MESKENE and TEL TAMER

IRRIGATION and CROPPING PLAN

REPORT

FOR

THE GENERAL ORGANIZATION OF CATTLE

of the

SYRIAN ARAB REPUBLIC

November 1979

PN AAP 303

INTRODUCTION

In September 1979, the United States Agency for International Development (USAID) contracted with the Soil Conservation Service for technical services and feasibility studies for an irrigation system (sprinkler) and a cropping plan for the establishment of two cattle (dairy) farms in the Syrian Arab Republic. The study was requested by the Syrian Arab Republic Government (SARG), in particular, the General Organization of Cattle (GOC). The General Organization of Cattle will establish two new cattle stations at Meskene and Tel Tamer. These plans call for the establishment of forage crops and irrigation systems for sustaining these crops. These proposed cattle stations are located in different climatic zones and will utilize water from different sources.

The objective of this study was to provide basic irrigation plans and forage cropping systems to supply the needed feedstuffs for the planned dairy cattle.

This report reflects some cost estimates for specific items. However, a thorough economic study was not made of this project to determine the cost benefit ratio.

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OBJECTIVES

1. Review existing data for the Meskene Farm Station compiled by the General Organization for the Development of the Euphrates Basin (GADEB) on soils, hydrology, climate, irrigation systems, etc.

2. Review the "East Meskene Irrigation Project Phase 2 Project Report" made by the Nipppon Koei Co., Ltd. Consulting Engineers, Tokyo, Japan, November 1975.

3. Review the "Crop Production and Feed Supply Survey, Kamishly Area of Northeast Syria" report made by the Washington State University, June 1976.

4. Study the soils, topography, farm layout, and water sources for each site, Meskene and Tel Tamer.

5. Develop the most efficient irrigation system for each project area, Meskene and Tel Tamer.

6. Make field evaluations to determine the soil intake curve for use in developing designs for irrigation systems.

7. Develop an irrigation guide for use in both locations.

8. Develop the most effective forage cropping system for each project area.

TEAM MEMBERS

To accomplish the objectives, a team was formed and brought to Syria. The team investigated the sites in the field and gathered data and general information from Syrian officials. The members of the team and their specialities were:

Mr. Billy J. Garner Irrigation Engineer Soil Conservation Service Harlingen, Texas	Irrigation Engineer
Mr. William M. Miller Conservation Agronomist Soil Conservation Service Temple, Texas	Agronomist

TEAM ACTIVITIES

The technical team arrived in Damascus, Syria on October 8, 1979. In Damascus the team received important briefings from:

Mr. Don Yeaman, US/AID, U.S. Department of State
Mr. Miles G. Wedeman, US/AID, U.S Department of State
Mr. Archie Hogan, US/AID, U.S. Department of State
Mr. Radwan Tchalabi, US/AID, U.S. Department of State

During the first week of the project, the team visited the Hama District Agricultural Office and met Mr. Bashar Makhloutah, Direct General; Mr. Mahmoud Al Zaim, Director, Plant Production; Dr. Abdul Mouazz Ammoury, Chief, Department Rural Engineering; Mr. Fariz Al Boushi, Director of Romanian Contract; Mr. Ezz Al Din Shikh Kheled, Department of Plant Production; and Mr. Nizar Dunia, Director, Jeb Ramleh Station.

The team visited the state dairy cattle station in the Ghab area, the new ICARDA Research Station at Aleppo, and the project sites at Meskene and Tel Tamer. After the review of the sites, the team met back at Hama with Mr. Bashar Makhloutah, Director General, and his staff and developed a work plan.

The Meskene project was studied first and followed by the Tel Tamer project. On October 30, 1979, the team had completed their field review of the project sites at Meskene and on Tel Tamer, and had met the second time with the GOC at Hama on information needed in the report. On that date, the team returned to Damascus to develop the irrigation and cropping plans and to put together their report.

The draft of their report was assembled and submitted for review to the GOC on November 13, 1979. The draft of the report was reviewed and explained in detail to the Director General and his staff on November 17, 1979, in Hama.

SPECIAL RECOMMENDATIONS

We are informed that currently rhizobia inoculants are not being used on legume seedings at planting time. Rhizobia cultures to inoculate seed are a very low cost item. These bacteria work symbiotically with the legume plant, fixing atmospheric nitrogen which the legume plant can utilize, and ultimately the following crops may benefit from this. This could help reduce overall costs for nitrogen fertilizers. Some estimates of potential nitrogen fixing abilities of some legume species are:

alfalfa	1058 kilograms/hectare
white clover	561 kilograms/hectare
vetch	435 kilograms/hectare

1. We recommend that rhizobia inoculants be used for the various species of legumes as they are seeded.

The plans for the physical plant of the Tel Tamer Project are located adjacent to the paved road on the south end of the property.

2. We recommend that the physical plant be relocated to the north end of the property on the class IV soils. At the present planned site, they will occupy class I lands which should be utilized for crop production.

   Moving the plant to the north end of the property would also place it further from the town of Tel Tamer and lower the risks of health and odor problems to the communtity.

In the present plan for both sites, the manure from the animals will be collected, stockpiled, and moved to the fields and used as fertilizer.

3. We recommend that a sewage lagoon be considered in the overall plan of the physical plants. Both sites have the essential landscapes that would complement such construction. A sewage lagoon would not require as much physical moving of the manure with equipment and men as the present plans. The manure would be applied to the fields in the irrigation water. The problem of offensive odors associated with a plant of this nature would be improved.

LAND CLASSIFICATION

The land classification for the two project areas has been done according to the suitability of the soils for agricultural irrigation use based upon a modified standard of land capability classification used by the United States Soil Conservation Service. The specifications for the land classifications standards are shown on Table 1.

Based on the standards in Table 1, the soils of the two projects are classified into four classes, class I, II, III, and IV, depending upon the degree of limiation for use in irrigation algriculture. Land classes I through III are arable land suited to irrigation agriculture. Land class IV is limited arable land. A soils map showing the approximate boundaries for each soil class is in the Appendix 1 for the Meskene Project and Apprendix 2 for the Tel Tamer Project. The descriptions of land classes are as follows:

SOIL CAPABILITY CLASSES

Class I

These are reddish yellow* loamy deep soils. They occupy nearly level to slightly depressed smooth upland plains. They are moderate to moderately slowly peremeable and have a high available water capacity.

* Soil colors are based on Munsell Soil Color Charts (1975 edition), 2441 North Calvert Street, Baltimore, Maryland 21218

TABLE 1

SPECIFICATIONS

FOR LAND CLASSIFICATION

Land Characteristics Of Soils	Class I	Class II	Class III	Class IV
Texture	Silty clay loam (subsoils slightly more clayey)	Silty clay loam	Silty clay loam	Silty clay loam (some gravel to pebbles)
Soil depth to gravel, rock, or other undesirable material	Over 200 cm	Over 200 cm	60 to 200 cm	30 to 60 cm
pH	7.4 - 7.7	7.4 - 7.7	7.4 - 7.7	7.4 - 7.7
Peremeability	Moderate to moderately slow	Moderate	Moderate	Moderate to moderately rapid
Drainage	Well to slightly depressed	Well	Well	Well
Slope	Less than 1%	Less than 1%	0.5 - 2%	0.5 - 4%

Class II

These are reddish yellow* loamy deep soils. They occupy nearly level smooth upland plains. They are moderately peremeable and have a high available water capacity.

Class III

These are reddish yellow* loamy moderately deep to deep soils. They occupy nearly level to gently sloping upland areas. They are moderately peremeable and have a medium to high available water capacity.

Class IV

These are reddish yellow* to brownish yellow loamy shallow to moderately deep soils. They occupy nearly level to gently sloping smooth upland areas. They are moderately to moderately rapidly peremeable and have a low to medium available water capacity.

IRRIGATION SYSTEM DESIGNS AND RECOMMENDATIONS

The soils are silty clay loams at both Meskene and Tel Tamer sites. The soil intake curve was determined in the field by the irrigation evaluation procedure outlined in "Methods for Evaluating Irrigation Systems, Agriculture Handbook No. 82," Soil Conservation Service, United States Department of Agriculture. A submerged orifice plate was built by a local sheet metal shop to measure the flow in the furrow. Based on the intake curve of the furrow evaluated for this soil, all furrow irrigation system designs were developed by using the irrigation guide for 0.5 intake curve. The maximum design sprinkler application rate should not exceed 0.5 inches per hour. This field irrigation evaluation data was used to develop the local irrigation guide (Appendix 3, Irrigation Guide).

Soil samples were also taken in the field with the soil at field capacity and submitted to a local laboratory to determine available moisture holding capacity. It was estimated that the available moisture holding capacity for this soil is 2 inches for each foot of depth from the surface.

The irrigation systems were designed to replace 50 percent of the available moisture for the root zone depth of the crop being grown. The irrigation guide (Appendix 3) shows the root zone depth and amount of moisture to replace for each crop. The irrigation frequency is determined by dividing the net moisture to be replaced by the peak period use rate.

* Soil colors are based on Munsell Soil Color Charts (1975 edition), 2441 North Calvert Street, Baltimore, Maryland 21218

Both the sprinkler and furrow irrigation systems were designed for 80 percent efficiency under ideal conditions. We recommend furrow irrigation for the deep soils with 0.5 percent slope or less. We recommend sprinkler irrigation for the shallower soils and on slopes of more than 1.0 percent. Either sprinkler or furrow irrigation can be used on slopes of 0.5 percent to 1.0 percent for deep soils. However, land leveling for furrow irrigation would require bench leveling.

We do not recommend using the sprinkler irrigation systems when the wind exceeds 8 MPH (miles per hour) velocity. Based on the climatic data (Appendix 4, Climatic Data Meskene and Tel Tamer), the wind may exceed 8 MPH (or 12.88 kilometers per hour) velocity for a few hours on some days in June, July, and August. High velocity winds may also alter the speed and direction of water movement with furrow irrigation to such an extent that application of irrigation water may be impractical.

The irrigation systems should not be used during very high velocity wind.

SOIL SALINITY

The reference used for the analysis of soil salinity was "Diagnosis and Improvement of Saline and Alkali Soils, Agriculture Handbook No. 60," United States Department of Agriculture. The soil and water samples from both sites were submitted to the soils laboratory at Hama for chemical analysis (Appendix 5, Chemical Analysis of Soils and Water).

The analysis for the four soils tested shows the conductivity of the saturation extract to be less than one millimhos/CM (EC x 10^3) at 25^oC, with a pH of 7.4 to 7.7. The electrical conductivity of the water sample from the irrigation canal at Meskene shows 0.23 mmhos/cm at 25^oC. This is only 147 parts per million of soluble salts and is excellent irrigation water. The source of this water is from the lake impounded by the Euphrates Dam and the water has very little silt.

The water analysis of the sample taken from the Khabour River at Tel Tamer shows 0.51 mmhos/cm at 25^oC. This is 326 parts per million total salts. This also is very good irrigation water. Normally, the Khabour River has very little silt. However, the records studied show that the silt content was high for short periods following large rain storms with a large amount of runoff water entering the river. Irrigation water should not be pumped from the Khabour when the river water is muddy because the silt would be a problem for the irrigation systems.

Based on the soil analysis for salinity (Appendix 5) and the quality of irrigation water, a soil salinity problem should not develop with proper irrigation water management. The soil is peremeable with good internal drainage. It has a high percent of free calcium and it does have some gypsum. However, we examined several pits up to 14 feet (or about 4 meters) deep and some hand dug irrigation wells at Meskene which are over 50 feet (or about 15 meters) deep. Our examination did not reveal any barriers or impermeable layers that would prevent the downward movement of water in the soil profile and create a water table. Most of the class IV soils with soil depth of two feet or less are underlain by peremeable material. The class IV soil will be sprinkler irrigated, only, with light applications of 2.5 inches (or about 6.5 cm) of water, maximum. During the peak period use for bermudagrass, this will require an irrigation water application every week.

It is very important not to over irrigate any of the soil in order to prevent the build-up of a high water table and salinity problems. Always pre-irrigate to bring the soil to field capacity before planting and then add only the amount of water each irrigation to replace the water used by the plants. Irrigation should not stop following light rains. However, the amount of rainfall should be deducted from the net moisture usually replaced with each irrigation. Irrigations should only bring the soil to field capacity without any excess or gravitational water.

With proper irrigation water mamagement a salinity problem will not develop.

ROADS AND GRASSED WATERWAYS

Good all weather roads are very important in order to harvest the crops on part of the field during the time another part of the field is beimg irrigated. Adequate road systems have been designed for sites at both Meskene and Tel Tamer. The roads are designed with a base width of 32.8 feet (or 10 meters), the top width of the road should be at least 20 feet wide (or 6 meters). The road should be one foot (or 0.3 meters) above natural ground. The roads should be topped with gravel in order to use the roads with farm equipment following local rains.

The road systems were laid out to fit the design of the irrigation systems as shown on the map for the irrigation systems layout (Appendicies 6 and 7). Roads are located all around each field and along each underground irrigation pipeline within the fields.

The irrigation fields were laid out 1640 feet by 1804 feet (or 500 meters by 550 meters). The underground PVC plastic irrigation pipeline will be along the center line of the field with a road along the pipeline. This will divide the irrigated field into two 902-feet-wide areas (or 275 meter width). The sprinkler wheel movement laterals will irrigate an area 880 feet long (or 268 meters) and the irrigated furrow will have a length of run 870 feet (or 265 meters). The same size fields were used for both sprinkler and furrow irrigated areas. The wheel movement lateral lines and the furrow irrigation length of runs will be in a straight line; however, they will be approximately on the natural ground contour.

Roads are also planned along the grassed waterways and along the outside boundaries of the two sites.

Two grassed waterways are planned at Meskene and one at Tel Tamer. The waterways will have a flat bottom 32.8 feet wide (or 10 meters). They are located in the natural lows as shown on the layout maps (appendices 6 and 7), and will have the natural grade of the low areas. The depth of the waterway will be one foot (or 0.3 meters) below the top of the road.

There will be an 18-inch (or about 46 cm) reinforced concrete culvert under each road that crosses the grassed waterway. The bottom of the waterways will be established in bermudagrass and will be harvested when the surrounding area is harvested.

The net area irrigated is about 90 percent of the total land area because of roads, grassed waterways, and field edges that are not irrigated. The cost of constructing the required roads and waterways for all of the irrigated area at Meskene and Tel Tamer is estimated as follows:

> The road network will require about 62 feet of road per acre, with each foot requiring one cubic yard of fill material. At $1.60 per cubic yard by dump truck in place, the cost would be about $100.00 per acre for the irrigated area. The estimated cost is SP 963.69 per hectare.

SPRINKLER IRRIGATION SYSTEM DESIGN

The irrigation field dimensions with roads around the boundaries are 550 meters by 500 meters. As many as three of these fields can be irrigated with one sprinkler system by pumping out of a sump. The sump is kept full by regulating the 10-inch steel gate valve from the concrete pipeline distribution system.

When three fields are irrigated by one sprinkler system, the main line will consist of the following pipe sizes:

					LOSS IN EFFICIENCY	
FEET	or METERS	INCHES DIAMETER PVC	GALLONS PER MINUTE GPM	or CUBIC METERS PER HOUR	POUNDS PER SQ. INCH PSI	or ATMOSPHERES
1640	500	12	1320	300	2.6	.18
1640	500	10	880	200	3.0	.20
1640	500	8	440	100	2.4	.16
Total main line friction loss					8.0	.54

A 6-inch valve will be installed every 60 feet (or 18.3 meters) along the main line for a total of 26 valves in each field. The main line will be PVC high pressure underground plastic irrigation pipe (ASTM D-1784, PVC type 1, grade 1, PVC 1120, 160 PSI (pounds per square inch) pipe, with SDR 26). (160 PSI is 10.88 atmospheres.)

Each field will have two side roll, wheel move sprinkler laterals with power mover, one for each side. There will be two moves per day during peak period water use. The 26 valves will be used in 13 days, therefore the irrigation frequency can be every 13 days when needed. Each sprinkler lateral will be 880 feet (or 268 meters) of 5-inch size pipe as an axle for the wheels. The sprinklers will be spaced 40 feet (or 12.2 meters) apart with 6-inch risers for a total of 22 sprinklers. Each sprinkler will apply 10 gallons per minute (or 2.27 cubic meters per hour) for a total of 220 gallons per minute for the sprinkler lateral. The laterals will be moved 60 feet (or 18.3 meters) to the next valve for each set. Each sprinkler will cover about 100 feet (or 30.5 meters) in diameter, thus with 10 GPM per sprinkler, a 40 foot by 60 foot spacing, the system will apply 0.4 inches per hour (or about 1 centimeter per hour). For a 4-inch (or 10.2 centimeters) water application, each set will require about 10 hours.

All of the sprinkler systems at Tel Tamer will be pumping uphill through the main line. All of the area north of concrete pipelines will be sprinkler irrigated. The difference in elevation must be considered in designing the systems. Some of the systems will pump against as much as 35 feet (or 10.7 meters) of additional head which is about 15 pounds per square inch pressure difference from the low field to the high field. In this case the two laterals in the upper field should have Rainbird Number 30 sprinklers with nozzle sizes 3/16 inch by 1/8 inch 20^{o} which will apply 10 GPM with 45 PSI (or 3.1 Atmospheres). The lower field should have laterals with Rainbird Number 30 sprinklers with nozzle sizes 3/16 inch by 3/32 inch 7^{o} which will apply 10 GPM with 62 PSI (or 4.2 Atmospheres). The centrifugal pump and electric motor should deliver 1320 GPM (or 300 cubic meters per hour) with 65 PSI (or 4.4 Atmospheres) pressure. This will require a 75 horsepower electric motor.

Each sprinkler system will deliver 7 GPM for each acre irrigated (or 3.9 cubic meters per hour for each hectare). This is enough to supply all of the water needs for a peak use rate of 0.3 inches per day (or 76.2 cubic meters per hectare per day) based on irrigating 24 hours per day at 80 percent efficiency.

The cost estimate for the sprinkler system main lines within the fields is about $200.00 per acre (or SP 1927.38 per hectare). The estimated cost of sprinkler laterals, electric motor, centrifugal pump, and sump installation is about $200.00 per acre (or SP 1927.38 per hectare) for a total of $400.00 per acre (or SP 3854.76 per hectare) for the sprinkler irrigation system.

FURROW IRRIGATION SYSTEM DESIGN

The furrow irrigation system requires land leveling and will use 15-inch low pressure plastic pipe within the irrigation fields. They will use gravity flow from the concrete main pipelines, and will deliver 1320 GPM (or 300 cubic meters per hour) to each alfalfa valve. The furrow system is designed to deliver 7 GPM for each acre (or 3.9 cubic meters per hour for each hectare) irrigated. The frequency of irrigation will be 14 days during peak period use rate of 0.3 inches per day (or 76.2 cubic meters per hectare per day).

A 12-inch alfalfa valve will be spaced every 800 feet (or 244 meters) along the plastic pipeline with 400 feet (or 122 meters) of 10-inch gated aluminum pipe used each way from the alfalfa valve. The gated pipe will have sliding gate openings every 40 inches (or one meter spacings). A length of plastic pipeline 32.8 feet (or 10 meters) will be installed under the roadway in order to have an alfalfa valve on each side of the road.

The run lengths for furrow irrigation are designed for 870 feet in order to have a 32-foot road (or 10-meter road). The system is designed to apply 40 gallons per minute for 4 hours time of application. The gross application will be 5.3 inches with 40-inch wide furrows. This will result in a net application of 4.25 inches at 80 percent efficiency.

The low pressure plastic pipe will have 50 PSI (or 3.4 Atmospheres) working pressure (ASTM D-1785, PVC 1120), and will be installed with a minimum depth soil cover of 30 inches. All plastic pipelines will be installed in soft soil material. If rock is encountered, the trench will be over excavated by 3 inches and back filled with 3 inches of soil material over the rock before the plastic pipe is installed. Low head plastic pipe requires water packing the backfill with the pipeline full of water. Each alfalfa valve will deliver 1320 GPM through the gated pipe in order to irrigate 33 furrows at one time, 110-foot width (or 33.526 meters), with 40 GPM per furrow.

In land leveling, the class I and class II soils can be excavated to a maximum depth of 1.65 feet (or 0.5 meters). The class III soils can be excavated to a maximum depth of 1.0 feet (or 0.3 meters). We recommend sprinkler irrigation,only, for class IV soils since they are 2 feet deep (or 0.6 meters) or less and these soil should not be land leveled.

The area to be furrow irrigated should be leveled with 0.05 foot per 100 feet grade in the direction of the furrows, away from the pipeline with 0.1 foot per 100 feet sidefall. The cubic yards should be calculated by using 60 percent cut and 40 percent fill. It is estimated that the cost of the plastic pipelines, alfalfa valves, and gated pipe will be about $200.00 (or SP 1927.28 per hectare) per acre. The land leveling will be about $200.00 (or SP 1927.28 per hectare) per acre. Sprinkler and furrow irrigation systems cost about the same and require about the same amount of labor. The furrow irrigation after land leveling is more efficient under most conditions and does not require a pump with electric motor for high pressure.

The fields for furrow irrigation were laid out with the same dimensions as the sprinkler irrigated area, 500 meters by 550 meters. If it is decided to sprinkle irrigate the areas planned for furrow systems, the concrete pipeline main distribution system would be used to deliver the water to the fields as with the furrow system. However, the furrow system will use 15-inch low pressure underground plastic pipe instead of high pressure plastic pipe used for the sprinkler systems. Also the low pressure pipe will use gravity flow from the concrete distribution pipelines and will not require pumping from a sump with high pressure.

Both types of irrigation systems will utilize the rainfall. Most of the rain is received during the months of October through April. This area receives only 10 inches per year with very little rain in June, July, and August.

CONCRETE PIPELINE DISTRIBUTION SYSTEM DESIGN

The irrigation distribution system at Tel Tamer required pumping all of the irrigation water from the Khabour River uphill to the area irrigated. This requires a 36-inch reinforced rubber gasket concrete pipe (ASTM C-76) to flow 9000 gallons per minute (or 2043 cubic meters per hour) in order to irrigate 1285 acres (or 520 hectares). The pipeline will have 4 feet (or about 1.2 meters) of soil cover. This system requires a standpipe about 100 feet (or 30 meters) from the river. The standpipe will be reinforced concrete below ground level 8 foot by 4.5 foot by 4.5 foot inside dimensions (or 2.5 meters with 1.4 meter by 1.4 meter), and will have 42 feet (or about 12.8 meters) above ground of 36-inch steel standpipe with 3/8 inch steel wall thickness. In lieu of a 36-inch steel standpipe and 36-inch reinforced concrete pipeline, a 30-inch high pressure pipeline can be used with a pressure release valve and an air release valve at the river.

We recommend two pumps with electic motors to pump 4500 gallons per minute (or 1022 cubic meters per hour) with 60-foot head (or 18.3 meters) each from the river. Each of the two pumping stations will have a 30-inch steel pipe from the river set just below the low flow level in the river, a two-stage vertical turtine pump, and a 120-horsepower electric motor. Each pumping plant will have a flap gate to prevent backflow from the pipeline. If only part of the area needs irrigating, only one pump will be used during this period. However, both pumps will be pumping at maximum capacity during peak period water use when all of the area is being irrigated.

This distribution system will cost $385,000 (or about SP 1,501,500) to irrigate 1285 acres (or 520 hectares) for a total cost of $300 per acre (or about SP 2887.5 per hectare) irrigated.

Estimated costs are:

1. Five thousand feet (or 1524 meters) of 36-inch reinforced concrete pipeline at $25 per foot (or SP 320 per meter) installed. Total estimated cost is $125,000 (or SP 487,500).

2. Fifteen thousand feet (or 4572 meters) of 30-inch rubber gasket concrete pipe (ASTM C-118) installed at $13.50 per foot (or SP 172.74 per meter). Total estimated cost is $202,500 (or SP 789,750)

3. Two concrete standpipes

   1.4 meter by 1.4 meter inside

   Total estimated cost is $7,500 (or SP 29,250)

4. Two pump installations at the river to pump 4500 GPM each

   Total estimated cost is $50,000 (or SP 195,000)

      Estimated grand total: $385,000 (or SP 1,501,500)

The irrigation distribution system at the Meskene area will be by gravity flow from the irrigation canal into 48-inch concrete standpipes. The total area irrigated is about 4200 acres (or about 1700 hectares). This requires 30,000 GPM (or 6810 cubic meters per hour). Therefore, three concrete pipelines were designed to deliver 10,000 GPM (or 2270 cubic meters per hour) each to the irrigated fields.

The size of the pipelines will be 30-inch rubber gasket concrete (ASTM C-118) from the irrigation canal. The estimated cost is $200 per acre (or SP 1927.38) for the distribution system.

Estimated costs are:

1. North pipeline along highway

   20,000 feet (or 6096 meters) at
   $13.50 per foot (or SP 172.74 per meter)
   Total estimated cost: $270,000 or (SP 1,053,000)

2. Middle pipeline

   22,000 feet (or 6705 meters) at
   $13.50 per foot (or SP 172.74 per meter)
   Total estimated cost: $297,000 (or SP 1,158,300)

3. South pipeline

   20,000 feet (or 6096 meters) at
   $13.50 per foot (or SP 172.74 per meter)
   Total estimated cost: $270,000 (or SP 1,053,000

      Estimated grand total: $837,000 (or SP 3,264,300

Based on irrigating 4200 acres (or 1700 hectares) the cost would be about $200 per acre (or SP 1927.38 per hectare) for the distribution system at Meskene.

Total cost of all irrigation system installations is estimated to be $800 per acre (or SP 7710 per hectare) at the Tel Tamer area, and $700 per acre (or SP 6746 per hectare) at the Meskene area.

We also discussed using the irrigation distribution system to supply water to the dairy buildings. The 48-inch concrete standpipe for the south 30-inch rubber gasket irrigation pipeline at Meskene will be near the southeast corner of the dairy building area and can supply the water needed by gravity flow. It will be about 26 feet above ground and will have the same static water level as the main irrigation canal.

If the irrigation canal delivers the designed flow of 30,000 GPM (or 6810 cubic meters per hour) at 370-meter elevation of water level in the canal, all the area below the 366-meter contour can be irrigated by gravity flow without pumping at the canal. The standpipe by the dairy buildings can supply all the water needed at elevation 370 meters.

The low head plastic pipelines wil require pumping at the irrigation canal into a 48-inch concrete standpipe 10 feet (or 3 meters) above ground to irrigate the area above the 366-meter contour.

TOTAL IRRIGATION SYSTEM ESTIMATED COSTS ARE

Items	Tel Tamer SP per Hectare	Tel Tamer Dollars per Acre	Meskene SP per Hectare	Meskene Dollars per Acre
Distribution System	2891.07	$300	1917.38	$200
Within field pipelines	1927.38	200	1927.38	200
Sprinklers or land leveling	1927.38	200	1927.38	200
Roads and waterways	963.69	100	963.69	100
Total Costs	SP 7709.52	$800	SP 6746.00	$700

The irrigation system designs are based on existing topography maps. Detailed construction specifications will have to be developed for all irrgation pipelines based on field surveys for each pipeline before installation.

CROPPING PLAN FOR CROPLAND

The cropping plan for soils in land classes I, II, and III will consist of about 25 percent alfalfa The remainder of the lands will be devoted to corn and sorghums for silage and/or green chop in the warm seasons, followed in the cool seasons by small grain and/or annual legumes for silage or green chop. The lands planted to alfalfa should be rotated every fourth or fifth year to areas formerly cropped to corn, sorghums, small grain, and annual legumes. In 12 to 15 years, alfalfa will have been grown on all the cropland. The lands planted to corn, sorghums, small grain, and annual legumes should be rotated annually between these crops.

Seedbed preparation, seeding, and all tillage operations are to be performed when the soil moisture content of the soils is about at 50 percent of field capacity. There should never be any traffic on the soils at any time when the soils are wet.

Alfalfa - Lands to be seeded to alfalfa should be plowed to a depth of 15-20 centimeters with a moldboard-type plow in August. If there is a zone of compaction in the surface soil, the plow slice should be adjusted to cut just below the compacted layer. The plowing operation should be followed by two disk harrow operations. Each of the disk harrow operations is to be performed at a 45 degree angle to the plowing operation. The last disk harrow operation should have a spike tooth harrow pulled behind it. These operations will help firm and smooth the seedbed. Just prior to the last disk harrow operation, fertilizer should be applied broadcast and worked into the soil for fertilizer rates see Appendix 8, Fertilizer Guide.

If the land is to be furrow irrigated, then low beds or corrugations will need to be made with a lister bedder just prior to seeding. If the land is not to be furrow irrigated, the last disk harrow and spike tooth harrow operations may be delayed until just prior to seeding. This will remove any weeds that may have emerged since the last tillage operation.

Seeding is to be done with a grass seed drill or a grain drill that is equipped to handle small seed such as alfalfa. The drill is to be equipped with packer wheels or the drilling operation is to be followed with a cultipacker-type tool to firm the soil around the alfalfa seed.

All alfalfa seed is to be inoculated with rhizobia bacteria (such as inoculant type A from the Nitragin Company) just prior to seeding. A sticker-type agent such as gum arabic will help keep the inoculant on the seed. For seeding rates and dates see Appendix 9, Planting Guide.

Corn and Sorghums - Lands to be seeded to corn or sorghums should be plowed to a depth of 15 to 20 centimeters with a moldboard-type plow in March or April; or as soon as the cool-season crop is removed. If a compacted layer is in the surface soil, the plow slice should be adjusted to cut just below the compacted layer. The plowing operation should be followed by 2-disk harrow operations each at a 45 degree angle to the direction of the plowing operation. The last disk harrow operation should have a spike tooth harrow pulled behind it. If the land is to be furrow irrigated, then low beds or corrugations will need to be made with a lister bedder just prior to planting.

Fertilizer should be applied just ahead of the last disk harrow operation if desired. For fertilizer rates see Appendix 8, Fertilizer Guide.

Planting is to be done with a grain drill. It is desirable that the drill be equipped with packer wheels to firm the soil around the seed. For seeding rates and dates see Appendix 9, Planting Guide.

Small Grain and Annual Legumes - These crops will follow corn and sorghum crops. Seedbed preparation for these crops will consist of running a sweep-type tillage tool 8 to 13 centimeters deep undercutting the corn and/or sorghum plants. This operation is to be performed late in July or August immediately following the harvest of the corn or sorghum crops.

Planting of the small grain and annual legumes will be done with a grain drill that is equipped with packer wheels. For annual legumes such as clovers, the drill must be equipped with appropriate seed boxes to properly handle small seed. All annual legumes should be inoculated with appropriate rhizobia-type bacteria just prior to seeding. A sticker-type agent such as gum arabic will help keep the inoculant on the seed. For seeding rates see Appendix 9, Planting Guide.

CROPPING PLAN FOR PERENNIAL GRASSES

The cropping plan for soils in land class IV will consist of perennial grasses such as Coastal bermudagrass (Cynondon dactylon) for silage, green chop, or hay during the warm season. During the cool season, these lands will be seeded to a mixture of vetch and rye for green chop, silage, or hay.

Seedbed Preparation and Seeding - All tillage operations are to be performed when the soil moisture content of the soils is about 50 percent of field capacity. There should never be any traffic on the soils at any time when the soils are wet.

Bermudagrass - Lands to be sprigged to bermudagrass should be plowed to a depth of 15 centimeters with a moldboard-type plow in October. If there is a zone of compaction in the surface soil, the plow slice should be adjusted to cut just below the compacted layer. The plowing operation should be followed by 2 disk harrow operations. Each of the disk harrow operations is to be performed at a 45 degree angle to the plowing operation. The last disk harrow operation should have a spike tooth harrow pulled behind it. These operations will help firm and smooth the seedbed.

The planting of the bermudagrass will be done with bermudagrass sprigs. A bermudagrass sprigging machine will be used. These sprigging machines are set on about 1-meter centers. A second trip over the land is required splitting the 1-meter rows leaving rows planted on approximately 50 centimeters. Immediately following the sprigging operation, a cultipacker-type tool is to be pulled over the land to firm the soil around the sprigs.

A fertilizer application could be applied just ahead of the last disking operation and worked into the soil. For guidance on fertilizer rates see Appendix 8, Fertilizer Guide. For guidance on sprigging rates and dates see Appendix 9, Planting Guide.

Rye and Vetch - These will be seeded into the existing stand of bermudagrass with a special type grain drill that can cut through the bermudagrass sod and plant the seeds in mineral soil. Examples of this type equipmen are the John Deere power drill and Midland Zip seeder. Companies other than those in the USA also make this type of equipment. The vetch is to be inoculated with rhizobia bacteria (such as inoculant type C from the Nitragin Company) just prior to seeding. A sticker-type agent such as gum arabic will help keep the inoculant on the seed. For guidance on fertilizer rates see Appendix 8, Fertilizer Guide. For guidance on seeding rates and dates see Appendix 9, Planting Guide.

MANAGEMENT OF CROPS

Proper management of annual and perennial crops is necessary to obtain the most efficient production level, maintain plant vigor, and protect the lands from excessive soil erosion.

At least 43,588 kilograms (air dry weight) per hectares of crop residues should be returned to the soils each year to help maintain a good physical condition of the soils. The best way to achieve this may be to let one of the crops grow almost to maturity, then incorporate it into the soil by disking or plowing. This is one of the keys toward keeping the land in good physical condition for sustained high production.

Alfalfa - Following stand establishment, crop harvest should be conducted when the plant is in one-tenth to one-quarter bloom. The cutter bar should be set at about 8 centimeters high. Planned fertilizer and water applications should come immediately after harvest along with the initial applications given prior to greenup in the spring. For guidance on fertilizer rates see Appendix 8, Fertilizer Guide.

To aid in stand maintenance, it is important to avoid top growth removal 6 to 8 weeks prior to the cessation of growth and to allow one growth each year to reach the full-bloom stage. For guidance on irrigation water application, see Appendix 3, Irrigation Guide.

Corn and Sorghums - For satisfactory results of using these crops for silage or green chop, high tonnages must be achieved. This requires the use of hybrid seed varieties on clean firm seedbeds along with high fertilizer and water application rates. Crops are to be drilled to get large plant populations, 200,000 to 300,000 plants per acre (or 494,200 to 741,300 plants per hectare).

Corn will need to be harvested when it is about 120 centimeters tall to avoid risks of the crop being blown over by wind. They will usually achieve this height in about 6 to 8 weeks after planting, and it may be possible to get two crops in the summer from the same land.

Sorghums should be harvested in the early booting stage. Planned applications of fertilizer and water should immediately follow each harvest. For guidance on irrigation water applications, see Appendix 3, Irrigation Guide. For guidance on fertilizer rates, see Appendix 8, Fertilizer Guide.

Small Grain - For the best quality of feed the forage should be harvested prior to booting (plants about 15 to 25 centimeters high). Planned fertilizer and water applications should follow each harvest of forage. Production of forage volume usually follows in this order: rye, wheat, oats, and barley. Animal preference usually follows in this order: wheat, oats, barley, and rye. Harvest should never be delayed beyond the soft dough stage for quality forage. For guidance on irrigation water application, see Appendix 3, Irrigation Guide. For guidance on fertilizer rates see Appendix 8, Fertilizer Guide.

Annual Legumes - For the best quality of feed, forage should be harvested in the bloom stage. Plants should be inoculated with the appropriate rhizobia at seeding. Nitrogen fertilizers should never be applied. Initial applications (prior to seeding) of phosphate fertilizers usually are the only fertilizers required. Planned water applications should come immediately following each forage harvest. For guidance on irrigation water application, see Appendix 3, Irrigation Guide. For guidance on fertilizer rates, see Appendix 8, Fertilizer Guide.

Bermudagrass - Following stand establishment, forage harvest should be conducted when the plant reaches heights of 30 to 36 centimeters. The cutter bar of the harvesting equipment should not be set lower than 8 centimeters. Planned fertilizer and water applications should come immediately after each harvest along with the initial applications given prior to greenup in the spring.

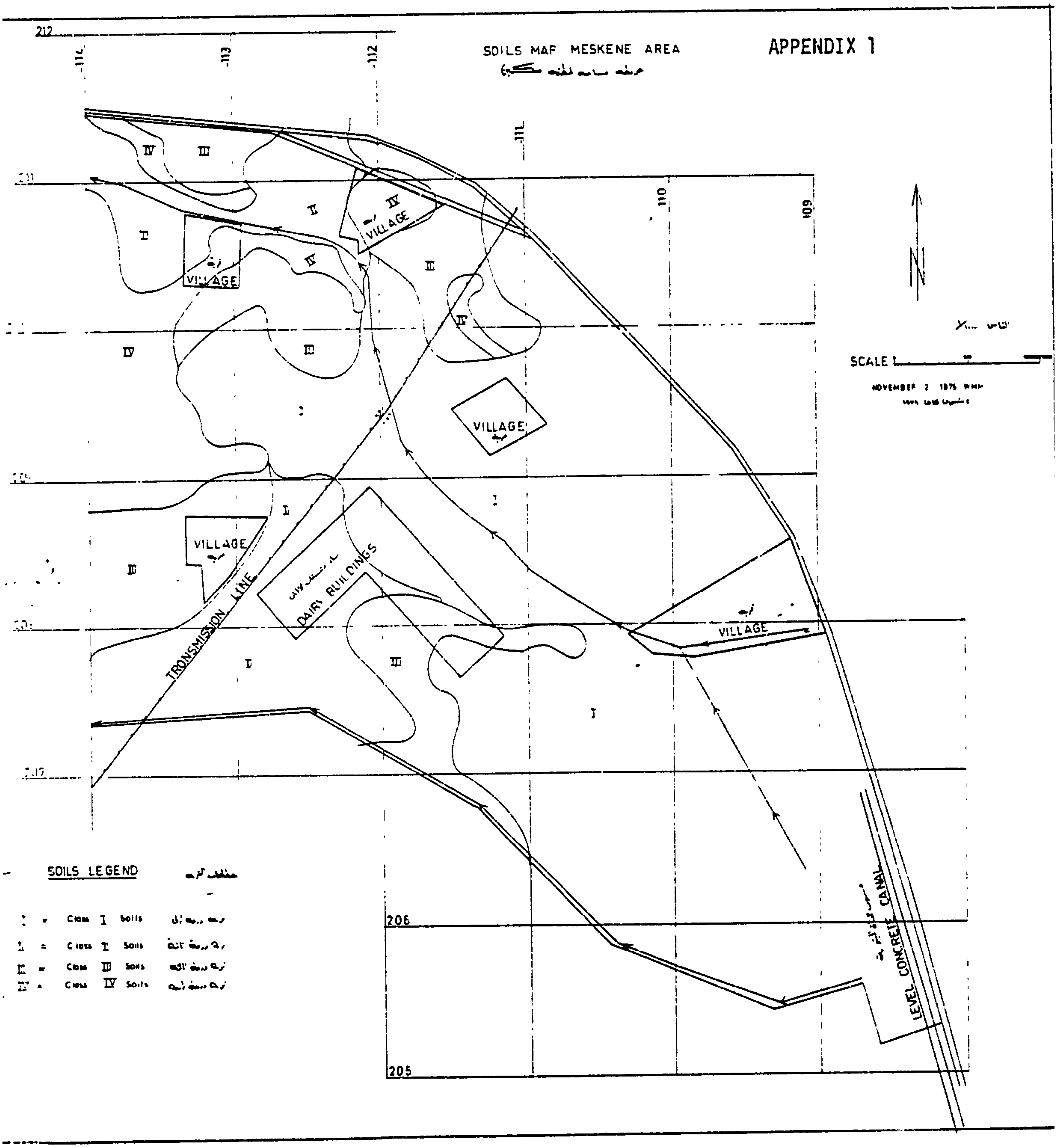
The last harvest in the fall (usually late in September or early October) should be permitted to make some seed heads. This harvest, the cutter bar should be lowered to 3 to 5 centimeters to remove excess forage and facilitate the seeding of vetch and rye for a winter crop. For guidance on irrigation water rates, see Appendix 3, Irrigation Guide. For guidance on Fertilizer rates, see Appendix 8, Fertilizer Guide.

INOCULATION OF LEGUMES

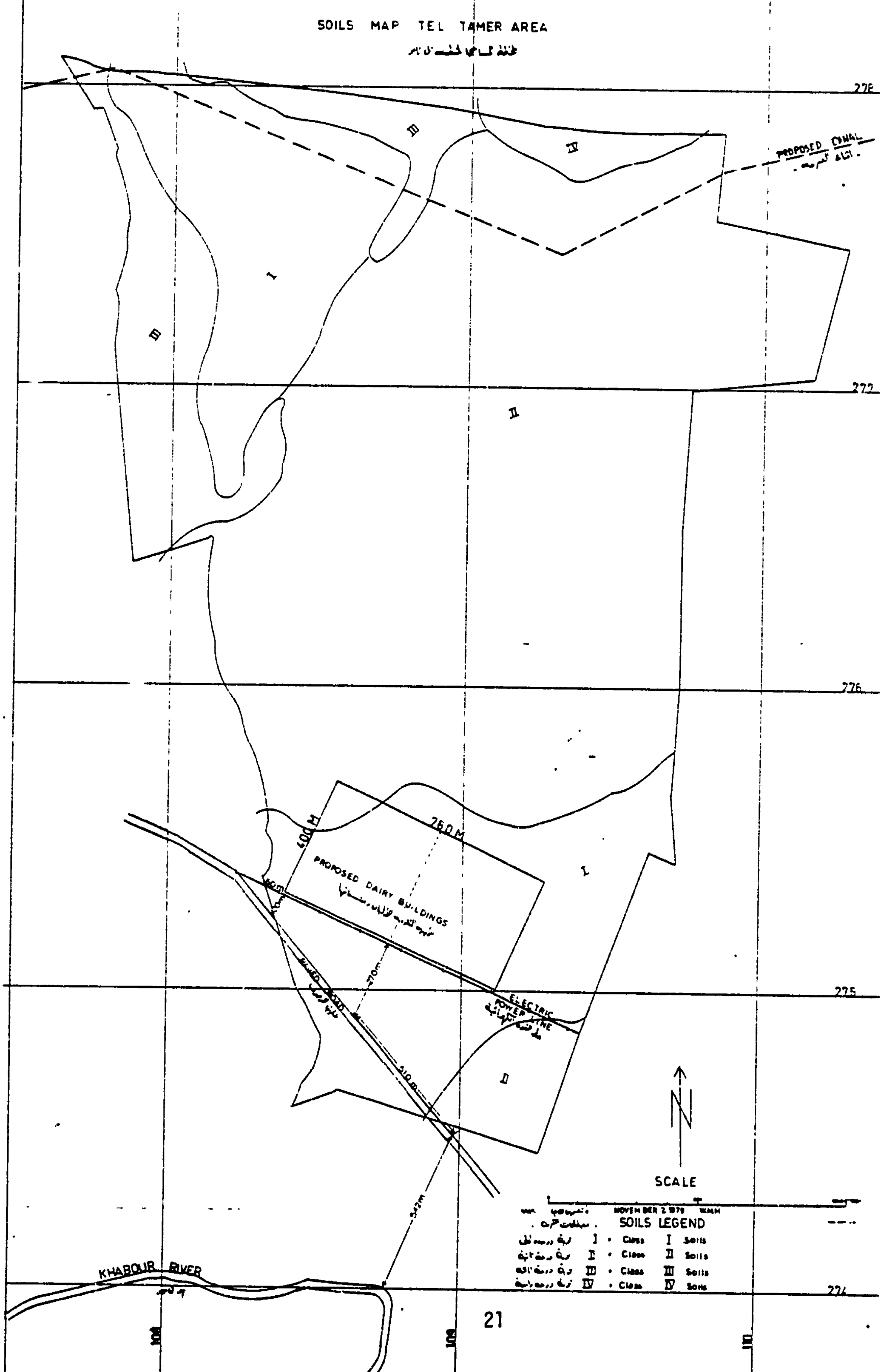
Legumes through their relationship with rhizobia bacteria can utilize nitrogen from the air. Nitrogen gas makes up about 78 percent of the earth's atmosphere.

To be sure that large numbers of the proper rhizobia bacteria are present in the soil with the seed, inoculate the seed near planting time with a high quality commercial inoculant that contains many live rhizobia. It does no good to inoculate seed with dead bacteria. If inoculum has been stored at 23 to 38°C for several weeks before it is used, then it will contain mostly dead bacteria. Inoculum should be kept in a refrigerator until it is used.

To properly inoculate seed, some materials in addition to the inoculant are needed. These materials are water, lime (CaCo3), and a sticking agent such as gum arabic. A 5- to 10-percent solution of sugar may be used as a sticking agent but it is not as good as gum arabic or a commercial agent. The inoculum is added to the dissolved sticking agent and the seed is thoroughly mixed with it. Only enough water should be used to make the inoculum paste having the consistency of cool syrup. After the seeds are all evenly coated with the inoculum, the lime should be added to the seed. Enough lime is added to thoroughly coat the seeds and absorb all the excess water. The lime is used to absorb excess moisture and to provide some protection to the rhizobia. When seed is properly inoculated in this manner, each seed will be coated with lime and the seeds will not stick together. Planting should be done in a few hours after the inoculation. Rhizobia do not live long at high temperatures and should be kept out of the sun and in a cool place.


APPENDIX 1
SOILS MAP MESKENE AREA
SCALE
NOVEMBER 2 1975
VILLAGE
DAIRY BUILDINGS
TRANSMISSION LINE
LEVEL CONCRETE CANAL
SOILS LEGEND
I = Class I Soils
II = Class II Soils
III = Class III Soils
IV = Class IV Soils

APPENDIX 2



SOILS MAP TEL TAMER AREA
108
109
110
PROPOSED CANAL
I
II
III
IV
400 M
250 M
PROPOSED DAIRY BUILDINGS
ELECTRIC POWER LINE
KHABOUR RIVER
SCALE
SOILS LEGEND
I · Class I Soils
II · Class II Soils
III · Class III Soils
IV · Class IV Soils

APPENDIX 3 IRRIGATION GUIDE

Explanation on the use of Appendix 3, Irrigation Guide:

TABLE 1 - Gives an estimate of the peak season water use by crops. This information is based on research and experience.

Example: Alfalfa will use approximately .762 centimeters of water per day during its fastest period of growth.

TABLE 2 - Gives the estimated water holding capacity of the different soils classes and guidance for replacing water in the soil.

Example: Class I land will hold approximately 30.48 centimeters of water per 1.829 meters of soil that will be available for crop use. In replacing this water back into the soil with a sprinkler irrigation system, it should not be replaced any faster than 1.27 centimeters per hour.

TABLE 3 - Gives guidance in the time needed to apply water with a furrow irrigation system.

Example: To apply 4 inches of water (or 10.160 centimeters) with 40 gallons per minute in a 40-inch row (or 101.6 centimeters) 800 feet long (or 244 meters), it would require about 205 minutes to get the water on the land. It would take approximately 330 minutes to get the water absorbed in the soil (opportuntty time).

TABLE 4 - Gives guidance on applying water with a sprinkler irrigation system.

Example: To apply 4 inches (or 10.16 centimeters) of water to the land, it will require a 10-hour set. If there is a 6 MPH (miles per hour) wind blowing with hot temperatures, only 50 percent of the diameter should be considered as properly watered and efficiency has been reduced to about 65 percent.

TABLE 5 - Gives guidance in estimating crop needs for water by months. Also estimates are given on how much water to apply by months to fill the soil reservoir to meet the water needs of the different crops.

Example: The estimated water use of crops is an extrapolation of data from the publication "Moisture Requirements in Agriculture Farm Irrigation" by Harry Burgess. McGraw-Hill Book Company, 1950.

The total water needs are divided up into monthly uses by estimate or to how the plant will grow. Average rainfall by month is taken from climatic data. Irrigation water needs are determined by subtracting estimated water use from average rainfall.

Gross application at 80 percent efficiency is an estimate of the amount of water that will need to be applied to fill up the soil reservoir without causing water to leach below the root zone of the plants by gravitation.

The number of irrigations reflect the times the irrigation systems will have to be set to apply the needed water to the land.

APPENDIX 3 IRRIGATION GUIDE

TABLE 1

Crop Group	Peak Period Consumptive Use Rates Per Day		Adapted Conservation Irrigation Method	
	Inches	or Centimeters	Level Furrow	Sprinkler
I				
Crop Systems:				
Corn	.30	.762	X	X
Sorghum	.25	.635	X	X
Barley	.25	.635	X	X
Oats	.25	.635	X	X
Rye	.25	.635	-	X
Wheat	.25	.635	X	X
Clovers				
Berseem	.25	.635	X	X
White	.25	.635	X	X
Arrowleaf	.25	.635	X	X
Vetch	.25	.635	-	X
II				
Crops Such as:				
Alfalfa	.30	.762	X	X
Bermudagrass	.30	.762	-	X

IRRIGATION GUIDE

TABLE 2

Soils	Available[1/] Moisture Holding Capacity: Inches Per Foot	or: Centimeters per 30 Centimeters	Crop Group	Moisture Replacement Depth: Feet	or Meters	Net Moisture to Replace: Inches	or Centimeters	Furrow Design Intake Curve	Maximum Sprinkler Application Rate Per Hour: Inches	or Centimeters
Class I and II	2.0	5.08	I	5	1.524	5.0	12.700	0.5	0.5	1.27
Silty clay loam	2.0	5.08	II	6	1.829	6.0	15.240	0.5	0.5	1.27
	2.0	5.08								
	2.0	5.08								
	2.0	5.08								
	2.0	5.08								
Class III Silty clay loam	2.0	5.08	I	4	1.219	4.0	10.160	0.5	0.5	1.27
	2.0	5.08	II	4	1.219	4.0	10.160	0.5	0.5	1.27
	2.0	5.08								
	2.0	5.08								
Class IV[2/] Silty clay loam	2.0	5.08	I	2	0.610	2.0	5.080	-	0.5	1.27
	2.0	5.08	II	2	0.610	2.0	5.080	-	0.5	1.27

1/ Values listed are for the normal soil profile in inches per foot of soil depth or centimeters per 30 centimeters of soil depth.

2/ Class IV silty clay loam will be sprinkler irrigated only.

TABLE 3

FURROW IRRIGATION
DESIGN TABLES FOR 80
PERCENT EFFICIENCY
INTAKE CURVE 0.5

Net Application Inches	Net Application Centimeters	GPM For 40-Inch Furrow	Cubic Meters Per Hour for 1 Meter Furrow	Run Lengths: Feet 400 / Meters 122 — Time of Application in Minutes	Feet 600 / Meters 182	Feet 800 / Meters 244	Feet 1000 / Meters 328	Opportunity Time in Minutes
3.0	7.6	40	9.0	74	114	152	-	220
		30	6.8	102	156	-	-	
		20	4.5	160	-	-	-	
3.5	8.9	40	9.0	84	128	179	-	275
		30	6.8	116	178	-	-	
		20	4.5	184	-	-	-	
4.0	10.2	40	9.0	94	142	205	257	330
		30	6.8	130	200	277	-	
		20	4.5	208	320	-	-	
4.5	11.4	40	9.0	106	161	223	289	390
		30	6.8	145	225	306	-	
		20	4.5	232	258	-	-	
5.0	12.7	40	9.0	118	180	240	320	450
		30	6.8	160	250	335	-	
		20	4.5	255	395	-	-	

TABLE 4

Estimated Sprinkler Efficiencies

1. Application rate 0.4 inches per hour or 1 centimeter per hour

2. Sprinkler spacing 40 feet along laterals or 12.2 meters spacing

3. Move laterals 60 feet per set or move 18.3 meters per set

4. Individual sprinkler output is 10 gallons per minute with a 100-foot diameter of wet area or 2.27 cubic meters per hour with a 30.5 meter diameter of wet area

a.

Gross Water Applied Per Irrigation Inches	or Centimeters	Number of Hours per set
2.0	5.0	5
3.2	8.1	8
4.0	10.2	10
4.8	12.2	12

b.

Wind Speed Miles Per Hour	or Meters per Second	Maximum Recommended Sprinkler Spacing Percent of Diameter	Length of Move Per Set Feet	or Meters	Efficiency Cool Temperature Percent	Efficiency Hot Temperature Percent
No wind	No wind	65	60	18.3	80	75
4 MPH	1.8	60	60	18.3	75	70
6 MPH	2.7	50	60	18.3	70	65
8 MPH	3.6	40	60 1/	18.3	60	60
Over 8 MPH	Over 3.6	30	SPRINKLING NOT RECOMMENDED			

1/ With 8 MPH (miles per hour) (3.6 meters per second) wind velocity, use 60 feet (18.3 meters) moves but offset 30 feet (9.15 meters) for alternate irrigation.

Table 5

IRRIGATION APPLICATIONS NEEDED AT 80 PERCENT EFFICIENCY

Crops		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Alfalfa														
Estimated water use	cm	1.27	1.52	5.58	6.35	20.32	22.86	21.59	20.32	7.62	2.54	1.77	1.27	113.01
	in	.5	.6	2.2	2.5	8.0	9.0	8.5	8.0	3.0	1.0	.7	.5	44.5
Average rainfall 1/	cm	3.81	3.04	3.55	2.54	1.01	0	0	0	0	1.27	1.77	3.81	20.80
	in	1.5	1.2	1.4	1.0	.4	0	0	0	0	.5	.7	1.5	8.2
Irrigation water needed	cm	-2.54	-1.52	2.03	3.81	19.31 2/	22.86 2/	21.59 2/	20.32	7.62	1.27	0	-2.54	92.21
	in	-1.0	-.6	.8	1.5	7.6	9.0	8.5	8.0	3.0	.5	0	-1.0	36.3
Gross application at 80% efficiency	cm	0	0	10.16	0	24.38	24.38	24.38	20.16	10.16	0	10.16	0	123.95
	in	0	0	4.0	0	9.6	9.6	9.6	8.0	4.0	0	4.0	0	48.8
Number of irrigations		0	0	1	0	2	2	2	2	1	0	1	0	11
Bermudagrass														
Estimated water use	cm	1.27	1.52	3.81	7.36	21.59	22.86	21.59	20.32	7.62	2.54	1.27	1.27	113.03
	in	.5	.6	1.5	2.9	8.5	9.0	8.5	8.0	3.0	1.0	.5	.5	44.5
Rye and vetch estimated water use	cm	7.62	7.62	21.84	12.70	0	0	0	0	2.54	7.62	8.12	7.62	75.69
	in	3.0	3.0	8.6	5.0	0	0	0	0	1.0	3.0	3.2	3.0	29.8
Total use	cm	8.89	9.14	25.65	20.06	21.59	22.86	21.59	20.32	10.16	10.16	9.39	8.89	188.72
	in	3.5	3.6	10.1	7.9	8.5	9.0	8.5	8.0	4.0	4.0	3.7	3.5	74.3

Table 5 - IRRIGATION APPLICATIONS NEEDED AT 80 PERCENT EFFICIENCY (Cont.)

Crops		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Average rainfall[1]	cm	3.81	3.04	3.55	2.54	1.01	0	0	0	0	1.27	1.77	3.81	20.80
	in	1.5	1.2	1.4	1.0	.4	0	0	0	0	.5	.7	1.5	8.2
Irrigation water needed	cm	5.08	6.09	22.09[2]	17.52[2]	21.08[2]	22.86[2]	21.59[2]	20.32	10.16	8.89	7.62	5.08	168.40
	in	2.0	2.4	8.7	6.9	8.3	9.0	8.5	8.0	4.0	3.5	3.0	2.0	66.3
Gross application at 80% efficiency	cm	10.16	10.16	24.38	24.38	24.38	24.38	24.38	22.35	10.16	10.16	10.16	10.16	205.23
	in	4.0	4.0	9.6	9.6	9.6	9.6	9.6	8.8	4.0	4.0	4.0	4.0	80.8
Number of irrigations		1	1	2	2	2	2	2	2	1	1	1	1	18
Corn														
Estimated water use	cm	0	0	0	0	6.35	17.78	22.35	6.85	0	0	0	0	53.34
	in	0	0	0	0	2.5	7.0	8.8	2.7	0	0	0	0	21.0
Wheat, oats or barley estimated water use	cm	6.09	6.60	11.93	17.01	20.06	0	0	0	3.81	5.08	6.35	6.85	83.82
	in	2.4	2.6	4.7	6.7	7.9	0	0	0	1.5	2.0	2.5	2.7	33.0
Total use	cm	6.09	6.60	11.93	17.01	26.41	17.78	22.35	6.85	3.81	5.08	6.35	6.85	137.16
	in	2.4	2.6	4.7	6.7	10.04	7.0	8.8	2.7	1.5	2.0	2.5	2.7	54.0
Average rainfall[1]	cm	3.81	3.04	3.55	2.54	1.01	0	0	0	0	1.27	1.77	3.81	20.80
	in	1.5	1.2	1.4	1.0	.4	0	0	0	0	.5	.7	1.5	8.2
Irrigation water needed	cm	2.28	3.55	8.38	14.47[2]	25.40[2]	17.78[2]	22.35[2]	6.85	3.81	3.81	4.57	3.04	116.33
	in	.9	1.4	3.3	5.7	10.0	7.0	8.8	2.7	1.5	1.5	1.8	1.2	45.8

Table 5 - IRRIGATION APPLICATIONS NEEDED AT 80 PERCENT EFFICIENCY (Cont.)

Crops		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Gross application at 80% efficiency	cm	10.16	0	12.19	24.38	24.38	24.38	24.38	12.19	0	10.16	0	0	142.24
	in	4.0	0	4.8	9.6	9.6	9.6	9.6	4.8	0	4.0	0	0	56.0
Number of irrigations		1	0	1	2	2	2	2	1	0	1	0	0	12
<u>Corn</u>														
Estimated water use	cm	0	0	0	0	6.35	17.78	22.35	6.85	0	0	0	0	53.34
	in	0	0	0	0	2.5	7.0	8.8	2.7	0	0	0	0	21.0
Berseem, white or arrowleaf clovers estimated water use	cm	5.08	6.85	16.00	19.05	20.32	0	0	0	1.27	2.03	3.04	5.84	79.50
	in	2.0	2.7	6.3	7.5	8.0	0	0	0	.5	.8	1.2	2.3	31.3
Total use	cm	5.08	6.85	16.00	19.05	26.67	17.78	22.35	6.85	1.27	2.03	3.04	5.84	132.84
	in	2.0	2.7	6.3	7.5	10.5	7.0	8.8	2.7	.5	.8	1.2	2.3	52.3
Average rainfall[1/]	cm	3.81	3.04	3.55	2.54	1.01	0	0	0	0	1.27	1.77	3.81	20.80
	in	1.5	1.2	1.4	1.0	.4	0	0	0	0	.5	.7	1.5	8.2
Irrigation water needed	cm	1.27	3.81	12.44	16.51[2/]	25.65[2/]	17.78[2/]	22.35[2/]	6.85	1.27	.76	1.27	2.03	112.01
	in	.5	1.5	4.9	6.5	10.1	7.0	8.8	2.7	.5	.3	.5	.8	44.1
Gross application at 80% efficiency	cm	10.16	0	12.19	24.38	24.38	24.38	24.38	10.16	0	0	10.16	0	140.20
	in	4.0	0	4.8	9.6	9.6	9.6	9.6	4.0	0	0	4.0	0	55.2
Number of irrigations		1	0	1	2	2	2	2	1	0	0	1	0	12

Table 5 - IRRIGATION APPLICATIONS NEEDED AT 80 PERCENT EFFICIENCY (Cont.)

Crops		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Sorghum														
Estimated water use	cm	0	0	0	0	3.30	10.16	20.06	17.78	12.70	0	0	0	64.00
	in	0	0	0	0	1.3	4.0	7.9	7.0	5.0	0	0	0	25.2
Wheat, oats or barley estimated water use	cm	6.09	6.60	11.93	17.01	20.06	0	0	0	3.81	5.08	6.35	6.85	83.82
	in	2.4	2.6	4.7	6.7	7.9	0	0	0	1.5	2.0	2.5	2.7	33.0
Total use	cm	6.09	6.60	11.93	17.01	23.36	10.16	20.06	17.78	16.51	5.08	6.35	6.85	147.82
	in	2.4	2.6	4.7	6.7	9.2	4.0	7.9	7.0	6.5	2.0	2.5	2.7	58.2
Average rainfall[1/]	cm	3.81	3.04	3.55	2.54	1.01	0	0	0	0	1.27	1.77	3.81	20.80
	in	1.5	1.2	1.4	1.0	.4	0	0	0	0	.5	.7	1.5	8.2
Irrigation water needed	cm	2.28	3.55	8.38	14.47[2/]	22.35[2/]	10.16[2/]	20.06[2/]	17.78	16.51	3.81	4.57	3.04	127.00
	in	.9	1.4	3.3	5.7	8.8	4.0	7.9	7.0	6.5	1.5	1.8	1.2	50.00
Gross application at 80% efficiency	cm	0	0	0	20.32	24.38	20.32	20.32	0	0	0	0	0	85.34
	in	0	0	0	8.0	9.6	8.0	8.0	0	0	0	0	0	33.6
Number of irrigations		0	0	0	2	2	2	2	0	0	0	0	0	8
Sorghum														
Estimated water use	cm	0	0	0	0	3.30	10.16	20.06	17.78	12.70	0	0	0	64.00
	in	0	0	0	0	1.3	4.0	7.9	7.0	5.0	0	0	0	25.2

Table 5 - IRRIGATION APPLICATIONS NEEDED AT 80 PERCENT EFFICIENCY (Cont.)

Crops		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Berseem, white or arrowleaf clovers estimated water use	cm	5.08	6.85	16.00	19.05	20.32	0	0	0	1.27	2.03	3.04	5.84	79.50
	in	2.0	2.7	6.3	7.5	8.0	0	0	0	.5	.8	1.2	2.3	31.3
Total use	cm	5.08	6.85	16.00	19.05	23.62	10.16	20.06	17.78	13.97	2.03	3.04	5.84	143.51
	in	2.0	2.7	6.3	7.5	9.3	4.0	7.9	7.0	5.5	.8	1.2	2.3	56.5
Average rainfall 1/	cm	3.81	3.04	3.55	2.54	1.01	0	0	0	0	1.27	1.77	3.81	20.80
	in	1.5	1.2	1.4	1.0	.4	0	0	0	0	.5	.7	1.5	8.2
Irrigation water needed	cm	1.27	3.81	12.44	16.51 2/	22.60 2/	10.16 2/	20.06 2/	17.78 2/	13.97 2/	.76	1.27	2.03	122.68
	in	.5	1.5	4.9	6.5	8.9	4.0	7.9	7.0	5.5	.3	.5	.8	48.3
Gross application at 80% efficiency	cm	10.16	0	12.19	22.35	24.38	22.35	20.32	20.32	20.32	0	0	0	152.40
	in	4.0	0	4.8	8.8	9.6	8.8	8.0	8.0	8.0	0	0	0	60.0
Number of irrigations		1	0	1	2	2	2	2	2	2	0	0	0	14

1/ Rainfall data is from Meskene area. Tel Tamer rainfall is slightly higher.
2/ During peak period consumptive use rate of 0.3 inches (0.76 cm), irrigate 24 hours per day with irrigation intervals of 13 days.

Monthly and Annual Values of Main Climatic Parameters in the Zone of the Proposed Irrigation Area (Meskene) 1/

Parameters	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total Annual
Air Temperature, (C°)													
Mean	5.7	7.5	11.7	16.3	22.0	27.0	29.2	29.2	25.3	19.1	11.9	9.4	17.7
Maximum	19.4	26.4	30.6	38.0	40.1	42.3	44.4	44.5	41.3	36.1	30.7	20.7	44.5
Minimum	-13.8	-7.8	-4.9	0.4	6.2	7.2	16.9	14.5	9.4	1.4	-5.8	-12.6	-13.8
Precipitation (mm)	39.2	29.7	36.6	25.0	10.1	0.1	0	0.2	0.7	13.4	17.3	37.9	210
Ave. number of days with precipitation	11	10	9	7	3	0	0	0	1	4	5	11	61
Air Humidity Absolute, mb	7.5	8.0	8.6	10.0	11.4	11.9	14.2	14.0	12.2	10.3	9.1	8.1	10.4
Relative %	78	73	64	58	48	38	40	41	43	51	66	78	56
Wind velocity m/sec	3.3	3.3	3.8	4.2	4.4	6.5	7.8	6.4	4.2	2.7	2.4	3.0	4.3
Evaporation (from water surface) mm	39	53	106	164	257	375	433	384	267	158	81	44	2361

1/ Information from Irrigation and Development of 17.0 Thousand Hectares in Meskene Area, S.A.R. Technical Project, Volume I Explanatory Report, Moscow, 1975.

CLIMATIC DATA MESKENE AND TEL TAMER

Monthly and Annual Values of Main Climatic Parameters [2/]
Air Temperature, Precipitation and Humidity from Tel Tamer
Wind Velocity, Evaporation & Soil Temperature from Hassakeh

Parameters	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total Annual
Air Temperature (C°) 1957-1974													
Mean	5.2	6.8	11.3	16.3	22.2	27.8	30.7	30.0	24.9	18.5	11.9	6.5	17.7
Maximum (absolute)	18.9	21.9	29.6	36.5	39.4	43.5	45.5	45.5	42.0	37.5	30.0	22.0	44.5
Minimum (absolute)	-9.8	-8.7	-4.5	-3.0	4.4	8.9	12.0	12.5	4.0	-3.0	-7.0	-12.6	-12.6
Precipitation (mm) 1955-1975	58	34	43	40	25	1	0	0	1	10	21	41	274
Air Humidity 1956-1974 Relative %	75	76	65	60	45	28	29	29	33	45	62	75	52
Wind Velocity (m/sec) 1959-1969	3.0 WNW	3.2 WNW	3.4 W	3.3 W	3.5 W	4.3 W	4.2 W	3.6 W	3.0 W	2.1 W	2.3 WNW	2.8 WNW	W
Evaporation (mm) Thornthwaite	5	9	25	57	115	187	228	198	130	66	23	7	1050
Soil Temperature (C°) 1960-1969													

APPENDIX 4 (Con't.)

CLIMATIC DATA MESKENTE AND TEL TAMER

Monthly and Annual Values of Main Climatic Parameters 2/
Air Temperature, Precipitation and Humidity from Tem Tamer
Wind Velocity, Evaporation & Soil Temperature from Hassakeh

Parameters	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total Annual
5 cm	6.6	7.8	11.9	17.1	24.3	31.2	34.5	34.7	29.2	20.7	13.6	8.1	-
10 cm	6.3	8.0	12.1	17.1	23.3	30.3	33.8	33.5	28.9	21.2	14.2	8.8	-
20 cm	7.3	8.5	12.2	17.1	23.0	29.3	32.7	32.7	28.8	22.0	15.4	9.9	-

2/ Information from Syrian Arab Republic Ministry of Public Works Project (Administration Damascus) Irrigation Project of Khabour River Catchment Basin - Technical and Economic Report with General Scheme - Volume II - Hydrology and Climate - Part two, Appendices Agrocomplect, State Economic and Engineering Corp., Bulgaria, Sofia, 1977.

APPENDIX 5

CHEMICAL ANALYSIS OF SOILS AND WATER[1/]
MESKENE AND TEL TAMER

	Soils							Water								
					pH											
Location	Ca Me/L	Mg Me/L	P_2O_5 PPM	K_2O PPM	Saturation Extract	1/5 Extract	1/5 Extract E.C.	pH	EC Millimhos/cm	% Dry Residue	Cations	PPM	Me/L	Anions	PPM	Me/L
Meskene[2/]																
Surface	1.683	1.08	10.0	337	7.4	6.5	0.25	7.8	0.23	0.004	Na	90	3.913	CO_3	-	-
Subsoil	0.99	1.23	8.5	262	7,6	6.4	0.28				K	50	1.278	HCO_3	-	0.256
											Ca	34.272	1.68	Cl	-	0.658
											Mg	18.6	1.53			
Tel Tamer[3/]																
Surface	1.48	1.09	11.0	372	7.5	6.5	0.28				Na	207	9	CO_3	-	-
Subsoil	0.99	1.23	3.5	265	7.7	5.5	0.27				K	32	0.818	HCO_3	-	0.368
											Ca	71.34	3.56	Cl	-	2.068
											Mg	34.9	2.87			

1/ Data from Laboratory at Hama

2/ Water out of Canal from Lake Assad

3/ Water from Khabour River at Pump site

APPENDIX 6 - See envelope on the back cover.

APPENDIX 7 - See envelope on the back cover.

FERTILIZING GUIDE

Crop	Rate of Application p/ha N	P_2O_5	K_2O	Time of Application
Corn (Silage 74 T p/ha)	1500	495	0	At or before planting
Legumes[1/] (Hay)				
Alfalfa (20 T p/ha)	0	495	0	Disk in prior to planting and for established stands topdress each spring
Berseem (10 T p/ha)	0	240	0	At or before planting
White (10 T p/ha)	0	240	0	At or before planting
Arrowleaf (10 T p/ha)	0	240	0	At or before planting
Vetch[2/] (12 T p/ha)	0	240	0	At or before planting
Small Grain (hay)				
Barley (9 T p/ha)	680	185	0	At or before planting
Oats (6 T p/ha)	680	185	0	At or before planting
Rye[2/] (12 T p/ha)	680	185	0	At or before planting
Wheat (10 T p/ha)	680	185	0	At or before planting
Sorghum (Silage)				
Forage (49 T p/ha)	1500	570	0	At or before planting
Bermudagrass (silage or hay) (25 T p/ha)	2590	570	0	Topdress in early spring with 863-570-0, after each cutting of forage apply 345-0-0, five harvests expected.

1/ These rates apply when the legumes have been inoculated with the proper rhizobia.

2/ Where vetch and rye is seeded in a mixture use the vetch fertilizer rate only.

FERTILIZER GUIDE (Con't.)

Manure from the dairy barns is a good source of organic materials and fertilizer and should be returned to the land. As much as 21.0 tons per hectare, (air dry weight), can be returned to the land each year without harmful effects to the soil or crops.

The per ton fertilizer value of this manure is estimated to be: nitrogen, 26 kilograms; phosphate, 4 kilograms; and potash, 22 kilograms. Approximately 50 percent of the nitrogen and phosphate and 90 percent of the potash becomes available to the plants the first year of application. A 21.0 ton per hectare application could represent: nitrogen, 263 kilograms; phosphate, 42 kilograms; and potash, 231 kilograms. This should be considered when planning the annual fertilizer program.

APPENDIX 9

PLANTING GUIDE

Crops	Planting Rates K p/ha	Depth of Planting (cm)	Best Time to Plant
Corn (Zea Mays)	1633	2-4	April - May
Legumes			
Alfalfa (Medicago Sativa)	109	1	September - October
Clovers			
Berseeme (Trifolium alexandrinum)	109	1	September - October
White (Trifolium repens)	109	1	September - October
Arrowleaf (Trifolium Vesicalosum)	109	1	September - October
Vetch (Vica Villosa), in Mixtures	163	1-2	September - October
Small Grain			
Barley (Hordeum bulbosum)	393	1-2	September - October
Oats (Avena sativa)	348	1-2	September - October
Rye (Secale cereale), in Mixtures	381	1-2	September - October
Wheat (Triticum aestivum)	489	1-2	September - October
Sorghums			
Forage (Sorghum Vulgare)	272	1-2	May
Bermudagrass (cynodon dactylon)	2.1 cu m/ha	3-6	January - March

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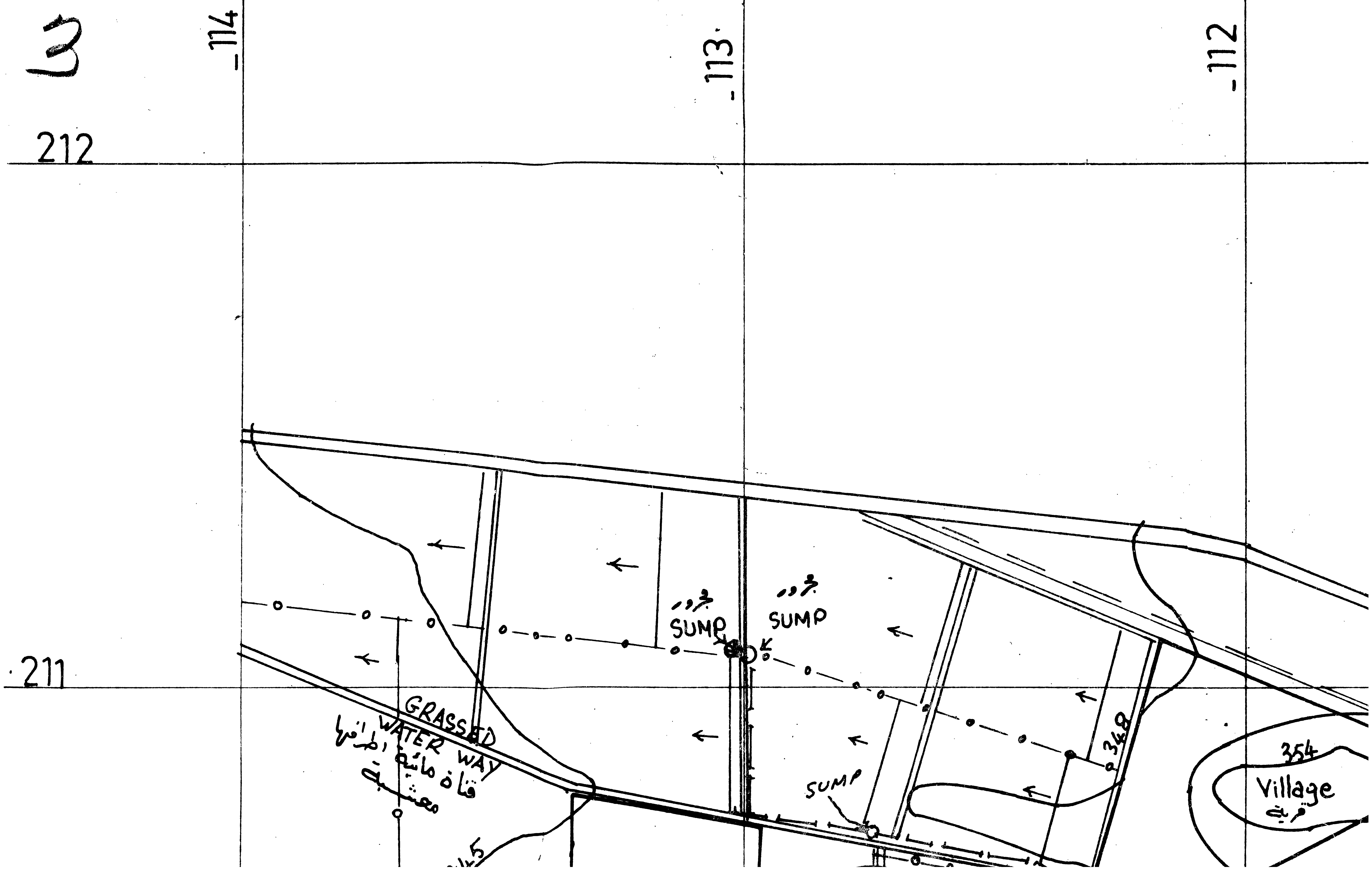
2 of 3



111

110

109

212

MESKENE

IRRIGATION SYSTEM

SCALE

1 METER = 10.000 METERS

CONTOURS IN METERS

8 NOVEMBER 1979

مسكنة

نظام الري (القناية)

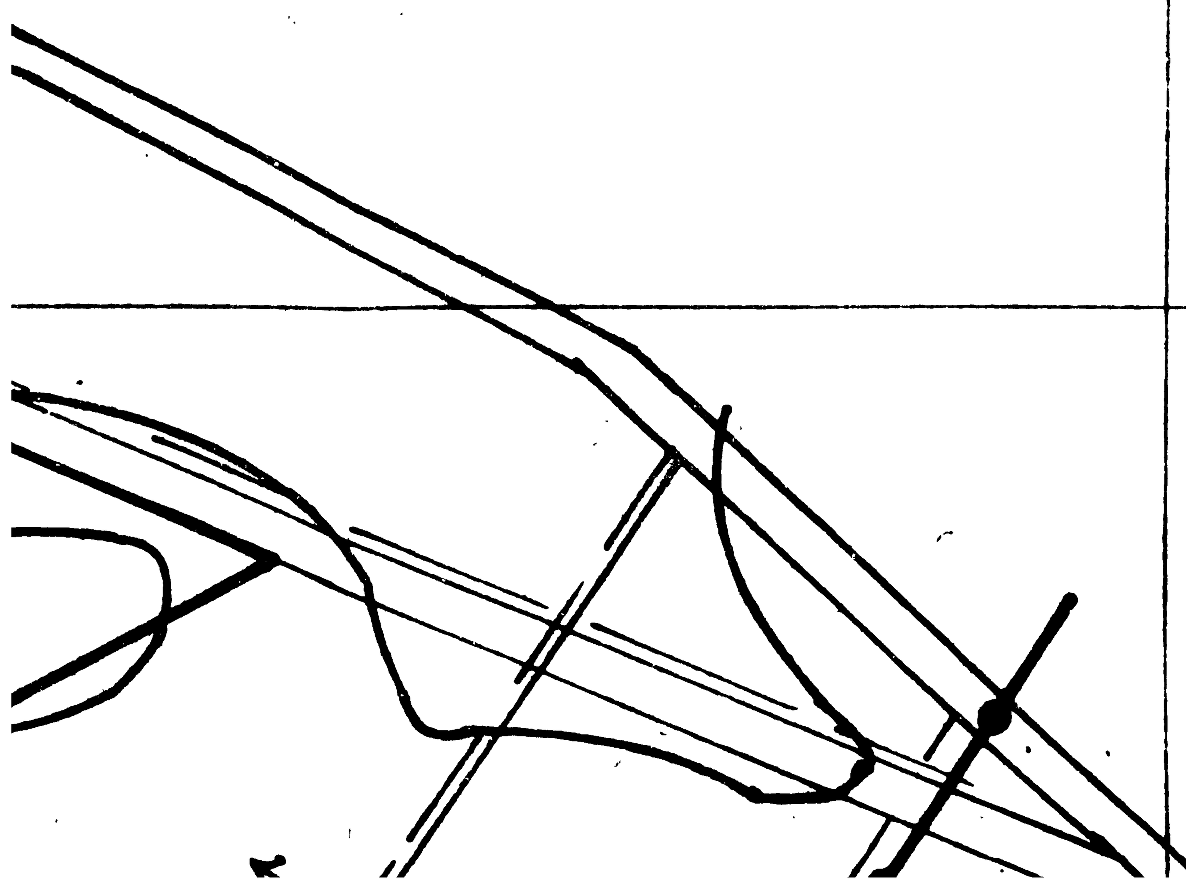
المقياس ١/١٠٠٠٠

خطوط الكونتور بالمتر

٨ تشرين الثاني ١٩٧٩

211

TOTAL AREA IRRIGATED
1700 HECTARES



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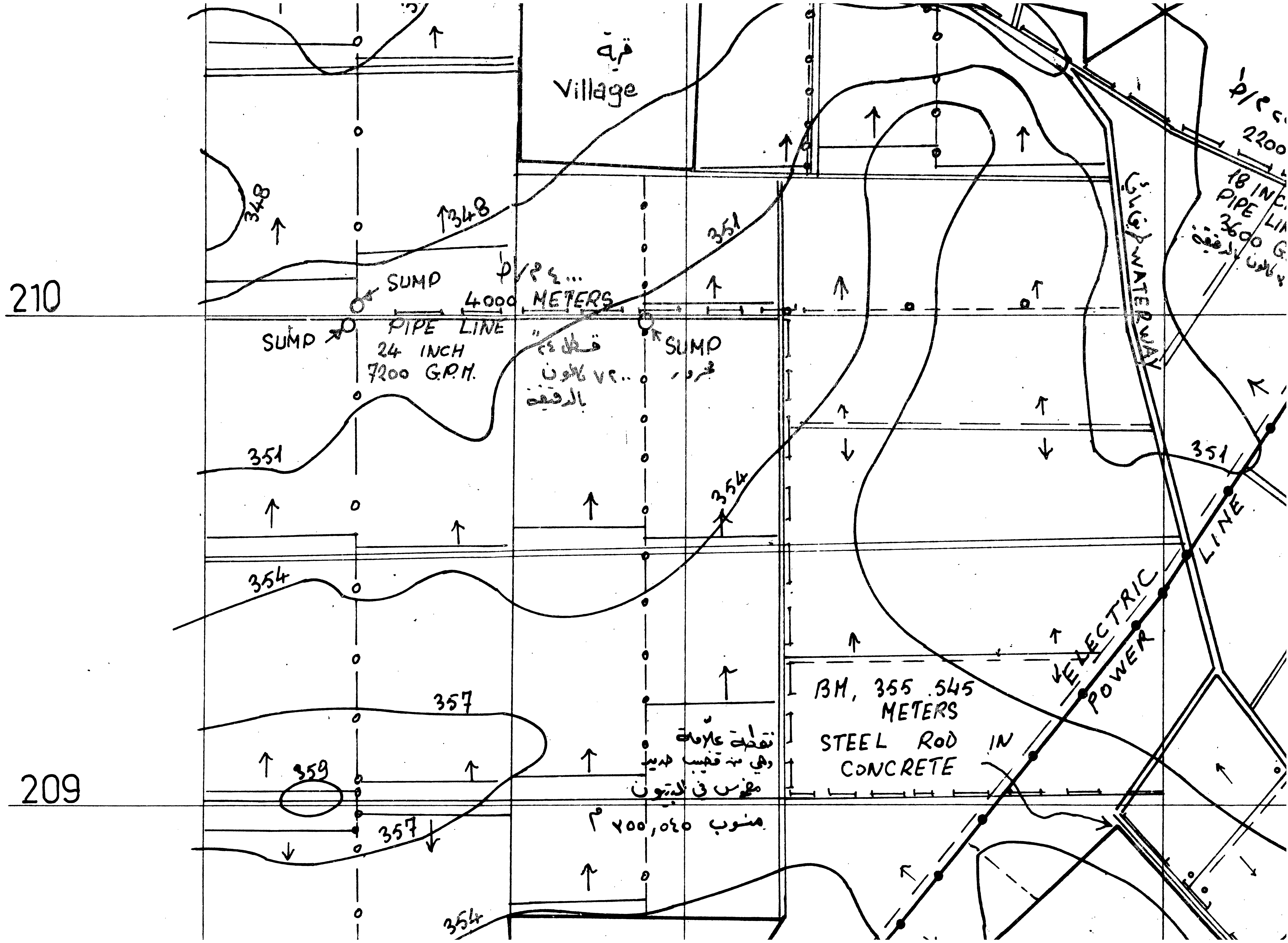
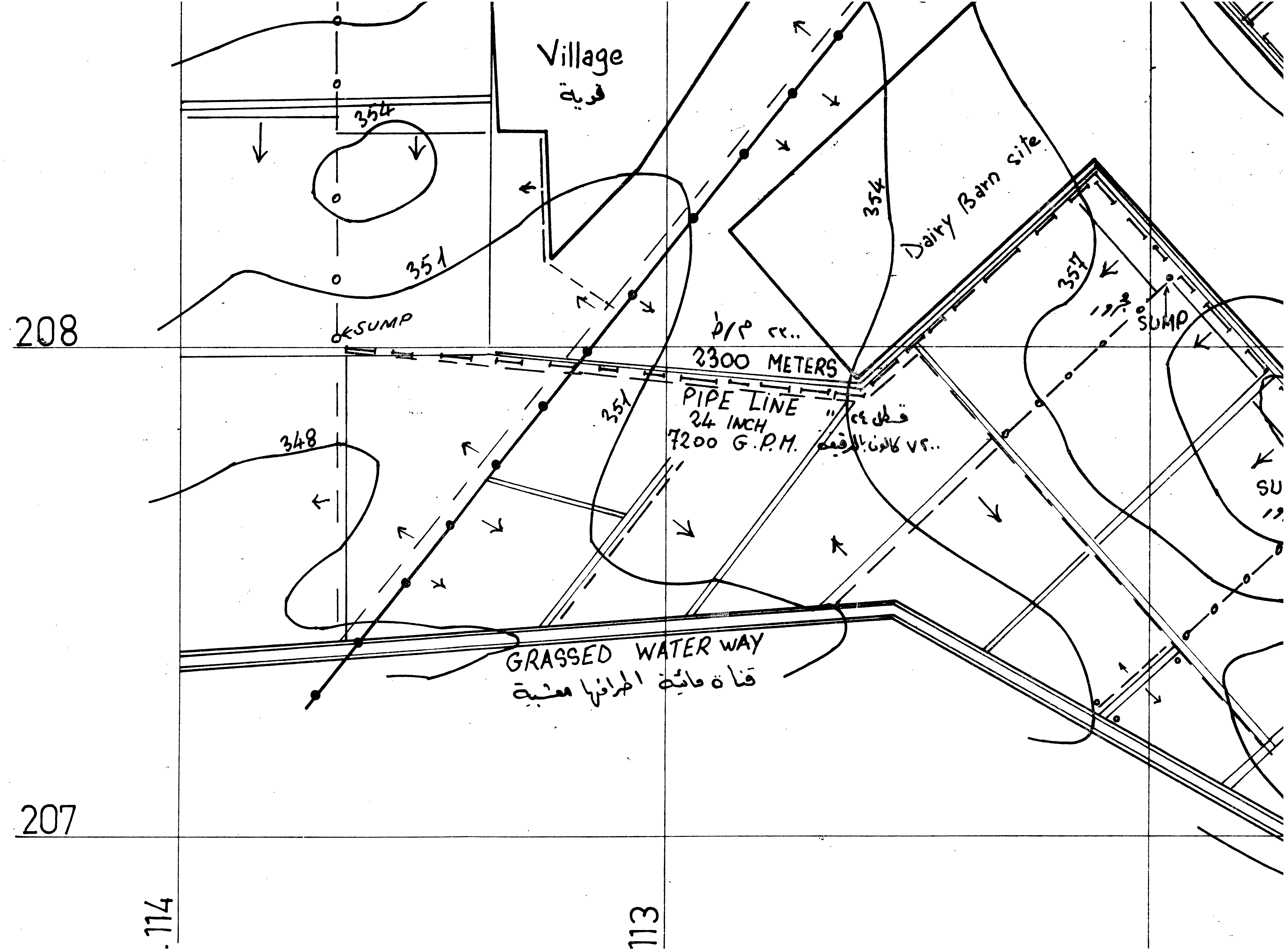
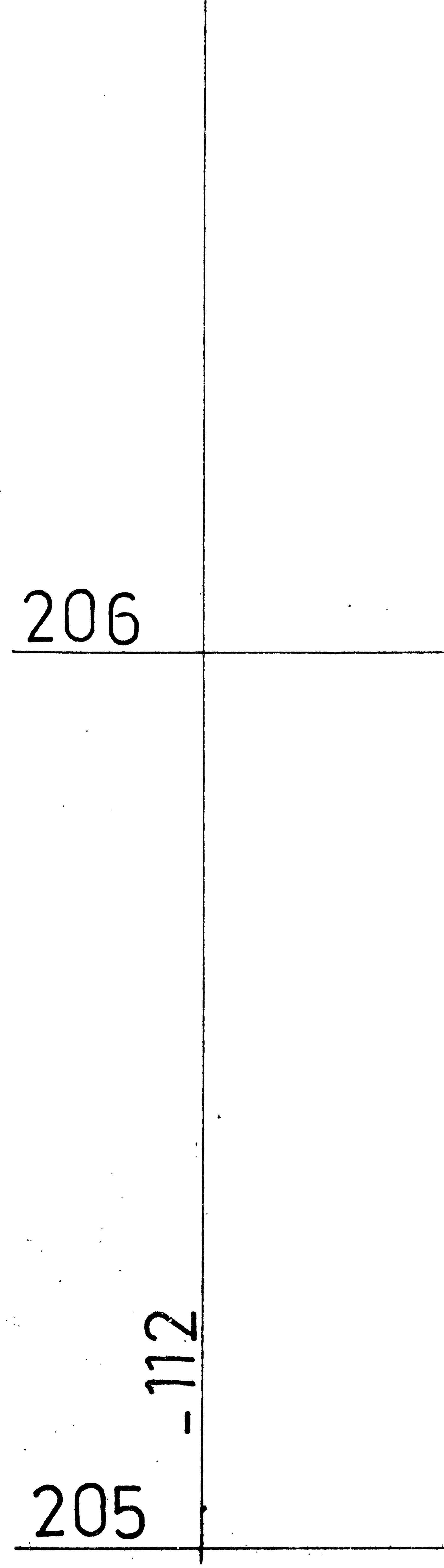


210
209
قرية
Village
348
351
354
357
359
SUMP
4000 METERS
PIPE LINE
24 INCH
7200 G.P.M.
WATERWAY
18 INCH
PIPE LINE
3600 G
2200
ELECTRIC POWER LINE
BM, 355.545 METERS
STEEL ROD IN CONCRETE

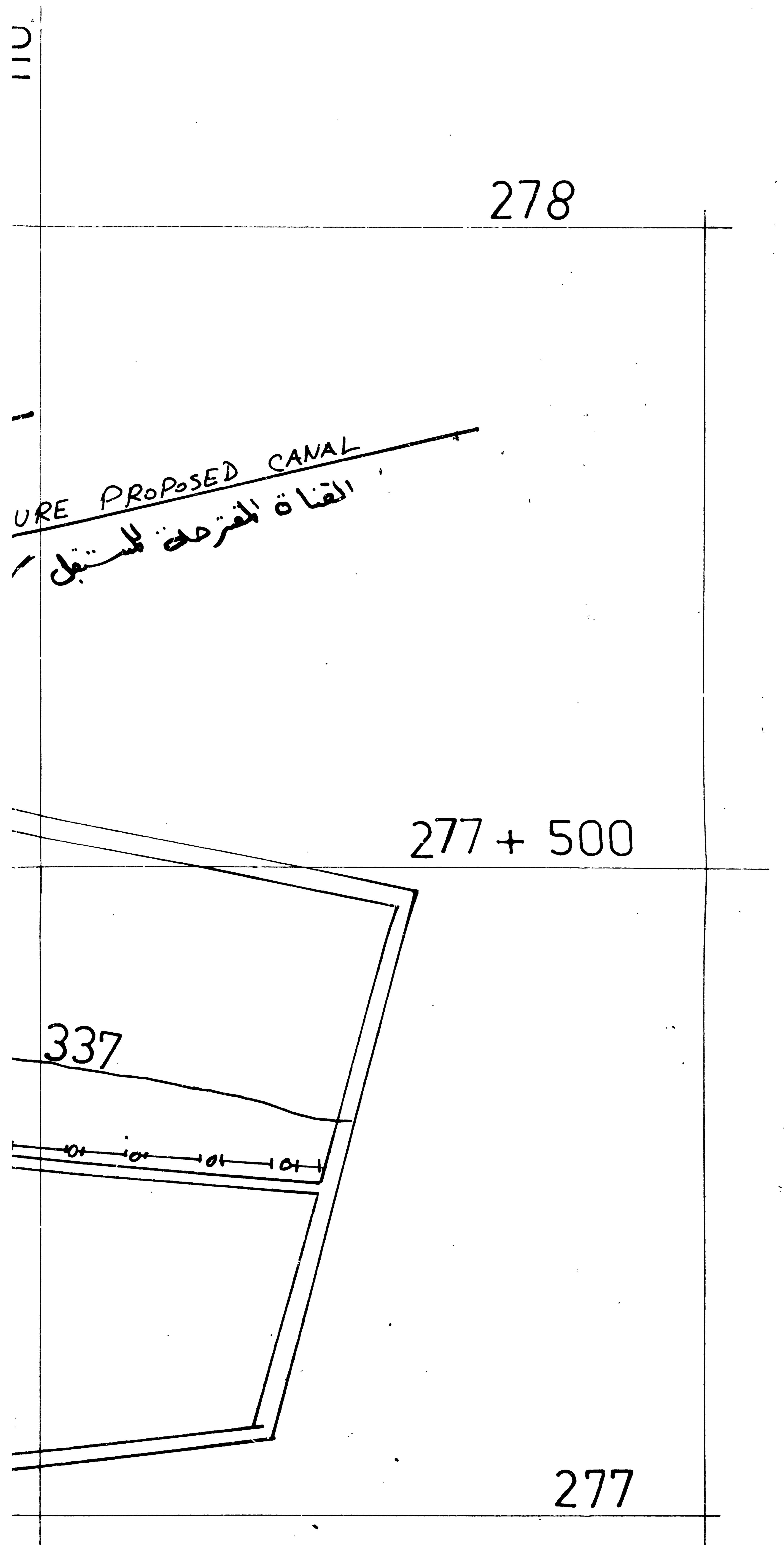

SHOWN WITH SUMPS AND LATERALS
425 HECTARES
FURROW SYSTEMS ARE SHOWN
WITH DIRECTION OF FURROWS
BY GRAVITY FLOW
1275 HECTARES
210
209
N
354
357
360
2400 METERS
24 INCH
PIPE LINE
7200 G.P.M.
الطريق القائم
EXISTING ROAD
قرية
Village


Village
قرية
354
351
348
SUMP
Dairy Barn site
2300 METERS
PIPE LINE
24 INCH
7200 G.P.M.
GRASSED WATER WAY
قناة مائية اطرافها معشبة
208
207
114
113

357
GRASSED WATER WAY
363
365
360
208
207
363
2000 METERS
30 INCH Concrete Pipe line
10,000 G.P.M
366
3000 METERS
30 INCH CONCRETE PIPE LINE
10,000 GPM
363
3800 METERS
30 INCH CONCRETE PIPE


206
-112
205

_111
_110
_109
205
206
WATER WAY
GRASSED WATERWAY
366
369
LEVEL IRRIGATION CANAL
370 METERS



SPRINKLER SYSTEMS
PUMP 1320 G.P.M. FROM SUMPS WITH 75 H.P.
ELECTRIC MOTOR BY EACH SUMP
CONCRETE STANDPIPES 48 INCH AND 30 INCH
WITH 24 INCH OVER FLOW INTO 30 INCH
STAND PIPE AT 335 METERS AND TOP OR
STAND PIPES 337 METERS 15 INCH LOW HEAD
PVC PLASTIC PIPE LINE FROM 30 INCH
STAND PIPE BY GRAVITY FLOW.

نظام الرش
مضخة ١٣٢٠ گالون بالدقيقة من
الجرور مع مولد قوته ٧٥ حصان من
جرور تتدرج من ٤٨" الى ٣٠"
الى ٢٤"
الارتفاع ٣٣٥ سطح ٣٣٧
٣٣٧ الانابيب ١٥"
من البلاستيك مع
٧١ انحدار الطبيعي للتربة

TOTAL AREA IRRIGATED
520 HECTARES

ALL 5 SPRINKLER SYSTEMS ARE NORTH OF 276+500 AND ARE SHOWN WITH SUMP AND LATERALS

300 HECTARES

276

ALL FURROW SYSTEMS ARE SOUTH OF 276+500 AND ARE SHOWN WITH DIRECTION OF FURROWS BY GRAVITY FLOW

220 HECTARES

275 + 500

TEL TAMER IRRIGATION SYSTEM

SCALE

1 METER 5000 METERS

CONTOURS IN METERS

NOVEMBER 8, 1979

تل تامر

نظام الري (الحالية)

المقياس ١/٥٠٠٠

خط الكونتور بالمتر

٨ تشرين الثاني ١٩٧٩

275

274 + 500

109+500
350
345
340
334
276+500
FUT
INCH STANDPIPE
GATE VALVE
EEL PIPE ALL SUMPS
2300 METERS
SUMP
SUMP
INCH RUBBER GASKET
CONCRETE PIPELINE
4500 GPM.
LINE

326.200 METERS
CONCRETE SLAB
IETER BY 2 METERS
METERS FROM RIVER.

الارتفاع ٣٢٦,٢٠٠م
بلوكات بيتونية
تبعد ٢٢ م عن النهر


108+500
109
350
345
337
SUMP
SUMP
2300 METERS
DESIGN POINT
OUTLET FROM 48
INTO SUMP 10 IN
AND 10 INCH ST
1.5×2×2 METE
30 INCH
CONCRETE
4500 GPM
RUBBER GASKET
PIPELINE
٤٥٠٠ غالون / بالدقيقة

30 INCH CONCRETE PIPELINE
334
331
331
٤٥٠٠ كالون بالدقيقة
4500 G.P.M.
30 INCH
CONCRETE
DAIRY BARN SITE
مكان تجميع منتجات الحليب
مع العناية بالحيوانات اللبونة
TRIC LINE
328
328
328
328
BM, 328.000 METERS ON NAIL IN NORTH EDGE OF PAVEMENT
GRASSED WATER WAY
قناة مائية معشبة
30 INCH CULVERT
550 METERS TO FARM
36 INCH REINFORCED CONCRETE OR 30 INCH HIGH PRESSURE 1524 METERS PIPELINE 9000 G.P.M.
WATER LEVEL IN KHABOUR RIVER OCT. 29, 1979 322.000 METERS
BM2
ON
1
22

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3 of 3


276
GRASSED WATERWAY
قناة مائية معشبة
ELEC
POWER
275
108
نهر الخابور
KHABOUR RIVER