experience of developing areas where Government has taken an active and effective role in promoting irrigation development.

The values of the economic parameters derived from the evaluation studies in the Report are favorable for projects of this kind. Accepting these values, the project must be rated as a potentially profitable enterprise and one that is worthy of careful consideration in the long-range program of development of agriculture in Syria.

The above relates economic feasibility only to direct project benefits. According to the projections given in the Report, indirect benefits will exceed the direct benefits at full development by a ratio of 1.4:1. As only the infrastructure costs are charged against the indirect benefits, the balance is a credit to the general economy of Syria. Indirect benefits are difficult to quantify; but if the above concepts are accepted in principle, the irrigation of the Akkar Plain is unquestionably an economically feasible undertaking.

In addition to the direct and indirect benefits which can be quantified, intangible benefits which cannot be expressed in monetary terms will flow with the project. These benefits, consisting of greater economic stability, increased vocational skills, better health conditions and increased job opportunities for the young people of Akkar Plain, will greatly enhance the well-being of the entire population of the region.

Financial Feasibility

As shown in the Report, the properly allocable capital and annual costs of irrigation cannot be recovered in a reasonable period of payout by levies against the direct benefits of development which are realized by the individual cultivators. This is not an uncommon forecast for a large-scale irrigation project which involves major storage works to serve broad areas of undeveloped land. It applies to virtually all of the irrigation developments which have been constructed in the Western United States under the program of the U.S. Bureau of Reclamation. This, despite the fact

that these projects collectively are considered as world standards for government-sponsored irrigation development, and individually they are favored with very generous repayment terms compared to those postulated for the Akkar Plain Project.

In any event, as shown in the Report, direct revenues from irrigation can pay all annual costs of irrigation and also make a substantial contribution toward the capital costs of the project works. The remaining deficits in revenues to repay the costs of the project works would be accounted for by appropriations from general tax revenues which, in effect, are drafts on the secondary benefits of development. This method of financing is realistic in the sense that it recognizes that the primary beneficiary of successful irrigation development is the general economy, and a portion of the direct costs of project development should properly be borne by revenues derived from indirect benefits which accrue to the economy.

From the foregoing it may be concluded that the project is financially feasible from the standpoint of repayment of capital costs and the payment of annual costs.

IMPACT ON THE ECONOMY

Change in Per Capita Income

Under present conditions, the estimated cash income per farm household on the Akkar Plain is SP 741. The disposable cash income, which includes a return to the farm from interest on fixed assets, is SP 5,000 or SP 515 per capita. With the project, this disposable income would increase to SP 39,000 per household or a per capita disposable cash income of SP 3,980.

This substantial increase in the disposable income of the farmers on the Akkar Plain is due to fully utilizing the existing resources. The estimated farm area of 11,670 hectares under the command of the surface water and groundwater irrigation systems will be irrigated with a 100 percent supply. Of this area, 50 percent will be intensely double-cropped with high yield vegetables and 50 percent double-cropped with other field crops.

The cropping pattern will not change significantly and no new crops will be introduced. The emphasis is placed on full water requirement irrigation, improved cultural practices, and generally intensifying the agriculture.

Increase in Products Produced and Impact on Imports

The table on the following page compares the project production and value of production for the future-without-project and future-with-project. The net annual increase in the value of production as shown in Column (12) is U.S. $44,854,636 (SP 174,933,000). The net increase in feed grain production consisting of wheat, sorghum and grain corn is 31,850 tons (Column (11)), having a value of U.S. $4,627,608 (SP 18,048,000), which would decrease the requirement of importing this amount of these commodities. The value of the net increase in vegetable production is U.S. $37,865,619 (SP 147,676,000) as shown in Column (12)). It is estimated that 40 percent of the increase in vegetable production could be exported, which would improve SARG's balance of payments of foreign trade.

The increase in agricultural production, along with the increase of disposable income on the Akkar Plain, will have a significant economic impact on the financial position of the Syrian Arab Republic. This impact will not only be felt in the immediate production area of the Akkar Plain, but will be noted throughout Syria and other parts of the Middle East.

INFRASTRUCTURE REQUIREMENTS

To fully realize the benefits of the agricultural development of the Akkar Plain, it is essential that the infrastructure facilities of the Project Area be enlarged and improved. These essential facilities include:

1. Agricultural Service Center -- To provide technical guidance, agricultural research, and on-farm development.
2. Farm-to-Market Roads -- To improve existing roads and to construct new roads required for transporting products to market and for access to educational and other facilities.

Projected Crop Production on the Akkar Plain

Crop	Unit Price	Future-Without-Project (17,179 ha)		Future-With-Project: Drainage (5,055 ha)		Future-With-Project: Surface & Groundwater Irrigation (11,670 ha)		Future-With-Project: Total		Net Increase	
	(U.S. $/ton)	Production (tons)	Total Value (U.S. $)	Production (tons)	Total Value (U.S. $)	Production (tons)	Total Value (U.S. $)	Production (5) + (7) (tons)	Total Value (6) + (8) (U.S. $)	Production (9) - (3) (tons)	Total Value (10) - (4) (U.S. $)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Feed Grains											
Wheat	155.76	7,748	1,206,828	2,709	421,954	26,048	4,057,236	28,757	4,479,190	21,009	3,272,362
Sorghum	123.11	2,165	266,533	785	96,641	3,260	401,339	4,045	497,980	1,880	231,447
Maize (grain)	125.41	--	--	--	--	8,961	1,123,799	8,961	1,123,799	8,961	1,123,799
Subtotal - Feed Grains		9,913	1,473,361	3,494	518,595	38,269	5,582,374	41,763	6,100,969	31,850	4,627,608
Groundnuts											
Peanuts	400.00	4,838	1,935,200	1,550	620,000	--	--	1,550	620,000	(3,288)	(1,315,200)
Vegetables[1]	105.13	87,172	9,164,392	27,976	2,941,117	419,375	44,088,894	447,351	47,030,011	360,179	37,865,619
Dry Beans	194.87	--[2]	--	--[2]	--	13,384	2,608,140	13,384	2,608,140	13,384	2,608,140
Vetch	44.00	--	--	--	--	10,409	457,996	10,409	457,996	10,409	457,996
Maize (table)	177.00	--[2]	--	--[2]	--	3,449	610,473	3,449	610,473	3,449	610,473
Total			12,572,953		4,079,712		53,347,877		57,427,589		44,854,636
											(SP 174,933,000)

(1) Vegetables include:
tomatoes, eggplant, cucumbers, squash, melons, etc.
(2) Included with vegetables

36

3. Educational Facilities -- To upgrade existing schools and to construct new facilities to improve the standard of the school system.

4. Health Care Center -- To provide improved health facilities and care and thus increase the productivity of farm management and labor.

5. Dairy -- To utilize production from Land Capability Class IV and improve the general diet of the people in the Project Area.

6. Processing Plants -- To process food, dairy products and livestock and thus obtain maximum return from products produced in the Project Area.

7. Grading and Packing Facilities -- To provide uniform grading and better packing of project products and thus improve their price structure.

8. Small Grain Storage -- To provide storage for the volume of small grains which will exceed the capacity of the on-farm storage.

INTERNATIONAL IMPLICATIONS

Under the Development Plan, the quantity and quality of the Janoubi River, which in its lower reaches is the boundary between Syria and Lebanon, will be altered by:

1. Diverting much of the flow of the Arouse River into the Abrache River Basin.

2. Channel improvement of the lower Janoubi River.

3. Increased return flow from the project lands.

The Arouse River would be diverted at Berge Arab into the Abrache River Basin, which would essentially dry up the stream at that point during periods of low flow. However, several spring-fed accretions to the stream occur below the point of diversion

and these are expected to increase under project operations as a result of return flow from project lands.

The Janoubi River Channel Improvement will change significantly the hydraulic properties of the channel. The 10-year frequency flood flows will be contained in the improved channel and thus reduce the flood hazards to bordering lands in Lebanon and Syria. Some productive land will be lost on both sides of the river to provide for the required berms and spoil banks. Trees and brush would be removed from both sides of the river to improve the channel hydraulics which would decrease the natural habitat for fish and wildlife. Until the river banks can be stabilized with appropriate grasses, the sediment load of the stream will increase and will be deposited at the Janoubi River estuary. However, the sea is very rough during the stormy periods and very little local sedimentation is expected. The construction of the Janoubi River Channel Improvement works will require the approval of the Government of Lebanon.

Under the Development Plan, the dry season flows of the Janoubi River will be increased substantially as a result of return flow from project lands. These return flows are expected to contain additional contamination than the existing water as a result of the increased use of fertilizers, herbicides and pesticides on project lands. This should not create any significant problem in the lower reaches of the Janoubi River. It is anticipated that there will be increased algae growth in the Janoubi River estuary due to the increased nitrogen in the water resulting from the expanded use of nitrogen fertilizer.

RECOMMENDATIONS

Akkar Plain Authority

An Akkar Plain Authority should be established to oversee the development as soon as the decision is made to implement the project. The complete development scheme affects most of the people of Syria, either as recipients of benefits or as a result of the monetary commitment of SARG to finance the construction. Therefore, it is recommended that an authority or directorate be established directly under the

Minister of Agriculture that would be responsible for the utilization of funds and the implementation of the plan. The utilization of the Ministry of Agriculture is considered essential since the plan is to develop the agricultural resources and all designs, scheduling, and plans should be reviewed and approved by those familiar with agricultural practices and agricultural development in the entire country.

Additional Studies

The various field investigations and office studies which were made in the course of preparation of this Report have established the feasibility of the irrigation development from the standpoints of all technical and economic considerations except to confirm the availability of storage on the Abrache River and to quantify the groundwater movement under the Akkar Plain. These studies must be completed before Phase Ii of the Development Plan can be implemented.

Rihaniyeh Damsite Investigations: A study must be undertaken to verify the economic feasibility of the Rihaniyeh Dam and Reservoir. The study should determine the most feasible location of the dam which could be located as much as 2 kilometers upstream of the proposed site. The investigation should include the drilling of exploration holes at the dam axis and reservoir area to determine the properties of the foundation materials. From this information it will be possible to prepare preliminary designs of the works required to reduce seepage at the dam, at the brim of the reservoir or in the reservoir. The investigations should also include an inventory of construction materials including earth, gravel and rock which would be required for the construction of the proposed earth-rockfill dam and its concrete spillway and appurtenant structures. A detailed cost estimate should then be made and the estimated costs resulting from the study should be compared with the costs used in this Report to evaluate the economic feasibility of the storage site.

Groundwater Investigations: The groundwater information presently available is not adequate to quantify the groundwater resource, and thus it is not possible to specify the works required for full development of the resource. A program of 10-12 exploratory wells 300-400 meters in depth properly distributed across the Akkar Plain

is required to obtain the necessary information about the aquifers. After the borehole has been carefully logged, a pumping test should be performed to obtain the characteristics of the aquifers and the specific capacity of the well. Pumping tests should also be conducted at existing drilled wells to determine the actual specific capacity of the well. Following the completion of the tests, the well owners should be furnished with recommendations which would fully develop the potential of the well.

Topographic Surveys: Topography of the Akkar Plain is available with a 5-meter contour interval and scale of 1:25,000, which is not adequate for laying out an irrigation system. The area which includes the project works should be mapped at a scale of 1:5,000 with a contour interval of one meter in the plain area and two meters in the relatively rugged and broken terrain of the bordering areas. This work can be carried out most expeditiously and economically by aerial photogrammetric mapping methods. Alignment and profile surveys of all of the main conveyance canals and drains would also be made. In addition, the sites of dams and major structures should be mapped at a scale of 1:1,000 and contour interval of one-half meter.

Materials Investigations: Additional field and laboratory studies should be made to make a final selection of the most favorable sites for producing satisfactory concrete aggregates, gravel and riprap.

Hydrologic Studies: The hydrologic studies which have been undertaken to determine all pertinent aspects of the regional hydrology of the area, including climate, runoff and occurrence of groundwater, should be continued and intensified.

IMPLEMENTATION

Implementation of the total Development Plan cannot be carried out until the results of the investigations for the Rihaniyeh Dam and groundwater are fully known. However, the works described in Phase I of the plan; a part of infrastructure works described in Phase II, Stage 1; and a portion of the groundwater development described in Phase II, Stage 2 could be undertaken immediately. Implementation of these works involves firstly the securing of firm financial arrangements for funding the works and the preparation of detailed designs, plans and specifications for the works described.

Janoubi River Channel Improvement

The Janoubi River Channel Improvement should begin immediately with the final design and field studies done during the dry season and construction to follow immediately. Improvements should be made to both sides of the channel which will require an agreement with the Government of Lebanon. In this work, earth materials would be excavated from the river banks to form the dikes and roads and thus increase the hydraulic capacity of the channel. The required excavating equipment would probably have to be imported; however, skilled equipment operators are presently available in Syria.

Drainage Improvement

The improvement of the surface drainage system on the Akkar Plain should be started concurrently with the Janoubi River Channel Improvement. The work is primarily earthwork and the required excavating equipment would probably have to be imported. Syrian operators are available to operate the equipment. The work also involves some concrete work including a small pumping plant. It is believed that the undertaking of this work is within the capability of the Syrian construction forces.

Agricultural Service Center

The construction of the Agricultural Service Center and its staffing should be undertaken immediately.

Groundwater Development

The improvement and enlargement of the existing wells should be undertaken immediately. Following the groundwater exploration described in the previous section, the plan for the full development of the groundwater resource should be finalized. The drilling of additional wells to develop the full potential should be undertaken as soon as the plan is finalized. As shown in the Report, this part of the Development Plan produces the highest benefit-cost ratio and should be undertaken at the earliest opportunity. The drilling equipment for drilling the deep wells would have to be imported

and the operation of the equipment could be accomplished by skilled Syrian workmen. The development and testing of the wells should be performed by a foreign contractor who is experienced in this type of work.

Infrastructure Development

The infrastructure requirements, other than the Agricultural Service Center, are scheduled for Phase II, Stage 1. SARG has already started improving many of the infrastructure items and its efforts should be accelerated and coordinated with the Akkar Plain Authority. The first priority, following the establishment of the Agricultural Service Center, should be the improvement of the existing roads and construction of new roads. The development of schools and health facilities should be developed gradually and in accordance with the overall government policy. Marketing and processing facilities should be provided in accordance with the schedule of increased production of the Akkar Plain.

Surface Water Development

The surface water development is scheduled for Phase II, Stage 1, and would be the last portion of the Development Plan for which construction would be initiated. The final planning, designing and constructing of this work is contingent upon the results of Rihaniyeh Dam investigation described in the previous section.

The construction of the Phase II, Stage 1, work as envisioned in the Development Plan would consist of the construction of an earth-rock dam having a maximum height of 36 meters and a concrete gravity overflow spillway section. This work would require a contractor with experience in earth dam and concrete dam construction and such a contractor is not native to Syria. This work would therefore require a foreign contractor. The surface irrigation system and the Berge Arab diversion system, however, could be constructed by Syrian contractors.