

ALBERTA'S EXPERIENCE IN IRRIGATION

by C. J. McAndrews

IRRIGATED AREAS
OF ALBERTA

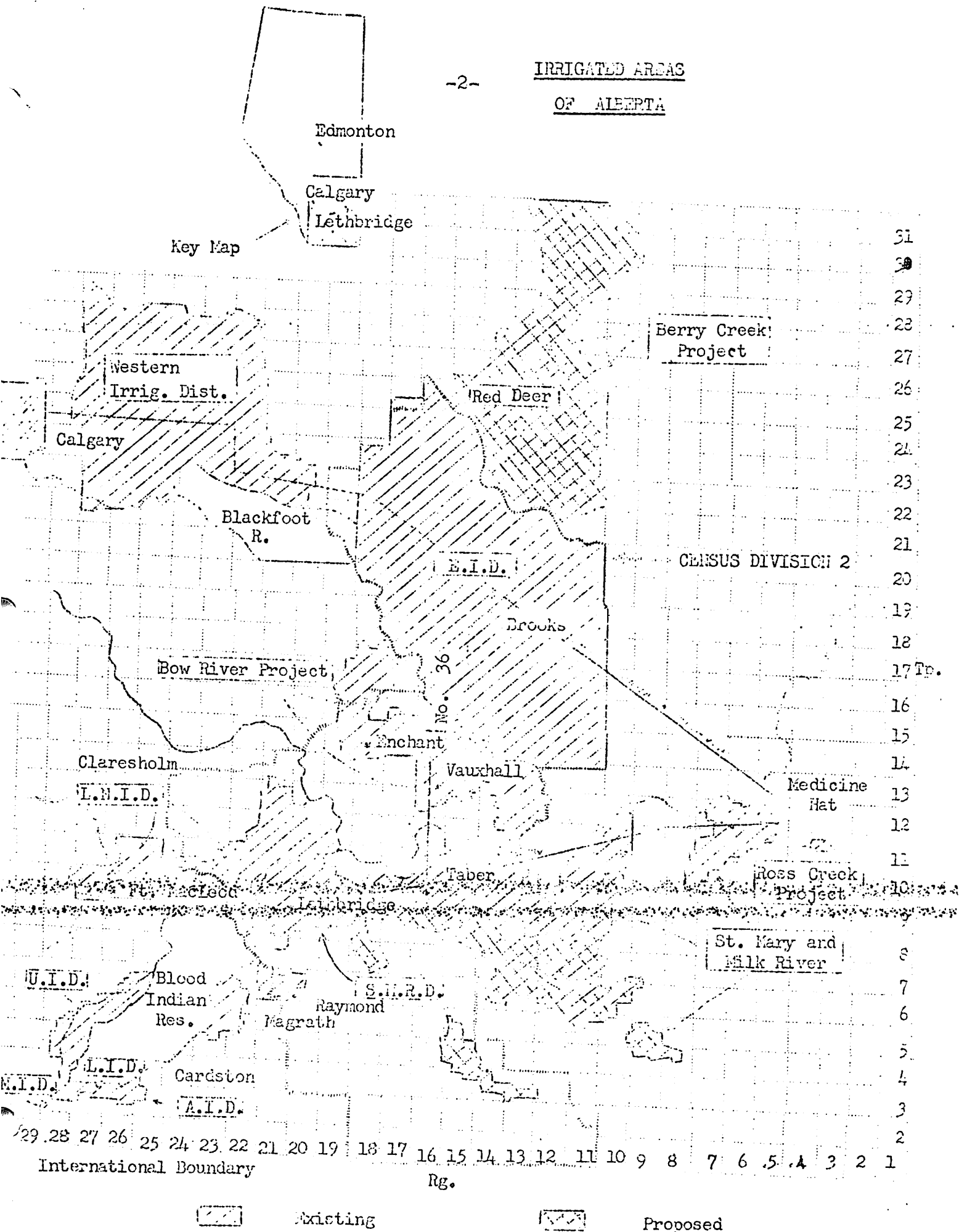


FIGURE 1

IRRIGATION EXTENT AND LOCATION IN ALBERTA

Source of Supply	Project	Closest Centre	Constructed by	Year Dev.	Operated by	Approx. Acres Under Irrig.	Total
Bow River	Bow River Proj. (Central Block)	Vauxhall Hays	Can. Land & Irrig. P.F.R.A.	1920	P.F.R.A.	63,000	
	(Blackfoot Reserve)			1955	P.F.R.A.	30,000	
	Bow River Dev. (West Block)	Enchant	Alberta	1958	Alberta	25,000	
	Western Irrig. District	Strathmore	C.P.R.	1911	Farmers	42,000	
	Eastern Irrig. District	Brooks	C.P.R.	1914	Farmers	200,000	365,000
Waterton River	United Irrig. District	Glenwood	Farmers	1924	Farmers	34,000	
Belly River	Mountain View Irrig. Dist.	Mountain View	Farmers	1932	Farmers	3,700	
	Leavitt Irrig. District	Cardston	Farmers	1943	Farmers	4,600	
	Aetna Irrig. District	Cardston	Farmers	1943	Farmers	8,300	50,600
St. Mary River	S.M.R.D. West Section	Lethbridge	A.R. & I.	1901-20	Alberta	82,000	
	Magrath Dist.	Magrath	Farmers	1926	Farmers	7,500	
	Raymond Dist.	Raymond	Farmers	1925	Farmers	19,000	
	Taber Irrig. District	Taber	Farmers & Prov. Gov.	1920			
				1950	Farmers	40,000	
	S.M.R.D. East Section	P. Island	Prov. Gov.				
			& P.F.R.A.	1955	Alberta	122,000	270,500
Old Man River	L.M.R.D.	P. Butte	Farmers	1923	Farmers	95,100	
	S. Macleod Dist.	Macleod		1946		3,000	99,100
Other Sources	Ross Creek Irrig. Dist.	Med. Hat	P.F.R.A.	1949	Farmers	2,100	
	Berry Creek Irrig. Dist.	Wardlow	P.F.R.A.	1938		3,000	
	Little Bow	High River	Farmers			200	5,300

In addition to the above there are about 650 private licensed irrigation schemes with a total area of approximately..... 75,000

Total number of irrigated acres in Alberta 865,500

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Alberta's experience in irrigation is not unique. The diversion and distribution of irrigation water has been constructed by private entrepreneurs, railway companies, the water users and the Government. The history of irrigation development in other countries has been similar. The justification and obligation for the construction investments have been based on agricultural production from the lands so irrigated. The projects have faced complex problems, some of which have been solved, but many of which still remain. There have been sacrifices and endurance. New marvels are now expected so that they might be used to make life easier and progress swifter.

The organization of irrigation districts was a development whereby water users assumed responsibility for project works with the support of Government. Development companies

discovered that they could not obligate the financial status of irrigation projects to revenue from water users as a

profit making enterprise. Provincial legislation was, consequently, provided for public or quasi-municipal organizations consisting of water users, to provide water at cost to lands. The Alberta Government passed the Irrigation Districts' Act in 1915.

The Taber Irrigation District was constructed in 1919 under agreement with the Canadian Pacific Railway Company whereby the Company constructed the works in exchange for bonds issued by the District. No payments of principal were required during the first ten year period so farmers might divert all available income to the development of their farms. The deferment of capital repayment was justified in experience. No part of the cost of works to convey water to Chin Coulee was assessed against the District, but the District purchased water at that point from the project to the west. The bonded debt was repaid with only four deferments of annual payments which occurred during the depression years, and with the assistance of a surplus revenue obtained through the purchase of a tract of land in the Chin District, which was resold to water users.

The Lethbridge Northern Irrigation District was constructed by means of a bond issue guaranteed by the Provincial Government. The bond issue was sold in 1921 and the project was in operation in 1924. A flood on the Old Man River in 1923 destroyed some of the works, which were restored through

assistance from the Provincial Government. It was also soon apparent that the water users could not pay the service and capital charges that were levied starting in 1924. Continuing distress was experienced. Three Commissions had been appointed by the early 30's to study the circumstances and

recommend corrections. The Provincial Government assumed a large portion of the repayment obligation on the bond issue. Alberta appointed an official trustee to supervise the administration of the project. An advisory committee elected by the water users assisted the official trustee. This arrangement still exists.

The Eastern Irrigation District organized in 1935 received the irrigation works from the Canadian Pacific Railway, who had previously owned and operated the project. The transfer also included the land contracts, unsold land and \$300,000.00 as a capital reserve for replacement of large structures. Although the allowance for replacing large structures seems inadequate, the District, in general, has operated successfully.

The Raymond and Magrath Irrigation Districts were erected in 1925 and 1926 respectively. Each of these Districts took over irrigation works from the Alberta Railway and Irrigation Company who also constructed some additional works under

agreement with the Districts. In each case, the Company accepted bonds as security, issued by the Districts under the authority of the Alberta Irrigation Districts' Act. Repayment difficulties occurred, but settlement of the bond issues was effected.

The United Irrigation District issued Provincial Government guaranteed debentures in 1922, with the lands of the District

as security, to construct irrigation works which were completed in 1924. Operating deficits were paid by the Provincial Government, who also assumed responsibility for the debentures. The water users were required to pay less than half the actual capital cost of the project.

The Leavitt, Aetna and Mountain View Irrigation Districts constructed their projects through assistance from the Prairie Farm Rehabilitation Administration, loans from the Alberta Government and contributions of labour and materials from each water user. The procedure was reasonably satisfactory, although some members endeavored to evade their full responsibility to the District. Some works were not completed.

The Canada Land and Irrigation Company was formed in 1917 through the amalgamation of three predecessor companies. The project was constructed over a period of years, with less than 11,000 acres being provided with water in 1924, 30,000 acres in 1930 and about 55,000 acres prior to 1940. The Company experienced difficult economic conditions and aid was negotiated from the Dominion and Provincial Governments.

Canada purchased the project in 1950, rehabilitated the existing works and extended the project by development of the Hays Tract. Under the administration of the P.F.R.A., it is known as the Bow River Project.

The Alberta Railway and Irrigation Project was authorized under the North-West Irrigation Act. The Company was formed

through amalgamation of a parent and subsidiary companies, with control of the Company being acquired by the Canadian Pacific Railway Company in 1912. Irrigation on the project dates back to 1901. Operation of the project was quite successful, but obsolescence of the capital works occurred in the absence of preventative maintenance. The Alberta Government purchased the project in 1946 and formed the St. Mary and Milk Rivers Development, as a Crown Corporation to administer it.

Postwar development by Alberta added over 100,000 acres to the S.M.R.D. Project and about 25,000 acres to the B.R.D. Project. These areas are administered and operated by Provincial Crown Corporations which purchase water from the P.F.R.A., who constructed and operate the head works of the respective Projects.

The objectives of administration, operation and maintenance of irrigation projects is the equitable apportionment of water among the users in quantities sufficient to satisfy crop requirements, keeping the irrigation systems in top operation efficiency and providing sufficient maintenance and replacement to obtain the longest life and greatest use of the facilities. These functions are performed at the lowest possible cost to the water users. This latter objective prompts the human element of "Let's put off fixing up the works until next year, because we are too hard up this year." The philosophy of

preventative maintenance has, therefore, been continually neglected, and thus permitted obsolescence to the stage that rehabilitation of works becomes a necessity.

Rehabilitation that includes betterment to a standard of modern technology may, however, be preferable to complete preventative maintenance. Facilities constructed fifty or more years ago may not meet the requirements of present day irrigation agriculture. The transition from horsedrawn construction to motorized construction has enabled improvements that are much more preferable. Reconstruction can now relocate canals and structures with specifications that are more adequate, but which were impossible and of unknown specifications when projects were originally constructed. The requirements for water service in thirty, fifty, or seventy-five years hence may be demanding of facilities that could be completely different than those that are now being constructed. If this is true, and if it can be accepted, then obsolescence should be permitted and administrations should be acceptable to change.

~~The Alberta experience would tend to support obsolescence~~

but has not derived an adequate formula for the financing of project rehabilitation. The Provincial statutes provide for satisfactory operation and maintenance organization. Each District is autonomous, except where official trustees have been appointed. Rules and regulations for the use of water

and the control of project works are supported by statutes and are flexible to meet specific district needs. Maintenance standards are the prerogative of the local authority. The source of project revenue is an assessment charged upon the irrigable acreage of the water user. Additional financial assistance has been received from the Governments by many of the projects. Grants have been negotiated on the basis of project need, without uniform consideration to all irrigation systems or alternative soil and water schemes.

The Alberta statutes relating to irrigation are numerous, but tend to exhibit similar authorities and controls. The Alberta Water Resources Act regulates the apportionment and diversion of water for all uses of this resource. The 'Irrigation Districts' Act provides for autonomy by water users to operate and maintain irrigation projects, and has been superseded by several acts of like content for a number of specific irrigation districts. The St. Mary and Milk Rivers Development and the Bow River Development Acts were legislated specifically for Provincial participation, ownership, and ~~control by the Alberta Government of works purchased or~~

constructed by Alberta in the two projects of the same names. It is only the Water Resources Act that applies to the Canada owned portions of these two projects.

The Alberta Water Resources Act contains the basic water laws. It preserves the Riparian Rights Doctrine and invests

the property of water in the Province. Priority to use water is based on the date of filing applications with precedence given in the order of domestic, municipal, industrial, irrigation, water power and other purposes. Application for cancellation of a previous right may be made for a purpose that has precedence over an existing use of water. Water rights are pertinent to the lands specified in the licenses and are inseparable therefrom. Water so licensed must be put to beneficial use and, if not, the license may be cancelled or the amount of water on it reduced. These laws are steeped in precedence and proven worthy in practice, but there is very little, if any, allowance for change. As the Province develops, there may be need for flexibility in the regulation of water resources. Irreversible decisions and regulations may eventually prove painful.

The Alberta Irrigation Districts' Act provides for a petition for formation by land owners, and the procedure and authority of formation by order of the Minister of Agriculture.

The water users elect a Board of Trustees which carries out the business of the district. Bylaws, financing, authority for construction and regulations are authorized by the Minister of Agriculture or the Irrigation Council. Damages due to seepage or overflow of water from canals or ditches of the District Board, if not settled through negotiation, are adjudicated by the Public Utilities Board. The expropriation of lands may be

ordered by the Minister with unsettled disputes being adjudicated by arbitration.

A water court may be appointed by the Lieutenant-Governor-in-Council to act in place of the Public Utilities Board and carry out other duties as may be assigned to it by the Government.

The Irrigation Council, consisting of not more than three members, is appointed by the Lieutenant-Governor-in-Council to advise each Board upon the conduct of the affairs of its district and to forbid or authorize Acts or courses of conduct proposed or entered upon by a Board.

Assessment is based on the acreage within the district that is irrigated. Irrigable lands have been so classified on the basis of soil productivity, topographic effect on the flow and control of water, and, with respect to some projects, on the basis of the location of land to markets, the drainability of soils, and other factors. Maps are prepared and revised from time to time to show the current irrigable acreage on each parcel of land within a district. An

assessment roll is prepared and the per acre charge is based on an estimate of annual operation and maintenance costs and the replacement of works. The water users are billed with the assessment either in the spring or the fall with interest accruing after the due date of payment. Incentives to pay are promoted in some districts by offering a discount on the

assessment if payments are made within a limited time. Appeals by water users regarding their irrigable acreage classification may be made to the Irrigation Council. Complaints regarding assessment may be made to a Court of Revision consisting of the District Board and may be appealed to a judge of the district court. All rates or arrears of rates may be recovered by suit.

Payments that are owing for more than one year on the 15th day of January in each year are entered on a Rate Enforcement Return. The Return is adjudicated by a judge of the district court, who authorizes the District to take title to the lands on which the payments are owing. The water user has a period of one year from the date of transfer of title to redeem ownership of the land by paying all of the assessments due. If the water user does not redeem title to the land, the district may sell the land, thereby recovering the debt owing to the district and submitting the balance of proceeds to the water user. The Irrigation Council may exclude a parcel of land from the adjudication upon an application by the owner of a parcel providing the owner has suffered hardship and the Council is satisfied that operations on the parcel will eventually pay all the irrigation rates.

The S.M.R.D. and B.R.D. Acts differ from the Irrigation Districts' Act mainly with respect to the source of funds for construction, ownership and management of operation and

maintenance. Government funds are appropriated for construction purposes. The Manager is a Corporation Sole appointed by the Lieutenant-Governor-in-Council. He is assisted by an Advisory Committee elected by the water users and in this respect is not unlike a district controlled by an official trustee. The irrigation works constructed under these two Acts have benefited as the result of the source of available funds. Repayment of the capital construction costs are assessed only in part on the water users in the amount of \$10.00 per irrigable acre. Drainage facilities and canal lining to alleviate seepage from canals have been rather extensively constructed, these being works that are not generally common on other and older projects.

There is a general lack of uniformity in administration, size of projects, standards of operation and maintenance, drainage facilities, and relationship between project and Government. The Eastern Irrigation District is a large project owned by the water users, controlled by them through a Board of Trustees and administered by a well organized and departmentalized staff. The organization consists of a manager and departments for operation and maintenance, engineering and construction, and clerical responsibilities. The personnel qualifications are of a high standard which is reflected in the business and operation of the District.

Some of the smaller irrigation projects, on the other

hand, are managed on a very limited part-time basis. Engineering facilities are nonexistent; clerical work is less than minimal.

The Taber Irrigation District though relatively small, consisting of less than 40,000 irrigable acres, is a very compact project of excellent lands, with access to numerous good markets. The three man Board of Trustees manage the project, being able to meet frequently, and each devoting a considerable amount of time to the affairs of the District. The clerical department is a well organized one-man full time employee operation. The operation and maintenance department consists of one water master and a staff of ditch riders plus casual labour. The project is not large enough to warrant an engineering department, but outside engineering assistance on a very limited scale provided by the Alberta Department of Agriculture is quite sufficient for the needs of the District. This organization appears to be quite adequate and successful.

Misuse of existing legislation appears to be a fault of small projects with limited management and clerical facilities. One project appears to be apportioning the water supply on a water share basis (which is not understood by the author) rather than by classifying the irrigable acreage of land and establishing water rights. Some districts do not take advantage of the rate enforcement proceedings and by such lack of action are in fact violating the legislation. Easements and rights-of-way

are often not obtained where project works are located, which may affect the District's liability to damage claims, if tested.

More effective organization to participate in local and provincial affairs affecting irrigation might require the consolidation of several small districts into larger units. Careful handling of personality conflicts would be essential. Costs might be less, and trained employees could be retained. Advocates of this suggestion indicate that operation, maintenance, and betterment of projects could be strengthened administratively and financially.

Many other differences are apparent. Most projects deliver water to each parcel of land being irrigated with control of the works provided by a ditch rider. The West Block of the S.M.R.D. differs in that water masters deliver water from points along a number of main laterals, and the water users are responsible either co-operatively or through additional organization to operate and maintain the distribution of water amongst themselves. Government appointed official ~~trustees and Corporation Soles are responsible to Government~~ and not directly to the water users. The Advisory Committees have no authority but are a convenient buffer between the water user and management. Boards of Trustees are responsible to the water users and must function in relation to the resources and general attitudes of the water users. Government provided

engineering services, drainage investigations, land classification services and administrative contact between districts and the Irrigation Council have been more accessible to some districts than others and are still not provided in equal proportions to all projects. The Provincial Auditor authorizes the assessment to be charged on the L.N.I.D., and audits the records of a number of districts, but not all of them.

Alberta's experiences of recent years have led to the appointment of several study groups and administrative committees. Costly construction in the West Block of the B.R.D. to irrigate shallow soils on rough topography during a period of reasonable precipitation for dryland farming, prompted numerous complaints from farmers in the same area and questions by outside interests. A study committee was appointed to hold hearings, consolidate their findings and make recommendations to improve the general status of irrigation in Alberta. Among the recommendations implemented was the appointment of an Irrigation Planning Board to study the feasibility of potential developments and to legitimize through recommendations to the Minister the timing and advisability for construction of new projects. The Board has access to engineering and agronomic studies but has been seriously handicapped by lack of economic and sociological information relative to the assignments processed to date. The Agricultural Rehabilitation and Development Act

and its administration required economic justification for irrigation proposals that have been suggested for Federal financial assistance. Economic studies have, consequently, been approved.

The postwar development of irrigation projects involved the P.F.R.A. Canada Soil Survey and several old and newly formed provincial agencies. After experiences of putting the cart before the horse, a co-ordinating committee, representing all participating groups, was organized so that progress would be in sequence and carried out by the responsible personnel.

Drainage was not given much consideration in the early days. Many acres of damaged land, particularly in parts of some projects have resulted, due to seepage or high ground water levels, causing waterlogged soils and accumulation of saline or sodium salt in the soils. The Canada Soil Survey and the P.F.R.A. have carried on numerous studies indicating the extent, source, reasons for and solutions to these problems. Alberta has been slowly building a service to investigate and provide engineering and agronomic designs for preventative and remedial action. The financial contribution to construction by Alberta has been reserved to the Crown owned projects. The Minister of Agriculture appointed a drainage committee to co-ordinate drainage data, the actions being taken by agencies of Government and Irrigation Projects,

and to advise, investigate and engineer drainage developments.

The economy of agricultural water developments has been difficult to comprehend due to many complexities which are probably seldom understood. The common procedure of construction has not completed the developments. Water has been stored, diverted, transported and distributed to farms without equivalent effort being given to the farm parcel. The economic unit upon which the success of projects depend, has been the farm, which must be developed by the land owner. Farm operators were often inexperienced in irrigation farm methods and limited in means to develop land to new and expensive systems. Large capital expenditures have been necessary to level land, establish farm irrigation systems to adapt to changes in cropping, fertilization, equipment, livestock and produce storage. Thus, with each irrigation development, there has been a lag in water utilization, in land utilization, and in the economic progress of farms.

Alberta has never lost a dam, but has lost many economic and social implications of irrigation development.

High value crops and livestock in demand at high prices have been necessary for the progress of farm developments over short periods. In general, the history of Alberta irrigation development appears to indicate that project construction has exceeded market demands. Greater emphasis on planning and foresight may be necessary so that projects are not constructed

too early or too late. Water users tend to express a feeling that it is as right for Government to make the streams and rivers of an arid region useful as it is to make useful the rivers and harbours of humid regions. The works are different but the purpose is for the economic development of the people.

The development of irrigation in Alberta has not been uniform throughout the years. Several periods of favourable rainfall led to the belief that dry farming was more profitable than the growing of irrigated crops. However, each period was followed by several dry seasons during which progress was recorded.

The successful introduction of alfalfa was substantially responsible for early progress in cropping practices. The growing of sugar beets stabilized farm returns during the earlier years. The Lethbridge Northern Irrigation District, by 1940, was producing wheat, coarse grains, alfalfa and other hay, potatoes, sugar beets, peas and beans valued at about \$1,675,000.00 which directly supported about 10,000 people.

Farmers in the Taber area made better progress with a greater variety of cropping alternatives, good soils, uniform topography and favourable climatic conditions for irrigated agriculture.

Farmers of the Eastern Irrigation District and Canada Land and Irrigation Company Projects produced grain and hay depending to a large extent upon livestock as the basis of

their economy. Adverse economic and agricultural conditions during the early years deterred rapid progress of the areas. The livestock population has increased in more recent times and the opportunity to develop farm irrigation systems has become more feasible, which appears to be favouring the advancement of economic growth.

The Western Irrigation District near Calgary, the Leavitt, Aetna, Mountain View and United Irrigation Districts are located generally on steep and rolling topography. Irrigation is only a supplementary need at least in some portions of these projects. The agricultural pattern is more of a dry land or ranching nature than of irrigation agriculture.

Farming in the postwar development areas has been passing through a very difficult transition period from methods of dry land farming well known by most of the land owners, to irrigation practices. Specialization in the newer areas has been tested. The water users have grown seed crops for forage, grain and oil, numerous vegetable crops, sugar beets, alfalfa

hay and irrigated pasture, in search of a competitive advantage

~~in their irrigation production. Many of the crops first~~
mentioned have been abandoned by individual growers after one or two years of experience, due to lack of the complex technical knowledge required for production, the uncertain marketing outlets and other difficult practices such as labour requirements.

There are several basic enterprises which irrigated farmers operate in Alberta. The basic enterprises vary according to the type and kind of markets, inclination of farmers for certain types of operation or the size of farm unit, type of soil, or climatic benefit, etc. Forage crops grow well under irrigation so livestock farming with dairy, beef cattle, sheep and pigs is stable and usually profitable. The sugar beet industry stabilizes irrigation agriculture within transportation distances to factories. Canning produce such as peas, corn, beans, pumpkin, carrots and table beets are the main crops on some farms. Potatoes are often grown on large per unit acreages. The production of edible oils grown from sunflower and other oil bearing seeds, appears to have a future on irrigated lands in Southern Alberta.

Sizes of farm units vary from small acreages of highly specialized high value crops to large units of several quarter sections. In the newly irrigated area land is used extensively, requiring large parcels to produce the required returns.

This creates a problem when irrigation is adopted, with large acreages to develop for the proper utilization of irrigation water. Portions of some farms often remain in dry land production for many years. While capital remains scarce, farm units are often divided into smaller sized acreages as the labour force increases. Then as the land is developed and operations are mechanized it becomes possible for the labour

force to operate large units and farm unit sizes often increase again slightly.

The fixed costs on an irrigated farm are high and income can be quite variable. These factors can cause severe stress on taxation, mortgage retirement, and complete farm development. Spreading costs of irrigation development over all properties, or persons, or businesses benefited directly, or indirectly, rather than merely over the watered land might be a sound and equitable policy. Municipal aspects could be co-ordinated with irrigation. Such would recognize the wide distribution of irrigation benefits.

Innovations at the farm level are to be encouraged. Economic evidence is required to justify and promote innovation of technical advancements. Successful farm operators are found on the poorer irrigated soils, rougher topographies, and in the poorer market areas as well as on the best lands and in favourable market and climatic areas. Productivity factors of a physical sense are, therefore, not the whole reason for success or failure on the farm. The business of farming is ~~probably more dependent upon financing, management and~~ technical farm knowledge.

Farm failures leading to enterprise abandonment occurs very slowly. Unlike other businesses which are usually abandoned as soon as failure is apparent, farm businesses have continued to exist in the face of apparent failure. Such

cases create a serious hardship upon the involved family that stubbornly clings to what they feel as their only real free hold on life and property. Early abandonment of such enterprises could enable successful rehabilitation of farm operators to alternative employment, particularly in cases where the farmer is still young in age.

The typical or average farmer is to be found statistically somewhere between the most successful and the failure. Policies, objectives, administrations, public relations, etc., are orientated to this level or a slightly lower level of farm operator. Research and progress are dependent upon the much more successful farmer who is often called the early adopter or innovator. Policies and administration should be co-ordinated with progress and should, therefore, set principal objectives at the level of better operations.

A suggestion of expected irrigation production by a typically successful water user is as follows:

Alfalfa - 4 tons per acre

Pasture - 2 animal units per acre

Sugar beets - 20 tons per acre

Potatoes - 40,000 pounds per acre

Canning peas - 3,000 pounds per acre

Canning corn - 12,000 pounds per acre

Wheat - 60 bushels per acre

Oats - 120 bushels per acre

Barley - 90 bushels per acre
Carrots - 30,000 pounds per acre
Cucumbers - 5,000 pounds per acre
Cabbage - 20,000 pounds per acre
Green beans - 6,000 pounds per acre
Tomatoes - 10,000 pounds per acre
Onions - 30,000 pounds per acre

The above production figures are not maximums that have been experienced but are probably higher than average.

Industry aims at the maximum economic utilization of resources. For example, the steel industry has efficiently conserved water to the degree that some plants record reuse factors of up to 800 and 2,000 per cent. The pulp and paper industry increased their reuse water factor from 42% in 1949 to 150% in 1959. These industries have aimed at the top levels of production and have not been satisfied with second best.

Irrigation agriculture is demanding of high level objectives. We should, therefore, want to know in detail the whole story of production factors, management, financing, and social status of the successful top quartile of farm operators. It would seem that this group should not be neglected in any investigation or study. It is also important to know about the middle quartiles. There are very few who are interested in the bottom quartile. However, if there is hope for advancement rather than failure, this group should be given a

chance, but their agony should not be prolonged.

Alberta's experience in irrigation indicates the need for co-ordination, co-operation, confidence, tolerance, humility and understanding between groups in Government, in irrigation, administration, commercial interests, and at the farm level, to produce and evaluate knowledge, to implement the betterment of project financing, and improve the farm level of production. Government and local organizations are vested with responsibilities to develop and evaluate knowledge and techniques and to facilitate the rehabilitation and development of projects and farms. Farm level objectives are not apt to be achieved until:

- (a) the farmer is conscious of what is happening to water, land, crops and other enterprises under his present management,
- (b) he knows what can happen under optimum management,
- (c) he has a desire to improve, and
- (d) services and information are provided with sufficient follow through to put such management and practices into effect.

The information to be gained from economic studies should be of interest at all levels. Project management is responsible for water supply and must depend upon farm income to support the project works. Governments are now the builders of irrigation projects and public funds should be put to full use.

Optimum operation and maintenance of irrigation projects cannot be reasonably expected if the production units of the whole scheme are not developed to an optimum level of economical and physical usefulness. Such agencies might consequently review the neglect or extravagance of their efforts.

The business aspect of irrigation agriculture is regarded principally as a public investment and responsibility. The discipline is traditionally a public service and will remain the responsibility of Governments to a great degree. The economic situation of the farmer may not, nevertheless, improve or progress. A new outlook on irrigation could still permit and even encourage innovations.