ABSTRACT OF THESIS

FEASIBILITY OF EXPANSION OF IRRIGATED FARMING IN YUMA COUNTY, ARIZONA

Submitted by

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of

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ABSTRACT

The feasibility of expanding irrigated farming in Yuma County, Arizona, and the sequence in which different areas should be developed, involves many considerations. It is assumed, for the purpose of this study, that further development of our agricultural resources is desirable, and that we are seeking for more efficient means for a more abundant living. Therefore, the major portion of this study is limited to production possibilities, and efficiency of production.

A description of the irrigable areas, including the communities now being farmed, as well as the districts which are not developed for farming, portrays the scope and nature of the problem. A total area of approximately 735,000 acres of irrigable land is delineated into six different districts, all of which differ somewhat in soils, available water supply, and cropping history for the lands now being farmed. According to the U. S. Bureau of Reclamation the entire area described in this report, is feasible for irrigation by water from the Colorado river, from an engineering standpoint.

Competition may settle the use of land, but in order that competition may function freely, all of the facts should be revealed. It has been endeavored to present some of the factual economic data pertaining to Yuma County's present agricultural enterprises, and correlate the information with future possibilities of farming activities in the county.

Analyses of the cropping histories, yields, and costs of producting crops in the different districts were made. Factors which influence efficiency of production were analyzed. The data were obtained from farming operations on lands adjacent and similar to the undeveloped irrigable lands, which ~~was~~ were designed to correlate the findings with the problem.

The data were obtained from several sources and by several methods. Cost figures were obtained by the conference method with commodity groups of growers, surveys of individual farmers, and cooperative record keeping with individual growers. Yield records were obtained from irrigation district officials, county agricultural conservation association records, and individual growers. Some of the cost data were supplemented by data compiled in a report on a farm management study in Salt River Valley. All data relating to irrigable land and available water

supply were obtained from the engineering reports of the U. S. Bureau of Reclamation. Price data were obtained from the Agricultural Marketing Service, U. S. D. A.

The cropping history of the lands in Yuma County which have been farmed with irrigation water diverted from the Colorado river show a wide diversity of crops being grown with economic success. Many of the crops successfully grown in the county are adapted to but a limited area of the nation. Cost and yield analyses show that the efficiency of crop production is far above the average of the nation. The estimated returns to capital and investment on an 80 acre farm vary from $1,071 to $2,574, depending on the type of agriculture pursued, as set up in the farm management plans in this report, which are based on average yield figures, and cost of production studies. The real farm income would be greater than the above figures, since it does not include the labor of the farmer and his family. The families standard of living could be substantially improved by growing a garden, a home orchard, and keeping two dairy cows, some chickens, and possibly some sheep for cleaning up ditch banks. If our Federal Government follows a plan of retiring sub-marginal land and placing farmers, from the land

so retired, on productive land, it appears that the expansion of irrigated agriculture in Yuma County, Arizona is of utmost importance. A study of this phase of the subject is needed.

There are 2,546,000 acre feet of Colorado River water available for irrigation purposes in this County. There are also sufficient irrigable lands which are feasible for irrigation in Yuma County to beneficially use the available Colorado River water. The Imperial Dam, 25 miles north of Yuma on the Colorado River, has been constructed for the diversion of water to the All-American Canal and also for the Yuma-Gila Project. The Headgate Rock Dam, one mile north of Parker on the Colorado River, is now under construction for the diversion of water to irrigate approximately 100,000 acres in the Parker Valley. Unless this water is put to beneficial use, there is great danger of losing its use for this Nation since the Mexican Government is making decided efforts to develop irrigated farming in the lower Colorado River basin in that country. If this development of irrigated agriculture in Mexico should appropriate the waters from the Colorado River now available to Yuma County for irrigation purposes, the beneficial use of water for this Nation would be lost or international strife would result.

It is assumed that it is a wise course for any nation to develop their natural resources and preserve their rights. If we are to follow this form of strategy, the early development of the Yuma Gila Irrigation Project in Yuma County must follow.

The policy of promoting the Nation's standard of living to the highest possible level is an American principle. The data in this report point out that the development of further irrigated farming in Yuma County, Arizona, would contribute a share in raising the standard of living of the people of this great Nation.

WATER SHOULD BE APPLIED TO THE VALLEY LANDS FIRST

The gravity main canal from the Imperial Dam is now completed for the First Unit of the Yuma-Gila Project. The gravity canal brings the water up to the first pumping plant where it is lifted onto the Mesa lands. There is a carry-over of funds from the Yuma-Gila Project appropriation amounting to approximately $1,500,000. While this money was appropriated for construction of the pumping plant to lift water onto the Mesa lands of the First Unit and construct a distribution system on these lands, it is possible to divert this money toward the Roll-Welton

canal which would supply water to the valley lands of the Second Unit.

While the present available funds for the Yuma-Gila Project are not in sufficient amount to complete the canal to carry water to the valley lands of the Roll-Wellton District, it will go a long way toward its construction and the use of these funds in this District would be most feasible for the follow- reasons:

1. There is an established farming community with a complete irrigation distribution system already constructed on a sizable portion of the land in the Roll-Wellton area. Some of the land is leveled and in production and needs only a dependable supply of irrigation water to return it to its original state of production which was a profitable farming enterprise according to all records available.
2. A capital investment of approximately $1,300,000 in houses, schools, highways, irrigation distribution systems, and other improvements necessary for a successful community has already been made in the Roll-Wellton area. These facilities are so located that they can maintain their value in

the event of the Colorado River water being made available to the area.

3. The people now living in the area form a splendid nucleus for the expansion of a successful community for irrigated farming.

4. A dire need for Colorado River water for irrigation purposes exists among 90 farmers in the Roll-Wellton District. This has been brought about by increased water diversion upstream which has practically shut off the surface flow and greatly reduced the underground flow for the area. Accompanying this decreased supply of water, there has been such a great increase in alkalinity in the irrigation water that many of the wells in the area have been abandoned and the remaining wells are so high in salt content that crop production has been drastically reduced. The high alkalinity of the irrigation water now available for the District makes it impossible to grow row crops and limits the area to a one-crop system, with greatly reduced yields. Out of 6,600 acres that were being farmed in the Mohawk Valley in

1931, approximately 50 per cent of the land is already abandoned due to alfalfa stands being killed out by excessive alkali accumulations. It has been found impossible to reestablish a stand of alfalfa on the lands with the existing water facilities. Water containing 1,500 parts per million total soluble salts is considered the maximum salt content safe for irrigation purposes. By 1936, all of the wells had exceeded the safe limits of salt content for irrigation purposes. Nine wells had been abandoned, 11 other wells ranged in salt content from 1,619 to 2,784 parts per million and there were 7 wells ranging from 3,197 to 4,841 parts per million total soluble salts. Three of the wells still in use range from 5,636 to 10,925 parts per million total soluble salts. Colorado River water having only a small amount of soluble salts would soon leach out the excess alkali from the land which has been farmed in the District.

5. With the abandonment of the wells and the consequent abandonment of farms served by these wells and the increased alkalinity of practically all of the wells from which

irrigation water is pumped, the cost per acre for irrigation purposes in the Roll-Wellton District has increased materially. The farmers in the District now pay from $10 to $14 per acre for irrigation water.

6. Soil survey reports show that the valley lands within the confines of the Yuma-Gila Project are the most feasible for development due to their good quality, high water holding capacity, fine texture, and comparative richness in available plant foods. On the other hand, the mesa soils of the First Unit of the Yuma-Gila Project are light of texture, having a high duty of water, contain a comparatively small amount of plant food elements, and, therefore, are limited to the production of speciality crops which are high in price and require large amounts of capital investments to produce. While the mesa lands are feasible for irrigation and will produce very efficiently some of the speciality crops, such as grapefruit and winter vegetables, there is no emergency existing which would call for the immediate development of these lands like the emergency existing in the

Roll-Wellton District where farmers are now living and are in distress.

7. The reestablishment of farmers from sub-marginal land could best be accomplished by placing them on the valley lands of the Yuma-Gila Project where general types of farming can be successfully followed. It is believed that the capital investment and operating expenses which would be necessary to establish a farmer on the mesa lands would be excessive in comparison to the valley lands.

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I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION BY GLENN E. BLACKLEDGE

ENTITLED FEASIBILITY OF EXPANSION OF IRRIGATED FARMING IN YUMA COUNTY, ARIZONA

BE ACCEPTED AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

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TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

AREA AND LOCATION OF IRRIGABLE LANDS

The development of modern irrigation methods in Yuma County, Arizona, is comparatively new. The Arizona irrigation census shows that in 1899 there were only 4,413 acres irrigated in Yuma County which was increased to 61,399 acres in 1929, chiefly due to the completion of the Laguna Dam and the Yuma Valley canal system in 1913 by the United States Bureau of Reclamation. During the past decade, another 10,000 acres have been brought under irrigation, bringing the total irrigated acres to approximately 71,000 acres. The total irrigable area in the County is about 735,000 acres.

The irrigable areas in Yuma County range in elevation from 94 feet in the Yuma Valley to 620 feet on the Mesa Lands of the Yuma-Gila Project. The Yuma United States Reclamation Project consisting of 55,000 acres is in what is known as the Yuma Valley and is located on the east side of the Colorado River Valley extending south from the City of Yuma to three

contour line. The Palomas area, or Fourth Unit, which comprises an area of 109,000 acres along the north side of the Gila River, extends eastward from the Muggins Mountains to the 600-foot contour line. The Parker Valley area is located along the east side of the Colorado River, extending from Parker, Arizona, on the north to Ehrenberg on the south and consists of approximately 100,000 acres. This project is all within the confines of the Colorado River Indian Reservation and approximately 8,000 acres have been irrigated by water lifted from the Colorado River by pumps.

Climate

The climate is distinctly arid and semi-tropical with practically twelve months of growing weather. The average range of growing season, according to 51 years of United States Weather Bureau records, is 355 days. The records of the Weather Bureau at Yuma, Arizona, show the maximum temperature for the past 27 years to be 119° Fahrenheit and the minimum, 22° Fahrenheit. The earliest date of killing frost is November 20 and the latest date of killing frost is February 18. The mean relative humidity ranges from 60.9 at 6 A. M. to 26.4 at noon. The average annual rate of per cent of possible sunshine is 89.7. The wind velocity averages 5.2 miles per

hour with a maximum annual average of 28.2 miles per hour and an absolute maximum of 44 miles per hour. Irrigation is positively essential for cultivation, but due to the climate, a wide range of crops is produced, including those which only a very limited area of the United States can produce. Untimely rains seldom damage crops in Yuma County, there being an average precipitation of 3.35 inches.

AVAILABLE IRRIGATION WATER

While some ground water is available for irrigation purposes, the main source of irrigation water for Yuma County is the Colorado River. The Federal authority for the Lower Basin States of Arizona, California, and Nevada, known as the Boulder Canyon Act, has approximately 2,800,000 acre feet of Colorado River water for exclusive beneficial use in perpetuity. According to the United States Bureau of Reclamation (4), 2,546,000 acre feet should be used in Yuma County for irrigation purposes. The United States Bureau of Reclamation recommends in their engineering report submitted in December, 1934, to use this amount of Colorado River water as follows: 140,000 acres in the Gila Valley Project requiring 4.5 acre feet per acre would use 630,000 acre feet of

miles north of the Mexican border. The Mesa Unit of the Yuma Project of 18,000 acres is located on the first bench above the Yuma Valley. The Gila Valley Project consisting of 585,000 acres is located along the lower Gila River Valley, reaching from the town of Aztec, Arizona, on the east and to Yuma, Arizona, on the west, where it borders the Mesa division of the Yuma Project. The United States Bureau of Reclamation has divided the Project into four major units as follows: The Yuma desert area of 139,000 acres lies between the Gila Mountains on the east and the Mesa Unit of the Gila Project on the west and from the Gila River on the north to the Mexican border on the south. The North and South Gila Valley area of approximately 11,000 acres, now most of which is irrigated, some by gravity water and some by pumping from wells, can be irrigated from the canals which will serve the Yuma desert area, making a total of 150,000 acres in the First Unit. The Wellton Mesa and the Mohawk Valley area, or Second Unit, comprises an area of 153,000 acres south of the Gila River extending to the 600-foot contour line and is between the Gila and Mohawk Mountains. The San Cristobal Valley, or Third Unit, comprises an area of 184,000 acres east of the Mohawk Mountains and south of the Gila River to the 600-foot

water; 445,000 acres of the Gila Valley Project would require 2.7 acre feet per acre and thus would use 1,225,750 acre feet; 11,000 acres in the North and South Gila Valley would use 4.5 acre feet per acre, thus using a total of 49,500 acre feet; 85,000 acres in the Yuma Project requiring 4.5 acre feet per acre would use 382,500 acre feet. The requirements for the Colorado River Indian Reservation would be 2.75 acre feet per acre on 90,000 acres which would account for a total consumption of 257,500 acre feet.

Approximately 90% of the irrigable land in the county remains undeveloped. There is an adequate supply of water available from the Colorado River to irrigate a large portion of the undeveloped irrigable land.

Although the U. S. Congress has made a small initial appropriation for the purpose of starting construction of irrigation works to deliver water to these lands, subsequent appropriations have been challenged and refused on the premise that the project is not feasible.

Soil surveys, engineering surveys, and water commission reports have been made for the lands in the proposed irrigation project. None of these reports or surveys has seriously considered the economic feasibility of the project.

Mr. Harold Ickes, Secretary of the U. S. Department of Interior, appointed a special committee to investigate the feasibility of the first unit of the Yuma-Gila irrigation project. The first unit is primarily mesa land, and differs materially from the valley lands. The special committee, composed of Dr. W. L. Powers, soils technician from Oregon Agricultural College; Mr. William Peterson, director of Agricultural Extension Service in Utah, and Mr. W. H. Code, a prominent irrigation engineer, made their report in 1936. While the special committee report deals in a general way with the feasibility of the entire project, its main objective was the feasibility of the mesa lands. The writer furnished considerable economic data for the special committee report, some of which is included in this thesis.

An economic analysis of the feasibility of irrigation expansion in Yuma County is a pertinent factor in the future welfare of the community, state, and nation. If the irrigable land in the county will become a valuable asset to the people when it is placed under irrigation, it is desirable that the available water from the Colorado River be used for that purpose. If the proposed expansion of irrigated agriculture in question is not economically feasible, its development should not take place.

According to a report of the International Water Commission, Mexico has 1,961,900 acres of irrigable land which can be irrigated by water from the Colorado River. More activity in expanding irrigated farming in the Colorado River basin in Mexico is manifest than in the United States. If the prior appropriation of water for beneficial use is still a criterion of International water rights, serious consideration of the feasibility of further irrigation development in Yuma County is of added importance.

It has been mentioned that the undeveloped irrigable areas in the county include both mesa and valley lands. Soils in the mesa lands are much lighter in texture, with less plant food and lower water-holding capacity than are the soils in the valley lands. This difference alone has a direct bearing on the adaptability of growing crops.

A farming community now exists in the valley area of the proposed project. The irrigation water used in the community is pumped from wells. The alkalinity of the well water has increased to such an extent that many of the wells have been abandoned, with consequent abandonment of farms. The remaining wells and farms now being operated are seriously threatened with failures due to high alkalinity of the

water. An adequate supply of good quality irrigation water appears to be the only solution for relieving this distressed farming community.

It seems desirable to analyze the comparative feasibility of developing irrigation on mesa lands as compared to valley lands. The sequence in which these two areas may have Colorado River water diverted to them is a land use problem recognized by the Yuma County Land Use Planning Committee.

The problem of the feasibility of further irrigation developments, and comparative feasibility of developing different areas in Yuma County can best be studied by analyzing the past farming performances of adjacent and similar lands which are now being farmed.

The study began in 1932 with an economic survey of the agriculture in Yuma Valley and Yuma Mesa. This was carried on by conferences and meetings of commodity committee groups of representative growers in the communities being studied. While some of these committee men had kept farm records and accounts and others had not, an average opinion of the committee in each commodity group was used in the final analysis.

Other data used in their study were obtained from irrigation district offices, Agricultural Adjustment records, and individual farm operators. The

irrigation district records were kindly made available by the secretaries and superintendents of the different projects.

Cost data on grapefruit production were obtained from records kept by ten grove operators on Yuma Mesa. A twelve-year record on 40 acres of grapefruit on the Yuma Mesa Grapefruit Syndicate's planting was kindly loaned to the writer by the late George M. Hill, who was manager in 1936 when this particular data were compiled.

A survey of the Mohawk Municipal Water Conservation District was made in 1936 by the University of Arizona Extension service workers under the direction of Dr. George W. Barr who was Extension Economist at that time. Some of the data accumulated from this survey are used in this study.

CHAPTER II

PRESENT IRRIGATED AREAS

A description of the present irrigated areas is presented for the purpose of showing conditions under which farming was developed in the county. When considering acreage, source of irrigation water, soils and general crop history, it is necessary to treat each community area separately. While all of the land in the county now being farmed is subject to irrigation by water from the Colorado River, two districts pump irrigation water from wells and the other four have different arrangements for obtaining Colorado River water. Soils and crop history also vary among the six farming areas. These variable factors influence the economy of farming in the several communities.

The Yuma United States Reclamation Project

The Yuma United States Reclamation Project is divided into three distinct areas: The Mesa division in Arizona; the Valley division, valley lands in Arizona; and the Reservation division, valley lands in California, including Indian lands.

The Valley division of this Project on the Arizona side has 52,378 acres developed for irrigated farming. Irrigation water for this Project is diverted from the Laguna Dam on the Colorado River. There has always been an adequate supply of water for irrigation purposes delivered to the Yuma Valley. The water master's estimates in 1930 was 151,067 acre feet or an average of 2.8 acre feet per acre. While this was an estimate, it is a well-known fact that the water users in the Yuma Valley use materially more water than 2.8 acre feet per acre at the present time. The increase is approximately 50 per cent and is believed to be due primarily to clear water being delivered as compared to heavy silt-laden water used prior to the completion of Boulder Dam which greatly desilts the water.

The Valley irrigation unit is protected by a levee from the City of Yuma to the International Boundary Line. Along the tops of these levees is a maintenance railroad. These levees have served as adequate protection of the valley since they were constructed.

The dissolved salts in the Colorado River water amounts to 800 or 1,000 parts per million during low water periods in the Fall and Winter months and to

a still smaller amount during the rest of the year. In general, the quantity of dissolved salts is not excessive. About one-third of the total soluble salts is sodium chloride and about one-third calcium sulphate. With reasonably good irrigation practices, the soluble salts are not a problem except where the water table is excessively high. The Colorado River water carries some nitrates.

Drainage is a recognized requirement on this Project and there has been constructed 62 miles of main and lateral drains, the water from which is pumped over the levee into the River at the southern extent of the Project. Test wells are located at each section corner and in some localities at closer intervals so that a close check can be kept on any fluctuations of the water table and additional drains provided wherever and whenever needed.

The original charge for irrigation construction works when prorated to Yuma Reclamation Service lands in the Valley division amounted to $75 per acre. Each owner was allowed a payment peribd of thirty years beginning with the date on which application was made for a water right. A majority of these applications was made in 1917. In addition to the repayment of construction charges, the Yuma Valley water users

must pay annual charges for operation and maintenance of their water distribution system.

There is a source of income which partially offsets these irrigation costs which is derived from power sold to power companies. This income varies from year to year and amounts to approximately 60 cents per acre on the average. The total amount of irrigation charges which includes construction charges, operation, and maintenance amounts to a sum ranging from $3 to $5 per acre.

Soils.--The soils of the Yuma Valley are alluvium deposited by the Colorado River and vary in texture from the sandy loams to heavy clay (5). These soils are of high fertility and are well adapted to the growing of semi-tropical plants as well as some of the cereal crops. While the soils in the Yuma Valley are highly productive, it is noteworthy that available phosphates are generally deficient and for the production of some crops, such as winter vegetables, the soils in general do not carry an adequate amount of nitrates. The Yuma Project is not materially different than other irrigation projects in that it has developed some alkali problems. There are two unfavorable soil conditions which are present in small, scattered areas throughout the Yuma Valley which are

not taken care of by drainage. One of these is slick spots where the soil is found to be of an impervious nature to a depth of 4 to 10 feet. Another soil condition which can be remedied by the use of gypsum and organic materials, such as barnyard manure and green manure crops, is a puddled condition in the top soil with loamy or sandy subsoil. The unproductive areas in the Project amount to approximately 900 acres. The Yuma County Land Use Planning Committee reports that approximately 5,000 acres in the Yuma Valley area are of poor quality or are affected by alkali.

Crops.---A great diversity of crops is grown in the Yuma Valley. The major crops during the early history of the Project were cotton and alfalfa. As the Project becomes older, new crops are introduced and substituted for the old crops. While the major portion of the land was devoted to the growing of alfalfa and cotton in 1929, a decade later, the cotton acreage was of minor importance. In 1939, the Yuma Valley produced 34 different farm crops. Largest acreages were devoted to alfalfa, there being 20,159 acres. Winter vegetables ranked second in acreage with 13,000 acres of lettuce, 2,800 acres of cantaloupes and 1,316 acres of mixed vegetables, making

a total of 16,356 acres of vegetables. The third ranking crop in acreage in 1939 was flax with 4,500 acres. This was a new crop introduced in 1937 and was increased to approximately 13,000 acres in 1940. The cropping possibilities in the Yuma Valley are so well diversified that rapid shifts from one crop to another are practiced.

South Gila Irrigation District

The South Gila Irrigation District consists of 12,400 acres of land lying south of the Gila River and east of Yuma. Sources of water for irrigation are derived from private wells and pumping systems, there being no gravity system of irrigation in the area. The largest acreage irrigated in the history of the Project was in 1938 with 4,004 acres in crops.

Soils.--In general, the soils of this area range from fine sand to clay and are generally rich, productive soils. These soils are composed of alluvium materials deposited by the Gila and Colorado Rivers in comparatively recent times (5). These soils are similar to those in the Yuma Valley in many respects, consisting principally of very fine, sandy loam and silty clay loam. An alkali condition prevails throughout the area but is not considered a serious problem.

Crops.--This area does not produce the diversity of crops that is produced in the Yuma Valley. This is probably due to the district's being rather small and also due to the source of irrigation being from wells. Some winter vegetables have been produced very successfully in this district in the past, such as head lettuce, carrots, and cantaloupes. The land in this district, at present, however, is devoted primarily to the production of alfalfa hay and seed, with a small acreage of cotton, barley, grain sorghums and bermuda grass seed.

North Gila Irrigation District

This area of land comprises 8,100 acres lying north of the Gila River flood plain and is known as the North Gila Valley. Irrigation water for the North Gila Valley Irrigation District is diverted from the Colorado River at Laguna Dam. While the District depends on the works of the Yuma Project for diversion of its supply of irrigation water, it is otherwise independent of the Yuma Project and makes no payment for construction and maintenance of the Dam.

Administration of the North Gila Valley Irrigation District is in the hands of the water users, irrigation water being charged for from year to year

according to the amount of actual cost for operation and maintenance. During the past two years, this cost has amounted to $2.58 per acre. Indebtedness amounts to $2.56 per acre based on an irrigable acreage of 4,880 acres. This irrigable acreage constitutes 60 per cent of the total area and is also the total acreage included under the North Gila Valley Irrigation District.

Soils.--The soils in the area are similar to those of the Yuma Valley, being of a highly productive nature. While damage from floods was a hazard for this District in the past, at present these hazards have been mostly eliminated by the construction of a number of dams on the Gila and Verde Rivers and their contributaries which control the flow of the Gila River.

Crops.--There is a fair diversity of crops grown in this area with alfalfa hay and seed production being a main enterprise. Other crops grown in the district include cotton, grain sorghums, wheat, barley, oats, corn, Bermuda grass seed and winter vegetables. The cropping history of the area shows that cotton has never had the prominent place enjoyed by feed crops. The ability to change cropping systems is a characteristic of irrigated agriculture in the

Southwest. This area is no exception to this rule, since the acreage devoted to various crops shifts readily from year to year as economic conditions change.

Roll-Wellton District

This district must necessarily be divided into four parts for descriptive purposes.

Area No. 1.--One area of land in this District comprises 11,800 acres of river bottom land lying north of the Gila River in what is known as the Mohawk Municipal Water Conservation District or the Roll area. This area is about twelve miles long and varies from 3 1/2 miles wide near the town of Roll to a narrow point 1 1/2 miles wide at the eastern extremity.

Thirty-one pumping units were installed to supply irrigation water for the District. While an adequate amount of water was obtained from these wells when the District was organized in 1923, the construction of dams on the upper Gila River and its contributaries has diminished the supply to an alarming extent. With the lowering of water tables, the water has become increasingly alkaline in character. The cost of pumping and water distribution has materially increased and a considerable portion of the

land has gone out of cultivation. When this District was organized, there were 18,000 acres included in its boundaries. At present, there are 4,153 acres being cropped.

The cost of irrigation water in this District averages about $10 per acre. These costs include electrical power, maintenance and operation of pumps and canals. While there is a bonded indebtedness of approximately $450,000 on the District, payments are in arrears and this item is not included in the $10 per acre charge.

Soils: The soils of the area range from fine silty loam to sandy loam (5). While these soils have proved to be of a highly productive nature, the continued application of irrigation water with a high salt content has built up an alkali condition in the soil which renders a great deal of it to an unproductive state.

Crops:: Due to the quality of irrigation water, this area has practiced practically a one-crop system. Some row crops, such as cotton and head lettuce, have been grown in the past but were soon discontinued due to alkali accumulation. The production of alfalfa seed has been the major enterprise on this Project. The average yield of alfalfa seed during the

life of the District has been in the neighborhood of 500 pounds per acre. However, with increasing alkali accumulation in the soil, it is becoming difficult even to maintain a stand of alfalfa over a major portion of the District.

Area No. 2.--Another area in the Roll-Welton District lying generally north and east of the town of Wellton comprises 35,000 acres of crop land. This is bottom land paralleling the general course of the Gila River, which forms the northern boundary of the area for a short distance. The area is approximately 7 miles long and varies from about 1/2 mile to 1 1/2 miles wide. Irrigation water is supplied from individually owned wells. The cost of irrigation water is approximately $8.50 per acre, which includes electrical power and maintenance of the power lines. The area is under the Gila Valley Power District and is bonded to the extent of $3 per acre in payment for power lines constructed in 1923. Payments on this bonded indebtedness are in arrears. Seventy-two per cent of the total amount levied since 1930 remains uncollected.

Soils: Soils in this District range from a very fine, sandy loam to fine sand (5). These soils are highly productive but like the soils in the Mohawk Valley are becoming excessively alkaline by the

continued use of irrigation water with a high salt content.

Crops: At the present time, there are only 1,433 acres of the area being cropped, most of which is alfalfa. Alfalfa seed production in this area has been very satisfactory.

Area No. 3.--Another area lies 16 miles northeast and 2 1/2 miles north of the town of Wellton in the Gila River bottom land in a bend formed by the River. The land is irrigated by individually owned wells. The power for pumping is electrical and furnished by the Gila Valley Power District. The cost of irrigation water in this little District is approximately $8.50 per acre. The increasing salt content of the well water is also a problem here.

Soils: The soils in this District are of the Gila series, ranging from very fine silty loam to sandy loam (5). The soils are highly productive. The limiting factor is the development of adequate and satisfactory supply of irrigation water.

Crops: The crops in this area are predominantly alfalfa, although cotton, small grains, and grain sorghums have been grown very successfully.

Area No. 4.--The other small area now being farmed in this District comprises approximately five

hundred acres of bottom land, lying in an abrupt bend of the Gila River immediately across the River from the center of the Mohawk Valley Irrigation District. This is also under pump irrigation, power being obtained from the Gila Valley Power District. Like the other areas in this District, the only limiting factor in the successful irrigated farming is a satisfactory supply of irrigation water.

Soils: The soils of this area are predominantly Gila very fine sandy loam (5) and are highly productive.

Crops: While cotton and small grain crops have been grown successfully, alfalfa is now the only crop being grown in this area.

Parker Valley

This area consists of 8,000 acres located on the east side of the Colorado River, extending south from the town of Parker approximately 12 miles. The irrigation water supply is pumped from the Colorado River by the United States Bureau of Reclamation at a cost to the farmers of approximately $5 per acre. At the present time, there is being constructed a diversion dam one mile north of Parker on the Colorado River for the purpose of diverting water to this area and an additional 90,000 acres lying along the east side of the Colorado River.

Soils.--Soils of the Parker Valley are predominantly fine sandy loam with some clay and sandy loam. The alkali condition is somewhat similar to the Yuma Valley, there being spotted alkali accumulations throughout the Valley. These soils are generally highly productive.

Crops.--The major crop grown in this Valley has been cotton for a good many years. At the present time, some diversification of crops is developing, there being a small acreage of alfalfa, wheat, grain sorghums and other feed crops grown there since the advent of the Agricultural Adjustment Administration.

Yuma Mesa (Unit B)

While there is 18,000 acres originally included in Unit B of the Yuma United States Reclamation Project, there is only canal and pump construction developed at present to serve 3,810 acres. The irrigation water for this District is lifted a height of 78 feet by pump from the Yuma Valley canal to the Mesa. The annual charge for water users for this district amounts to approximately $15 per acre. This includes only operation and maintenance since the construction charges havealready been paid.

Soils.--The soils of the area are classed as Superstition sands (5). The soil is generally

calcareous and coarse, ranging from loose and clean to somewhat firm and loamy. The water holding capacity is very low, the soil being uniform to a great depth and containing approximately 90 per cent sand. There are occasional bands and layers of gravel and some of clay, but in general the soil is so pervious that irrigation must be done with a large head and runs or "lands" must be short in order to avoid the wasting of water. The soil is low in nitrates, phosphates and is not especially rich in other plant foods. On the other hand, it is a soil easily worked and is free from harmful accumulations of alkali salts.

Crops.--The only crops which have been grown in this District of commercial importance are grapefruit, oranges and limes. The major portion of the land now cultivated is planted to grapefruit trees. The production of grapefruit has been very successfully carried on and the unit cost more than compares favorably with other grapefruit growing areas. There are, at present, 1,033 acres of grapefruit trees in bearing, 173 acres of oranges and 53 acres of limes. Twelve-year-old grapefruit trees in this area produce approximately 1,000 field boses of grapefruit. Some field crops in this area, such as alfalfa and cotton, have been grown in an experimental way. While the growing of alfalfa and cotton has been satisfactory,

the amount of water required to grow these field crops has been excessive from an economic standpoint. The use of phosphate fertilizer is absolutely necessary for good growth of alfalfa on this soil. Experiments on winter tomato production show this crop to be adaptable to the area since there is a high-price market period when the tomatoes ripen which more than offsets the excessive cost of irrigation and commercial fertilizers.

CHAPTER III

FEASIBILITY OF FURTHER IRRIGATION DEVELOPMENTS

It has been pointed out that the development of irrigated farming in Yuma County is in its infancy. There is available for irrigation purposes an adequate supply of irrigation water to irrigate at least an additional one-half million acres of arable land.

In order to determine the feasibility of any enterprise, it is necessary to analyze enterprises which are as nearly similar as possible to the proposed enterprise or enterprises under consideration. In any estimate of this kind, certain basic assumptions are necessary.

It must be assumed that the type of farm which has been found to be profitable in the adjacent valleys and mesa lands which are already being farmed will serve as an accurate gauge for future farming developments.

A second assumption is that the proposed areas for irrigation development will enjoy the same versatility and flexibility of cropping habits that have been enjoyed by the land already developed for irrigation.

A third assumption has to do with the yield expected. In the case of cotton, the yield as determined by the Agricultural Adjustment Administration is used and for all other commodities, at least the average of four- or five-year records are used.

A fourth assumption has to do with the prices expected for the production. The prices of commodities are based on the average price of the ten-year period, 1925 to 1934, inclusive. This particular period covers years of relatively high prices from 1925 to 1929 and years of relatively low prices from 1930 to 1934.

The fifth assumption has to do with the costs of production. For this estimate, the current costs of labor, seed, machinery and power are used. Water cost used is based on the study by Mr. Preston of the Bureau of Reclamation, which is $8 per acre per annum. Taxes are figured at $3 per acre for a year, which is about 30 per cent less than current taxes in Yuma Valley, but it is assumed that taxes during the first ten years in a new area would be relatively lower.

Type of farms

All estimates are based upon an 80-acre unit, not that the writer feels that all units should be 80 acres in size, but that it has been used as an

example in the thought that this might well be established as a minimum. In the estimate, five acres have been deducted for roads, ditches, homesteads and a garden area, leaving 75 acres for the growing of commercial crops.

The following are suggested types of farms from which great variations will be expected and to which many types of farms will be added as and if the area develops.

Table 1.--TYPICAL TYPES OF FARMS IN YUMA COUNTY

	Kind	Number of Years
1.	Cotton	4
	Alfalfa Hay	4
2.	Cotton	3
	Alfalfa Hay	4
	Wheat or Barley	1
3.	Alfalfa Hay	4
	Winter Vegetables (Examples used herein are lettuce and cantaloupes)	4
4.	Alfalfa Hay	
	Cattle (Possibly a larger unit would be advantageous)	
5.	Alfalfa Hay	4
	Wheat and Grain Sorghums	1
	Cotton	3
6.	Alfalfa Hay	
	Wheat, grain sorghums and dairy	
7.	Cotton	4
	Alfalfa and Alfalfa seed	4

Production expected

In the following estimates it is assumed that a period of two or three years of alfalfa farming would precede the beginning of a rotation program.

Table 2.--AVERAGE YIELDS OF CROPS

Crops	Amount per acre
Cotton Lint (The 5-year, 1928-1932, Yuma County average)	416 pounds
Cotton Seed	800 pounds
Alfalfa Hay	
First year, straight hay	3 tons
Other years, straight hay	5 tons
Other years with two crops of seed.	2 tons
Alfalfa Seed - two crops	400 pounds
Wheat	21 bushels
Barley	24 bushels
Hegari grains	1½ Ton
Hegari silage	12 tons
Lettuce	100 crates
Cantaloupes	120 crates

Table 3.--PRICES EXPECTED FOR CROPS, BASED ON PAST EXPERIENCE

Crops	Per unit Prices
Cotton (Ten-year, 1925-1934, farm prices for short staple lint in Arizona was 13 3/10 cents)	$ .12 Lb.
Cotton Seed	25.00 Ton
Alfalfa Hay (Ten-year price unbaled approximately $12.00)	10.00 Ton
Alfalfa Seed (Ten-year price)	.137 Lb.
Wheat (Ten-year price)	1.90 Cwt.
Barley (Ten-year price)	1.47 Cwt.
Hegari grain	1.00 Cwt.
Hegari silage	5.00 Ton
Lettuce (After deducting packing costs)	.80 Crate
Cantaloupes (After deducting packing costs)	.80 Crate

Cost of production of crops per acre

Alfalfa hay.--The following costs are based upon costs developed for Yuma County by the conference method with a committee of producers in 1932 with adjustments for changes in rates since that time. (See Page 12, Extension Circular No. 72, entitled an Economic Survey of Yuma Valley and Yuma Mesa Agriculture)

Table 4.--COST OF PRODUCING ALFALFA HAY

Cost per acre	
Taxes	$ 3.00
Irrigation water	8.00
Cost of irrigating, 8 times at 25¢	2.00
Cutting (3 cuttings plus 1 cutting of grass at 75¢)	4.50
Raking, 6 times @ 35¢	2.10
Bunching and trimming bunches, 5 times @ 75¢	3.75
Baling, 5 tons @ $2.00	10.00
Total cost per acre	$33.35

The cost of producing alfalfa hay and seed is estimated on the same basis as outlined above.

Wheat.--Cost of producing wheat is based on the Farm Management study made in the Salt River Valley (3) which includes the three-year average, 1928 to 1930. These estimates are adjusted to conform with present prices and other items of differences between the Salt River Valley Project and the Yuma-Gila Project.

Table 5.--PER ACRE COST OF PRODUCING WHEAT

Man Labor	$ 1.10
Horses or tractor and machinery	1.00
Water	4.00
Seed	1.70
Taxes	1.50
Cut and thrash	4.00
Sacks and twine	2.00
Hauling	1.00
Total	$16.30

Barley.--These estimates are based on the same study as outlined above (3).

Table 6.--PER ACRE COST OF PRODUCING BARLEY

Man Labor	$ 1.10
Horses or tractor and machinery	1.00
Water	4.00
Seed	1.70
Taxes	1.50
Cut and thrash	4.50
Sacks and twine	2.20
Hauling	1.10
Total	$17.00

Hegari grain and silage.--The basis of these costs have been determined from the Farm Management study made in the Salt River Valley (3).

Table 7.--PER ACRE COST OF PRODUCING HEGARI GRAIN

Man Labor	$ 3.00
Power and Equipment	4.00
Water	4.00
Seed	.10
Taxes	1.50
Cut and thrash	7.00
Sacks and twine	1.80
Total	$21.40

Table 8.--PER ACRE COST OF PRODUCING HEGARI SILAGE

Man Labor	$ 3.00
Power and Equipment	4.00
Water	4.00
Seed	.10
Taxes	1.50
Harvest	12.00
Total	$24.60

Table 9.--PER ACRE COST OF PRODUCING COTTON (3)

Man Labor	$ 5.80
Power and Equipment	6.00
Water	8.00
Seed	1.20
Hoeing and thinning	2.00
Taxes	3.00
Picking	10.60
Supervision and hauling	1.20
Ginning	3.70
Bagging, ties and insurance	1.50
Total	$43.00

Table 10.--PER ACRE COST OF PRODUCING FLAX
20 BUSHEL YIELD

Preharvest operation costs	$ 4.40
Material costs, water and seed	9.35
Harvesting	7.25
Overhead costs, taxes, interest, equipment	7.10
Total	$28.10

Lettuce.--The writer does not have available Farm Management studies which include cost of producing

lettuce. The total per acre growing costs, including use of land, taxes, water, all labor, power and materials and fertilizer would be approximately $65.00 per acre.

Cantaloupes.---It is estimated that the total cost of producing cantaloupes is approximately $50.00 per acre. This cost includes everything necessary to deliver the crop to the packing shed.

Anticipated returns from certain types of farming from the proposed future irrigation developments

Below is an indication of returns which might be expected from types of farming as listed. It should be noted that the farmer's labor in each case is included under cost, so that the farm income would be the figure given, plus the value of the farmer's own labor and that of his family. Therefore, the farmer's real income would be increased in proportion to the amount of labor contributed by him and his family.

Table 11.--ANTICIPATED RETURNS FROM FARM TYPE NO. 1

Alfalfa four years - Cotton four years
(Four cuttings of hay each year)

Year	Crop	Per acre value of product	Per acre cost of Production	Per acre return for management and land investment
1st	Alfalfa	$30.00	$33.35	- $ 3.35
2nd	Alfalfa	50.00	33.35	+ 16.65
3rd	Alfalfa	50.00	33.35	+ 16.65
4th	Alfalfa	50.00	33.35	+ 16.65
5th	Cotton	59.92	43.00	+ 16.92
6th	Cotton	59.92	43.00	+ 16.92
7th	Cotton	59.92	43.00	+ 16.92
8th	Cotton	59.92	43.00	+ 16.92
	TOTAL			$114.28

Average return per acre for management and land investment . . . $14.28

Annual return for management and land investment for 80 acre farm (75 acres net x $14.28) is . $1071.00

Table 12.--ANTICIPATED RETURNS FROM FARM TYPE NO. 3

Alfalfa four years - Lettuce and Cantaloupes four years (Cantaloupes to be double cropped with lettuce two out of the four years)

Year	Crop	Per acre value of product	Per acre cost of production	Per acre return for management and land investment
1st	Alfalfa	$ 30.00	$ 33.35	- $ 3.35
2nd	Alfalfa	74.76	34.80	+ 39.96
3rd	Alfalfa	74.76	34.80	+ 39.96
4th	Alfalfa	74.76	34.80	+ 39.96
5th	Lettuce	80.00	65.00	+ 15.00
6th	Lettuce & Cantaloupes	176.00	112.00	+ 64.00
7th	Lettuce & Cantaloupes	176.00	112.00	+ 64.00
8th	Lettuce	80.00	65.00	+ 15.00
	TOTAL			$274.53

Average return per acre for management and land investment . . . . . $ 34.32

Annual return for management and land investment (75 acres net x $34.32) $2574.00

Table 13.--ANTICIPATED RETURNS FROM FARM TYPE NO. 5

Alfalfa four years - wheat and grain sorghums one year - cotton three years

Year	Crop	Per acre value of product	Per acre cost of production	Per acre return for management and land investment
1st	Alfalfa	$ 30.00	$ 33.35	- $ 3.35
2nd	Alfalfa	74.76	34.80	+ 39.96
3rd	Alfalfa	74.76	34.80	+ 39.96
4th	Alfalfa	74.76	34.80	+ 39.96
5th	Wheat & Hegari	53.94	37.70	+ 16.24
6th	Cotton	59.92	43.00	+ 16.92
7th	Cotton	59.92	43.00	+ 16.92
8th	Cotton	59.92	43.00	+ 16.92
	TOTAL			$183.53

Average return per acre for management and land investment . $ 22.94

Annual return for management and land investment on an 80 acre farm (75 acres net x $22.94) $1720.50

Table 14.--ANTICIPATED RETURNS FROM FARM TYPE NO. 7

Alfalfa four years - Cotton four years (Last three years, alfalfa, two crops seed and two crops hay)

Year	Crop	Per acre value of product	Per acre cost of production	Per acre return for management and land investment
1st	Alfalfa	$ 30.00	$ 33.35	- $ 3.35
2nd	Alfalfa	74.76	34.80	+ 39.96
3rd	Alfalfa	74.76	34.80	+ 39.96
4th	Alfalfa	74.76	34.80	+ 39.96
5th	Cotton	59.92	43.00	+ 16.92
6th	Cotton	59.92	43.00	+ 16.92
7th	Cotton	59.92	43.00	+ 16.92
8th	Cotton	59.92	43.00	+ 16.92
	TOTAL			$184.21

Average return per acre for management and land investment . . . . . $ 23.03

Annual return for management and land investment for an 80 acre farm (75 acres net x $23.03) $1727.25

The farm management plans which have been outlined are designed primarily for the bottom or valley lands which may be brought under irrigation, for they are based on similar valley lands now under cultivation having comparable soil conditions. The

cropping systems listed are only a few of the many which may prove economically sound in this County. For the Mesa lands, the soil of which is very light in character and has very low water holding capacity, the above farm management plans would not be favorable under the present price levels. Recent investigations in the growing of alfalfa on the Yuma Mesa shows that it takes approximately 10 acre feet of water per acre for the first year. This might possibly be cut down to as low as 6 acre feet per acre by the third year by adding humus and accumulating silt from the irrigation water. In addition to the heavy water requirements for growing field crops on the lighter Mesa soils, it is apparent that phosphates in the form of commercial fertilizers must be applied at the rate of 400 pounds of single superphosphate per acre for each year in order to obtain a comparable yield of alfalfa with the valley lands.

The following table is an estimate of the initial capital investment required for an 80 acre farm in the Yuma-Gila Project.

Table 15.--INITIAL CAPITAL INVESTMENT REQUIRED FOR AN 80-ACRE FARM IN THE YUMA-GILA PROJECT

	Initial Investment	Annual Interest	Annual Depreciation	Annual Total Annual Charges
Leveling, ditches, fences and initial cost of land which has been estimated at $30 per acre for an 80-acre farm.	$2,400	$120	0	$120
Farm buildings*	2,000	100	100	200
Power and machinery: Four mules @ $100 each; mower, rake, plow, cultivator, disc, harrow, etc.	850	**	**	**
Automobile	700			250
Domestic water	50			
TOTAL	$6,000			$570

* Including an allowance for an electric refrigerator and for a cash outlay required for the installation of an evaporation type of cooling system.

** Cost of power and machinery in this report is figured in crop costs and therefore omitted here.

It is believed that the above statement of initial capital investment necessary for establishing a farmer on the Yuma-Gila Project is conservative. This assumes that the land is given to the settler under the Homestead Act.

The income to a family on an 80-acre farm in the Yuma Gila Project would be made up of the returns to capital and investment variously estimated in this report at $1,071 to $2,574, depending upon the type of agriculture pursued. Since the above figures do not include any returns for labor which might be performed by the farmer and his family, an additional income may be expected. In the case of Farm Type No. 1, a labor allowance of $5.50 per acre has been included in costs, or $412 per farm unit. The prevailing labor rate is 30 cents per hour. From the total income thus provided, there must be deducted, however, the cost of operating the family automobile, interest and depreciation on the farm buildings and interest charges on the initial cost of the land, plus the cost of leveling, making ditches, fencing, etc. These extra costs, as shown in the table entitled "Initial Capital Investment Required for an 80-Acre Farm in the Yuma-Gila Project," amounted to about $570. The net figure, therefore, would range from $913 to $2,416. It would appear that an income of this size would adequately provide for an average farm family, since a home and an automobile and capital investment are taken care of in costs.

It should be noted that the above estimates are conservative in the sense that figures used for

the three factors determining net returns, yields, prices, and costs, have sound bases. In no case do the figures used for yield exceed average yields of recent years obtained in Yuma County. Furthermore, the prices used in no case exceed the 10-year, 1925-1934, average price received by Arizona farmers at the ranch, and in certain cases, particularly that of cotton price and of alfalfa price, the prices used were substantially less than the 10-year average.

The standard of living provided by this income may be substantially improved by the addition to the setup of one or two dairy cows and possibly a few sheep for cleaning up ditch banks, and the use of an acre of land for farm garden and orchard; also the production of a few chickens, principally to provide food for home consumption.

The expansion of irrigated farming in Yuma County especially in the Valley lands of the Yuma-Gila Project is desirable not only in lieu of the fact that the soils are highly productive and the climate allows a great versatility of cropping systems but also from the standpoint of availability of irrigation water. With 2,800,000 acre feet of Colorado River water available for irrigation purposes in the County and only 71,000 acres under cultivation at the present

time, it appears that further development of irrigated farming in Yuma County is not only feasible but inevitable. With periodic droughts in many of the farming sections of the nation including some of the irrigation projects, a territory with irrigable lands and plenty of water seems most feasible and desirable for development.

Possibilities of citrus production on proposed Yuma-Gila Project

It is recognized that the soil and climate in the Yuma desert area which would be included in the Yuma-Gila Project is especially well adapted to citrus growing. The plausibility of making any extensive new plantings of grapefruit trees is doubtful. The expansion of grapefruit plantings in Texas and Arizona offers a problem for serious consideration to the prospective citrus grower as well as the present owners of grapefruit groves. It is estimated that Arizona's grapefruit production will have doubled at the end of six years. However, there are several reasons why the possibilities of grapefruit production in this area should be considered. First, many natural hazards, such as climate, insects, and diseases may eliminate a considerable amount of the present acreage of grapefruit. Second, consumption of the grapefruit

in the United States may increase so materially that new plantings would be desirable. Third, the cost per unit of growing grapefruit in the Yuma desert area is comparatively low. Example: The cost per field box on the Yuma Mesa during the season 1933-34 was 15.8 cents (1) while the cost per field box in the Imperial and Coachella Valley area was 29.6 cents (1) for the corresponding period. The cost for 1934-35 in the Yuma Mesa was 13.1 cents per field box, while the cost for the season 1935-36 was estimated at 11 cents per field box. The diminishing cost per field box is accounted for by the increased yield each year.

In setting up an initial capital investment with expected returns and production for a grapefruit grove, it is necessary to use available data on past performance. The following tables representing costs, yields and returns are taken from the accounts of the Yuma Mesa Grapefruit Company which represents a major portion of the planting on Unit B of the Yuma Mesa. While a charge of $232 per acre was made by the Government for the land on Unit B, it is assumed in this report that the Government will make free grants to farmers on the Yuma-Gila Project. The cost set up for installing a concrete irrigation distribution system and the cost of leveling the land is somewhat

lower than the costs were on Unit B. The costs for leveling and installing the concrete irrigation distribution system as set up in this report is $100 while the cost of these same items in 1923 when Unit B was put into production was $130 per acre. The price per field box used in this report is the average price during the past decade.

Table 16.--INITIAL CAPITAL INVESTMENT WITH RETURNS FOR A 40-ACRE CITRUS GROVE

Leveling land and installing Concrete Water Distribution System	$4,000
Trees at 75 cents each	2,700
Stake, dig holes, and planting trees	360
Buildings, power, and equipment	2,850
Automobile	700
Domestic water	50
Care - First year:	
Labor	1,000
Water ($8 per acre O. & M. & Construction)	320
Fertilizer	240
Depreciation, taxes, insurance, etc.	400
Total	$12,620
Second Year: (40-Acre Grapefruit Grove)	
Interest on first year's total investment ($12,620)	$ 631
Care of trees (Same as first year)	1,960
Total	$2,591
Third Year: (40-Acre Grapefruit Grove)	
Interest on second year's total investment ($15,211)	$ 760.55
Care of trees (Same as second year)	1,960.00
Total	$2,720.55

Fourth Year:

Interest on third year's total investment ($17,931.55)	$ 869.58
Care of trees (Same as third year)	1,960.00
Total	$2,829.58

Fifth Year:

Interest on fourth year's total investment ($20,761.13	$1,038.07
Care of trees (Same as fourth year)	1,960.00
Total	$2,998.07

Sixth Year:

	Debit	Credit
Labor	$1,600.00	
Irrigation water ($8 per acre O. & M. & Construction)	320.00	
Fertilizer	1,000.00	
Depreciation, taxes, insurance, etc.	800.00	
Interest on total investment to date ($23,759.20)	1,187.96	
9,240 Field Boxes at 43 cents*		$3,973.20
Total	$4,907.96	$3,973.20
Loss	$ 934.76	

Note: * Price per field box is net to grower after picking, hauling, packing, shipping, etc. is deducted.

Seventh Year:

	Debit	Credit
Care of grove (Same as sixth year)	$3,720.00	
Interest on investment to date ($25,831.92)*	1,294.10	
11,360 field boxes at 43 cents		$4,884.80
Total	$5,014.10	$4,884.80
Loss	$ 129.30	

Note: * Preceding year's losses are added to total investment.

Eighth Year:	Debit	Credit
Care of grove (Same as seventh year)	$3,720.00	
Interest on total investment to date ($27,305.32)	1,365.27	
14,640 field boxes at 43 cents		$6,295.20
Total	$5,085.27	$6,295.20
Profit		$1,209.93*

Note: * Profits from preceding years are deducted from total investment.

Ninth Year:	Debit	Credit
Care of grove (Same as eighth year)	$3,720.00	
Interest on total investment to date ($27,460.66)	1,373.00	
19,280 field boxes at 43 cents		$8,290.40
Total	$5,093.03	$8,290.40
Profit		$3,197.37

Tenth Year:	Debit	Credit
Care of grove (Same as ninth year).	$3,720.00	
Interest on investment to date ($25,636.62). . . .	1,281.82	
28,080 field boxes at 43 cents		$12,074.40
Total	$5,001.82	$12,074.40
Profit		$ 7,072.58

Eleventh Year:		
Care of grove (Same as tenth year).	$3,720.00	
Interest on investment to date ($19,845.56) . . .	992.28	
31,680 field boxes at 43 cents		$13,622.40
Total	$4,712.28	$13,622.40
Profit		$ 8,910.12

Twelfth Year:	Debit	Credit
Care of grove (Same as eleventh year)	$3,720.00	
Interest on investment to date ($11,927.72). . . .	596.39	
40,000 field boxes at 43 cents		$17,200.00
Total	$4,316.39	$17,200.00
Profit		$12,883.61

It will be noted that the total investment is retired at the end of the twelfth year. It should also be noted that a maximum investment of $27,460.66 is carried in the ninth year. These figures indicate that anyone planting a grapefruit grove must have an adequate supply of capital to carry the grove for a period of approximately ten years, besides their own living expenses. On the basis of these figures which are of course based on past performance and prices, a grapefruit grove in this area would offer a splendid fifteen-year investment.

The price of grapefruit has not been maintained at a 43 cent per field box level during the past few years. In fact, the price has receded to a point during the past three seasons where the income just about equals the operation costs. At the same time, the operation costs have been reduced materially in such items as cultivation and fertilizer materials and production has been maintained at the same high

level. The cost of production per field box of grapefruit on the Yuma Mesa is at the present time, materially less than any grapefruit growing district from which cost figures are available. However, if present low prices previal, it does not seem possible that grapefruit production can be made a profitable enterprise.

According to the past Weather Bureau records, the chances of grapefruit trees on the Yuma Mesa being damaged by freezing are rather remote. This is not true of the major portion of the grapefruit acreage in the United States.

The yield of grapefruit on mature trees on the Yuma Mesa is recognized to be the highest in the nation, being considerably higher than in the Salt River Valley of Arizona. The average yields per acre by states were found to be as follows: Arizona, 13.2 tons; Texas, 5.4 tons; and Florida, 8.3 tons.(1) Considering the number of immature trees in Arizona and Texas, a marked expansion of grapefruit production can reasonably be expected during the next several years. Calculations based upon probable number of trees on a full bearing basis indicate that the Southwest will have approximately 50 per cent increase in production by 1943. The increased production for the entire United States, however, should not be much

greater than 15 per cent by 1943. Considering the fact that the consumption of grapefruit per capita in America has approximately doubled during the twelve-year period, 1928 to 1927, inclusive, and the fact that the American people are still capable of again doubling their consumption of grapefruit, it seems feasible that in an area where it has been demonstrated that grapefruit production costs are the lowest in the nation, further plantings will be made sometime in the future. Abandonment will likely occur in those producing areas having the highest production costs. Either a substantial abandonment of grapefruit groves must occur in the United States or the consumption must materially increase before any further plantings of grapefruit trees could be considered economically feasible. The transportation and handling costs represent by far the largest portion of the money which the consumer pays for grapefruit. Reductions in transportation and distribution costs of grapefruit to the consumer would directly benefit the growers. A rising price level would also tend to raise prices to the consumer and consequently benefit the grower. Another feature which has some bearing on the grapefruit situation is the fruits and juices which compete with grapefruit. A study was made showing changes in receipts in fresh fruits in New York City (1). The

increase in receipts in grapefruit during the period 1929 to 1936 amounted to 9 per cent, while the increase in all citrus fruits amounted to 10 per cent. Except for a slight increase in peaches, the receipts of all other fruits declined: bananas, 23 per cent; grapes, 49 per cent; cantaloupes and other melons, 29 per cent; watermelons, 38 per cent; and apples, 32 per cent.

Although the Mesa lands of the Yuma-Gila Irrigation Project are highly adaptable to grapefruit, it is doubtful that further grapefruit plantings in the area will be made for several years unless economic trends change very radically. A careful study of the prospective demand for grapefruit is needed.

CHAPTER IV

THE PROBLEM OF LAND USE IN RELATION TO AVAILABLE RECLAMATION FUNDS

Since government funds for irrigation reclamation purposes are limited and at the present time only enough money to develop approximately 35,000 acres in the Yuma-Gila Project has been appropriated, it would seem most desirable to divert irrigation water to the land in the Project which is the most feasible for irrigated farming. There are great differences in the farming possibilities between the valley and mesa lands included in the Project. Some of the pertinent facts pertaining to these differences which are related to the comparative feasibility of some of the mesa lands and valley lands in the Project are listed and discussed in the following paragraphs.

THE ROLL-WELLTON AREA

The Mohawk Municipal Water Conservation District

Organization.--The Mohawk Valley Irrigation District was organized in 1923. In 1926, the Board of Directors adopted the present name for the District

which is the Mohawk Municipal Water Conservation District. The lands of the District are located in the bottom of the Gila River from 35 to 50 miles northeast of Yuma, Yuma County, Arizona.

Only one bond issue was sold which was dated July 1, 1926. The bond issue consisted of 500 one thousand dollar bonds, carrying 6 per cent interest payable on coupons semi-annually, the principal being payable serially, $25,000 on July 1, 1937, and a similar amount on July 1 of each succeeding year until and including 1956. The issue was sold January 9, 1927. The sale price was $850 per one thousand dollar bond plus accrued interest for the period January 1 to January 9, 1927.

The money received by the District for the bonds can roughly be accounted for as follows:

Table 17.--EXPENDITURE OF MONEY RECEIVED BY THE MOHAWK MUNICIPAL WATER CONSERVATION DISTRICT FROM $500,000 BOND ISSUE

Amount apparently received ($500,000 less 15%)	$425,000
Amount diverted to interest fund (Portion of money received for bonds which was set aside and used for payment of interest on bonds)	60,000
Amount of money received from bonds which was apparently utilized for capital expenditures up to and including the year 1930	365,000
Total	$425,000

For a number of years interest was paid to those holders of bonds who clipped their coupons and forwarded them to the Yuma County Treasurer when due. It appears that the interest was paid up to the beginning of the year 1932.

In the year 1935, the cost of operation and maintenance, exclusive of depreciation, was about $30,300 compared with $28,800 in 1934. The expenditures for the year 1935 included the following:

Table 18.--OPERATION AND MAINTENANCE CHARGES FOR THE MOHAWK MUNICIPAL WATER CONSERVATION DISTRICT, 1935

Electric power	$21,741
Operation and maintenance of wells and pumps	2,711
Attorney's fees and salary	1,230
Zanjero's salary	1,038
Salary of secretary and directors	908
Operation and maintenance, auto and truck	843
Maintenance, ditches	630
Other	1,199
Total	$30,300

The wells, pumps, equipment and ditches were not fully maintained under the above schedule and a

small item should be allowed for depreciation of these facilities.

In addition to the above costs, debt service on Mohawk Municipal Water Conservation District bonds annually up to and including June 30, 1936, was $30,000. For the year ending June 30, 1937, and annually thereafter for nineteen years principal charges of $25,000 will be due in addition to six per cent interest on the unpaid balance.

Another item of cost has to do with the payment of principal and interest on Gila Valley Power District bonds. This latter District was organized for the purpose of providing an electric power distribution system and to supply electric power to lands in the District. The Gila Valley Power District covers approximately 90,000 acres and embraces all the lands of the Mohawk Municipal Water Conservation District, except for about 1,900 acres. The power district is bonded to the extent of $3.00 per acre on the entire acreage within the District.

A per acre tax is levied for the power district which by years was, with fractions dropped, as follows: 1930, 60¢; 1931, 74¢; 1932, 58¢; 1933, 47¢; 1934, 44¢; 1935, 50¢. A major portion of the irrigation within the power district is also within

the Mohawk District. In addition to selling power for irrigation purposes, the district delivers power to the town of Wellton and for household uses. Taxpayers who have become delinquent in the payment of Mohawk Municipal Water Conservation District taxes were on June 20, 1936, in general, delinquent in the payment of Gila Valley Power District taxes.

In order to meet the interest and principal payments and to meet expenses not covered by direct collections, the County Board of Supervisors were authorized to make a tax levy prorated to each acre of land in the district. The levy for this purpose in 1930 was $5.23 per acre on 18,132 acres, or a total levy of $94,796. Collection of this levy was very difficult and six years later, on June 1, 1936, there still remained uncollected of this amount, in the form of delinquent taxes, $47,313, or 50 per cent of the total. The levies on subsequent years, 1931 to 1935, inclusive, and the record of collections is shown in the following table.

Table 19.--LEVIES FOR TAXATION PURPOSES AND RECORD OF COLLECTION OF TAXES IN THE MOHAWK MUNICIPAL WATER CONSERVATION DISTRICT, 1930 to 1935 INCLUSIVE

Year	Acres Included in Assessment	Rate per Acre	Total Levy	Amount of levy Uncollected June 1, 1936	Per cent of levy Uncollected June 1, 1936
1930	18,132	$5.2280	$94,796	$47,313	50
1931	18,195	4.5000	81,879	58,084	71
1932	18,196	1.2200	21,436	16,353	77
1933	18,153	2.9283	53,286	42,418	80
1934	18,189	.9484	17,250	13,855	80
1935	18,200	1.9000	34,579	26,052	75

The mounting nature of delinquent taxes is mostly irrigation district taxes. The major portion of the lands in the Mohawk District have been delinquent in taxes since 1931. On June 20, 1936, taxes for 1935 were delinquent on 75 per cent of the lands. The 25 per cent on which 1935 taxes were paid included about 5 per cent on which some taxes were delinquent for prior years and were being paid under a term payment plan. Tax delinquencies during the past four years have continued in the same trend as in the previous five year.

Inability of the district to obtain sufficient funds for operation from the taxation method led the district to devise a scheme whereby the pumps could be kept running. There have been various steps in the process of development of this plan, but in June, 1936, the plan was as follows: The Gila Valley Power District billed the Mohawk Municipal Water Conservation District once per month for power consumed at the rate of 1.4 cents per kilowatt-hour. The Mohawk Municipal Water Conservation District, in turn, collects 1.8 cents per kilowatt-hour on the average from the farm operators who receive the water. The four-tenths of a cent spread between the price the Gila Valley Power District receives for power and the price which the farmers of the Mohawk District pay for power provides a small fund for operation and maintenance costs. Receipts from power sales to farmers for which cash was received in 1935 amounted to $26,583 and in 1934 to $27,367. In 1936 a portion of the money received by the Mohawk District as payment of Gila Valley Power District charges was used to liquidate an obligation incurred for the purpose of purchasing certain pump replacements. There appears to be no other important source of income for the Mohawk District in 1934 and 1935.

In the payment of its obligation, other than that of bonded debt service, the Mohawk Municipal Water Conservation District issued warrants. Warrants drawn prior to June, 1936, were listed under six funds in the county treasurer's office as shown in the following table. In the case of four of these funds, "General", "Construction", "Salaries", and "Maintenance and Operation", the warrants were redeemed if and when taxes had been collected. The amount of these warrants outstanding on June 20, 1936, was $74,092. By funds the amount outstanding is shown in the following table. Two other funds, "Electrical Operation and Maintenance" and the "Overhead Fund" had been maintained prior to June, 1936, on a cash basis. The source of money for the "Electrical Operation and Maintenance" fund was the charge made by the district equivalent to an average of 1.4 cents per kilowatt-hour. Moneys from this fund are paid to the Gila Valley Power District. The source of revenue for the "Overhead Fund" was four-tenths of one cent collected by the District from water users at the time the water users pay for power.

Table 20.--MOHAWK MUNICIPAL WATER CONSERVATION DISTRICT WARRANTS OUTSTANDING JUNE 20,1936

These draw 6 per cent interest per annum and are usable to extent of both principal and interest in payment of Mohawk Municipal Water Conservation District taxes.

Funds	Last warrant paid			Amount Outstanding
	Number of Warrant	Date of Issue	Date called for payment	
General	1478	Nov. 5, 1929	Aug. 4, 1933*	$34,522.80
Construction	2053	Sept. 11, 1930	Sept.6, 1933	8,202.67
Salary	2210	Feb. 3, 1931	Feb. 16,1933	914.78
Maintenance & Operation	2036	Sept.11,1930	Jan. 14,1932	30,452.25
Electrical Operation & Maintenance		All Paid		All Paid
Overhead Fund		All Paid		All Paid
Total				$74,092.50**

* Partial Payment
** The Yuma County Treasurer's Office estimates the total outstanding warrants plus interest to be about $95,000.00 at the present time.

Cropping history and returns.--When the district was organized, the lands in the area were largely undeveloped, although there are evidences to indicate

that a part of the lands had been put under irrigation in the latter part of the 19th Century. Three wells were drilled in the area in the fall of 1924. The acreage under irrigation increased from 300 acres in 1925 to a maximum of 6,200 acres in 1931.

Some cotton, small grains were planted in 1929. A major portion of the acreage under cultivation in the District has always been alfalfa hay and seed. The maximum acreage of crops other than alfalfa was reached in 1931. The decline in acreage in crops other than alfalfa was due to accumulation of excess salts from irrigation and to unfavorable prices for the products. The following table of crops grown in the district in the year 1936 is fairly representative of the cropping habits of the district from 1933 to 1937.

Table 21.--1936 CROP ACREAGES IN THE MOHAWK MUNICIPAL WATER CONSERVATION DISTRICT

Crop	Acres	Per cent of all cropped acreage
Alfalfa (grown largely for seed)	2,593	72
Cotton - Short staple	573	16
Barley	161	4
Wheat	101	3
Maize and hegari	71	2
Other, including pasture	110	3
Cropped acreage in 1936 - Total	3,609	
Double cropped - Deducted	108	
Net land cropped in 1936 including pasture	3,501	
Land once cropped but not used for crops in 1936	2,137	
Total improved area within the district, all of which had been cropped at some time in the years 1925 to 1936 inclusive	5,638	

Note: Above figures include 195 acres crop failure in 1936.

The crops in 1938-39-40 have followed the same trend with a reduced acreage of cotton and small grains until almost the entire area is now devoted to the production of alfalfa hay and seed and bermuda grass seed.

The following table is not representative of the crop yields in the district at the present time nor during the first six years when the land was farmed. These yields, however, are fairly representative of the average yields obtained during the history of the Project. All yields, especially those of cotton and small grains, were higher during the first five years of the Project, while the yields at present are lower.

Table 22.--YIELDS IN MOHAWK MUNICIPAL WATER CONSERVATION DISTRICT IN 1934, 1935, and 1936

Crop	Yield		
	1934	1935	1936
Alfalfa hay	2.6 tons	2.8 tons	1.3 tons*
First seed crop	384 lbs.	440 lbs.	
Second seed crop	158 lbs.	186 lbs.	
Cotton - Short staple	369 lbs.	348 lbs.	
Maize or hegari fodder	1 ton	0.9 ton	
Barley	1,600 lbs.	1,500 lbs.	960 lbs.
Wheat	900 lbs.		920 lbs.

* To June 1 only.
Note: Yields based on acreage actually harvested. Yields for 1934 are based on incomplete data.

The low yields of wheat, barley, maize and cotton are attributed to the high alkalinity of the irrigation water, with its consequent accumulation of alkali in the soil. The quality of irrigation water used in this area will be discussed later, under the heading of water supply and analysis.

Capital investment in the district.--The improvements within this district include irrigation structures and equipment owned by the Mohawk Municipal Water Conservation District, farmers' homes and other farm buildings and fences, 27 miles of power line and 3 transformer stations owned by the Gila Valley Power District, a cotton gin owned by a cotton company, a public school building owned by the school district, on which there is an outstanding debt of about $48,000, and a few small buildings in the town of Roll.

The irrigation facilities consist of 31 drilled wells, 20 of which were equipped for pumping on June 1, 1936, approximately 25 miles of ditches with concrete diversion gates, drops, siphons, and roadway bridges.

Besides the irrigation works considerable expenditures for flood protection have been made. A levee of 15.8 miles in length has been constructed

along the south side of the district to protect the agricultural lands from overflow of the Gila River. Also, approximately 11.5 miles of storm drainage channels have been constructed on north and south section lines to convey flood water to the Gila River from the north side of the district where natural run-off from the higher mesa lands is intercepted. Other developments that have to do with the irrigation system are 13 miles of telephone lines, a warehouse, office building and a dwelling for the district's manager.

The following table itemizes the replacement cost and worth of irrigation facilities and properties of the District on June 1, 1936.

Table 23.--ESTIMATED VALUES OF IRRIGATION FACILITIES OWNED BY THE MOHAWK MUNICIPAL WATER CONSERVATION DISTRICT

Items in use June 1, 1936	Approximate re-placement cost	Approximate worth to dist.
20 Irrigation Pumping Plants, complete		
Wells	20,083	10,820
Structures.	6,835	3,833
Equipment	52,155	31,329
32.6 miles of distribution ditches with structures	65,200	65,200
1.4 miles of old Mohawk Canal, reconstructed. .	1,400	1,400
11.5 miles of storm drainage channels	17,250	17,000

Table 23.--ESTIMATED VALUES OF IRRIGATION FACILITIES OWNED BY THE MOHAWK MUNICIPAL WATER CONSERVATION DISTRICT (CONT.)

Items in use June 1, 1936	Approximate replacement cost	Approximate worth to dist.
8 groups of tripod deflectors for river control	16,000	8,000
Warehouse and machinery shed	2,000	1,700
Office building	2,500	2,200
Dwelling house	5,500	4,800
Grounds	300	300
Total	$189,223	$146,582
Items not in use June 1, 1936		
10 Irrigation Pumping Plants		
Wells	9,341	0
Structures	1,680	440
Equipment	430	324
10.5 miles of distribution ditches with structures	21,000	0
2.9 miles of old Mohawk Canal, reconstructed.	2,900	0
15.7 miles of levee with structures	65,000	0
13 miles of telephone system	5,000	0
Total	$105,351	$ 764
Grand Totals	$295,574	$147,346

The usable value of the property is estimated at a little less than $150,000. Several items of construction equipment, such as a dragline, concrete mixer, and concrete forms have not been accounted for

in the table. Also, there are other miscellaneous items of machinery, engineering instruments, spare pump parts and office equipment that would aggregate probably eight or ten thousand dollars in value.

It will be noted that replacement costs are not shown for 10 of the wells, for 13.4 miles of irrigation ditches with structures, for telephone system, or for the levee. The 10 wells are not equipped and have water of such extreme salt content that they are considered unfit for further use and hence of no present value to the district. In 1927, when the levee was constructed, it was contemplated that the entire acreage of the Project would soon be developed, and there seemed to be a strong reason for having an earth embankment along the north side of the river to protect the District against overflow. Much of the Project that would have benefitted by the levee has never been developed. Also, the levee has not been properly maintained and in its present condition it is practically useless as a flood water barrier, the chief reason being that in many places the embankment is riddled with the burrowings of small animals. The telephone system connecting a number of the wells with the District Office has gone into disuse and has not been maintained for the last 4 or 5 years. This item

of service appears to be superfluous and, therefore, was not considered to have any worth at the time of this study.

The total value of farm buildings was found to be approximately $55,000; the value of fences was approximately $9,000, and other improvements $5,000, making a total value of fixed farm improvements of $69,000. This is exclusive of such movable equipment as farm machinery valued at over $40,000. Summarizing the improvements within the District, regardless of owner, we have the following:

Table 24.--VALUE OF IMPROVEMENTS WITHIN THE MOHAWK MUNICIPAL WATER CONSERVATION DISTRICT

Irrigation structures and equipment	$147,000
Farm buildings, fences and other farm structures including value of all buildings in town of Roll exclusive of those on railroad property	69,000
Farm machinery	40,000
Power lines and transformer (value not estimated)	
School house	50,000
Cotton gin (value not estimated)	
Improvement affected in value of land as result of leveling approximately 6,000 acres	(See text)
County road improvement	

While some of the farmers in the District estimate that there is a capital investment in the District of approximately one million dollars, the

items "Power Lines and Transformer", "Cotton Gin", "Improvement Affected in Value of Land as Result of Leveling Approximately 6,000 Acres", and "County Road Improvement" would have to account for $694,000 if the above estimates are correct. An estimate on the value of the road construction in the District given by Mr. W. L. Ellison, Yuma County Engineer, is $50,000. The power line of the Gila Valley Power District cost $250,000. Approximately one-third of this power line is in the Mohawk Municipal Water Conservation District which would make the value of the power line in the District $83,333. A fair value on the cotton gin would be $40,000. It is estimated that the present average cost of clearing and leveling land of this character is $40 per acre. With an estimated 6,000 acres cleared and leveled in the District, an item of $240,000 could well be set up as a capital investment, making an additional total of $423,333 or a grand total for the estimated capital investment within the District of $729,333.

Types of farmers in the district.--The following observations have been made by means of personal contact and survey. The typical farm operator based on averages at the time of this study was 40 years of age and had farmed for 17 years. These farm

operators are almost entirely of Northern European stock and are above the average in farming ability. The majority of the people in the District are high-type citizens. A large majority of the farmers and their wives have attended some college or university and several of them are college graduates. Under favorable conditions, these farm operators should form a nucleus for a large, successful farming community.

Water supply and analyses.--The water supply for the Mohawk Municipal Water Conservation District is derived entirely from drilled wells located within the district boundaries. The location of the wells and pumping plants is on the bottom lands near the Gila River and draws water from underground storage that is recharged by underflow down the Gila River Valley, percolation from flood flows in the river and a slow movement of ground water from the sides of the valley.

The well logs show that the water-bearing materials encountered in any one well are typical of all of the District wells. The surface soil varies from 0 to 20 feet in thickness and is underlain by fine sand with a depth varying from 36 to 61 feet. Directly below the sand is a stratum of coarse gravel from 30 to 63 feet thick which constitutes the main water-bearing material. The depths of the wells, the

depth range of the coarse gravel and other well data are presented in the following table.

Table 25.--WELL DATA

Well No.	Date Drilled	Total Depth Drilled	Range of Water-Bearing Gravel	Discharge Capacity Of present Equipment June 1, 1936	Total Pumping Lift June 1,1936
		(Feet)	(Feet)	(Second Feet)	(Feet)
1	Oct. 1924	112	50-99	4.50	(54.0)
2	Nov. 1924	100	47-80	Not equipped	
3	Dec. 1924	102	50-101	5.30	47.0
4	Nov. 1925	108	45-108	5.25	48.5
5	Dec. 1925	90	36-83	Abandoned	
6	Jan. 1926	101	61-92	Not equipped	
7	Mar. 1926	92	56-90	Not equipped	
8	Apr. 1926	83	50-80	3.52	43.6
9	July 1926	95	58-89	4.77	47.4
10	Mar. 1927	104	50-99	5.92	50.0
11	Mar. 1927	107	55-104	4.01	(65.0)
12	June 1927	104	50-100	4.96	43.5
13	Sept.1927	83	42-80	Not equipped	
14	Oct. 1927	83	40-77	Not equipped	
15	Oct. 1927	83	45-77	5.00	33.9
16	Oct. 1927	112	50-100	5.38	36.3
17	Apr. 1928	83	40-77	Not equipped	
18	Apr. 1928	101	50-98	5.90	42.5
19	Nov. 1928	101	56-98	3.00	53.9
20	Nov. 1928	104	56-101	4.80	59.6
21	Dec. 1928	77	47-74	Not equipped	
22	Oct. 1929	89	47-89	5.32	53.4
23	Nov. 1929	86	50-74	3.83	45.9
24	Nov. 1929	86	53-86	3.92	46.3
25	Dec. 1929	102	56-102	Not equipped	
26	Jan. 1930	128	56-113	4.10	44.1
27	May 1930	83	47-80	5.06	42.7
28	May 1930	102	56-100	5.30	50.7
29	May 1930	95	56-92	3.47	46.0
30	June 1931	99	36-84	Not equipped	

Weighted average pumping lift according to water pumped in 1935 . . . . . .50.1

A careful analysis of the salt content of the irrigation waters has been made over a period of years by the Agricultural Chemistry Department of the University of Arizona. Partial results of these analyses are shown in the following table.

Table 26.--CHEMICAL ANALYSES OF IRRIGATION WATER BY WELLS IN THE MOHAWK MUNICIPAL WATER CONSERVATION DISTRICT

(Analyzed by the Department of Agricultural Chemistry and Soils, Arizona Agricultural Experiment Station)

Well No.	Date	Total Soluble Salts	CO_3	$\frac{Na}{Ca+Mg+Na}$
1	4/13/28	1490	55	64
		1623	24	67
	July 1928	1862	0	70
	10/29/28	1720	7	67
	11/27/28	2402	5	52
	3/25/29	1871	0	62
	July 1930	2466	0	60
	July 1931	1926	0	63
	June 1933	2073	24	65
	Oct. 1933	2573	0	62
	8/12/34	1655	0	57
	6/26/35	3320	0	58
	6/2/36	4183	0	55
4	3/9/26	2591	0	47
	4/10/26	2647	5	68
		2214	T	45
	5/12/27	2567	50	42
	4/13/28	2583	24	63
	6/28/28	2939	0	57
	10/29/28	3158	0	52
	11/27/28	2532	0	55
	3/29/29	2745	12	53
	5/21/29	2836	0	63
	July 1930	2940	0	55

Table 26.--CHEMICAL ANALYSES OF IRRIGATION WATER BY WELLS IN THE MOHAWK MUNICIPAL WATER CONSERVATION DISTRICT (CONT.)

Well No.	Date	Total Soluble Salts	CO_3	$\frac{Na}{Ca+Mg+Na}$
4	July 1931	3870	T	55
	Oct. 1933	3055	0	59
	8/12/34	3252	0	61
	6/26/35	3786		59
	June 1936	3990	0	67
9	3/16/28	1778	26	65
	6/28/28	2899	0	74
	10/29/28	3324	19	62
	3/29/29	2596	33	51
	5/21/29	2912	0	61
	July 1930	2848	0	66
	July 1931	3085	T	55
	July 1931	3143	0	63
	8/12/34	3652	T	77
	6/26/35	3613	0	56
	June 1936	4773	0	53
12	3/16/28	1474	22	60
	6/28/28	2083	10	66
	10/29/28	2043	0	67
	3/29/29	2056	36	63
	5/21/29	2112	0	67
	7/ /31	5255	T	59
	10/ /33	4719	0	57
	6/26/35	5039	0	63
	6/ /36	5636	0	56
16	3/16/28	1712	7	75
	6/28/28	1578	10	63
	10/29/28	1773	24	61
	3/29/29	1521	24	56
	5/22/29	1603	0	58
	7/ /31	1667	T	56
	6/ /33	1939	0	53
	8/12/34	1794	0	48
	6/26/35	2051	0	51
	6/ /36	2141	0	56
20	3/29/29	2378	14	62
	5/27/29	2672	0	66

Table 26.--CHEMICAL ANALYSES OF IRRIGATION WATER BY WELLS IN THE MOHAWK MUNICIPAL WATER CONSERVATION DISTRICT (CONT.)

Well No.	Date	Total Soluble Salts	CO_3	$\frac{Na}{Ca+Mg+Na}$
20	7/ /31	2778	0	58
	6/ /33	4183	7	62
	8/12/34	5968	0	47
	6/26/35	6610	0	59
	6/ /36	8284	0	88
25	7/ /30	3087	0	54
	7/ /31	5147	0	41
	6/ /33	7351	T	60
30	7/ /31	6557	10	69
	10/ /33	1751	0	77
	8/12/34	1447	0	73
	8/12/34	8231	0	66

In general, the wells farthest from the river channel have water of higher salt content. Ten of the District wells were not used or had been abandoned because the salt content had been found too high for irrigation use. These abandoned wells are among those farthest from the river channel. The area in which satisfactory wells can be obtained seems to be limited to a strip along the south side of the District. To irrigate the higher lands farthest from the river, it is necessary to convey the water in long contour ditches or to use booster pumps, either practice adding materially to the costs of supplying

water to the land.

The quantity of water available for use by the District is of vital importance. There must be an adequate supply available each and every year for a serious shortage during one or more years would result in a loss of crops or costly revamping of pumping equipment. Records of water table elevations are meager as no definite program for measuring depths to water level has been carried out by the District. Available records indicate that there had been an appreciable lowering of the water table. Measurements taken in February, 1935, showed the water level to be from 7 to 15 feet lower than when the wells were drilled. The frequency and the amount of flow of flood waters down the Gila River bed determines greatly the amount and quality of irrigation water available for this District. The construction of the Coolidge Dam and a subsequent increase of consumptive use of irrigation water on the Gila River and its tributaries above the Gillespie Dam has greatly lessened the frequency of surface flow in the Gila River opposite the Mohawk District. Recent construction of a dam on the Verde River, one of the tributaries to the Gila River, has greatly reduced the run-off since this has almost entirely eliminated flood water in the Gila River opposite the Mohawk District.

Records taken from the Secretary's office of the Mohawk Municipal Water Conservation District show that the net duty of water in 1931 when the maximum acreage was under cultivation was 3.2 acre feet per acre. However, with the decrease in cultivated acreage and the neglect of the distribution system, the duty of water has been somewhat higher during the past few years.

The cost of pumping and maintenance of canals and equipment during the year 1939 amounted to approximately $10 per acre. This is an increase of about $1.53 per acre in irrigation costs since 1935 when the cost was $8.47 per acre.

The Gila Valley Power District

Organization.--While the Gila Valley Power District covers approximately 90,000 acres and embraces practically all of the lands in the Mohawk Municipal Water Conservation District, the following has to do with lands now being irrigated in the Roll-Wellton District other than the Mohawk Valley.

All of the wells in the District outside of the Mohawk Valley are owned by individual farmers. The Power District is bonded for $250,000 which is approximately a bonded indebtedness of $3 per acre. The Power District, which has for its only function

the selling and distributing of power, is governed by a Board of Directors composed of the water users in the District. All wells and irrigation systems are privately owned and operated.

Cropping history and returns.--The cropping history in this area has not been materially different from that of the Mohawk Valley, the soils and irrigation water being practically of the same nature. Like the Mohawk Valley, the farmers in this area have grown some cotton and small grains in the past but at the present time almost the entire cultivated acreage is devoted to the production of alfalfa seed and hay.

Capital investment in the District.--Approximately two-thirds of the Gila Valley Power District lines are in this area which amounts to about $167,000. The land which has been cleared and leveled in the District amounts to 5,100 acres of which there are 2.270 acres now being farmed. The capital investment in land leveling would be about $60,000.

Irrigation structures and equipment now usable within the area would amount to about $80,000. Buildings, fences, and other farm structures including value of all buildings in the towns of Wellton and Tacna but excluding railroad property would amount to approximately $200,000. County road improvement in

the area would amount to about $25,000. It is estimated that farm machinery owned by farmers in this District would cost at least $50,000 to replace. The school house at Wellton is worth about $20,000. Summarizing the capital investments in this area which are necessary for the establishment of any irrigated farming community, it is noted that an estimated investment of $602,000 would be required to establish a nucleus of a farming community in a similar area, the development of which has not been started.

Types of farmers in the District.--The old pioneer type of farmer predominates in this area. There are some very substantial people who have been farming in this District for the past 20 years and have made a living on the land in spite of adverse water conditions and low farm prices. It is believed that the farmers now farming in this area like those in the Mohawk Valley form a splendid nucleus for expanding a much larger and more successful irrigated farming community.

Water supply and analyses.--The supply of irrigation water for this District is not different than that of the Mohawk Valley. The same adverse conditions affecting the wells in the Mohawk Valley apply equally to the other wells within the boundaries of the Gila Valley Power District.

Yuma Mesa area

Organization.--Agricultural development on the Yuma Mesa was made possible by the authorization of the Yuma Auxiliary Division of the Yuma Reclamation Project by an act of Congress in 1917 for the purpose of developing 45,000 acres of land. Construction was started in 1920. A pumping plant was installed on the east main canal of the Valley Division of the Yuma Project for the purpose of lifting water 78 feet on the Yuma Mesa. The construction of canals, ditches, flumes, and pipes was completed to make water available for 3,810 acres. Public notice was issued October 3, 1919, for the sale of these lands. Prospective settlers paid $232 per acre with all construction charges prepaid. Purchasers of land after February 21, 1925, however, were permitted to pay the charges for land and water rights in ten equal annual installments with 6 per cent interest on deferred payments.

Although nearly all of the land in this First Unit of the Yuma Mesa Auxiliary Division of the United States Yuma Reclamation Project was sold, many of the purchasers did not keep their contracts and, therefore, relinquished their holdings to the Government. At the present time, practically all of the undeveloped lands in the area are held by the Government and are subject to resale on the original terms.

Farming within the area is at present devoted almost wholly to the production of citrus crops which constitute 97 per cent of the irrigated acreage. The favored crop is Marsh seedless grapefruit, amounting to 1,033 acres or 85 per cent of the area in citrus orchards. The balance of the citrus groves constitutes 173 acres of oranges and 15 acres of limes. Three acres of the area are planted to dates. From time to time small acreages are devoted to the growing of winter vegetables, and various leguminous crops are intergrown with citrus for soil improvement.

Ownerships of lands are in relatively small tracts, many of which are absentee-owned. There are 106 individually-owned tracts under irrigation. For purposes of economical operation, however, it is the usual practice to combine several tracts under the supervision of a resident manager. In practically all cases the tract owner is responsible for operating expenses including supervision. A few tracts are owner-operated. There are 16 operating units varying from 5 to 215 acres in size. There is no tenancy in the area.

Citrus production of present orchards on the Yuma Mesa has not reached its peak. The average age of trees is 11 years, ranging from 5 to 24 years, and

it will be several more years before peak production is obtained. Grapefruit trees on the Yuma Mesa in the full-bearing stage will yield 1,000 field boxes per acre and over with reasonable care. Reported average yields for the 1927-38 season are as follows:

Grapefruit - 683 field boxes per acre (40 pounds per field box)

Oranges - 4,828 pounds per acre

Limes - 1,000 pounds per acre

An enterprise analysis study of grapefruit production was made by Mr. Loyd Shinn, Extension Economist for the University of Arizona, and the writer. Records were kept by 10 grove operators. The following table represents the data obtained.

Table 27.--SOME PER-ACRE COSTS OF GROWING GRAPEFRUIT ON THE YUMA MESA, 1937

Coop. No.	Production Per Acre, Tons	Irrigation Water Used Acre-Feet	Cultivation	Applying Commercial Fertilizer	Irrigating	Pruning	Total (1)
4	16.57	6.39	$6.36	$2.92	$10.65		$19.93
1	15.298	5.28	20.84	1.08	13.71	$3.63	39.26
11	16.91	5.83	12.64	.10	6.54		19.28
7	15.1	6.39	6.94	1.85	16.54	14.17	39.50
2	17.64	5.5	18.79	.96	11.11	3.51	34.37
10	10.18	5.1	13.80		5.35		19.15
3	15.91	5.3	15.95	.97	8.76	3.33	29.01
9	16.05	5.42	11.93	.30	9.96	.36	22.55
8	15.76	5.33	8.92	.30	7.78	.36	17.36
12	11.04	6.38	9.22	1.08	10.07	2.13	22.50

(1) Total labor cost up to harvest included in total in Table 28.

Table 28.--SOME PER-ACRE COSTS OF GROWING GRAPEFRUIT ON THE YUMA MESA, 1937

Coop. No.	Material Costs		Overhead Costs		Total Preharvest Costs	
	Irrigation water	Fertilizer	Taxes	Supervision	Per Acre	Per Ton
4	$14.34	$29.44	$4.22	$17.32	$85.25	$5.14
1	12.12	25.10	4.13		80.61	5.27
11	16.00	13.77	4.13	27.00	80.18	4.74
7	14.34	16.42	4.22	3.38	77.86	5.15
2	12.75	26.42	4.00		77.54	4.39
10	15.13	8.31	4.62	27.00	74.21	7.29
3	12.12	18.10	4.14		63.37	3.98
9	12.40	22.97	3.80		61.72	3.84
8	12.23	24.23	4.36		58.18	3.69
12	13.76	13.95	4.07		54.28	4.91

It will be noted from the above table that this area is highly efficient in the production of grapefruit. The cost of production of grapefruit per ton in this area is the lowest of any District so far as the writer has been able to ascertain. Due to economic stress and recent experimental findings in grapefruit production, growers in this area have still further reduced their costs without reducing their high yields. It is estimated at this time that the total cost of production of grapefruit has been reduced at least 20 per cent during the past three years due to new improved cultural practices which include more timely application of nitrate fertilizer so as to cut down the material applied by 50 to 60 per cent, and reduced cultivation costs which in turn reduces the the use of water.

Since the Gila Valley or the Yuma-Gila Project has been started with the completion of the Imperial Dam, a considerable amount of experimentation on the growing of crops on the Yuma Mesa has been started. The University of Arizona has established an experimental farm on the Yuma Mesa for the purpose of determining the feasibility of growing different crops on this land. This experimental work is timely since the soils of the First Unit of the Yuma-Gila Project are practically the same as the soils

where the experimental work is being conducted and since water is expected to be available for 35,000 acres of the 139,000 acres in the First Unit within a very short time.

Eighty acres of the experimental farm has been planted to alfalfa. The duty of water during the first year of alfalfa is very interesting and pertinent. Different plots were laid out with different amounts of fall. The amount of water required to maintain satisfactory plant growth ranged from approximately 13 acre feet per acre on the land having no fall to approximately 8.3 acre feet on the land having a fall of .3 foot per hundred feet. This, of course, denotes a very low water holding capacity for the soils in this area which is to be expected since the soil contains about 90 per cent sand. However, from past experience of irrigation on the Yuma Mesa land, it can be expected that the water requirements for growing alfalfa during the years following the first year will be somewhat less due to the accumulation of humus and silt. The high duty of water as indicated by the requirements for the first year's growth of alfalfa appears to be entirely too high for the successful cultivation of common field crops such as are now grown in adjacent farming districts. Another pertinent point regarding the growing of alfalfa on these lands

was brought out in the tests made on the fertilization of alfalfa with phosphates. The plots which did not receive any phosphate fertilizer made a very unsatisfactory growth of alfalfa. It was necessary to apply the equivalent of two hundred pounds of single superphosphate in order to obtain a satisfactory growth of alfalfa.

Tests on growing several winter vegetables on the Yuma Mesa have been made by the University of Arizona. Chief among these and the most promising is tomatoes. A resume of the tomato growing tests made in the season 1938-39 indicates favorable possibilities for this crop on the Yuma Mesa.

Detailed records on labor, material costs, and yields were kept by the horticultural department, University of Arizona. The items of cost were tabulated at the suggestion of the writer. The following lists of approximate production costs of growing tomatoes, based on the trial plantings made on the Yuma Mesa in the season 1938-39, is presented herewith:

Table 29.--ESTIMATED COST PER ACRE OF GROWING TOMATOES ON YUMA MESA

Seed Bed:	
1. Seed	$ 0.50
2. Fertilizer	.30
3. Manure	.20

Table 29.--ESTIMATED COST PER ACRE OF GROWING TOMATOES IN YUMA MESA (CONT.)

Seed Bed:	
4. Arsenate Dust	$ 0.20
5. Preparing soil (labor)	.50
6. Planting in paper bands	1.00
7. Cost of bands	11.00
8. Irrigation and labor for care of plants	2.00
9. Water cost	.50
10. Lath and construction of grame	2.50
Total	$18.70
Field Costs:	
1. Plowing, disking, floating, marking, furrowing	4.50
2. Labor for manure application in furrow	3.50
3. Manure cost	12.00
4. Re-furrowing	.75
5. Pulling and transporting plants	1.50
6. Transplanting	3.50
7. Water	12.50
8. Labor, irrigation	15.00
9. Fertilizer - commercial	50.00
10. Cultivation	3.00
11. Hoeing	4.00
12. Fertilizer application	13.50
13. Arsenate dust and labor for dusting	5.50
Total	$129.25
14. Brushing	
Paper (North)	20.00
Posts	4.00
Wire	2.00
Labor	35.00
Paper (South)	20.00
Total	$81.00
Cost up to harvest	$228.95
15. Harvest labor	30.00
16. Packing (Estimated at 300 lugs per acre yield)	
Lug cost	35.05
Packing	18.00
Grading	6.00

Table 29.--ESTIMATED COST PER ACRE OF GROWING TOMATOES IN YUMA MESA (CONT.)

Field Costs (Cont.):	
16. Packing (Cont.)	
Hauling	6.00
Inspection	1.00
Total	$71.05
Grand total, growing, harvesting, packing	$330.00
17. Cutting off vines, raking, burning	2.00
18. Final total cost per acre	$332.00
Final cost per lug, estimating 300 lug marketable yield (30 lbs. per lug)	$ 1.11
Cost per pound	3.7 cents

It will be noted that the largest item in the cost of producing tomatoes is that of labor, although there are some rather expensive items in the way of materials. However, the fact that much of the production cost is labor favors the small grower who would do a large part of the work himself. Although the estimated cost of production is $1.11 per 30-pound lub or 3.7 cents per pound, the price of tomatoes is relatively high during the months when these tomatoes were harvested, which was between November 29 and February 28. The above table of costs is applied to the average production of all varieties in the test. Production of the Penn State variety was 574.2 crates per acre, which is considerable higher than the average.

While the wholesale price of tomatoes on the Los Angeles market, according to the Agricultural Marketing Service, United States Department of Agriculture, during that season averaged from 6.2 cents per pound in December to 9 cents per pound in February, the average price for the same months in the period 1932-39 was well above 10 cents per pound. With an estimated deferential between the cost of production on the Yuma Mesa and the wholesale market price at Los Angeles of approximately 6 cents per pound and with an estimated production of 300 thirty-pound lugs per acre, it is indicated that commercial winter tomato production on the Yuma Mesa would be an attractive enterprise.

Capital investment in the District.--Since there are only 16 operating units on the Yuma Mesa with only about 1,500 acres leveled and irrigated, the capital investment is comparatively low, unless we consider the growing of trees as capital investment. Since the growth of trees is not a permanent asset which would add to the value of irrigable lands which are not now irrigated, it does not seem reasonable to list this investment as a capital investment for the purposes of this report. There were approximately 1,500 acres purchased and paid for at the rate of

$232 per acre which includes the construction of the entire irrigation system. This amounts to $348,000. It is estimated that leveling of this land due to its light texture and the use of modern heavy equipment can be accomplished for $30 per acre. This would make an additional capital investment of $45,000. The county road improvements and buildings in the area would represent approximately $50,000, thus making a total of $443,000.

Type of farmers in the District.--While there are 106 individually-owned tracts under irrigation, there are only 16 operating units and a majority of the land is absentee-owned. A major portion of the grapefruit plantings are cared for by hired labor under paid management.

Water supply and analyses.--This area is served by Colorado river water through the United States Yuma Bureau of Reclamation Project. The quality of the Colorado River water is very satisfactory for irrigation purposes.

The following table represents the cost of irrigation water and crop returns from this area.

Table 30.--OPERATIONS AND MAINTENANCE RESULTS ON UNIT B OF THE AUXILIARY PROJECT FOR THE YEARS 1935, 1936, 1937, 1938

	1935	1936	1937	1938
Gross operation and maintenance cost	$20,979.00	$ 21,923.00	$ 23,776.00	$ 25,337.00
Water rental and miscellaneous revenue collections	892.00	1,125.00	1,212.00	1,247.00
Operation and maintenance collections	18,019.00	16,541.00	16,631.00	17,735.00
Unpaid operation and maintenance charges	3,112.00	2,014.00	1,378.00	1,345.00
Minimum charge per acre	10.00	8.00	8.00	8.00
Acres paying O. &. M. charges	1,706.48	1,673.98	1,518.48	1,563.00
A.F. per acre delivery under minimum charge	3.00	3.00	3.00	3.00
Rate per A.F. for excess water	2.00	2.00	2.00	2.00
Water pumped, A.F.	-	10,720.00	11,646.00	12,413.00
Water delivered to farms, total	6,416.00	7,011.00	7,268.00	7,935.00
Water delivered to farms, A.F. per acre irrigated	5.21	5.79	5.84	6.27
Water pumped, per acre irrigated	-	8.85	9.37	9.92
Acres irrigated	1,232.00	1,211.00	1,245.00	1,255.00

Table 30.--OPERATIONS AND MAINTENANCE RESULTS ON THE UNIT B OF AUXILIARY PROJECT FOR THE YEARS 1935, 1936, 1937, 1938 (CONT.)

	1935	1936	1937	1938
Acres cropped	$ -	$ 1,145.00	$ -	$ -
Acres in cultivation	-	-	1,245.00	1,255.00
Crop value - total	-	388,981. 00	190,949.00	224,769.00
Crop value - per acre cropped	-	339.77	-	-
Crop value - per acre cultivated	-	-	153.40	178.98
Energy used in pumping K. W. H.	-	1,392,600.00	1,547,100.00	1,635,800.00
Average price per K. W. H.	-	0.00513	0.00478	0.00686
Total cost of energy used	-	7,145.00	7,397.00	11,230.00

It will be noted that the minimum charges per acre ranges from $8 to $10 per acre and that there is an additional charge of from $5 to $6 per acre for excess water use, making a total irrigation cost ranging from approximately $13 to $16 per acre. There is always an abundance of irrigation water available for this area.

While the debt accumulation and taxes on the Mesa project are not nearly so great as in the Roll-Wellton area, their relationship to the feasability of expansion in the two respective districts is not pertinent, the fact that grapefruit grove owners are not dependent on the income from their agricultural enterprise for a living offers a contrasting situation to the farmers in the Roll-Wellton district where they are dependent on their farm incomes. A more detailed study on this subject is desirable.

CHAPTER V

SUMMARY

FEASIBILITY OF FURTHER IRRIGATION RECLAMATION IN YUMA COUNTY

Competition may, in the long run, settle the final use of land. In order that competition function freely, all of the pertinent facts should be revealed.

There are many factors to be considered when judging the feasibility of development of any new enterprise, whether it be in agriculture, industry, or any other business. Past performance or history is one of the chief assets in determining the correct course to follow in the future. A fair history has been presented of the performance of agricultural lands now being farmed in Yuma County which are very much similar to the undeveloped irrigable areas in the County. Another questions which must naturally arise is "Can we stand expansion in agriculture in the face of the so-called over-production era?" In defense of the over-production argument against further development of irrigation projects, it must be pointed out that there are millions of acres of land being farmed in the United States which are sub-marginal.

The history of the lands reclaimed in Yuma County by the diversion of Colorado River water for irrigation reveals the fact that this land is not sub-marginal, but on the other hand, it is one of the most productive areas in the Nation. If the Nation follows a plan of retiring sub-marginal land and placing these farmers on productive land, the expansion of irrigated agriculture in Yuma County, Arizona, is of utmost importance. A study on this phase of the subject is needed.

The fact that many crops, some of which are adapted to but a limited area of the United States, are successfully produced in this district makes further irrigation developments in Yuma County exceptionally desirable.

There are 2,546,000 acre feet of Colorado River water available for irrigation purposes in this County. There are also sufficient irrigable lands which are feasible for irrigation in Yuma County to beneficially use the available Colorado River water. The Imperial Dam, 25 miles north of Yuma on the Colorado River, has been constructed for the diversion of water to the All-American Canal and also for the Yuma-Gila Project. The Headgate Rock Dam, one mile north of Parker on the Colorado River, is now under

construction for the diversion of water to irrigate approximately 100,000 acres in the Parker Valley. Unless this water is put to beneficial use, there is great danger of losing its use for this Nation since the Mexican Government is making decided efforts to develop irrigated farming in the lower Colorado River basin in that country. If this development of irrigated agriculture in Mexico should appropriate the waters from the Colorado River now available to Yuma County for irrigation purposes, the beneficial use of water for this Nation would be lost or international strife would result.

It is assumed that it is a wise course for any nation to develop their natural resources and preserve their rights. If we are to follow this form of strategy, the early development of the Yuma-Gila Irrigation Project in Yuma County must follow.

The policy of promoting the Nation's standard of living to the highest possible level is an American principle. Data presented in this report points out that the development of further irrigated farming in Yuma County, Arizona, would contribute a share in raising the standard of living of the people of this great Nation.

WATER SHOULD BE APPLIED TO THE VALLEY LANDS FIRST

The gravity main canal from the Imperial Dam is now completed for the First Unit of the Yuma-Gila Project. The gravity canal brings the water up to the first pumping plant where it is lifted onto the Mesa lands. There is a carry-over of funds from the Yuma-Gila Project appropriation amounting to approximately $1,500,000. While this money was appropriated for construction of the pumping plant to lift water onto the Mesa lands of the First Unit and construct a distribution system on these lands, it is possible to divert this money toward the Roll-Wellton canal which would supply water to the valley lands of the Second Unit.

While the present available funds for the Yuma-Gila Project are not in sufficient amount to complete the canal to carry water to the valley lands of the Roll-Wellton District, it will go a long way toward its construction and the use of these funds in this District would be most feasible for the following reasons:

1. There is an established farming community with a complete irrigation distribution system already constructed on a sizable portion of the land in the Roll-Wellton area. Some of the land is leveled and in

production and needs only a dependable supply of irrigation water to return it to its original state of production which was a profitable farming enterprise according to all records available.

2. A capital investment of approximately $1,300,000 in houses, schools, highways, irrigation distribution systems, and other improvements necessary for a successful community has already been made in the Roll-Wellton area. These facilities are so located that they can maintain their value in the event of the Colorado River water's being made available to the area.

3. The people now living in the area form a splendid nucleus for the expansion of a successful community for irrigated farming.

4. A dire need for Colorado River water for irrigation purposes exists among 90 farmers in the Roll-Wellton District. This has been brought about by increased water diversion upstream which has practically shut off the surface flow and greatly reduced the underground flow for the area. Accompanying this decreased supply of water, there has been such a great increase in alkalinity in the irrigation water that many of the wells in the area have been abandoned and the remaining wells are so high in salt content that crop production has been drastically reduced.

The high alkalinity of the irrigation water now available for the District makes it impossible to grow row crops and limits the area to a one-crop system, with greatly reduced yields. Out of 6,600 acres that are being farmed in the Mohawk Valley in 1931, approximately 50 per cent of the land is already abandoned due to alfalfa stands' being killed out by excessive alkali accumulations. It has been found impossible to re-establish a stand of alfalfa in the lands with the existing water facilities. Water containing 1,500 parts per million total soluble salts is considered the maximum salt content safe for irrigation purposes. By 1936, all of the wells had exceeded the safe limits of salt content for irrigation purposes. Nine wells had been abandoned, 11 other wells ranged in salt content from 1,619 to 2,784 parts per million and there were 7 wells ranging from 3,197 to 4,841 parts per million total soluble salts. Three of the wells still in use range from 5,636 to 10,924 parts per million total soluble salts. Colorado River water having only a small amount of soluble salts would soon leach out the excess alkali from the land which has been farmed in the District.

5. With the abandonment of the wells and the consequent abandonment of farms served by these

wells and the increased alkalinity of practically all of the wells from which irrigation water is pumped, the cost per acre for irrigation purposes in the Roll-Wellton District has increased materially. The farmers in the District now pay from $10 to $14 per acre for irrigation water.

6. Soil survey reports show that the valley lands within the confines of the Yuma-Gila Project are the most feasible for development due to their good quality, high water holding capacity, fine texture, and comparative richness in available plant foods. On the other hand, the mesa soils of the First Unit of the Yuma-Gila Project are light of texture, having a high duty of water, contain a comparative small amount of plant food elements, and, therefore, are limited to the production of speciality crops which are high in price and require large amounts of capital investments to produce. While the mesa lands are feasible for irrigation and will produce very efficiently some of the speciality crops such as grapefruit and winter vegetables, there is no emergency existing which would call for the immediate development of these lands like the emergency existing in the Roll-Wellton District where farmers are now living and are in distress.

7. The reestablishment of farmers from submarginal land could best be accomplished by placing them on the valley lands of the Yuma-Gila Project where general types of farming can be successfully followed. It is believed that the capital investment and operating expenses which would be necessary to establish a farmer on the mesa lands would be excessive in comparison to the valley lands.

The history of irrigation farming in Yuma County, Arizona, shows an adaptation for a wide diversification of crops, many of which are produced in but limited areas of the United States. The climate, soil, and available irrigation water make it possible to grow many out-of-season crops, such as winter head lettuce, spring cantaloupes, winter tomatoes, and citrus fruits.

Exceptionally high yields of crops have been accompanied by comparative low production costs, which makes farming in Yuma County more profitable than it is in many districts of this nation. An average return to capital and investment on an 80 acre farm, ranging from $1,071 to $2,574 is an estimate made for Yuma County based on average yields, production costs and prices which have prevailed in the valley areas. Since the soils and climate in the undeveloped portions

of the county are very similar to the areas now being farmed, it is reasonably expected that expansion of irrigated farming will meet with economic success.

While it appears that the expansion of irrigated agriculture is feasible for all of the irrigable areas in the county, it is obvious that the valley lands should receive first consideration. With a large number of farm families in the United States attempting to make a living on sub-marginal land, the expansion of irrigated farming in the valley areas of Yuma County, Arizona, should be expedited.

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