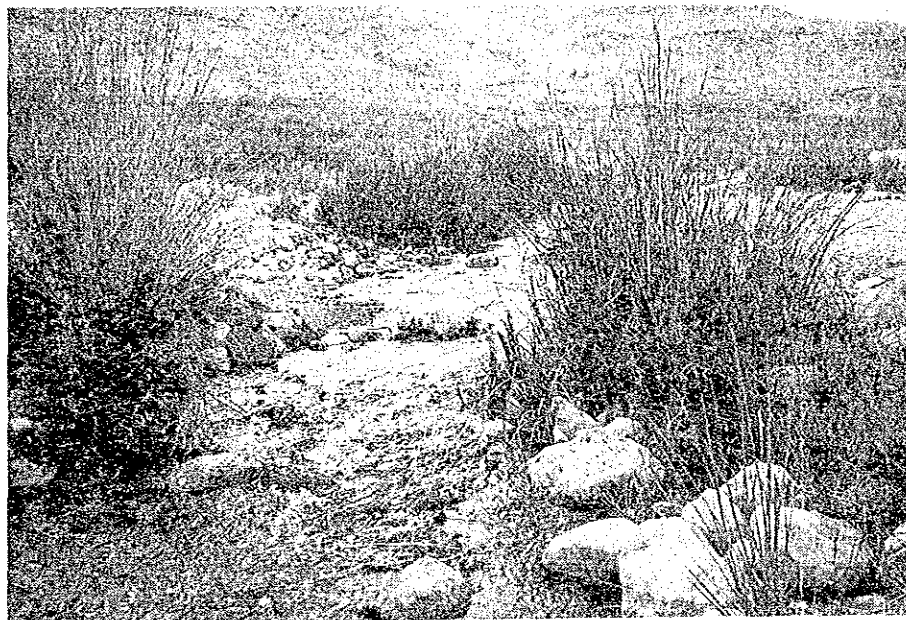


CHAPTER 3 AFRA-BURBEITA HOT SPRINGS MULTIPURPOSE PILOT PROJECT



Base Flow of Wadi Hasa at Burbeita

3. AFRA-BURBEITA HOT SPRINGS MULTIPURPOSE PILOT PROJECT

3.1 Introduction

In the Master Plan, a multipurpose pilot project is proposed for (1) aquaculture, (2) greenhouse horticulture, (3) irrigated agriculture, and (4) tourism. This project has been studied in three sectors and the results are presented in Annex-B for horticulture and agriculture, in Annex-E for tourism, and in Annex-J for aquaculture.

This chapter presents an integrated summary of the sector studies on this multipurpose project.

3.2 The Project Area

3.2.1 The Afra and Burbeita Hot Springs

(1) Location and present conditions: Afra and Burbeita are the best known hot springs in the Study Area. They are located in the Hasa Valley about 15 km to the north of Tafila. The Afra hot springs are located at the bottom of a gorge of Wadi Bureis, a tributary of Wadi Hasa. The Burbeita hot springs are situated in the riverbed of Wadi Hasa about 3 km northeast of Afra hot springs.

The access to the site is easy by a paved road of about 8 km long from the King's Highway, a further 35 km from Karak, 20 km from Tafila, and 150 km from Amman. A new road is under construction to connect Burbeita and Afra. After completion of the Afra-Burbeita road, the hot springs will have two different means of access, one from the bridge on Wadi El La'ban and the other from north of Tafila.

The broad river banks of Wadi Hasa in the vicinity of Burbeita are presently used for irrigated agriculture using the base flow of Wadi Hasa to grow various vegetables and fruits. There are several houses scattered in the Valley.

Electricity will be provided by 1990 under the Third Five-Year Plan.

Since improvement of access and expansion of space at Afra hot springs in 1987, the number of visitors to Afra increased remarkably. Visitors come from Tafila, Karak and also from Amman. People also go to Burbeita hot springs. Afra hot spring is more popular, however, because of its better temperature and the volume of hot water for health care.

At present, there are no facilities at either Afra or Burbeita hot springs to accommodate tourists except for the small terraces surrounded by the concrete partitions at Afra hot springs. There is no restaurant or toilets, and people camp and cook on the terraces. Garbage is thrown into the river and contaminates the water.

(2) Discharges and water temperature: There are 2 main hot springs at Afra. Their discharges and temperatures are given in Table 3-1. At Burbeita, there are 4 main hot springs, of which the discharges and temperatures are shown in Table 3-2.

(3) Hydrogeological condition: Afra spring water discharges directly from joints in the sandstone of the Kurnub Formation which is overlain by the Ajlun Group of Lower Cretaceous age. They discharge at several points in the gorge, and the spring water has no taste but has smell of iron.

Burbeita hot springs were identified at four main points along Wadi Hasa by field reconnaissance. They discharge from recent wadi gravels, terrace deposits or talus deposits. However, the geological situation indicates that the spring water originates in the Kurnub Formation. None of the water from these four springs has any taste except smell of iron.

The Hasa Fault System may explain the discharge of thermal water in the Kurnub Formation (see Fig. 3-1).

(4) Water quality: General chemical characteristics of the hot springs' water are similar to those of groundwater in the main aquifer system of the Highlands as pumped in existing well fields (Table 3-3). Elias Salameh & Omar Rimawi (1984), however, reported high contents of radon gas in water from both Afra and Burbeita hot springs, and that Afra hot springs contain much radon and CO₂ gases. The authors also explained that the minor or zero content of dissolved oxygen and nitrate, and high CO₂, H₂S or N₂ gases in the discharge from a deep aquifer is due to oxidation-reduction of organic matter within the groundwater flow system, most probably caused by anaerobic bacteria. The correlation diagram of Rn222 and CO₂ content shows a strong relationship between the concentration of radon and the amount of CO₂.

Variations in the chemical composition of thermal water from Afra hot springs is presented in Table 3-4. These findings indicate that the Afra thermal water is similar to water in the sandstone aquifers of Southern Jordan except for the abnormally high contents of radon and CO₂ gases and their high temperature.

3.2.2 Air Temperature

The air temperature at the site, which has an elevation of about 260 m AMSL, could be judged from the data of two nearby stations; Tafila at EL 1,200 m AMSL and Wadi Wala at EL 450 m AMSL. This demonstrates a significant climatic contrast between summer and winter seasons.

In summer the temperature will rise to 35°C in the day time and drop to 18°C at night with a daily difference of 17°C. In the field survey, an extreme of 40°C was observed. In winter the temperature may drop to 5°C at night while it goes up to 17°C by day. The wind speed is moderate at 5 to 6 knots or 2.8 to 3.1 m/s throughout the year.

3.3 Plan Formulation

3.3.1 Development Objectives

The objectives of this Project are set out as follows:

- (1) to create a model New Village with new job opportunities by promoting pioneer projects
- (2) to develop necessary technologies for aquaculture and greenhouse horticulture utilizing thermal energy of hot springs and to demonstrate the effects
- (3) to provide people in the region with a place for recreation and hot spring treatment

3.3.2 Basic Concepts

At the Afra-Burbeita project site, the following resources are available:

- (1) thermal energy of Afra and Burbeita hot springs
- (2) base flow of Wadi Hasa
- (3) existing farmland of about 78 ha and potential land of about 70 ha located along both banks of Wadi Hasa
- (4) manpower (Villagers are cultivating farmlands with the base flow.)

With the above resources, this Project is formulated to develop the Afra-Burbeita Valley by developing the four schemes described below:

- (1) Aquaculture: There is a significant demand for fresh fish in Jordan. Both public and private sectors are venturing into new aquacultural projects, although aquaculture development is relatively new in Jordan.

The Aquaculture Scheme is formulated on the following basic concepts:

- (A) The practical culture system operated successfully in other part of Jordan should be applied to this Scheme before the introduction of any advanced system which requires complex equipment.
- (B) New potential species applicable to this Scheme should be considered in addition to tilapia.

This Scheme will bring economic benefits through the creation of new industries in the region, the supply of domestic fresh fish in the Kingdom to meet the potential demand, and the saving of foreign currency by import substitution.

(2) Greenhouse Horticulture is a pioneering project in Jordan in utilization of geothermal energy for horticulture. The fruit growing in greenhouses is also a new technology in the Kingdom. Some trials are being carried out by Jordan University in the Jordan Valley but they have not yet reached practical application. Therefore, technical co-operation with foreign country in this field will be expected.

This Scheme has the following specific objectives:

- (A) identification of suitable crops for greenhouse horticulture utilizing geothermal energy
- (B) development of suitable cropping methods for greenhouse horticulture
- (C) development of suitable building structures for greenhouse horticulture
- (D) demonstration by model farms of greenhouse horticulture to farmers
- (E) training of extension workers and farmers in greenhouse horticulture

Many kinds of vegetables, mushrooms, flowers and fruit trees can be tested in greenhouses. In view of the present overproduction of vegetables in Jordan, priority should be given to fruit trees such as grapevines, oranges and papayas. The demand for high quality fruits in the off-season must be strong in Jordan.

There will be a great opportunity for development of fruit production in greenhouses because it can assure farmers of:

- (A) early harvesting (3 months earlier than ordinary method for grapes in the case of Japan), resulting in higher market prices
- (B) a longer harvesting period
- (C) stable yields

(D) higher utilization rate of family labour by staggering the growing seasons

(3) Irrigated Agriculture Scheme: There are about 78 ha of irrigated farmland in the Burbeita Valley. Farmland located on both banks of Wadi Hasa is irrigated by gravity flow or by low head pumps. Farmland located at higher slopes on the left bank is irrigated by two small springs and two sets of high head pumps. It is proposed to rehabilitate these irrigation facilities to attain higher production.

(4) Tourism Scheme: The tourism development of Afra and Burbeita hot springs is positioned as a social welfare project for local people who have limited opportunities to enjoy recreational activities.

The tourist attractions of Afra and Burbeita are the hot springs and the landscape. There is one unexcavated ruin on the hill but at present there is no access road. Once access has been provided and excavation has been carried out, it will become one of the tourism resources of the project area. The proposed horticulture and aquaculture plants will also be attractive for visitors both for viewing and tasting.

To offer better conditions for visitors, basic accommodation facilities is required, such as lodging facilities and restaurants. These will contribute to protection of the environment from the current contamination.

Construction of a Rest House with a swimming pool and a Medical Rehabilitation Station are proposed for recreation and health care with the hot spring water. Sports facilities such as a public swimming pool, tennis courts, etc. are also required to increase the number of visitors and their expenditure.

(5) Water consumption by this Project will be nominal. Most of the water once abstracted from Afra and Burbeita to the project site will return to the main stream of Wadi Hasa and, therefore, will not affect

water use downstream reaches in the Southern Ghor. Aquaculture does not consume water. Greenhouse horticulture mainly utilizes heat energy of the hot water, and water consumption for irrigation in the greenhouse will be nominal as its floor area will be only 4,500 m². Rehabilitation of existing irrigated agriculture would increase water consumption to about 0.6 MCM/yr. However, this would not affect the downstream water use since the increase will take place mainly in winter when there is surplus base flow. Water consumption for tourism development will also be nominal.

Attention, however, must be paid to maintaining water quality. Adequate treatment should be provided for wastewater from the proposed Rest House and other facilities.

3.3.3 Site Selection

There are limited opportunities for locating project facilities in the vicinity of Afra hot springs. A site for this Project must be chosen from two alternatives; a hill slope on the left bank of Afra, and farmland on the left bank of Wadi Hasa near Burbeita.

First alternative site: The construction of a pipeline to this site would be difficult due to the fragile rock wall on which the pipeline would have to be installed. Moreover, the hot water would have to be pumped through a static head of about 200 m from Afra hot springs, making the operation cost expensive.

In view of the optimum water temperature for tilapia and other warm water species of 26 to 30°C, Burbeita hot springs are more suitable as the source for rearing water than Afra hot springs. When warmer water is required for aquaculture in winter, it could be brought from the greenhouse, which will discharge hot water of 34°C even in winter.

The alternative site has good access from both Afra and Burbeita hot springs. The required lift of the hot water from Afra is only about 40 m, and the base flow of Wadi Hasa can be transmitted to the fish plant with a minimum pumping head. The distance between Afra hot

springs and this site is about 3 km (see Fig. 3-3 for profile of proposed hot water pipeline). The site is on cultivated land located beside the main stream of Wadi Hasa, but has an enough height from the riverbed to be safe against flooding although some protection dikes for river banks should be provided. The Rest House can be placed on the left bank of the Burbeita Valley at about 280 m AMSL.

On the basis of the above considerations, the second alternative was selected as the project site.

3.3.4 Water Transmission Systems

A preliminary layout plan of the Afra-Burbeita Project is shown in Fig. 3-2.

Hot water of about $0.024 \text{ m}^3/\text{s}$ will be transmitted from Afra to the project site by a 3 km long pipeline of $\phi 250$. The hot water will be once pumped up about 40 m in static head, and will then flow down by the gravity (Fig. 3-3). The hot water from Afra will be distributed to the Rest House, Medical Rehabilitation Station, a public swimming pool, greenhouses, and fish plants (if required in winter in addition to the greenhouse discharge).

Three low diversion weirs will be constructed on the main river course of Wadi Hasa. From upstream, Nos. 1 and 2 weirs will be exclusively for irrigation water supply. No. 3 weir will be mainly for water supply to the fish plants but partly for the irrigation. Water from weir Nos. 1 and 2 will be sent to the farmlands by pipeline by gravity flow. Water from No. 3 weir will require pumping up about 10 m to the fish plants and about 200 m in total to the higher farmlands located on the left bank.

Drinking water will be pumped up from a well of about 50 m deep which will be sunk on the left bank beside the greenhouse site.

3.3.5 Aquaculture Scheme

(1) Culture species: Tilapia and Giant Freshwater Prawn have been selected and proposed as the culture species for the Project (see Annex-J for details).

(2) Availability of fry, feed and skilled manpower

Broodstock and fry: The initial broodstock or fry of Red Tilapia can be purchased from Arab Fish Company (AFCO) farm and those of other tilapia will be obtained from Azraq cooperative fish farm. Giant Freshwater Prawn has been imported for experimental work by AFCO. However, fry production has not been carried out. The initial broodstock of the prawn will have to be imported. The fry can easily be produced at the farm once the initial broodstock or fry are transferred and acclimatized.

Feed: There are few compounded feed materials for fish cultivation in Jordan. Presently AFCO purchases pellet feed from a meal company in Amman which produces mainly crumble feed for poultry. Although the quality of pellet needs improvement, a sufficient quantity of feed could be procured in Jordan at a low price than imported pellets which are marketed at around JD 350 per ton. Since the production of tilapia has been carried out without significant nutrition problems, the domestic pellet feed can be used as the main feed source of this Scheme. In future, by-products from slaughterhouses, wastes from restaurants, etc. could be examined as sources of the feed materials.

Skilled manpower: Unfortunately there is no Jordanian aquaculture technician at present. Even in AFCO the chief aquaculturist has been hired successively from Europe or Southeast Asia. At the initial stage of operation the assistance of a foreign expert will be needed for at least two years.

(3) A preliminary layout plan of the facilities is prepared as shown in Fig. 3-4.

(4) Production scale is proposed as follows:

<u>Culturing Species</u>	<u>Production Scale</u> (t/yr)	<u>Volume of Water Supply</u> (litre/min)
Tilapia	150	2,500
Giant Freshwater Prawn	8	500
Total	158	3,000

The recommended production system is detailed in Annex-J.

3.3.6 Greenhouse Horticulture Scheme

If the water temperature of the discharge tailing from the greenhouse is set at 34°C, a greenhouse floor area of 4,500 m² can be heated with a hot water supply of 1,200 litre/min in the coldest winter (refer to Annex-B for details). Construction of the greenhouses having this floor area is therefore proposed. In the greenhouses, high value-added products will be cultivated such as fruit trees, flowers and so forth, and these will be sent to market especially in winter.

3.3.7 Irrigated Agriculture Scheme

A layout plan of this Scheme is presented in Fig. 3-2. Necessary pipelines and pump stations are listed in Table 3-5. As shown in the drawing, two pipelines, PL-1 and PL-2, extend upstream and downstream respectively from Intake Weir No. 1. Also from Intake Weir No. 2, PL-3 extends on the left bank and PL-4 on the right bank respectively. Intake Weir No. 2 is provided because the available water at the No. 1 site is not sufficient. The Intake Weir No. 3 is located downstream from the road crossing at Burbeita. From there, a pressure pipeline PL-5 extends up the hill slopes on the left bank to a height of about 200 m. Farmland on the right bank downstream would continue to be irrigated from the existing open channel.

3.3.8 Tourism Scheme

(1) Rest House: The scale of Rest House proposed is 50 rooms for accommodating increasing visitors to the springs as a base for bathing and picnics. Each room will have 3 to 4 beds since most visitors would be in families or groups. The Rest House will have the facilities such

as a restaurant, a coffee shop, a coffee terrace, a look-out terrace, a swimming pool, and tennis courts.

Operation of the Rest House will need an undertaker from the catering or hotel industries. The proposed aquaculture, horticulture and irrigated agriculture will provide the visitors with a special local menu. Transportation of food, drinks and all other materials will contribute to promotion of the transportation industry. The Rest House itself will create about 40 job opportunities including part time employees. The Rest House will also function as a community centre in the Valley.

(2) Medical Rehabilitation Station: this is one of the facilities most desired and anticipated by the local people at Afra hot springs. The water quality of the hot springs has been tested by the Ministry of Health, and it is reportedly effective for skin disease and orthopedic treatment. Some visitors to Afra even now stay for treatment purposes and even though there is at present no medical specialist. In future some specialist in hot spring treatment will need to be stationed at Afra for the effective treatment of visitors.

The Medical Rehabilitation Station will be attached to the Rest House. The main facilities for the hot spring treatment will consist of bathing pools for skin disease patients, and other pools with different water temperatures for orthopedic patients and relating facilities such as massage rooms, training rooms, etc.

Not only the indoor rehabilitation treatment should be taken into consideration but also outdoor treatment. The mild winter temperatures in the Valley will lighten the difficulties of orthopedic patients under treatment in winter time. Outdoor treatment programmes such as walking, stretch gymnastics, visiting the fish plants and greenhouses, etc. will be taken up as one of the activities of the Station.

3.4 Costs

The construction cost of this Project is estimated at about JD 1.8 million (equivalent to US\$ 5.3 million) in total. The costs of the required civil works are presented in Table 3-6. Specific costs of each scheme including the allocated cost of the civil works are as follows:

(1) Aquaculture Scheme	Land preparation etc.	JD 72,000
	tilapia	325,000
	prawn	251,000
	<hr/>	
Sub-total		648,000
(2) Greenhouse Horticulture Scheme		
	Water supply system	181,000
	Greenhouses	18,000
	<hr/>	
Sub-total		199,000
(3) Irrigated Agriculture Scheme		424,000
(4) Tourism Scheme	Water supply system	26,000
	Rest House	300,000
	Medical Rehabilitation Station ...	200,000
	<hr/>	
Sub-total		JD 526,000
Total		JD 1,797,000
Contingency		933,000
<hr/>		
Grand Total		JD 2,730,000

In addition to the construction costs above, costs for infrastructures such as electricity supply, communications, housing and so forth will be required to establish the model New Village in the Valley.

3.5 Implementation Schedule and Project Management

- (1) Implementation schedule of the Project is shown in Fig. 3-5.
- (A) Aquaculture Scheme: Using the preliminary framework of the Scheme as presented in Annex-J, basic design and detailed design can be implemented successively. After the basic and detailed design which will take about 4 to 5 months, construction work will take about one year, before the pilot operation can be started. After

trials have been carried out successfully, full-scale operation could commence after about 5 years from commencement of the pilot operation..

- (B) Greenhouse Horticulture Scheme will be implemented after detailed study of the market, the culture of varieties of flowers and fruit trees and so forth.
- (C) Irrigated Agriculture Scheme can be proceeded after completion of detailed design of the necessary facilities.
- (D) Tourism Scheme: An early implementation of this Scheme is recommended to accommodate increasing visitors.

(2) Project management

- (A) Aquaculture Scheme: As aquaculture requires 24 hours operation, it is recommended that management be conducted by private firms. However, if implemented only by a private organization, there may be several constraints to the marketing of a large quantity of live or fresh fish. It is recommended that the Scheme be implemented on the initiative of the public sector but that practical operation be carried out by private management during pilot stage till a suitable marketing structure has been formulated for live and fresh fish in the Kingdom. The Scheme could then be operated and managed by the private sector.

The formulation of cooperatives among local people will be the most effective means of technical transfer and promotion of the aquaculture industry. In this case operation should be carried out by cooperative members from the very start of the operation.

- (B) Greenhouse Horticulture Scheme is recommended to be managed by JCO with technical assistance from foreign experts.
- (C) Irrigated Agriculture Scheme is proposed for promotion by a Burbeita Valley Cooperative which will be newly organized by land owners in the Valley under technical assistance by JCO.
- (D) Tourism Scheme: Since the scheme is positioned for the social welfare of the local inhabitants, the Rest House and the Medical Rehabilitation Station would be financed by the Tourism Investment Department of SSC and the Ministry of Health. Operation of the facilities would be undertaken by SSC, and MCTA would undertake the

tourism promotion.

3.6 Conclusions and Recommendations

(1) Conclusions: It is proposed that a multipurpose pilot project be developed for aquaculture, greenhouse horticulture, irrigated agriculture and tourism, using the thermal energy of Afra-Burbeita hot springs and the base flow of Wadi Hasa, to form the basis for a model New Village to be located during the design stage in the Hasa Valley. This Project would accelerate development of other hot springs such as Wadi Ben Hammad.

Aquaculture Scheme: The high demand for fresh fish supply in Jordan was confirmed. The project site in Burbeita was identified to be the best in the Study Area. Under proper management of the recommended production system, 150 tons of Red Tilapia and 8 tons of Giant Fresh-water Prawn could be harvested annually with a water supply of 3,000 litre/min. Preliminary analysis suggests that, if a soft loan is provided, the Scheme will be financially viable.

Greenhouse Horticulture Scheme: Greenhouses with a floor area of 4,500 m² could be constructed with a hot water supply of 1,200 litre/min. In the greenhouses, high value-added products would be produced such as fruit trees, flowers and mushrooms.

Irrigated Agriculture Scheme: It is proposed to develop irrigated agriculture on 25 ha of the flood plain of Wadi Hasa by constructing a dike, as well as improvement of the existing irrigated agriculture of 78 ha. A new drip irrigation system would cover 103 ha in total. Since the unit cost of the irrigation water is estimated at 85 fils/m³, intensive irrigated agriculture could be promoted in the Valley.

Tourism scheme: Construction of a Rest House with 50 bedrooms and a Medical Rehabilitation Station is proposed as a social welfare programme mainly for the local people.

The construction cost of this Project is estimated at JD 2.73 million (equivalent to US\$ 8.0 million), consisting of JD 0.97 million for the aquaculture, JD 0.33 million for the greenhouse, JD 0.64 million for the irrigated agriculture, and JD 0.79 million for the tourism development including contingency.

(2) Recommendations: Before implementation of the Project, hygiene conditions at Afra hot springs must be improved by building more toilets and establishing a garbage collection system for visitors.

It is recommended that basic and detailed designs of the Project be carried out as a first step, with cooperation from Mu'tah University. Socioeconomic studies, especially the market study for the Greenhouse Horticulture Scheme and for the Tourism Scheme are also recommended for commencement as soon as possible.

Table 3-1 DISCHARGE AND TEMPERATURE OF AFRA HOT SPRINGS

Site	Discharge (litre/sec)	Temperature (°C)		Date Measured
		Water	Air	
Upper spring	16.0	48	-	3/2/87
	-	48	34	16/8/87
Lower spring	2.5	45	-	3/2/87
	-	46.5	38	7/8/87
Wadi upstream	23.3	43	-	3/2/87
Wadi box culvert	126	47	38	7/8/87

Source: The Study Team

Table 3-2 DISCHARGE AND TEMPERATURE OF BURBEITA HOT SPRINGS

Site	Discharge (litre/sec)	Temperature (°C)		Date Measured
		Water	Air	
Hot Spring No. 1	-	37	34	16/8/87
Hot Spring No. 2	9.0	38	34	16/8/87
Hot Spring No. 3	4.9	42	37	7/8/87
	7.3	41	34	16/8/87
Hot Spring No. 4	7.5	44	40	7/8/87
River No. 1	11	30	30	16/8/87
River No. 2	-	30	37	7/8/87
	43	33	35	16/8/87
River No. 3	40	34	34	16/8/87
River No. 4	80	38	40	7/8/87

Source: The Study Team

Table 3-3 WATER QUALITY

Sam- ple No.	Date	Place	Source	EC (ms/cm)	TDS (mg/l)	pH	Ca ⁺⁺ (Meq/l)	Mg ⁺⁺ (Meq/l)	Na ⁺ (Meq/l)	K ⁺ (Meq/l)	Cl ⁻ (Meq/l)	SO ₄ ⁻⁻ (Meq/l)	CO ₃ ⁻⁻ (Meq/l)	HCO ₃ ⁻ (Meq/l)	NO ₃ (mg/l)	SiO ₂ (ppm)	DO
	14/10/86	Abiad mine	Cooling w.	2.05	7.80	3.00	2.80	13.33	0.14	0.14	12.79	4.0	0.0	4.00			
	14/10/86	Abiad mine	Slimes	2.23	7.83	3.10	2.80	14.00	0.14	0.14	12.18	1.70	0.0	6.00			
	14/10/86	Hasa mine	Slimes	5.14	7.70	4.80	7.70	37.88	0.15	0.15	38.95	6.70	0.0	5.20			
	02/02/87	Afra	Hot spring	0.64	7.42	1.60	1.50	2.11	0.08	0.08	1.98	2.00	0.0	2.40			
	04/02/87	Sultani dam	rainwater	0.76	4.86	8.08	2.28	1.11	4.1	0.16	2.91	2.46	0.0	2.05	5.09		
	04/02/87	Wadi Abiad	slimes 1/	2.79	1814	7.67	9.38	4.42	17.8	0.1	11.47	17.02	0.0	2.67	32.8		
	04/02/87	Wadi Hasa	slimes	5.40	3510	7.92	11.5	9.27	33.9	0.16	41.8	10.7	0.0	1.65	52.9		
	18/07/87	Karak road	Wala base	1.140	730	7.38	5.12	3.33	3.4	0.1	3.48	2.39	0.0	6.14	7.35		
	18/07/87	Karak road	Mujib base	1.410	902	7.72	4.08	4.8	5.6	0.19	6.42	3.62	0.0	4.55	1.99		
	18/07/87	Wadi Afra	Base flow	0.710	454	7.8	3.61	1.29	2.1	0.11	2.33	1.75	0.0	2.93	0.97	24.3	
			upstream from spring														
	18/07/87	Afra	Hot spring	0.560	358	7.07	3.0	0.8	1.8	0.08	1.88	1.2	0.0	2.68	0.0	25.8	
	20/07/87	Burbeita	Hot spring	0.810	518	7.85	3.57	1.84	2.5	0.16	2.79	1.47	0.0	3.81	0.53	28.0	
	21/07/87	Qatrana	dam water	0.400	256	7.6	1.37	0.65	1.9	0.25	1.02	0.5	0.0	2.42	8.9	28.0	
	07/08/87	Burbeita	Upstream hot spring	0.550	352	6.7	2.15	1.37	1.9	0.19	2.18	0.9	0.0	2.32	0.0	25.2	
	24/08/87	Wadi Afra	River flow	0.570	365	8.15	2.4	1.7	1.4	0.07	1.87	1.5	0.0	2.32	0.31	20	8.0
	24/08/87	Wadi Burbeita	River flow	0.770	493	7.85	4.0	1.2	2.2	0.2	2.53	1.0	0.0	4.03	1.2	21	7.0

1/: SS concentration was 73,600 mg/litre.

Source: The Study Team, Analyzed at the Laboratory of MAU

Table 3-4 VARIATIONS OF CHEMICAL COMPOSITION OF AFRA HOT SPRINGS

Variable	Minimum	Maximum	Mean	Std. Dev.	Sample Size
Rn C/min	37.0	301.0	147.2	113.6	5
CO ₂ mg/lit	73.0	179.0	121.1	51.5	5
Temperature °C	43.0	49.0	47.3	2.5	5
pH	6.4	7.9	7.2	0.52	6
EC ms/cm	476.0	576.0	504.8	36.4	6
Na mg/lit	31.7	40.0	36.3	2.8	6
K mg/lit	1.96	3.91	2.94	1.07	6
Mg mg/lit	11.0	19.7	14.2	3.3	6
Ca mg/lit	42.9	55.1	47.7	4.5	6
Cl mg/lit	69.2	83.8	74.0	5.4	6
NO ₃ mg/lit	0.0	0.0	0.0	0.0	6
SO ₄ mg/lit	37.4	76.8	50.1	14.6	6
HCO ₃ mg/lit	108.6	175.1	129.5	25.6	6

Source: Elias Salameh & Omar Rimawi (1987):
 Natural Radioactivity and Hydrochemistry of Some Jordanian
 Groundwater Resources, Water Research & Study Centre,
 University of Jordan, 40 pp.

Table 3-5 CIVIL WORKS OF AFRA-BURBEITA PROJECT

Facilities	Standard
(1) Intake Weir	H = 5m, L = 20 m 2 sets H = 5m, L = 30 m 1 set
(2) Pipeline for Irrigation	ϕ 75mm x 550m ϕ 100mm x 2680m ϕ 150mm x 4670m ϕ 200mm x 750m ϕ 350mm x 530m 9180m
For Hotel & Greenhouse & Fish Plant	ϕ 200mm x 3500m
For Greenhouse & Fish Plant	ϕ 250mm x 750m
For Drinking Water	ϕ 50mm x 700m
(3) Pump station	
P-1 for Irrigation	ϕ 32mm x 3.7kW or 5HP x 1set
P-3 for Irrigation	ϕ 65mm x 15kW x 2sets
P-4 for Hotel & Greenhouse & Fish Plant	ϕ 125mm x 12kW x 2sets
P-2 for Irrigation	ϕ 100mm x 45kW x 2sets
for Greenhouse & Fish Plant	ϕ 150mm x 7.5kW x 2sets
for Drinking Water	ϕ 40mm x 3.7kW x 2sets
(4) Reservoir	
for Irrigation	V = 15m ³ x 4sets V = 1200m ³ x 2sets
for Hotel & Greenhouse & Fish Plant	V = 50m ³ x 1set
(5) Road	6m(B) x 1650m(L)
(6) Revetment Dike	2m(H) x 1800m(L)
(7) Farm Development	50.0ha
(8) Fish Plant	3.0ha
(9) Greenhouse	0.45ha
(10) Well	1set
(11) Rest House	
(12) Drip Irrigation System	103ha

Source: The Study Team

Table 3-6 CONSTRUCTION COSTS OF CIVIL WORKS

Project	Work	Construction cost (JD 1000)
1. Fish Plant	Intake weir	18
	Pipeline ϕ 250 x 750m	4
	Farm Development	4
	Pump station	10
	Road & Revetment Dike	36
		<hr/> 72
2. Tourism	Pipeline ϕ 200mm x 3500m	
	ϕ 50 mm x 700m	19
	Pump station	7
	<hr/> 26	
3. Greenhouse	Pipeline ϕ 200 x 750m	126
	Pump station	43
	Reservoir	12
	Farm Development	18
		<hr/> 181.6
4. Rehabilitation of Irrigation Facilities	Intake weir	24
	Pipeline ϕ 75mm - ϕ 350mm L=9,230m	69
	Pump station	85.5
	Reservoir	88
	Farm Development	59
	Drip Irrigation	62
	Road & Revetment Dike	36
		<hr/> 423.5

*1 Construction costs of pipeline and reservoir are distributed by annual yield

*2 Construction cost of pump station is distributed by pump capacity or by yield

*3 Construction cost of road and revetment dike divide into two equal parts between irrigation and fish plant

Source: The Study Team

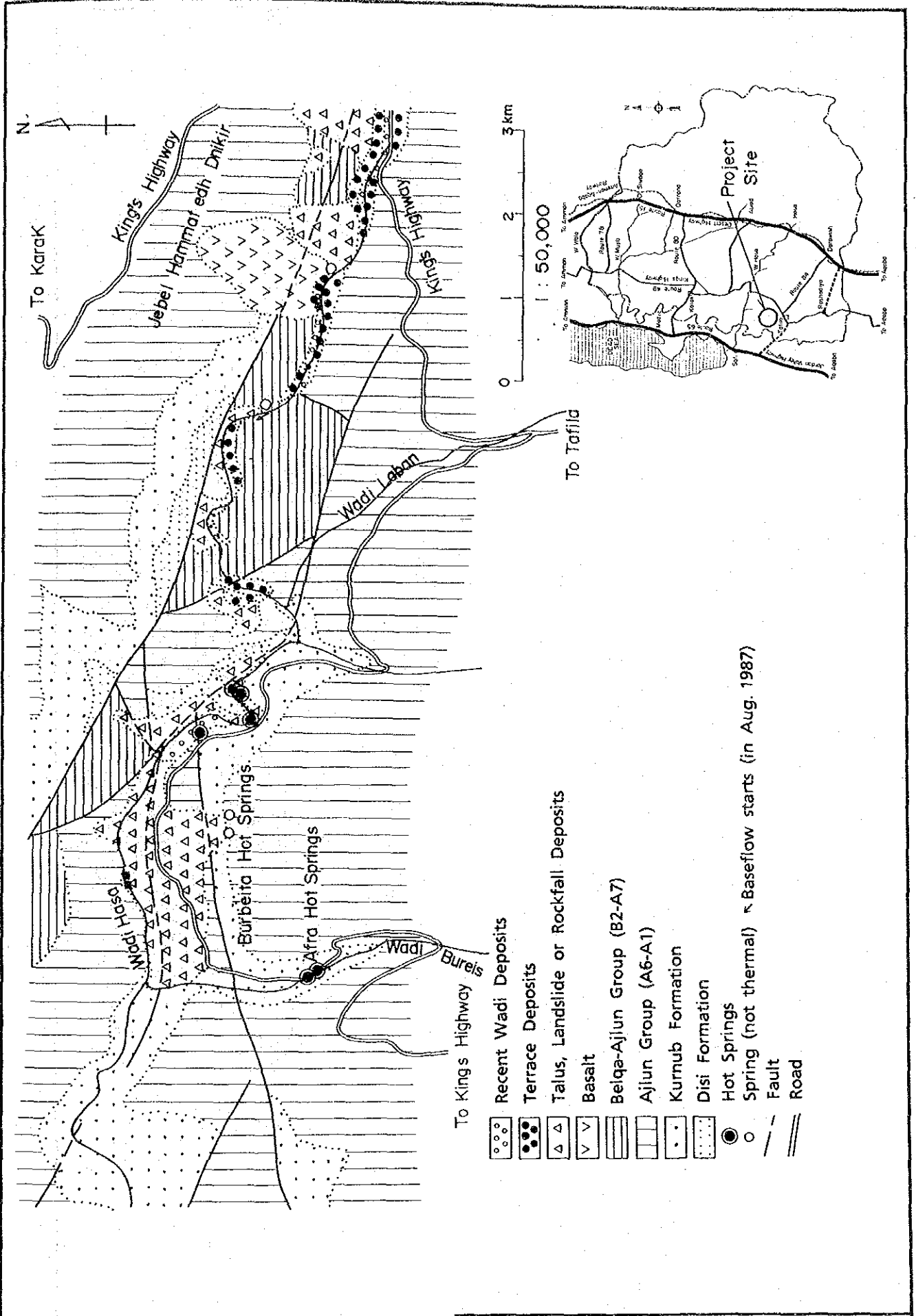


Fig. 3-1 Location and Geology of Afra-Burbeita Valley

THE HASHEMITE KINGDOM OF JORDAN
 THE STUDY ON INTEGRATED REGIONAL DEVELOPMENT MASTER
 PLAN FOR THE KARAK - TAFILA DEVELOPMENT REGION
 JAPAN INTERNATIONAL COOPERATION AGENCY

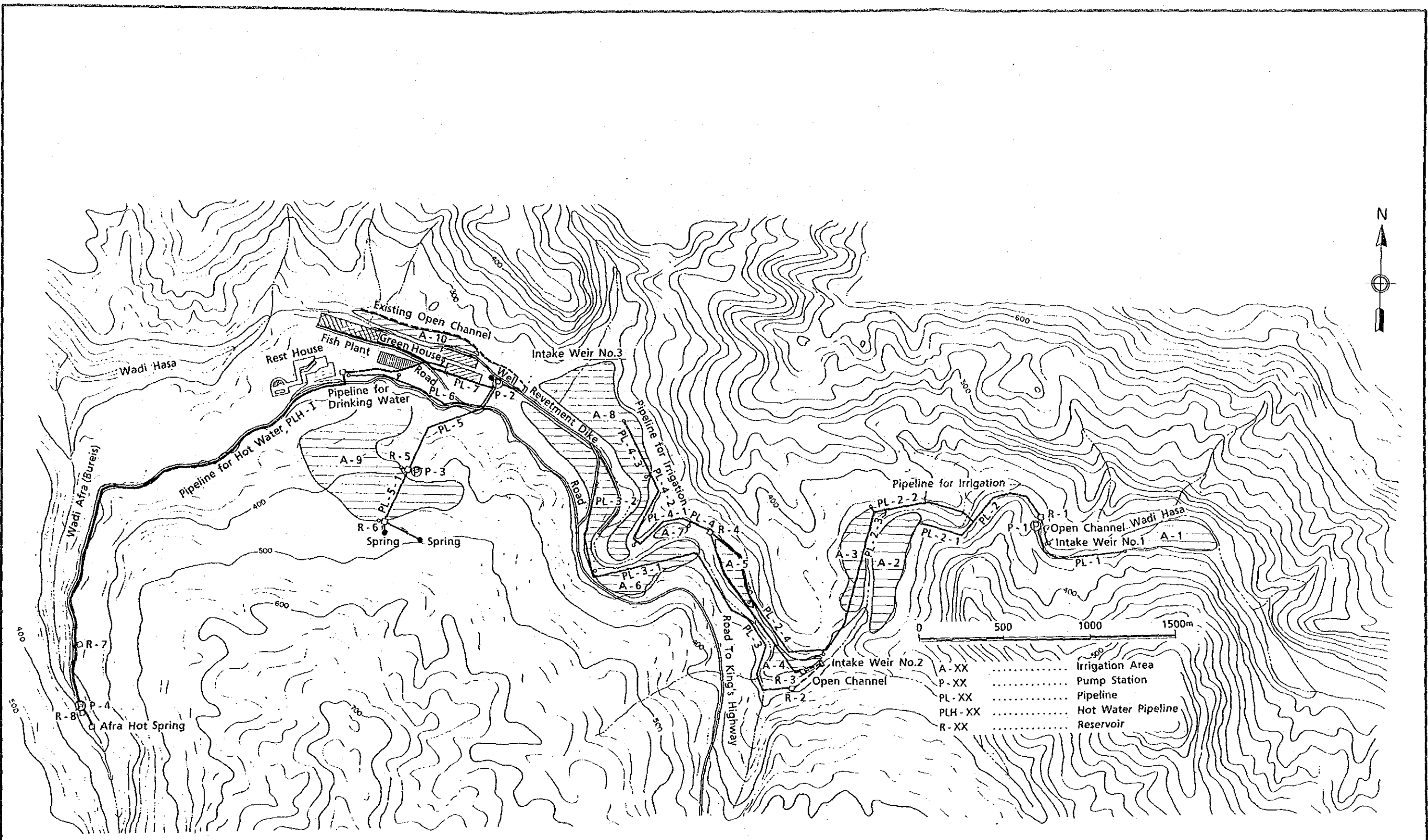


Fig. 3-2 General Layout of the Afra-Burbeita Hot Springs Multipurpose Pilot Project

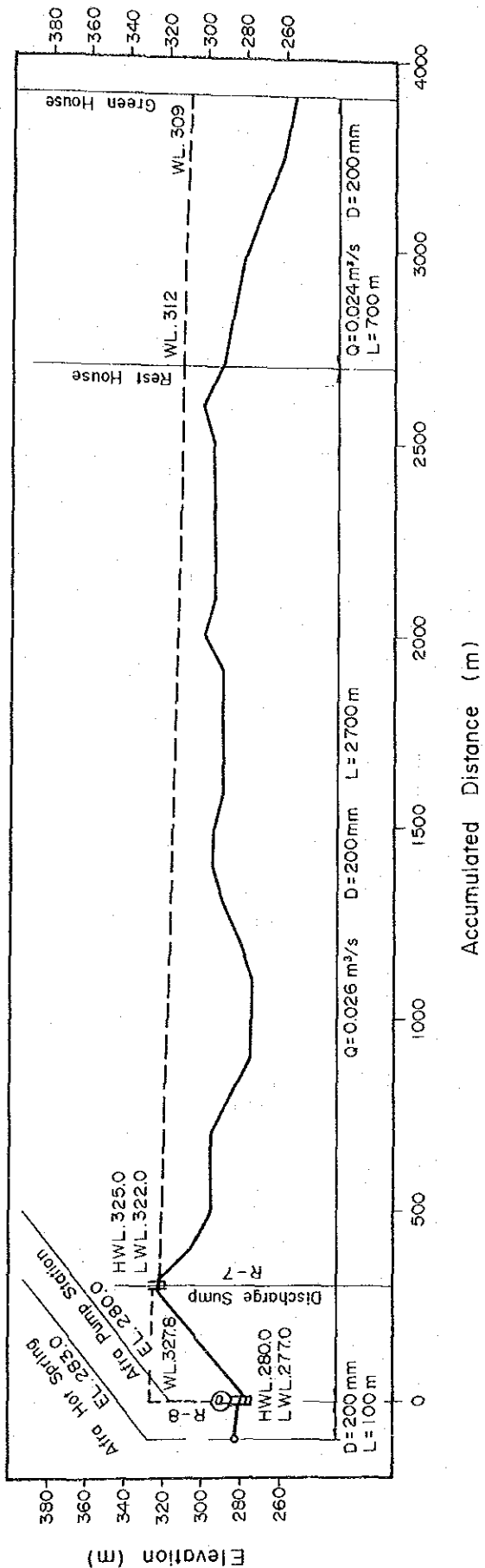


Fig. 3-3 Profile of Proposed Hot Water Pipeline

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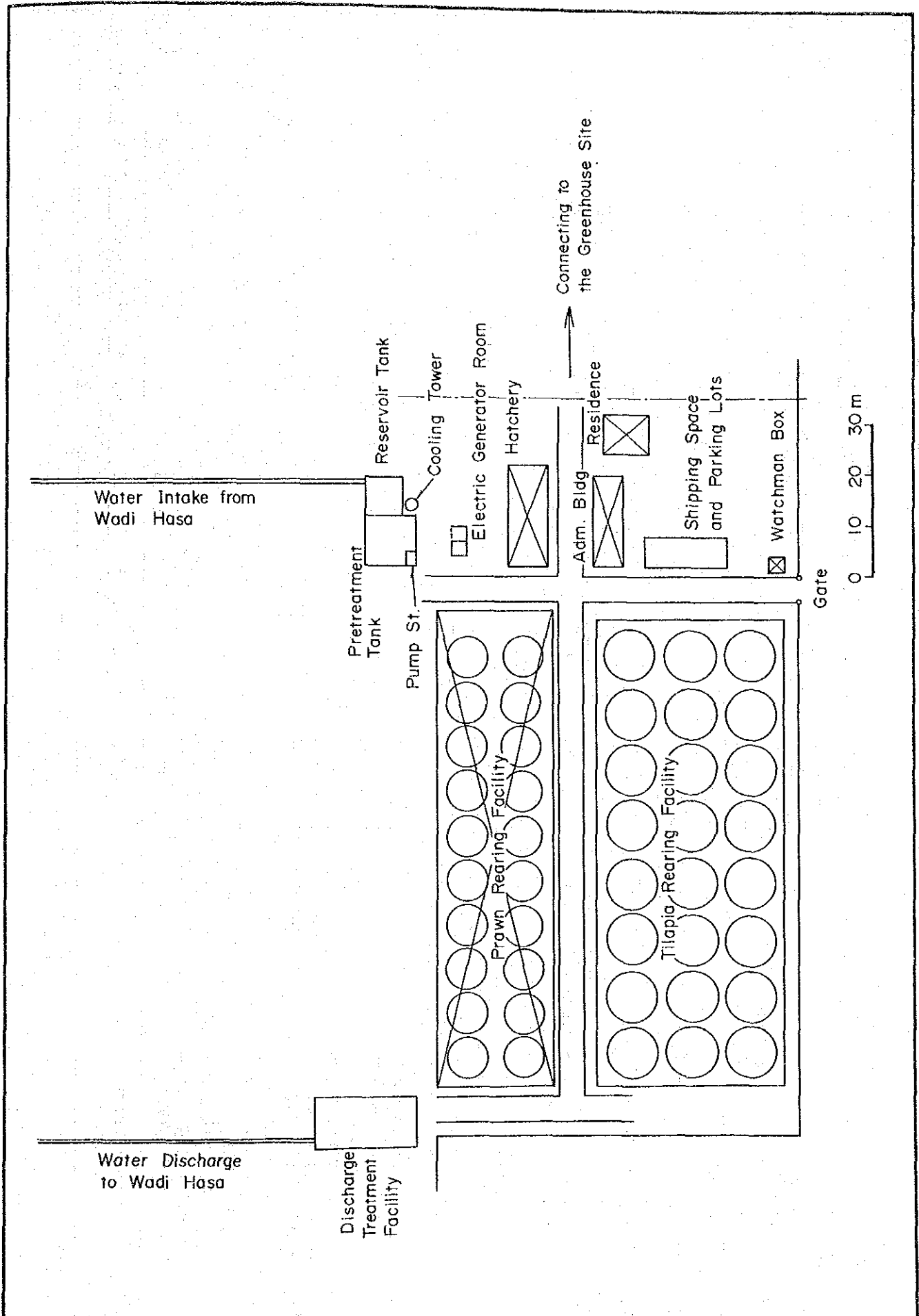


Fig. 3-4 Preliminary Layout of Proposed Fish Plant

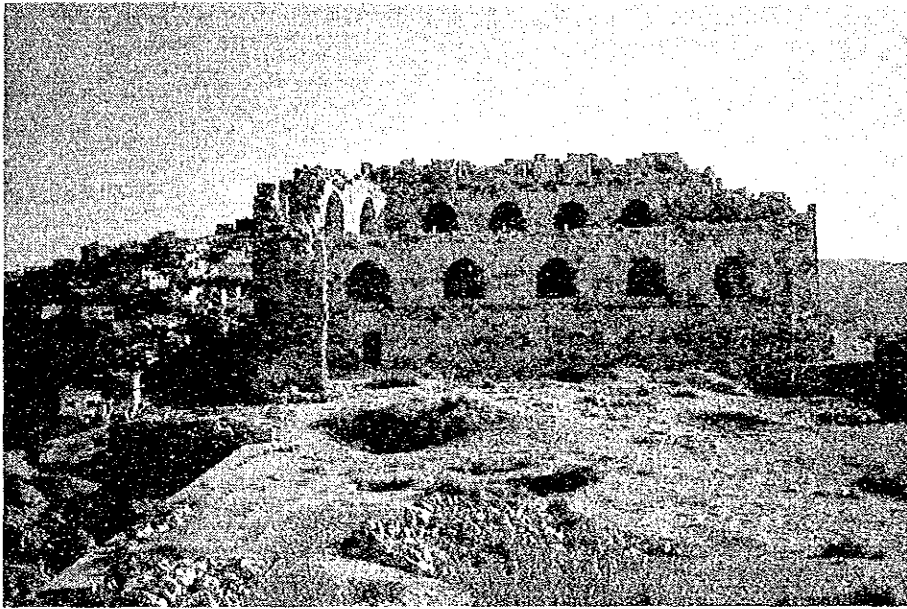


Item No.	Work Items	Year																		
		88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	
(1)	<u>Preparatory Works</u> - Review and examination of the study - Project organization - Financing - Land acquisition																			
(2)	<u>Basic Design and Socioeconomic Study</u> - Overall Scheme - Aquaculture Scheme - Greenhouse Scheme - Irrigated Agriculture Scheme - Tourism Scheme																			
(3)	<u>Overall Scheme</u> - Infrastructures - Water transmission system - Land preparation																			
(4)	<u>Aquaculture Scheme</u> - Tender to construction - Pilot operation																			
(5)	<u>Greenhouse Scheme</u>																			
(6)	<u>Irrigated Agriculture Scheme</u>																			
(7)	<u>Tourism Scheme</u> - Improvement of hygiene - Rest House and Medical Rehabilitation Station																			

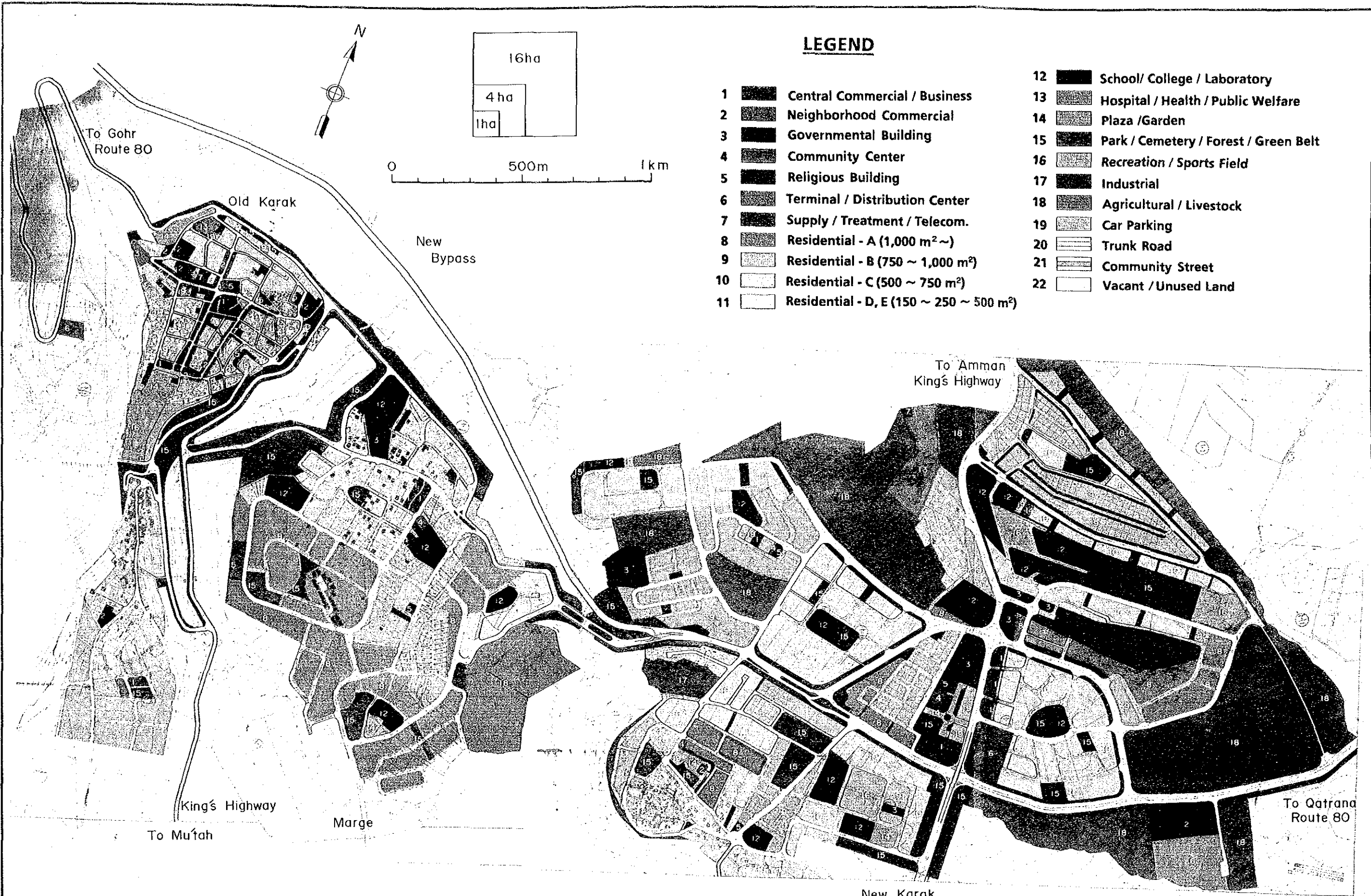
Fig. 3-5 Preliminary Implementation Schedule for the Afra-Burbeita Hot Springs Multipurpose Pilot Project

Fig. 3-5 Preliminary Implementation Schedule for the Afra-Burbeita Hot Springs Multipurpose Pilot Project

CHAPTER 4 KARAK URBAN DEVELOPMENT PROJECT



Karak Castle



LEGEND

- | | | | |
|----|--|----|---------------------------------------|
| 1 | Central Commercial / Business | 12 | School/ College / Laboratory |
| 2 | Neighborhood Commercial | 13 | Hospital / Health / Public Welfare |
| 3 | Governmental Building | 14 | Plaza /Garden |
| 4 | Community Center | 15 | Park / Cemetery / Forest / Green Belt |
| 5 | Religious Building | 16 | Recreation / Sports Field |
| 6 | Terminal / Distribution Center | 17 | Industrial |
| 7 | Supply / Treatment / Telecom. | 18 | Agricultural / Livestock |
| 8 | Residential - A (1,000 m ² ~) | 19 | Car Parking |
| 9 | Residential - B (750 ~ 1,000 m ²) | 20 | Trunk Road |
| 10 | Residential - C (500 ~ 750 m ²) | 21 | Community Street |
| 11 | Residential - D, E (150 ~ 250 ~ 500 m ²) | 22 | Vacant / Unused Land |

Future Landuse Plan of Karak

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 THE STUDY ON INTEGRATED REGIONAL DEVELOPMENT MASTER
 PLAN FOR THE KARAK - TAFILA DEVELOPMENT REGION
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4. KARAK URBAN DEVELOPMENT PROJECT

4.1 Introduction

Karak is the capital city of Karak Governorate and is expected to develop rapidly as a foothold development centre in the region. The existing urbanized area in Old Karak, however, has no more spare land for new houses, buildings or any other urban facilities owing to topographical constraints. Therefore, in order to secure the sustainable growth of the city towards the 21st century, relocation of most of the urban functions to newly developed areas in New Karak has been proposed in the Master Plan.

The Project has three components; (1) Karak Urban Development Programme, (2) Old Karak Tourism Development Programme, and (3) Karak Handicraft Centre Programme.

4.2 Project Background

4.2.1 The Project Area and Landuse

(1) Project area: Karak is located 120 km south of Amman. Excluding steep slopes, rocky land and some agricultural land in the municipal area, the project area may be divided into the following three parts (see Fig. 4-1):

- (A) Urbanized or built up area Old Karak, Thallaja (hereinafter referred to as Old Karak)
- (B) Area of on-going urbanization .. Marge
- (C) Unurbanized area All adjacent land between Ab Hamur and Thanniya (hereinafter referred to as New Karak)

Land areas and populations of each part are as shown in Table 4-1.

(2) Landuse: Topographical features of these areas are as follows:

- (A) Old Karak is situated on a towered table land which slopes northwards. The Castle of Karak stands at the highest point. Thallaja

lies to the south of the Castle, completely separated from Old Karak by topography and situated on another table land which slopes to the north, east and west.

- (B) Marge also slopes to the north but the slope is slightly gentler than that of the two table lands above.
- (C) New Karak slopes gently to the south while Thanniya is generally flat.

An outline of present landuse is given in Table 4-2 and Fig. 4-2. The main features in each area may be summarized as follows:

(A) In Old Karak

- Commercial use is predominant.
- Governmental use is dispersed in Old Karak.
- Greenery is comparatively little.
- Public open space is short especially for car parking, streets and parks.
- Most land in Thallaja is used for residential purposes without having public open spaces.

(B) In Marge

- Most land is for residential use.
- There is little commercial use.
- Unused land is comparatively prominent.

(C) In New Karak

- Most of land is still undeveloped: half of it is used for agriculture and the other half for unspecified use.
- There are some established areas of pine forest.

4.2.2 Socio-economy

The population of Karak City (including Thanniya) was estimated to have been 15,655 in 1985 with an annual growth rate of 3.2 per cent in the period 1979-1985. Karak City has a central position as centre of administrative, industrial and commercial activities in the Governorate. Also, many branch offices of the central government are located there.

4.2.3 Infrastructures

(1) Roads: There are two national trunk roads in Karak. One is Route 49, which is called the King's Highway, running from north to south. The other is route 80, which extends east and west and connects the Desert Highway with the Ghor region. Both of these roads curve sharply at some points and have steep gradients of more than ten degree in the City. On that account traffic on the roads is forced to be inefficient, dangerous, and wasteful of time and fuel. In view of their importance as national trunk roads, their alignments should be made flatter and straighter.

As for streets in the City, there are many hairpin curves and steep gradients everywhere. The man-car separation system is still incomplete. Limitation of car-parking in the City makes drivers park on a street, and accelerates congestion. Therefore it is necessary to construct public car-parking wherever possible or to restrict driving cars into the central area of the City.

Most of streets in the City with total length of around 12 km are paved with asphalt. Although pedestrian walks have been developed, roadside trees and some street furniture including minimal space for pedestrians are not sufficient. Despite present financial constraints, efforts should be made to enhance the environment of the streets as the face of the regional capital city.

(2) Water supply: In Karak, the water supply system is available to most households, offices, shops and other facilities. Nevertheless the existing sources of water at Ain Sara spring and Sultani well field will not be capable of meeting the estimated future demand of 1.8 MCM/yr in the year of 2005 and another source has to be developed. Further details on this is provided in Annex-A.

(3) Electricity: In the project area, electricity is supplied from 132 kV and 33 kV transmission lines which are connected to the Interconnected System at the Qatrana Substation. There is also a power plant in Karak City, which has one gas turbine (18 MW) and three diesel gene-

rators (3 x 1.5 MW). The electrification ratio in the City has reached 100 per cent.

(4) Sewerage: In the Five-Year Development Plan for Karak Region (1986-1990), a sewerage network and treatment plant is scheduled for Karak with the target year 1988. This project aims at serving Karak City with a 36.5 km sewerage network and a treatment plant with a capacity of 800 m³/day. The cost is estimated at JD 2.3 million.

Related to the sewerage project, another project is planned to establish a station for reuse of treated wastewater. This project aims at utilizing water from a treatment plant for irrigation purpose in Karak. It includes the establishment of a pilot agricultural station for irrigation by the treated wastewater and monitoring water from the plant. The cost is estimated at JD 60 thousands.

Thus provision of a sewerage system is in progress, and its capacity will cover the future demand for treatment estimated at more than 700 m³/day.

(5) Social infrastructure: At present, Karak has the following urban facilities:

Hospital.....2	Community college.....1
Health centre.....1	Vocational training centre.....1
Village clinic1	Secondary school.....6
(at Thanniya)	Preparatory school.....6
Mother and child	Primary school.....8
centre1	Slaughter house.....1
Private pharmacy6	Vegetable market.....1
Private clinic6	Sport stadium.....1
Dental clinic3	Public parks.....several
Medical laboratory2	

4.2.4 Tourism Activities

Karak is situated at a key point on the regional tourism network; a crossroads to the Dead Sea, Tafila, Amman and Qatrana. The Castle of

Karak is the most notable tourism resource in the region and is the only resource which has been prepared for exhibition to visitors including foreigners. Old Karak is being renovated but still has the typical characteristics of a medieval city.

4.2.5 Small Scale Industries

In Karak City, there are 95 industrial establishments, which represents 41.7 per cent of the total of such establishments in the area of the Master Plan Study. However, the scale of the establishments is so small that no establishments with 5 employees or more have been reported. The major types of industry are for consumer goods and housing related products.

4.3 Draft Master Plan for Karak Urban Development

4.3.1 Development Objectives

The Karak Urban Development Project has three principal objectives:

- (1) To enhance the local economy both in the number of job opportunities and in income levels by promoting tourism related industries and incubating handicraft and small scale industries in Old Karak
- (2) To enhance the urban functions of Karak as a centre of the region by integrating the public administrative offices in New Karak, improving the infrastructures and urban facilities in accordance with a long-term urban master plan, and by improving the regional transportation system
- (3) To provide citizens with quality housing in a comfortable environment with greenery

4.3.2 Basic Concepts

(1) Planned area: The planned area is divided into three districts; Old Karak, Marge and New Karak. These districts are expected to play separate roles as follows:

- (A) Old Karak: Tourism and commercial areas as the main roles
- (B) Marge: Residential area as the main role
- (C) New Karak: Administration, transportation node, education and residential areas as the main roles

- (2) Resources
- (A) Old Karak: The Castle and City Walls, associated commercial areas, the bus terminal site and the governmental building sites should be redeveloped.
- (B) Marge: Planned street grid, larger and cheaper building lots compared to those of Old Karak, and well planned use of space
- (C) New Karak: The gentle slope land facing south, the extensive fields, the established pine forest, and the intersection of Route 80, Route 49 and the University Road should be utilized.

4.3.3 Development Strategies

(1) Karak Urban Development Programme

(A) Old Karak

- to promote residents moving to Marge and New Karak
- to restore the Castle and its surroundings
- to improve the existing commercial area as a shopping promenade excluding cars
- to avoid the congestion of housing on steep slopes
- to create as much public open space as possible

(B) Marge

- to make large scale residential lots
- to secure school sites
- to settle a lot of green open spaces

(C) New Karak

- to conserve as much existing green open spaces as possible
- to develop a city centre
- to develop a road network
- to develop a residential area
- to secure school sites

(D) General

- to exclude transit traffic
- to make roads flatter and straighter to eliminate danger spots
- to develop a large residential area on sloping land and to use the limited flat area diverted from agriculture or forestry as effectively as possible

(2) Karak Museum City Programme

- To develop the tourism industry in Old Karak through the rehabilitation and restoration of the Castle and related structures.
- To attract tourists through an atmosphere of the medieval period, event programmes and other attractive resources.

(3) Old Karak Handicraft Centre Programme

- To promote local handicrafts
- To promote tourism and commercial activities
- To generate income of local people in and around Karak City
- To provide skill and knowledge to local people and contribute to social development

4.3.4 Development Frameworks

(1) Planned area: 673 ha in total including the roads. Areas by district are as follows:

District	Planned Area (excluding trunk roads)	Roads	Total
Old Karak	83.5	11.7	95.2
Marge	133.2	19.8	153.0
New Karak	362.1	62.9	425.0
Total	578.8	94.4	673.2

Note: (A) Streets less than 7.5 m wide were not counted as trunk roads.
(B) Municipality area was not used for this purpose because there were uncertain factors like the merger or incorporation of towns and villages into the municipality.

(2) Planned population was set as follows:

District	<u>Existing Population</u>	<u>Planned Population</u>	
	1985	1995	2005
Old Karak	11,000	10,000	8,000
Marge	2,700	7,000	11,000
New Karak	2,000	7,000	17,000
Total	15,700	24,000	36,000

Note: (A) Population in 1985 was estimated based on the data of MOP and the field survey by MMRAE Regional Planning Dept. Sept. 1986.

(B) New Karak includes Thanniya Village.

(3) Planned employment in 2005 was set as follows:

1. Commercial Service	2. Public Sector Admin./O&M	3. Agriculture Manufacture Construction	Total
1,900	4,100	3,000	9,000

4.3.5 Draft Landuse Plan

Based on the objectives, concepts, strategies and frameworks, and also referring to the existing Town Plan of Karak, Thanniya and Ab Hamur, a future landuse plan was formulated as shown at the start of this Chapter and as summarized in Table 4-3. Main development items may be summarized as follows:

(1) Old Karak

- (A) Castle Square will be developed by means of renewal of the evacuated governmental building site in front of the Castle as part of the Old Karak Tourism Promotion Program (1.5 ha).
- (B) Restoration of the Castle and City Walls with technical lighting e.g. laser beams (4.1 ha).
- (C) The handicraft centre at commercial zone (0.2 ha).
- (D) The central commercial area will be improved as a comfortable shopping promenade excluding all cars except for carrying goods for sale (3 ha including a hotel).
- (E) The existing bus terminal will be changed into the main car park (0.8 ha).
- (F) Small scale car parks will be developed around the commercial zone (1.3 ha).
- (G) Some *Pocket Parks* will be established along streets (1.0 ha).
- (H) The road which runs behind the Castle, connecting Karak to Elfrani, will be rerouted so as to run directly into the main car park.

(1) Public open spaces will be developed such as for parks, forest and green belt (9.2 ha).

(2) Marge

(A) A community zone will be developed with a shopping centre (1.0 ha).

(B) Some neighborhood parks will be developed (2 ha).

(C) School sites will be secured to provide for an increasing number of children (8.5 ha).

(3) New Karak: A detailed description is presented in Sub-section 4.3.7.

(4) General

(A) A bridge is proposed to be constructed between Old Karak and Marge (400 m).

(B) A bypass is proposed to be constructed connecting New Karak to Ain Sara (4 km at gradient 1/20).

4.3.6 Planned Infrastructures

(1) Roads: Construction of more than 40 km of trunk and community roads is necessary.

(2) Water supply: Extension of the distribution network will be necessary. Construction of a new pipeline is proposed to transmit water from the proposed Lajjun well field to Karak (see Figs. 4-8 and 4-9). Additional capacity in the supply system will cover new demands from around 2,900 households, other buildings and facilities.

(3) Electricity: Extension of the power distribution line is necessary. The increased capacity of the power distribution system should cover new demands from around 2,900 households, other buildings and facilities as with the water supply.

(4) Sewage: The capacity for collection and treatment will be expanded to cover new demands from around 2,900 households, other buildings and facilities, as with the water supply.

4.3.7 Planned Urban Facilities

New Karak will be given roles of administration, transportation node, education and residential community. A combined development of governmental buildings, a shopping centre and a community centre will be established. This will be located in the triangular zone which is surrounded by Route 49, Route 80 and the newly proposed road connecting Route 49 to the University Road (see the future landuse plan on the first page of this Chapter). A large plaza will link these three facilities.

Facing this, and beside the new road will be the bus terminal and taxi pool for convenience of inter-regional transportation, thus completing the City Centre.

To the north will be located the green zone and educational zone. At present most of this green zone is governmental land. Therefore, it should be conserved by the relevant authorities as a model of environmental protection.

Both the eastern and the western parts of New Karak will be used as residential zones. A low cost housing zone is included in the eastern part.

The southern part is presently Thanniya Village which has a different administrative body from Karak City. However, it is proposed to merge this village with Karak City in order to prevent duplicated investment for development of infrastructure and urban facilities.

Proposed development items may be summarized as follows:

(1) Combined Governmental Complex: this will symbolize the facilities of New Karak. The Complex will bring together all the governmental offices that lie scattered in Old Karak at present. The Complex will not only provide facilities for smooth and efficient services, but will also facilitate more effective administration. The Complex will have 3 ha of premises, of which 1 ha will be occupied by the plinth area of 4

story buildings.

(2) Shopping Centres: these will be located at three places to vitalize the commercial activities of New Karak. The primary centre of these will be sited near the Governmental Complex (total 2.3 ha).

(3) Central Plaza: this will be set among the Governmental Complex, the Shopping Centre and the Community Centre with large car park to complete the City Centre and as the symbol of New Karak. Car traffic will be completely excluded from the Central Plaza (2.2 ha).

(4) Bus terminal and taxi pool (2.4 ha).

(5) School sites will be developed for each block (20 ha).

(6) Green open spaces (46.7 ha)

(7) Residential area by classification will be as follows:

Classification	A	B	C	D/E	Total
area (ha)	19.8	61.1	77.1	13.7	171.7

Note: Classification is set by the minimum lot area of residence.

A: 1,000 m², B: 750 m², C: 500 m², D: 250 m², E: 150 m²

4.4 Karak Museum City Programme

This Programme consists of restoration and rehabilitation of the Castle of Karak, the Castle Square, the Historic Quarter, the City Walls and Towers, and provision of the Event Programmes.

(1) The Castle

(A) Excavation is required before restoration of the Castle to clarify the floor plan and structures. Preceding the excavation, a study will be made to prepare an appropriate excavation programme including arrangements for any necessary reinforcement of the structures.

- (B) Study of the fragments and structures: The excavated fragments of the structure will be studied to clarify the history, architecture and structural systems of the Castle.
 - (C) A visitors' route will be provided in the Castle.
 - (D) Installations and Equipment
 - (a) Explanation and guide panels should be provided artistically. The signs should be installed to guide visitors along the visitor's route, which would be arranged in accordance with scenarios for attracting visitors' interests.
 - (b) Lighting should be provided not only to light dark places but also as a space design in the ruin with exhibition effects, including exterior lighting for the Castle, City Walls and Towers.
 - (c) Safety devices need to be provided for the safety of visitors. Any opening in the walls, floors, and steps must have hand-rails. Steps and footpaths must be checked and reinforced.
 - (d) Exhibition equipment: Show cases, hanger systems and glass windows for the exhibition will be provided.
 - (E) The site should be kept clean for public exhibition of the Castle.
 - (F) Establishment of facilities:
 - (a) Museum of medieval history: The existing museum in the Castle can be expanded for exhibition of the history of the Crusades and Moslem army, battle of the Castle, etc.
 - (b) Hotel and Restaurant: It is proposed to build a Castle Hotel in the Castle for tourists to enjoy the atmosphere of the medieval period. Furniture and employees' uniforms should match with the historic atmosphere. An old-fashioned restaurant can be one of the the tourists attractions. An administration office may be attached to the Castle Hotel for control and management of the Castle Hotel and restaurant.
- (2) The Castle Square should be designed and prepared for various events and tourists attractions as an open space for multi-purpose use (See Fig. 4-3). The Square should be free from the car traffic. The background and pavement would be designed in medieval style. It could be used also as an open-air theatre at the night. An institute of

medieval history and an atelier would be established beside the Castle Square for a study and restoration of the Castle.

- (3) The Historic Quarter: For restoration of the proposed Historic Quarter, the following works need to be undertaken by the public sector:
 - (A) Street design: pavement, planting, fountains, lighting, and sign boards
 - (B) Tourists facilities: tourist office, public toilets and public telephone
 - (C) Public facilities: post office, telephone and telegraph office, clinic

The tourism activities of the private sector would be encouraged by the above public investment. They would include:

- (A) Souvenir shops, handicraft shops, an international market, drug-stores, book stores, boutiques, jewelry shops, photo shops, a duty-free shop, daily food stores, convenience stores
- (B) Family restaurants, local style restaurants, fast food restaurants, buffets, coffee shops, music restaurants
- (C) Some tourist hotels and pensions would be built in the Historic Quarter. Hotel support industries such as laundry, food and beverage supply, printing, maintenance shops, etc. will be better located out of the Historic Quarter.

Image sketches of the restored Historic Quarter are shown in Fig. 4-4.

- (4) The City Walls and Towers: The Castle, Castle Square, Historic Quarter and other parts of Old Karak should be surrounded by restored City Walls and Towers. The existing eight towers should first be restored. Masonry works, walkways, interior works need to be restored. Then lighting, railings and safety devices should be installed. The City Walls will finally be restored or reconstructed between Towers.

- (5) The Event Programmes should be given due weight as they could be strong attractions to the tourists. These events may be presented main-

ly in the Castle and the Castle Square unless like a parade they might also pass the Historic Quarter.

A performance of old music and dancing would be made during dinner time at the restaurant in the Castle Hotel. Other event programs such as plays, ceremonies, exhibitions, banquets, sound and light would be made in the Castle and/or the Castle Square.

Event programmes to be performed in the Castle Square would consist of a day time programme and an evening programme as follows:

- (A) The day time programme would be arranged in accordance with the tourists arrival time. It might include an open-air market, exhibition, parade and ceremony.
- (B) The evening programme will be the highlight of the attractions after dark. It might include music and dancing, a play or opera, light and sound, a fashion show, and an open air cafe terrace. A historic festival like the Jerash Festival is worth promotion.

4.5 Handicraft Centre Programme

(1) Site selection: Three candidate sites were identified as shown in Fig. 4-5. Of these the site on the east street is the most suitable, because:

- (A) In the alternative at the Castle Square, implementation of the Centre would have to wait for the relocation of the existing government offices. Moreover this alternative would tend to confine the visitors to the Square and hinder them to spreading to other areas in Old Karak.
- (B) The alternative at the north end of the central street is rather far from the Castle. In addition, this alternative would necessitate extra building costs because of the sloped site conditions.

At the proposed site on the east street, there is a concentration of small scale workshops which should have been relocated to the new Industrial Zone after its scheduled completion by Karak Municipality in November 1987. Considering the relocation and also the dominance of old buildings there, restoration of this street should be given priority as part of the Historic Quarter. Therefore, a

location midway along the street may be the best site, considering also its good access to and from the bus terminal. The Centre can also have a good view to the east.

(2) Functions of the Centre

- (A) Manufacture and sales of tourism related handicrafts: Candidate items of handicrafts are embroideries and laces, carpets and rugs, local clothes, woodwork, basketry (straw baskets and saucers), stoneware including marble and oil shale, metalwork and accessories including daggers, leather products (bags, jackets and decorations), pottery and earthenware (at a later stage and/or at a separate site), semi-processed agro-products such as jam, sweets, pickles (at a later stage and/or at a separate site), and so on. Sales promotion activities will utilize the various tourist facilities in Karak and Amman.
- (B) Displays and demonstrations: The handicrafts will be displayed in a studio fashion in a space like an indoor pocket park, where visitors may enter freely and rest. The manufacturing processes will be demonstrated in the various studios.
- (C) Training and improvement of local handicrafts: A trainer will be assigned for each type of handicraft. The trainers and permanent staff will participate in training of local people and in marketing and improvement of local handicrafts.
- (D) To act as a cooperative of local people for manufacture and sale of their handicrafts

(3) Requirements for the Centre

- (A) Manpower: To attract a daily average of nearly 200 visitors and to train local people, 40 members of staff will be required.
- (B) Facilities and spaces: To accommodate visitors, trainees and permanent staff, approximately 700 m² of land should be acquired for workshops, a hall, offices and the indoor pocket park (see Figs. 4-6 and 4-7). Car parking space could be provided in the basement, and the roof could be used for outdoor work such as drying.
- (C) Water: The water demand is estimated at about 30 m³/day.

4.6 Costs

(1) Karak Urban Development Programme: A quite rough estimation can be given for reference to indicate the financial scale of the Project (Tables 4-4 to 4-7):

(A) Old Karak	JD 644,000
(B) Marge	JD 897,000
(C) New Karak	JD 10,600,000
(D) <u>General</u>	<u>JD 18,800,000</u>
Total	JD 30,941,000

(2) Karak Museum City Programme: The costs of the Karak Museum City Program are estimated at JD 1.95 million as broken down below:

(A) Restoration and rehabilitation of the Castle	JD 800,000
(B) Restoration of the Historic Quarter	JD 550,000
(C) <u>Restoration of the City Walls and Towers.....</u>	<u>JD 600,000</u>
Total	JD 1,950,000

Note: The cost for the restoration of the Castle Square is included in that of Karak Urban Development Programme.

(3) Karak Handicraft Centre Programme: The total investment cost is estimated at about JD 240,000. The total annual operation cost is estimated at JD 200,000, including salaries of all the staff, materials, utilities, equipment and payment to the cooperative members. If the trainers of the Centre could be paid from separate budgets, the total operation cost will be JD 172,000 per annum. On the other hand, the sales income is estimated to exceed JD 180,000. Therefore, the Centre can operate at a small profit gain while generating income for the cooperative members, if the initial cost and trainers are paid from separate budgets as a social development project.

4.7 Implementation Schedule and Project Management

An implementation schedule for the Karak Urban Development Project is shown in Fig. 4-10. A detailed study on the Karak Handicraft Centre should first be made for its early implementation, followed by a feasibility study on the Museum City and Urban Development Programmes. Implementation of Phases 1 and 2 of the Urban Development Programme

including the Government Complex and infrastructures in New Karak would start in the 1990's, in parallel with restoration of the Castle and related works of the Museum City Programme in Old Karak. Phase 3 of the Urban Development including the Central Plaza in New Karak would be implemented in the long-term.

The Regional Development Council of Karak should be responsible for management and coordination between the wide-range of related ministries and agencies. The investment in infrastructure should be supplied by public bodies with careful allocation of financial resources. Also, in regard to the urban facilities, the public sector should have the main responsibility for implementing these projects.

For Karak Museum City Programme, a tourism development executing committee will need to be organized under the Regional Development Council to manage and coordinate the restoration activities and the private investment. The committee will comprise officials of the Ministry of Social Development, the Ministry of Industry and Trade, the Ministry of Tourism, the Ministry of Labour, the Industrial Development Bank, Karak Governorate and Karak Municipality. Mu'tah University is also to be represented in the committee as it possesses specialists in the history of Jordan. As for management of the Karak Handicraft Centre, an independent semi-public organization will need to be established under the committee.

4.8 Conclusions and Recommendations

(1) Conclusions: Karak City is proposed for development as a regional centre of tourism, commercial, administrative and handicraft manufacturing activities. It is proposed that the Karak Urban Development Project be implemented under three programmes as shown below:

Karak Museum City Programme: this is planned to remodel the whole town of Old Karak as a *Museum City* by restoring the Castle of Karak, Historic Quarter, City Walls and Watch Towers. The evacuated land of administrative buildings would be called the Castle Square and be used as a plaza where various event programmes will be provided for tourists.

These will attract tourists and will have a significant impact on starting tourism development in the region.

Karak Handicraft Centre Programme: this is to incubate the craft industry as an integral part of the *Museum City*. This would contribute to development of the female work force in the region. The Centre can be self-financed except for the initial investment and the training cost, which should be borne by separate budgets.

Karak Urban Development Programme: proposed relocation of administrative facilities to New Karak and the development of a quality housing estate and commercial facilities in New Karak can give a new horizon to Karak City. Expansion of infrastructures such as roads, water supply and sewerage, and so forth will be required to enhance urban services for this regional centre.

The total construction cost of the Project is estimated at about JD 33.13 million (equivalent to US\$ 97.4 million), consisting of JD 1.95 million for the Karak Museum City Programme, JD 0.24 million for the Karak Handicraft Centre Programme, and JD 30.94 million for the Karak Urban Development Programme.

(2) Recommendations: The Study Team recommends that a start be made on a more detailed study on the Karak Museum City and Urban Development Programmes, and on detailed design and implementation of the Karak Handicraft Centre.

Table 4-1 LAND AREA AND POPULATION IN KARAK

District	Area (ha)	Population	Density per ha
Old Karak	95.2	11,000	115.5
Marge	153.0	2,700	17.6
New Karak	425.0	2,000	4.7
Total	673.2	15,700	23.3

Sources: MMRAE Regional Planning Department, MOP

Table 4-2 PRESENT LANDUSE

Classification	Old Karak	Marge	New Karak
1. Commercial	4.9	0.2	0
2. Religious	0.9	0.1	0.2
3. Residential	22.9	24.1	34.7
4. Administrative	1.3	2.5	4.9
5. Industrial	1.6	0	0
6. Educational	4.5	3.5	14.6
7. Green	13.2	0	65.7
8. Ruins	2.6	0	0
9. Bus terminal	0.4	0	0
10. Power supply	0	0	3.7
11. Agriculture	0	4.5	228.9
12. Unspecified	42.9	43.5	150.7
Total	95.2	78.3	503.4

Sources: MMRAE Regional Planning Department
The Study Team

Table 4-3 FUTURE LANDUSE PLAN OF KARAK

(ha)

Classification	Old Karak	Marge	New Karak	Total
1. Central Commercial	3.0	0.2	2.3	5.5
2. Neighborhood Commercial	1.5	-	-	1.5
3. Governmental Building	-	1.3	12.4	13.7
4. Community Center	0.4	0.2	0.9	1.5
5. Religious	0.5	0.3	0.5	1.3
6. Terminal/Distribution	0.6	-	2.4	3.0
7. Supply/Treatment	0.2	-	4.1	4.3
8. Residential - A	-	43.0	19.8	62.8
9. Residential - B	11.9	15.1	61.1	88.1
10. Residential - C	18.6	24.5	77.1	120.2
11. Residential - D/E	25.4	-	13.7	39.1
12. School/Laboratory	2.2	8.5	19.9	30.6
13. Hospital/Health	1.0	-	6.3	7.3
14. Plaza/Garden	2.3	0.8	2.2	5.3
15. Park/Forest/Green	9.2	21.9	46.7	77.8
16. Recreation/Sports	4.1	-	13.6	17.7
17. Industrial	0.5	-	-	0.5
18. Agricultural	-	16.8	76.7	93.5
19. Car Parking	2.1	0.6	2.4	5.1
20. Road/Street	11.7	19.8	62.9	94.4
Total	95.2	153.0	425.0	673.2

Source: The Study Team

Table 4-4 CONSTRUCTION COSTS OF OLD KARAK URBAN DEVELOPMENT

Sub-project	Item	Unit cost (JD/m ²)	Scale	Amount (JD)
1. Existing Gov. Bldg.	demolition	6.0	10,000	60,000
2. Castle Square	building	80.0	2,000	160,000
	pavement	2.5	12,000	30,000
3. Small scale parking	pavement	2.5	13,000	32,500
4. Pocket park	gardening	6.0	10,000	60,000
5. Road improvement	pavement	2.5	10,000	25,000
6. Afforestation	-----	3.0	92,000	276,000
Total				643,500

Source: The Study Team

Note: Cost for restoration of the Castle and for construction of the handicraft centre are not included.

Table 4-5 CONSTRUCTION COSTS OF MARGE URBAN DEVELOPMENT

Sub-project	Item	Unit cost (JD)	Scale	Amount (JD)
1. Community zone	building	80.0/m ²	4,000 m ²	320,000
2. Neighborhood park	gardening	6.0/m ²	20,000 m ²	120,000
3. School sites	excavation	3.0/m ³	20,000 m ³	60,000
	reclamation	3.0/m ³	20,000 m ³	60,000
4. Afforestation	-----	3.0/m ²	219,000 m ²	657,000
Total				897,000

Source: The Study Team

Table 4-6 CONSTRUCTION COSTS OF NEW KARAK URBAN DEVELOPMENT

Sub-project	Item	Unit cost (JD)	Scale	Amount (JD)
1. Road	excavation	3.0/m ³	188,700m ³	566,100
	pavement	2.5/m ²	629,000m ²	1,572,500
2. Water supply	pipng	6.0/m	160,000m	960,000
3. Sewerage	pipng	22.0/m	120,000m	2,640,000
4. Combined Gov. Complex	building	80.0/m ²	40,000m ²	3,200,000
5. Shopping centre	building	80.0/m ²	13,800m ²	1,104,000
6. Central plaza	pavement	2.5/m ²	16,000m ²	40,000
	gardening	6.0/m ²	6,000m ²	36,000
7. Bus terminal / taxi pool	building	80.0/m ²	4,000m ²	320,000
	pavement	2.5/m ²	20,000m ²	50,000
8. School sites	excavation	3.0/m ³	20,000m ³	60,000
	reclamation	3.0/m ³	20,000m ³	60,000
Total				10,608,600

Source: The Study Team

Note: (A) Cost for development of residential sites is not included.

(B) Unit cost data show the figures for Aug. 1987, obtained from a private contracting office in Amman by JICA Study Team

Table 4-7 CONSTRUCTION COSTS OF GENERAL URBAN DEVELOPMENT

Sub-project	Item	Unit cost (JD)	Scale	Amount (JD)
1. Bridge	excavation	3.0/m ³	48,000m ³	144,000
	pavement	2.5/m ²	8,000m ²	20,000
	RC	50.0/m ³	144,000m ³	7,200,000
sub-total				7,364,000
2. Bypass	excavation	3.0/m ³	180,000m ³	540,000
	pavement	2.5/m ²	100,000m ²	250,000
	RC	50.0/m ³	360,000m ³	18,000,000
sub-total				18,790,000

Source: The Study Team

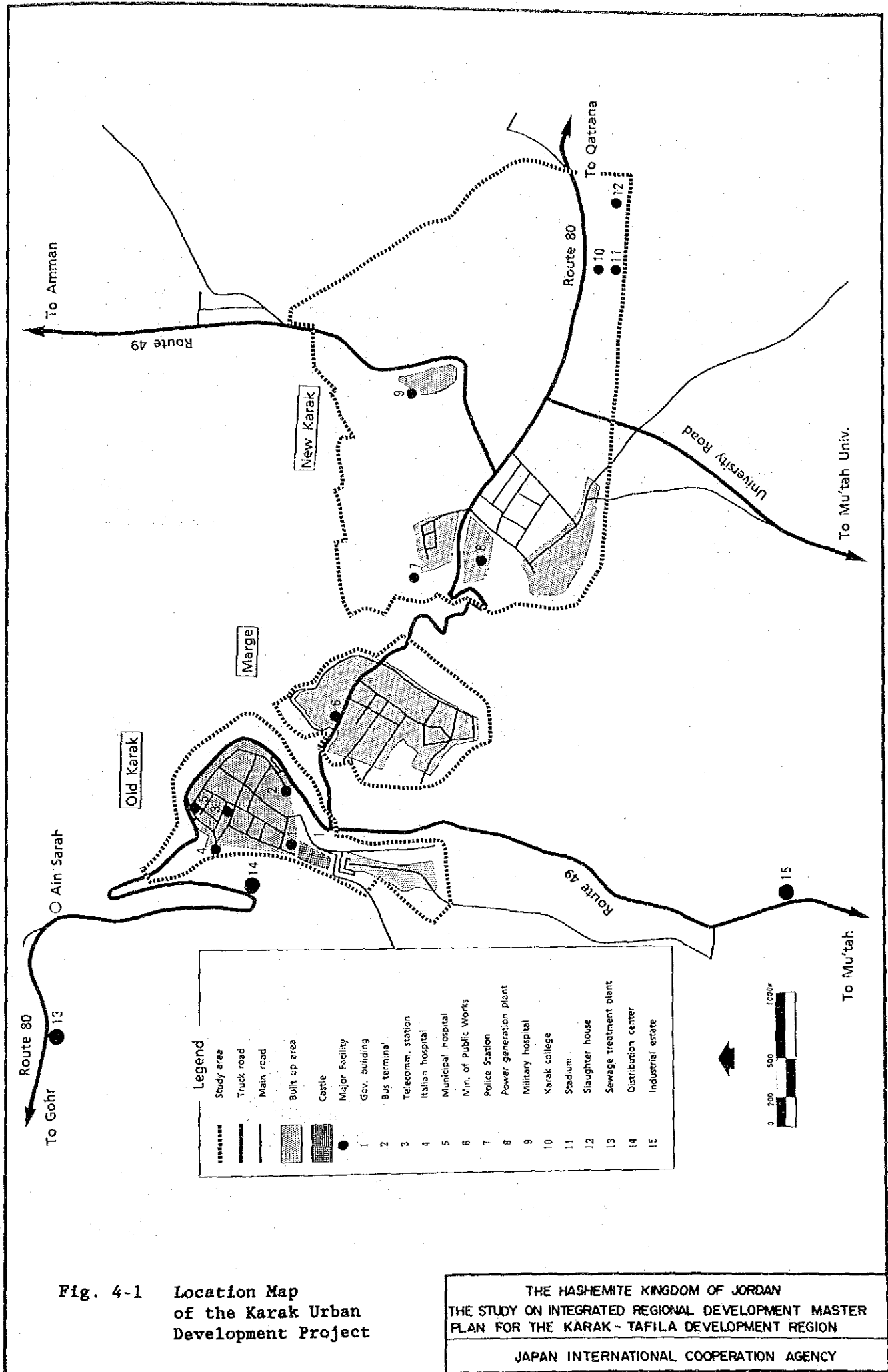


Fig. 4-1 Location Map of the Karak Urban Development Project

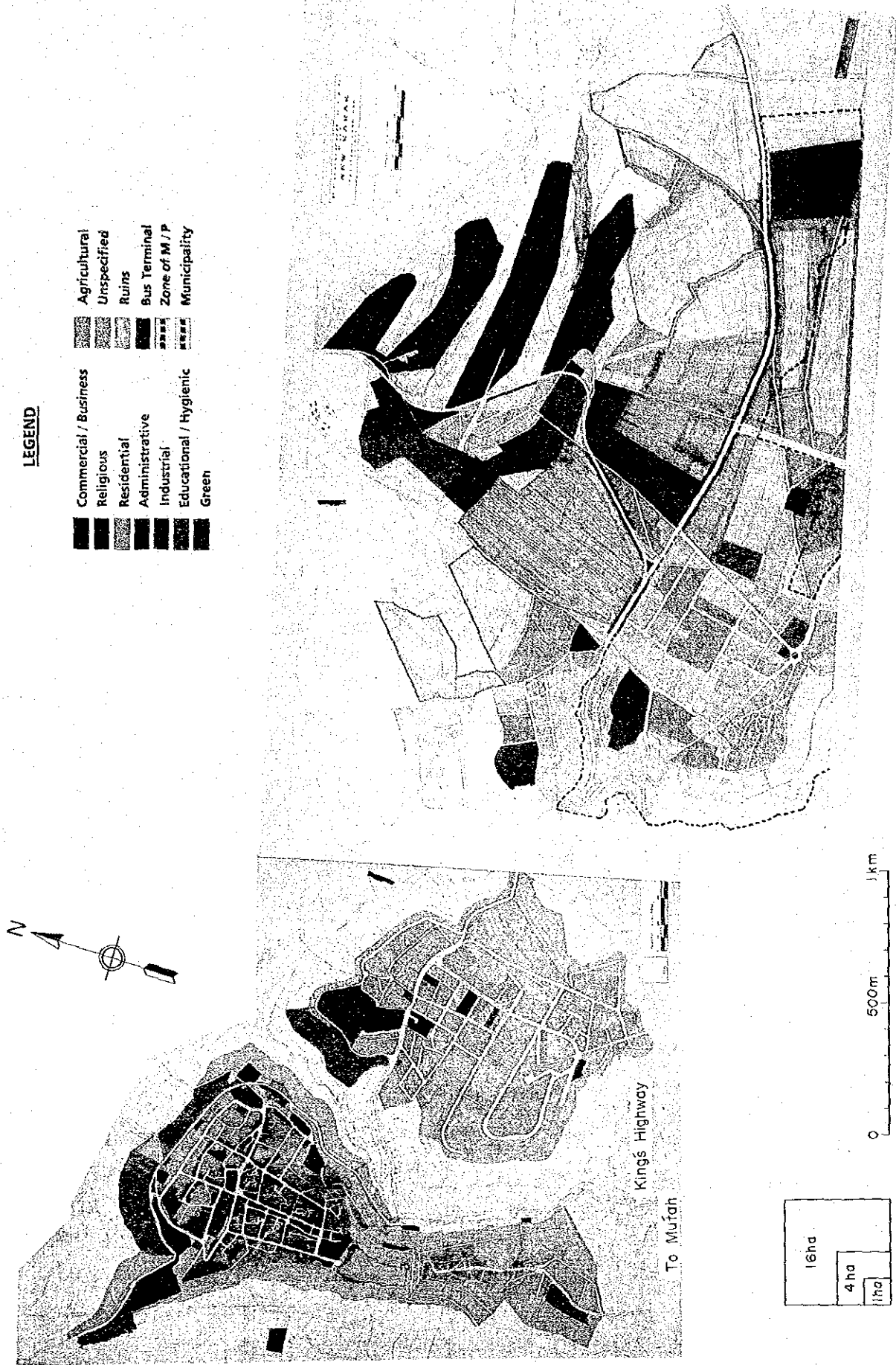


Fig. 4-2 Present Landuse of Karak

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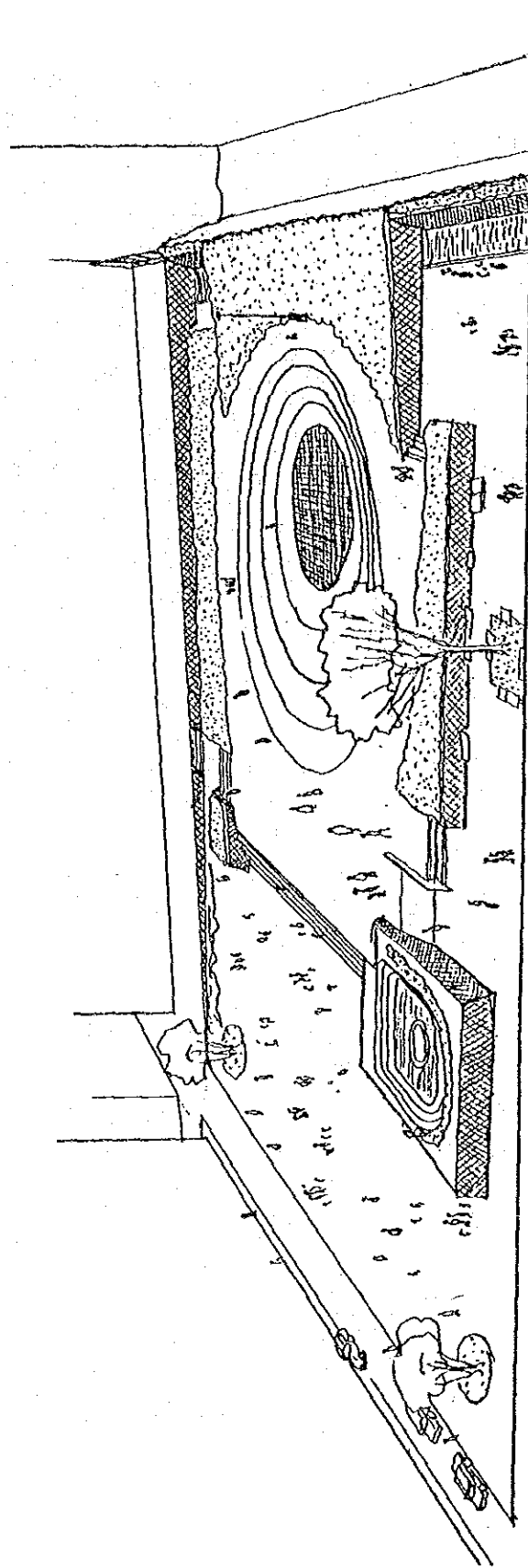


Fig. 4-3 Image Sketch
of Restored Castle Square

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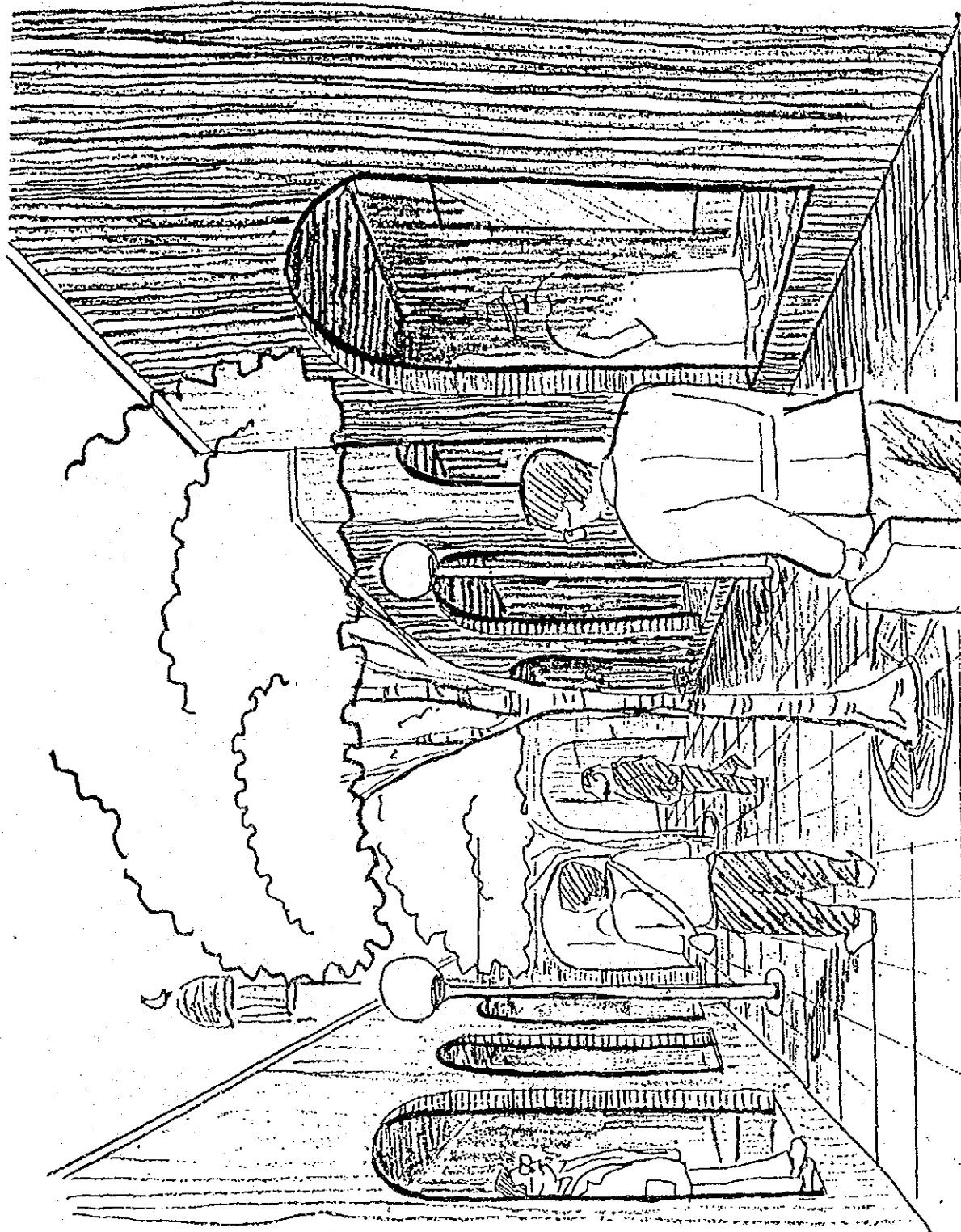


Image Sketch of Restored Historic Quarter (1/2)

K. Hashino / 1987

Fig. 4-4 Image Sketch
of Restored Historic Quarter
(1/2)

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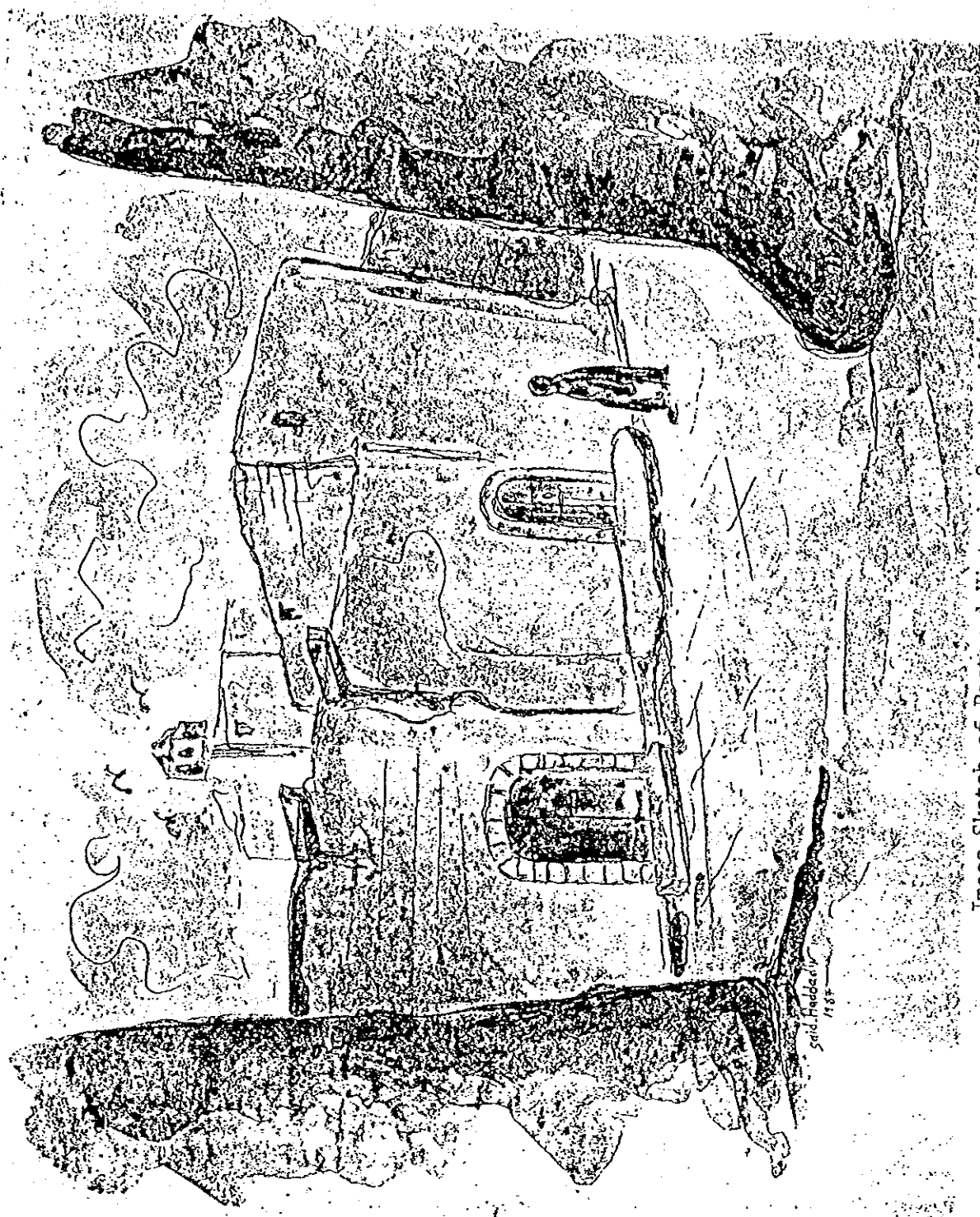


Image Sketch of Restored Historic Quarter (2/2)

Fig. 4-4 Image Sketch of Restored Historic Quarter (2/2)

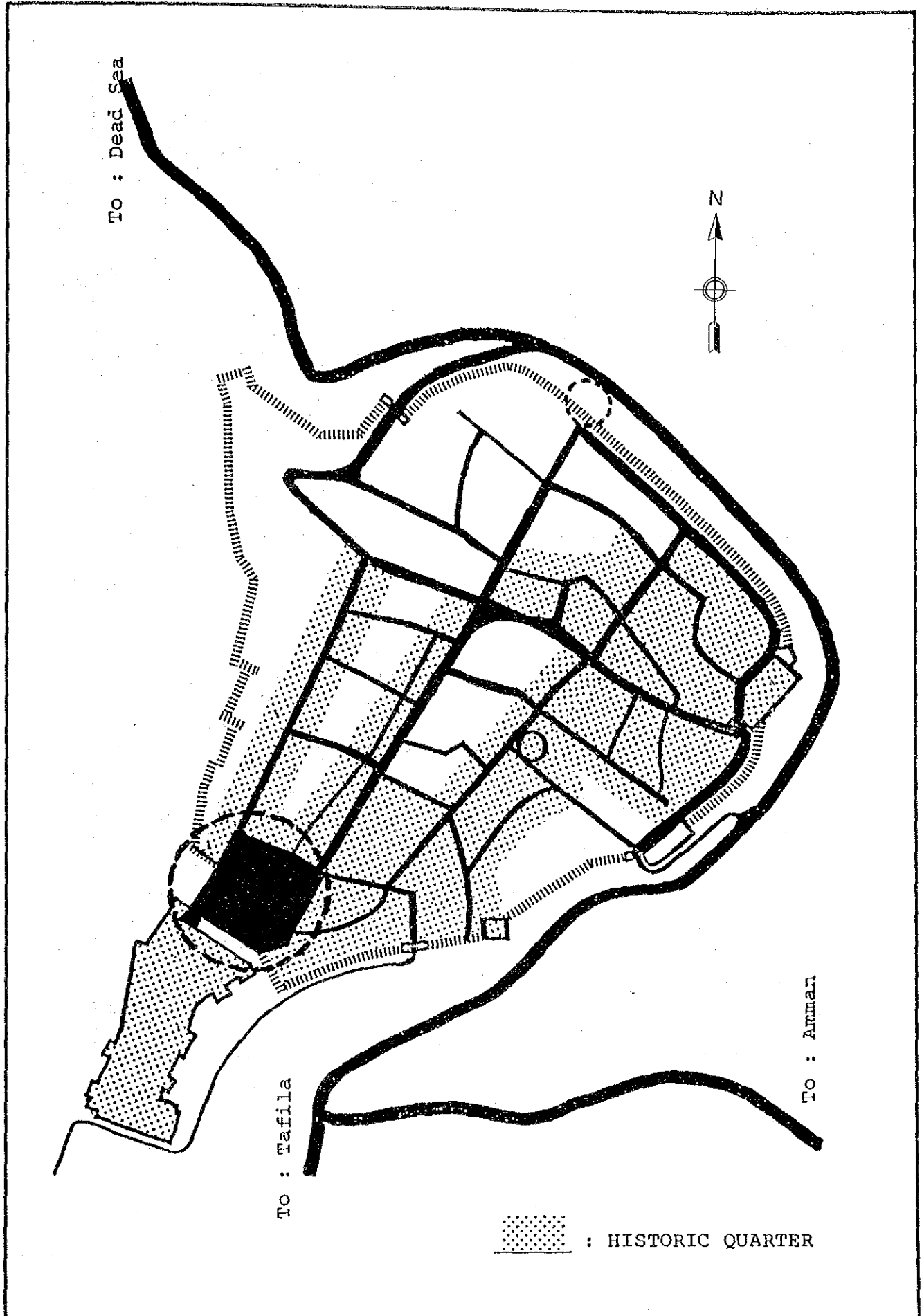
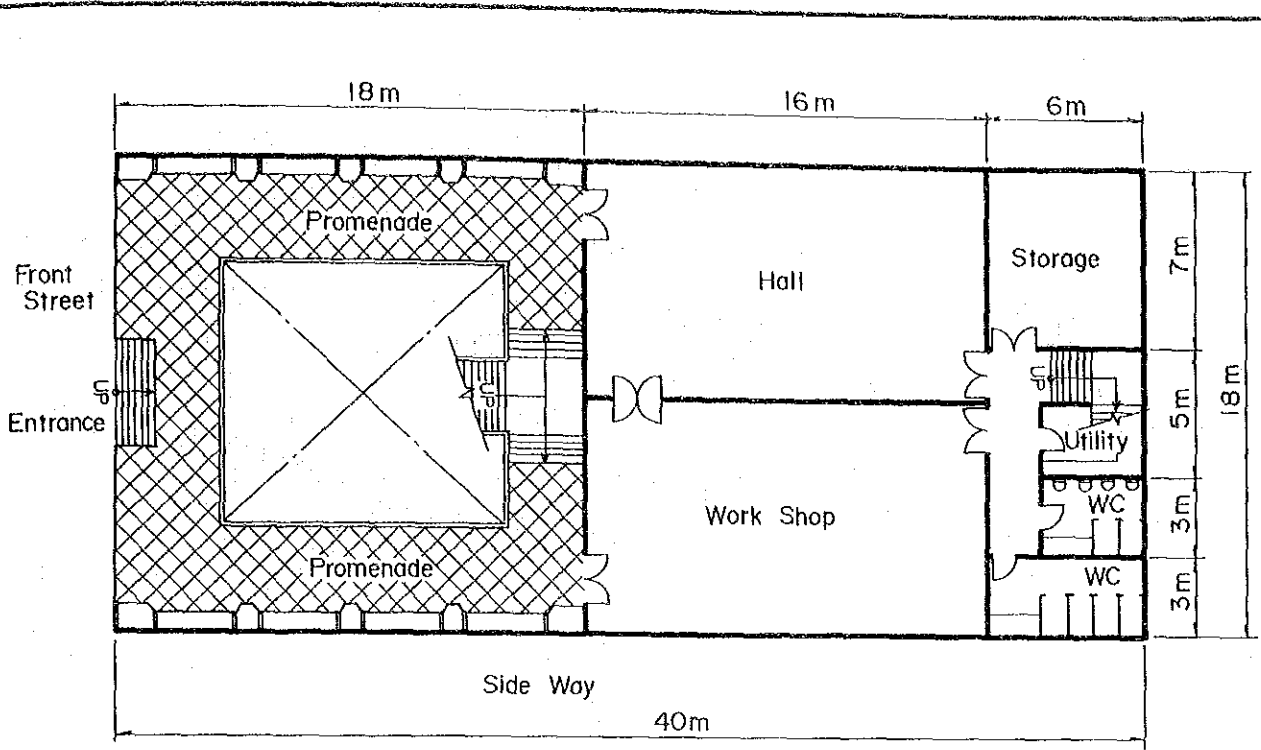
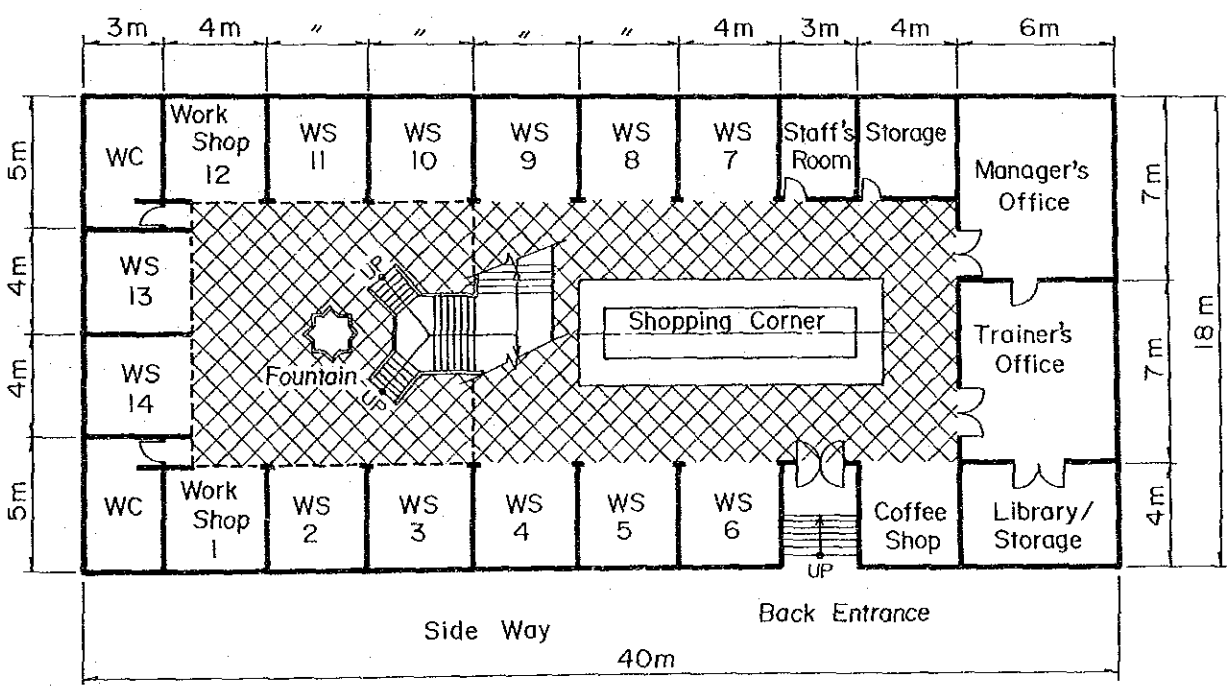


Fig. 4-5 Candidate Sites for Karak Handicraft Centre

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IF Plan



GF Plan

Fig. 4-6 Floor Plans of Karak Handicraft Centre

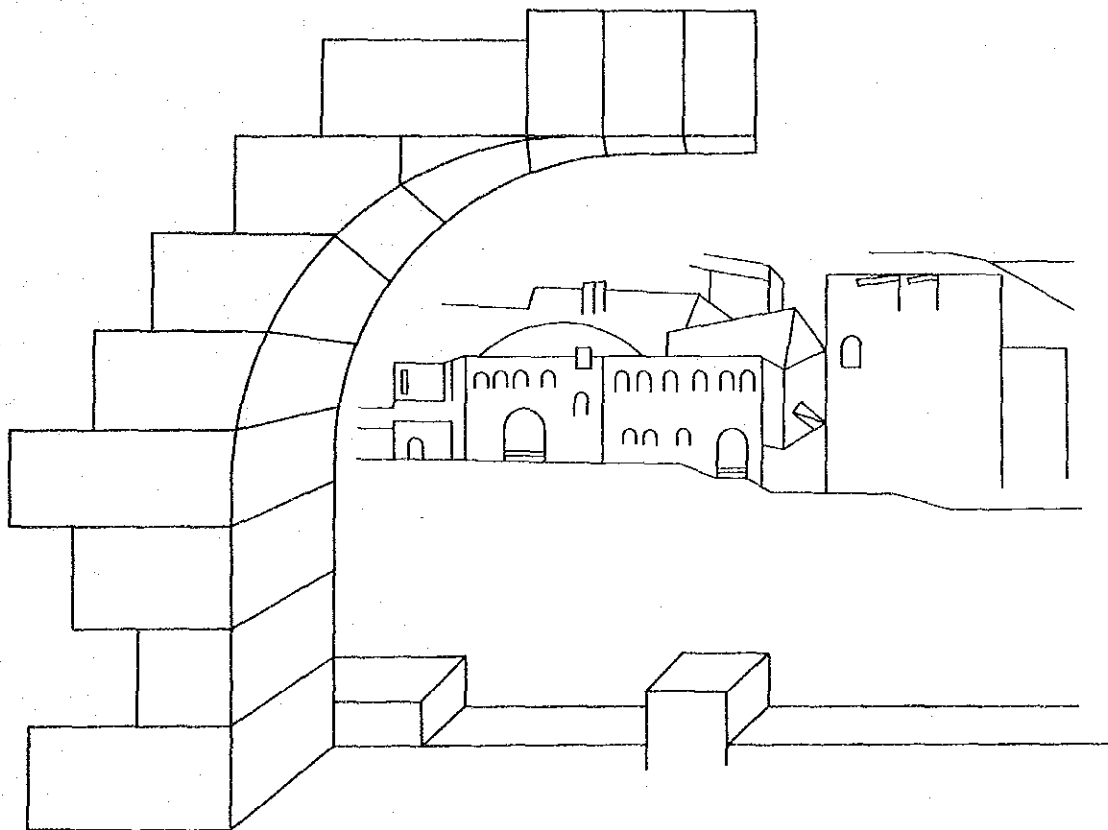
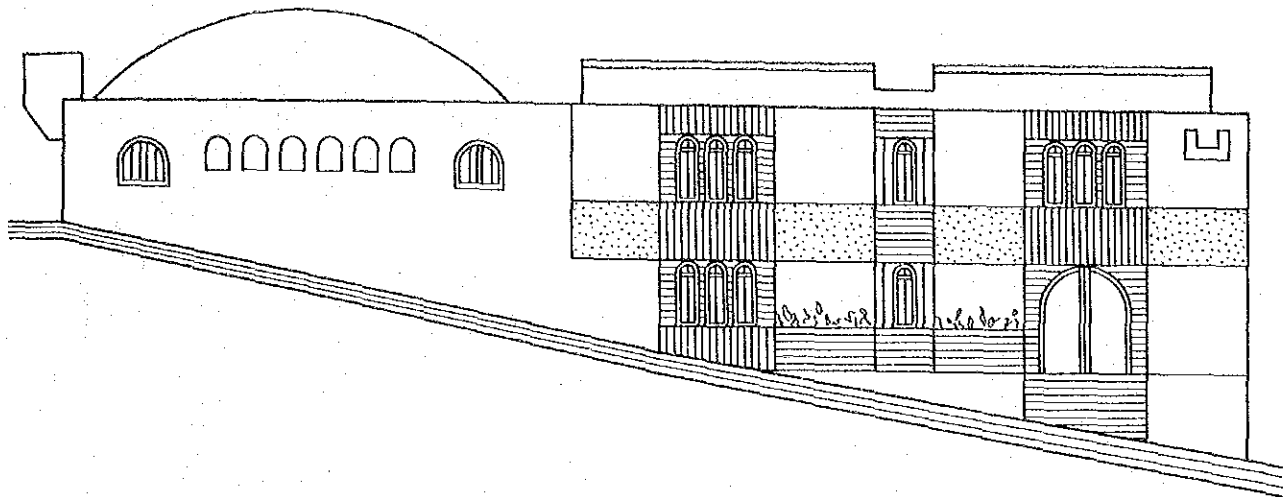


Fig. 4-7 Image Sketch
of Karak Handicraft Centre

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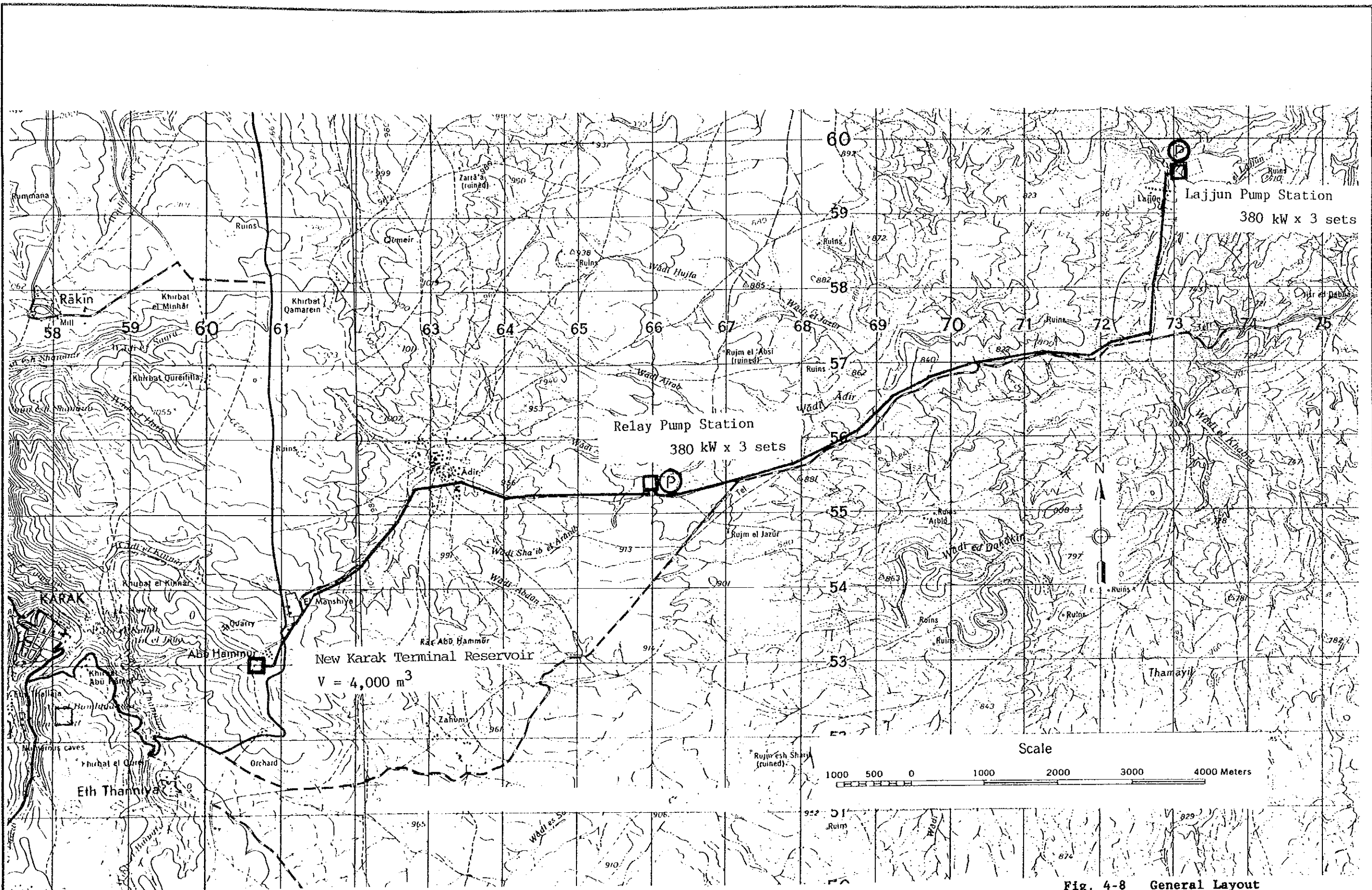


Fig. 4-8 General Layout of Proposed Lajjun-Karak Pipeline

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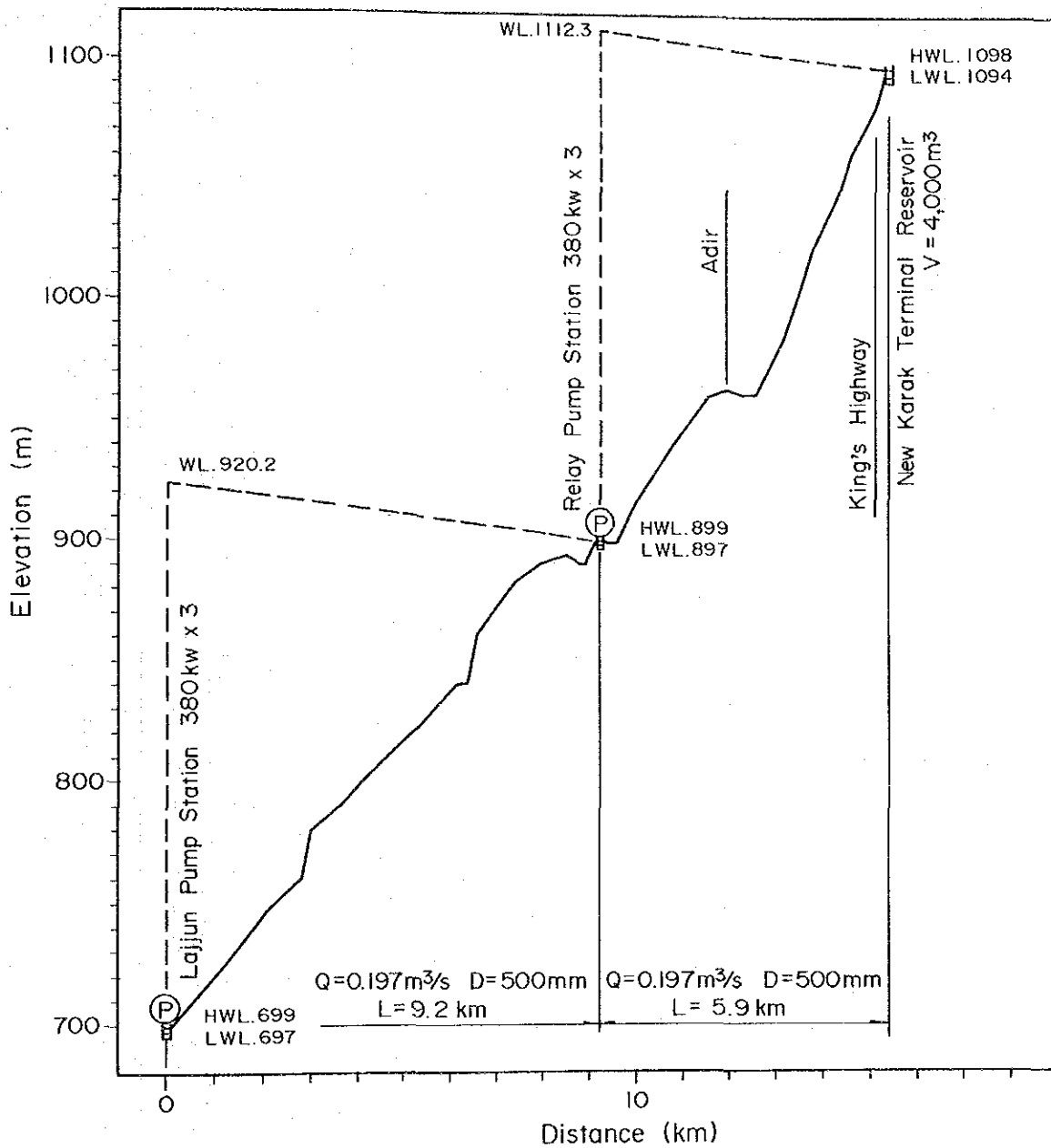
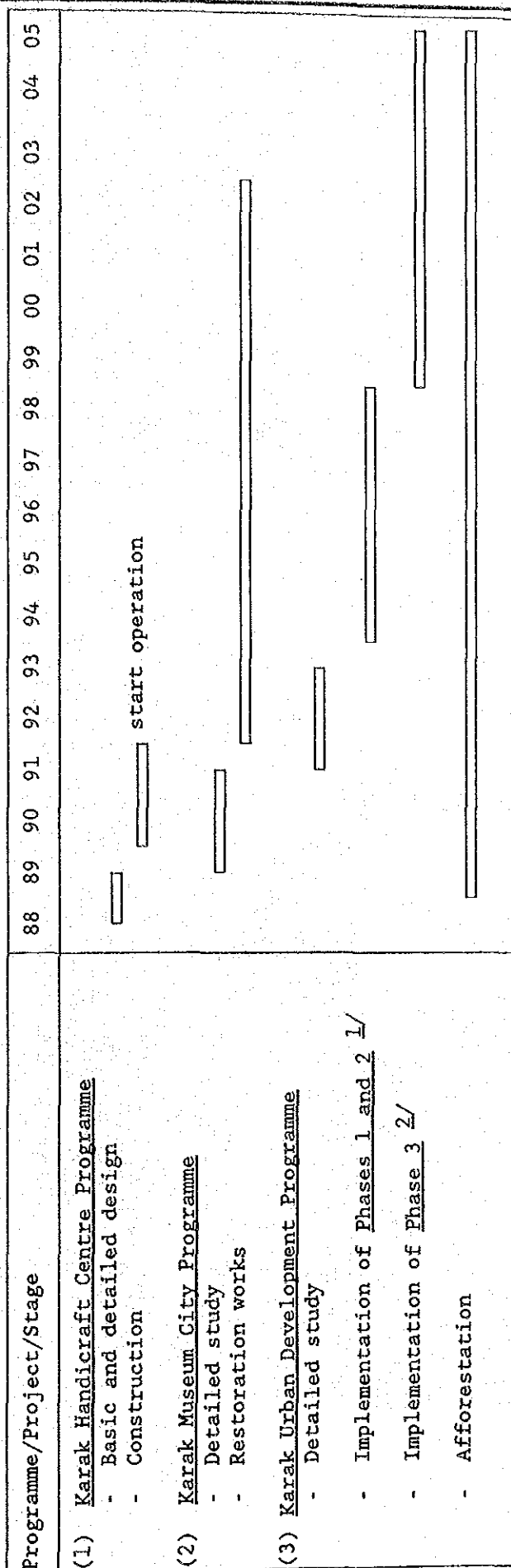


Fig. 4-9 Profile of Proposed Lajjun-Karak Pipeline



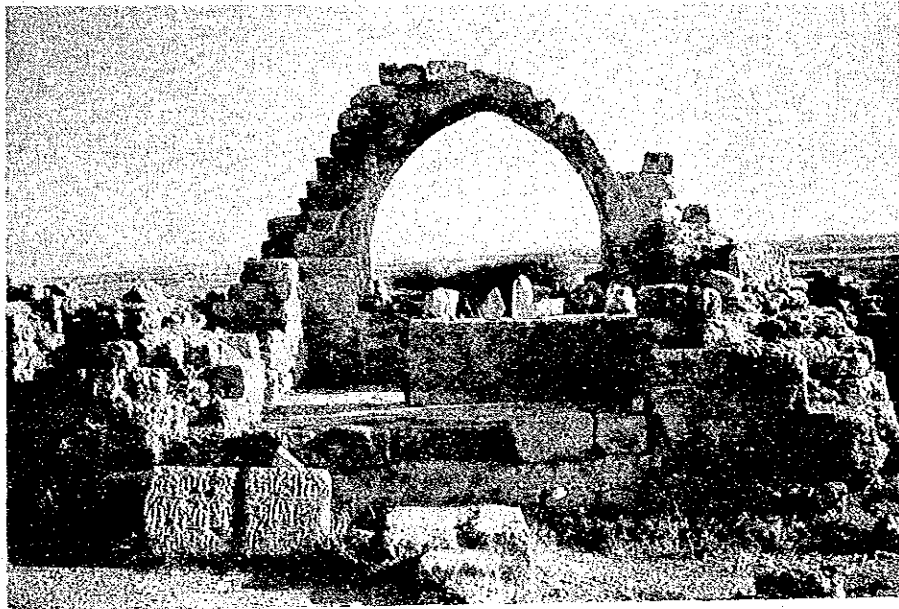
^{1/}: Phases 1 and 2 include construction of New Governmental Complex; part of residential lots; infrastructures in New Karak; Marge urban area; road improvement in Old Karak; Bus Terminal in New Karak; New Bridge

^{2/}: Phase 3 includes establishment of Shopping Center; Central Plaza; part of residential lots in New Karak; small car parks and Pocket Park in Old Karak; improvement of Central Commercial Zone in Old Karak; bypass to Ain Sara

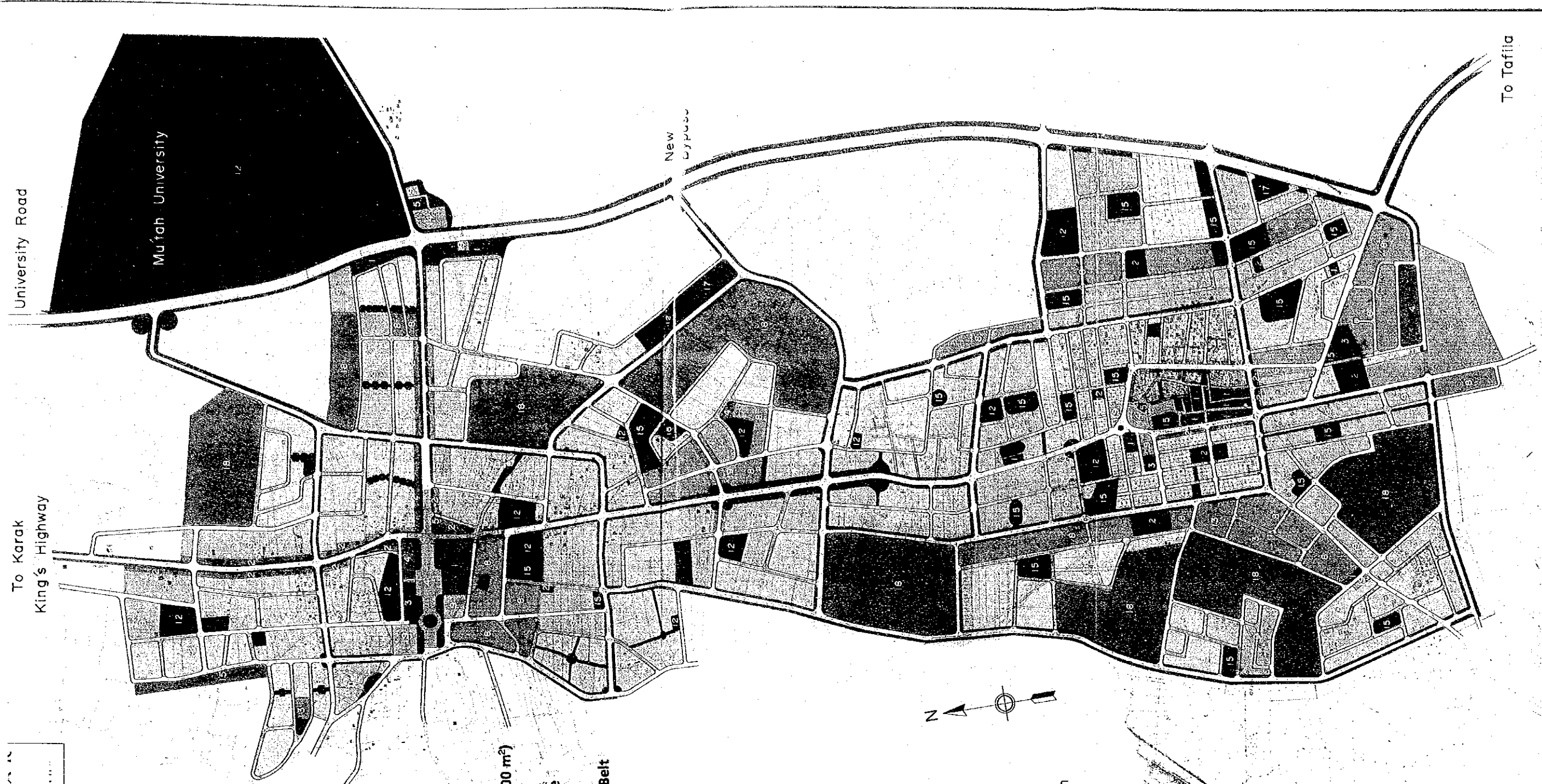
Fig. 4-10 Preliminary Implementation Schedule for the Karak Urban Development Project

Fig. 4-10 Preliminary Implementation Schedule for the Karak Urban Development Project

CHAPTER 5 MU'TAH-MAZAR URBAN DEVELOPMENT PROJECT

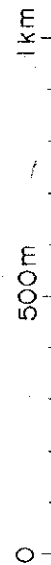
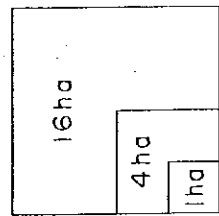


Islamic Monument at Mu'tah



LEGEND

- | | |
|----|--|
| 1 | Central Commercial / Business |
| 2 | Neighborhood Commercial |
| 3 | Governmental Building |
| 4 | Community Center |
| 5 | Religious Building |
| 6 | Terminal / Distribution Center |
| 7 | Supply / Treatment / Telecom. |
| 8 | Residential - A (1,000 m ² ~) |
| 9 | Residential - B (750 ~ 1,000 m ²) |
| 10 | Residential - C (500 ~ 750 m ²) |
| 11 | Residential - D, E (150 ~ 250 ~ 500 m ²) |
| 12 | School/ College / Laboratory |
| 13 | Hospital / Health / Public Welfare |
| 14 | Plaza /Garden |
| 15 | Park / Cemetery / Forest / Green Belt |
| 16 | Recreation / Sports Field |
| 17 | Industrial |
| 18 | Agricultural / Livestock |
| 19 | Car Parking |
| 20 | Trunk Road |
| 21 | Community Street |
| 22 | Vacant / Unused Land |



Future Landuse Plan of Mu'tah-Mazar

THE HASHEMITE KINGDOM OF JORDAN
 THE STUDY ON INTEGRATED REGIONAL DEVELOPMENT MASTER
 PLAN FOR THE KARAK-TAFILA DEVELOPMENT REGION
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5. MU'TAH-MAZAR URBAN DEVELOPMENT PROJECT

5.1 Introduction

The Mu'tah-Mazar Urban Development Project aims to merge the existing towns of Mu'tah and Mazar as an education and industry oriented urban centre along the King's Highway Corridor (Technopolis). The Project has two components: Mu'tah-Mazar Urban Development Programme; and Mu'tah Industrial Estate Programme.

For the Mu'tah-Mazar Urban Development Programme, a Draft Urban Master Plan was prepared under this study. It includes frameworks, an infrastructure expansion plan and necessary urban facilities to accommodate a growing population, and a future urban landuse plan.

Within the draft urban master plan, the Mu'tah Industrial Estate Programme is prepared to incubate small and medium scale industries taking an advantage of its proximity to Mu'tah University and the geographic location with easy access to the Aqaba seaport and QAIA.

5.2 Project Background

5.2.1 The Project Area and Landuse

(1) Project area: Mu'tah-Mazar is located 12 Km south of Karak. The project area comprises the existing municipal area including all the urbanized area and some adjacent agricultural land. The centres of the two towns are 4 km apart but urbanization has already narrowed the distance between them (see Fig. 5-1 for the project location).

Land and population of the project area are shown in Table 5-1.

(2) Landuse: Topographical features of the area are as follows:

- (A) Mu'tah has an altitude of 1,160 m AMSL and is situated in a shallow basin with an almost level surface.
- (B) Mazar has an altitude of 1,230 m AMSL in flat topography.

Present landuse conditions are simple. The central part of the area along Route 49 is used for roadside commercial activities. Beyond this is residential and beyond this again is agricultural.

Present landuse is summarized in Table 5-2 and Fig. 5-2.

5.2.2 Socio-economy

The populations of Mu'tah and Mazar were approximately 3,500 and 5,000 in 1985 respectively. The main source of income is from agricultural produce, although the area has a number of small scale industries and commercial activities. Mu'tah University is the only university in southern Jordan and has both military and civilian campuses.

5.2.3 Infrastructures

(1) Road: There are two major trunk roads in Mu'tah. One is Route 49 (the King's Highway) leading to Tafila, the other is the University Road. Mazar has only Route 49.

Streets in the cities are generally straight except for the southern exit point of Route 49. However, the straightness of the trunk road is a cause of danger because drivers do not slow down in the cities.

Outside the City, most of the roads are unimproved agricultural roads. For expanding the urban area, improvement of rural roads will be needed.

(2) Water supply: In Mu'tah-Mazar the water supply system is already well-developed and serves most households and buildings.

(3) Electricity: The electrification ratio in the city has reached 100 per cent.

(4) Sewerage: In the Five-Year Plan for Karak Region (1986-1990), the sewerage project in Mu'tah-Mazar is scheduled to be implemented including treatment plants, and the project also covers Al Adnaniyah village.

The cost is estimated at JD 1.0 million.

(5) Social infrastructures: the principal existing urban facilities are health centres, mother and child care centres, a vocational school, secondary schools, preparatory schools and primary schools.

5.2.4 Tourism Activities

There are a monument to the battle between Islam and the Byzantines in Mu'tah and the tomb of the Muslim martyrs in Mazar. Both are important in Islamic history and good resources for tourism development of the area.

5.2.5 Small Scale Industries

There are 35 small scale industries; 13 in Mu'tah and 22 in Mazar. Construction, non-metallic mineral products industries and metal products industries are predominant.

5.3 Draft Master Plan for Mu'tah-Mazar Urban Development

5.3.1 Development Objectives

The Mu'tah-Mazar Urban Development Project has three principal objectives:

- (1) to establish an industrial and research centre or *technopolis* on the King's Highway Urban Corridor from Karak to Tafila, by promoting small and medium scale industries in coordination with the development of Mu'tah University
- (2) to enhance the urban functions of Mu'tah-Mazar to support these economic and research activities by integrating the individual functions of Mu'tah, Mazar and Mu'tah University and by developing the necessary urban facilities in accordance with a long-term urban master plan
- (3) to provide citizens with quality housing in a comfortable environment with greenery

5.3.2 Basic Concepts

(1) Planned area: the future urban functions of Mu'tah and Mazar are proposed as follows:

- (A) Mu'tah: Scientific research, technology development, and industry
- (B) Mazar: Residential and commercial community

(2) Resources

(A) Mu'tah: Mu'tah University should be the main *engine for development*. The semi-ruinous area in the centre of the city will be redeveloped and the extensive area of flat land will be utilized for a variety of objectives. The famous monument to the battle with the Byzantines gives a historic flavour to the city.

(B) Mazar: The agglomerated commercial area and the plaza around the famous tomb of a descendant of the Holy Prophet (p.b.o.h.) at the centre of the city will provide the focus for development of the city.

Mu'tah University and the proposed Mu'tah Industrial Estate will be the core of the *Technopolis*. The principal roles of the civilian wing of the University will be research and development of technologies and the supply of qualified manpower to the Estate, while the principal role of the Estate will be manufacturing and provision of technical services to the King's Highway Urban Corridor.

The University and the Estate could cooperate in the following aspects:

- (A) The University can conduct practical research for development of appropriate technologies which can be applied to the factories in the Estate, or the University and the Estate can conduct joint research for commercial production of original products.
- (B) The Estate can manufacture equipment and consumables and can provide technical services needed by the University including tools for experimentation, printing related products and services, maintenance services and so forth.
- (C) Some of the graduates of the University could find jobs in the Estate.

- (D) The students of the University can have an on-the-job-training in the Estate.
- (E) The University and the Estate can share sophisticated equipment such as computers and costly testing equipment.

5.3.3 Development Strategies

(1) Mu'tah-Mazar Urban Development Programme

(A) General

- to provide a refined environment and facilities to encourage consumption by the people of the University and the Industrial Estate in the city area
- to conserve existing green land as much as possible
- to exclude transit traffic and to release streets to pedestrians
- to clear the axis of Mu'tah-Mazar
- to secure school sites
- to locate a large residential lot without unnecessary use of agricultural land
- to establish green open spaces along roads

(B) Mu'tah

- to develop a core of Mu'tah

(C) Mazar

- to redevelop the central commercial area
- to develop more residential lots

(2) Mu'tah Industrial Estate Programme

- to incubate and develop small and medium scale industries and non-manufacturing business activities
- to promote manufacturing, maintenance and provision of technical services with appropriate management
- to provide utilities and agreeable environments including parks and greenery for the factory workers

5.3.4 Development Frameworks

(1) Planned area: some 710 ha in total including roads

	Planned area (Excluding trunk road)	Roads	Total
Mu'tah-Mazar	621 ha	88.8 ha	709.8 ha

Note: (A) Streets of less than 7.5 m wide are not counted as trunk roads.

(B) Areas outside the planned area which is still included in the municipalities are almost agricultural land.

(2) Planned population:

	Existing Population		Planned Population	
	1985		1995	2005
Mu'tah-Mazar	8,500		16,000	30,000

Note: (A) Population in 1985 is estimated based on MOP and the data of the field survey by MMRAE Regional Planning Dept., September 1986.

(B) Planned population includes the University population both staff and students.

(3) Planned employment in 2005:

1. Commercial	2. Public Sector Admin./O & M	3. Agriculture Manufacture Construction	Total
1,500	4,200	3,300	9,000

Note: (A) Staff of Mu'tah University are counted in the public sector.

(B) Residents of Mu'tah-Mazar who will work in the Industrial Estate are assumed at 1,500 of the planned total employment of 2,500.

5.3.5 Draft Landuse Plan

A future landuse plan has been formulated as shown in the figure of the first page of this Chapter and in Table 5-3 on the basis of the

objectives, concepts, strategies and frameworks and referring to the existing town plans of Mu'tah and Mazar.

5.3.6 Planned Infrastructures and Urban Facilities

(1) The University Road will be extended to the exit point of Route 49 at the southern part of Mazar (3.7 km), and the outer ring roads will be constructed (approximately 20 km).

(2) The water supply system and the sewerage system with a treatment system will be constructed and extended for the enlarged region including the Mu'tah Industrial Estate and Mu'tah University (for approximately 3,600 households).

(3) Parco Mu'tah, a symbolizing complex of the city, will be constructed as a new city centre. It will have a large car park, a plaza, governmental offices, a convention hall, business service offices, a computerized information centre, a design centre (fashion, interior, commercial graphics, computer graphics and so on), a language laboratory, and a shopping centre (8 ha).

(4) School sites will be secured (19 ha).

(5) High qualified residential lots and housing will be constructed (200 ha). The residential area by classification will be as follows:

Classification	A	B	C	D/E	Total
Area (ha)	38.8	116.0	114.5	74.7	344.0

Note: Classification is set by the minimum lot area of residence.

A: 1,000 m², B: 750 m², C: 500 m², D: 250 m², E: 150 m²

(6) Street-side commercial activities will be promoted by providing car park, footpaths, pocket parks, arcades and street furniture.

(7) A hotel will be constructed to accommodate visitors to the University and the Industrial Estate (40 rooms).