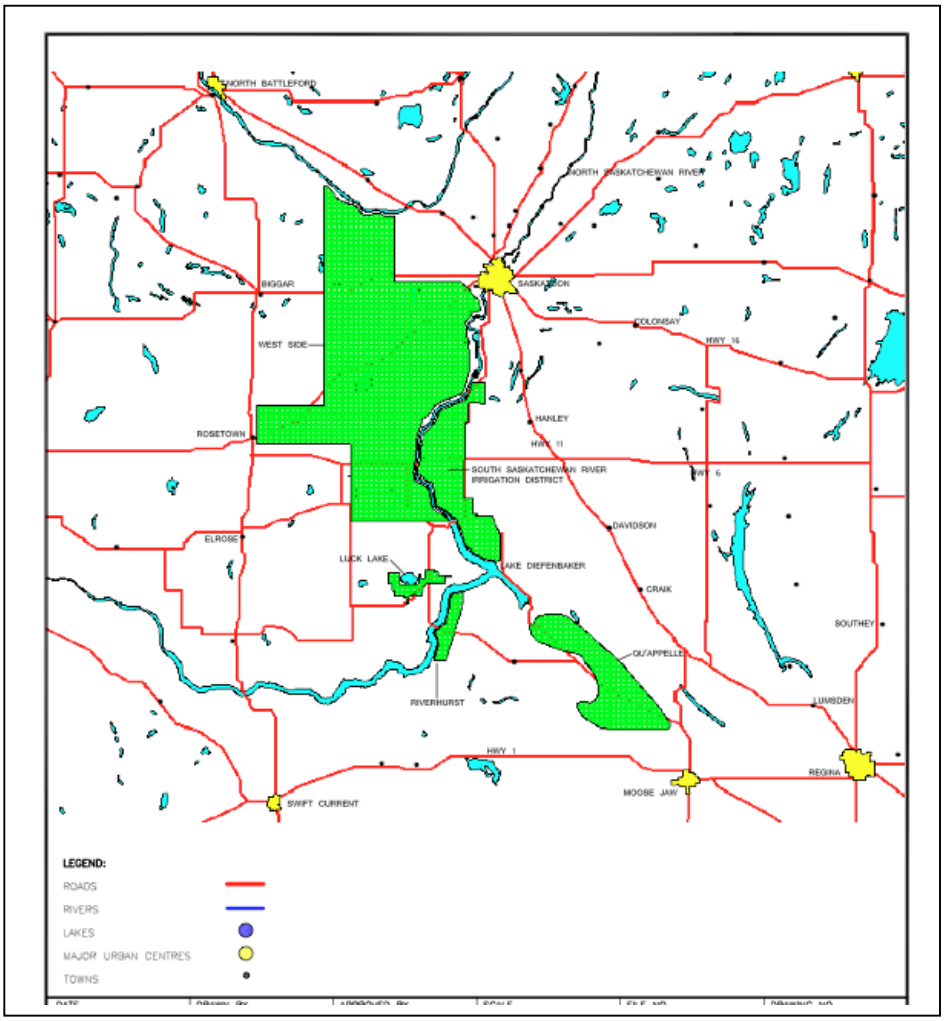
CHAPTER
6

Lake Diefenbaker Irrigation Evaluation Scenario and Analysis

Boundary Evaluation and the Geography of Impacts



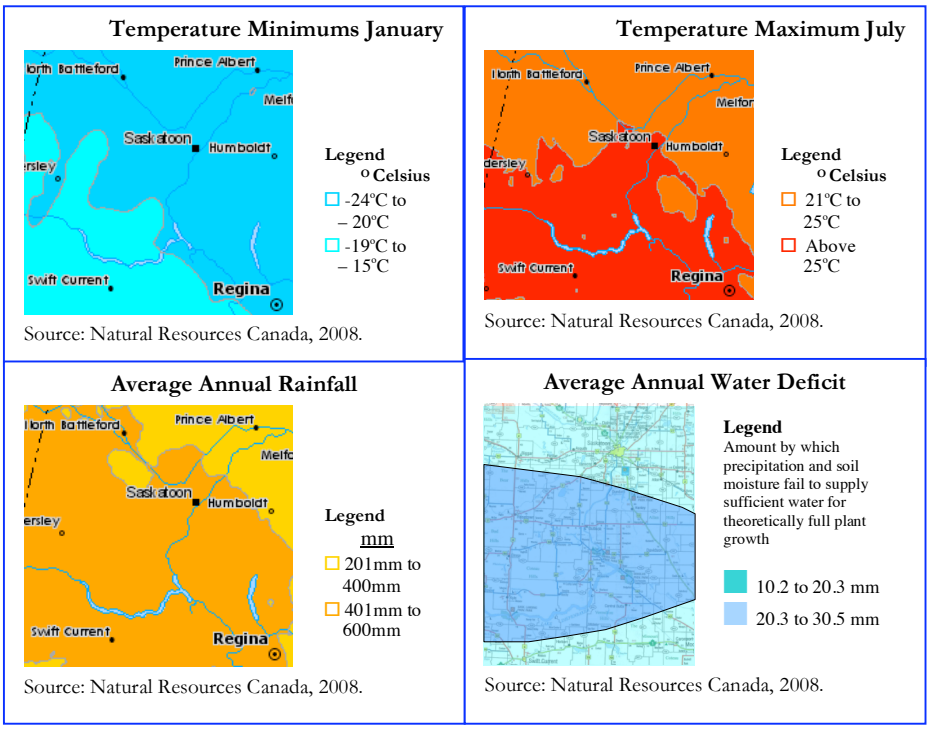
The Lake Diefenbaker Development projects are located in the centre of a triangle between Saskatoon and North Battleford to the North and Regina, Moose Jaw and Swift Current to the south. While most of the developments originate around the Lake Diefenbaker water supplies, the benefits are rapidly transmitted into the surrounding areas and cities that will supply much of the expertise to develop the projects and will directly participate in the benefits through agricultural value added building block investments, tourism, water supplies and wildlife activities.

Climate

Lake Diefenbaker has a continental climate with cold winters and warm summers.

Temperatures range from – 24C in a typical January winter to over 25C in July in an average year. However, given the wide variability in temperatures and precipitation that occurs each year's extremes can create much hotter summers and much colder winters in any one year. Much of the Lake Diefenbaker area experiences a water deficit where evaporation exceeds precipitation.

Figure 22 - Temperature Ranges and Average Annual Precipitation and Annual Water Deficits in the Lake Diefenbaker Region in an Average Year



In an average year, precipitation through most of the area would lie between 400 and 600 mm. Significantly, however, evaporation would exceed the amount of rainfall received and the combination of soil moisture and precipitation during the growing season lead to water deficits of from 10 to 30 mm each year. Notably, however the natural variability in the Prairie climate commonly leads to ranges as much as 30% above and below the average leading to much higher levels of water shortage and the prospect of drought.

The region is located in a climatic region that is at the centre of the Prairie drought zone. The region experienced six major droughts over the forty years between 1960 and 2002. The region has an average frost free growing season with the last spring frosts averaging May 23rd and the first fall frosts on September 15th, providing an average frost free growing season of about 107 days for frost sensitive crops and 118 days for most crops. Temperatures generate 2,200 corn heat units around Outlook nine years in ten. Daily evaporation demand is on average 6 mm and 8 mm during the peak growing season of July and August. These climatic parameters can be expected to increase with global warming.

Demographic and Socio Economic Activity

Table 31 shows the major socio-economic and demographic characteristics of the primary rural impact area of the region. The total population of the areas impacted by the irrigation districts amounted to some 11,466 in 2006, down by 6% since 2001. The population of the area is aging. Nearly one quarter of the population is already over the age of 65. Six thousand people are employed in the area.

Table 31 - Demographic and Socio Economic Characteristics of the Lake Diefenbaker Region

Geographic Location	Total Population		Change in Population 2006-2001	Total Population Under 19		Total Population over 65		Labour Force	Employed
	2006	2001	%	#	%	#	%	#	#
RM of Fertile Valley No. 285	609	602	1.2	180	29.56	55	9.03	435	400
RM of Dundurn No. 314	632	562	12.5	185	29.27	45	7.12	385	375
Town of Outlook (in RM of Rudy)	1,938	2,129	-9	415	21.41	585	30.19	890	860
Village of Broderick (in RM of Rudy)	77	83	-7.2	25	32.47	5	6.49	55	35
Village of Brownlee (in RM of Eyebrow)	50	55	-9.1	15	30.00	10	20.00	45	40
Village of Conquest (in RM of Fertile Valley)	167	163	2.5	45	26.95	30	17.96	85	85
Village of Elbow (in RM of Loreburn)	294	298	-1.3	45	15.31	110	37.41	125	125
Village of Eyebrow (in RM of Eyebrow)	135	136	-0.7	25	18.52	35	25.93	60	55
Town of Hanley (in RM of Rosedale)	464	495	-6.3	120	25.86	110	23.71	220	200
Village of Tugaske (in RM of Huron)	105	116	-9.5	20	19.05	20	19.05	60	55
Village of Strongfield (in RM of Loreburn)	47	42	11.9	15	31.91	5	10.64	40	30
Village of Riverhurst (in RM of Maple Bush)	121	143	-15.4	15	12.40	50	41.32	50	50
Village of Macrorie (in RM of Fertile Valley)	78	96	-18.8	20	25.64	10	12.82	-	-
Village of Lucky Lake (in RM of Canaan)	295	354	-16.7	75	25.42	100	33.90	100	100
Village of Loreburn (in RM of Loreburn)	113	143	-21	25	22.12	25	22.12	60	60
RM of Enfield No. 194	301	356	-15.4	80	26.58	35	11.63	190	180
RM of Huron No. 223	233	249	-6.4	70	30.04	40	17.17	135	130
RM of Maple Bush No. 224	186	208	-10.6	35	18.82	40	21.51	110	110
RM of Canaan No. 225	165	191	-13.6	35	21.21	20	12.12	120	120
RM of Loreburn No. 254	350	384	-8.9	110	31.43	45	12.86	235	220
RM of Coteau No. 255	468	511	-8.4	160	34.19	60	12.82	325	320
RM of Rosedale No. 283	455	493	-7.7	135	29.67	55	12.09	300	300
RM of Rudy No. 284	434	430	0.9	165	38.02	40	9.22	270	265
Town of Lumsden (in RM of Lumsden)	1,523	1,596	-4.6	445	29.22	210	13.79	815	780
RM of Lumsden No.189	1,627	1,631	-0.2	440	27.04	210	12.91	1,085	1,030
Towns and Villages	**5,407**	**5,849**	**-7.51**	**1,305**	**24.14**	**1,305**	**24.14**	**2,605**	**2,475**
Rural Municipalities	**5,460**	**5617**	**-5.15**	**1,595**	**29.21**	**645**	**11.81**	**3,590**	**3,450**
Total	**10,867**	**11,466**	**-6.33**	**2,900**	**26.69**	**1,950**	**17.94**	**6,195**	**5,925**
Communities and Rural Municipalities with Declining Populations				Source: Statistics Canada, Community Profiles, 2008					

Significantly, most of the rural municipalities and many of the small villages are losing population. Of the twenty six urban and rural jurisdictions in the area only five of them had a growing population between 2001 and 2006. This trend of rural population decline has been continuing for many years.

Agriculture

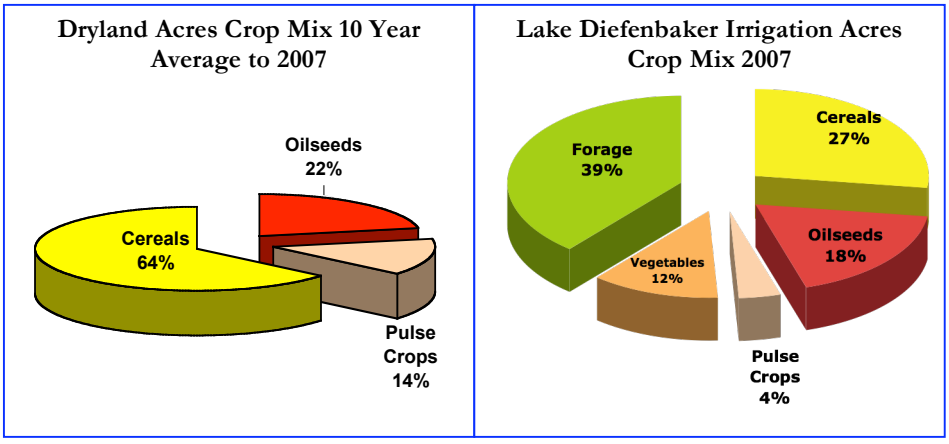
There are 9,484 square kilometers of farmland in the study area most of which is under dryland farming operations in 1,409 farms. The farm population is also aging and the average age of farm operators is now over fifty. The major crops from the region are shown in Table 32 and show the dependence on the main dryland cereal and oilseed crops grown in the province. The region accounts for about one quarter of all the cereals produced in Saskatchewan, 17% of the oilseeds and 34% of the pulse crops. There are some 0.7 million cattle in the region, about 20% of the provincial herd of 3.4 million in 2006.

Table 32 - Major Crops in the Lake Diefenbaker Region and Saskatchewan

	Cereals	Oil Seeds	Pulse	Vegetable	Forage
Lake Diefenbaker Region					
Average Harvested Acres 1997 - 2005	5,417,084	1,325,377	1,567,218	11,000	3,502,222
Average Production Tonnes	4,407,029	649,296	812,421	674,741	16,783,056
Saskatchewan					
Average Harvested Acres 1997 - 2005	20,520,000	7,341,667	3,665,622		
Average Production Tonnes	17,535,656	3,762,700	2,426,278		
Lake Diefenbaker Region % of Total					
Average Harvested Acres 1997 - 2005	26.40%	18.05%	42.75%		
Average Production Tonnes	25.13%	17.26%	33.48%		
Source: Statistics Canada and Saskatchewan Ministry of Agriculture Lake Diefenbaker Region comprises crop districts; 2b, 3an, 3bn and 6b.					

Currently the region has about 100,000 acres under irrigation. About 60% of the Lake Diefenbaker irrigation is undertaken within nine irrigation districts. The remainder is private irrigation. There are significant differences in the crop mixes of the dryland and irrigated acres in the area. Over the past ten years 64% of the dryland acres have been in cereals with the balance in oilseeds (21%) and pulse crops (15%). Irrigated acreage however is to be found mostly in forage crops as a basis for a livestock economy while only 27% of the acreage is in cereals and 18% in oilseeds. Significantly irrigation provides an opportunity to allocate some 12% of the acres to the high value vegetable crops that are mainly potatoes in the Lake Diefenbaker area.

Figure 23 - Distribution of Major Crop Acreage for the Provincial 10 Year Average and the Lake Diefenbaker Irrigated Area for the Ten Year Averages to 2006



The net effect of the irrigated acreage in the Lake Diefenbaker area is to increase yields, revenues and net incomes. Table 33 shows the additional returns the existing irrigated areas generate over dryland agriculture on both the acreage crop mix and the production crop mix for the 2007 crop financial planning parameters.

Table 33 - Comparison of Dryland and Irrigated Returns/Acre 2007 Crop Budgets Under Average Climatic Conditions

	Dryland Returns $/Acre	Irrigated Returns $/Acre	Difference Between Dryland Irrigated Returns $/Acre
Revenues	$150.39	$636.32	$485.93
Expenses	$152.22	$449.98	$297.76
Total Returns	**-$1.83**	+$186.34	+$188.17
Based on the Acreage Distribution of the Crop Mix			
Source: Saskatchewan Ministry of Agriculture Annual Crop Budgets, 2008.			

The Lake Diefenbaker Region has a climate that is vulnerable to drought. Droughts effectively reduce the returns on dryland agriculture while the irrigation returns remain stable. Table 34 shows the benefits of irrigation for the 2001 drought in the region by comparing the dryland and irrigated returns per acre. This shows clearly the losses that are incurred under the dryland farming regime during the 2001 drought that approaches a loss of $100 per acre or approximately $50 million over the local area with potential for irrigation. The potential gain from adopting irrigation simply based on crop returns represents $277 per acre or nearly $140 million.

Table 34 - Comparison of Dryland and Irrigated Returns/Acre 2007 Crop Budgets Under the 2002 Drought Year

	Dryland Returns $/Acre	Irrigated Returns $/Acre	Difference Between Dryland Irrigated Returns $/Acre
Revenues	$91.10	$636.32	$485.93
Expenses	$182.22	$449.98	$297.76
Total Returns	**-$91.12**	+$186.34	+$277.46
Based on the Acreage Distribution of the Crop Mix			
Source: Saskatchewan Ministry of Agriculture Annual Crop Budgets, 2008.			

Other Activities

The Lake Diefenbaker area is also home to a number of other activities that have been described in earlier chapters. The lake provides a reliable water supply for the SaskPower Coteau Creek generating station, a well developed tourism industry based on hunting, fishing, wildlife, watersports and recreational real estate. There are many golf courses throughout the region and a sailing harbour at Elbow.

Tourism development is primarily a summer activity and the population of the region experiences a major growth with the movement of many of Saskatchewan's urban population into cabins and campgrounds for all or part of the summer.

Lake Diefenbaker Irrigation Outlook Scenario

Project Schedules and Irrigation Uptake Rates

Chapter 5 describes the detailed costs, schedules and irrigation potential for the five irrigation infill and development projects:

1. Westside
2. South Saskatchewan River Irrigation District
3. Riverhurst Irrigation District
4. Lucky Lake Irrigation Project
5. Qu'Appelle South Irrigation Project

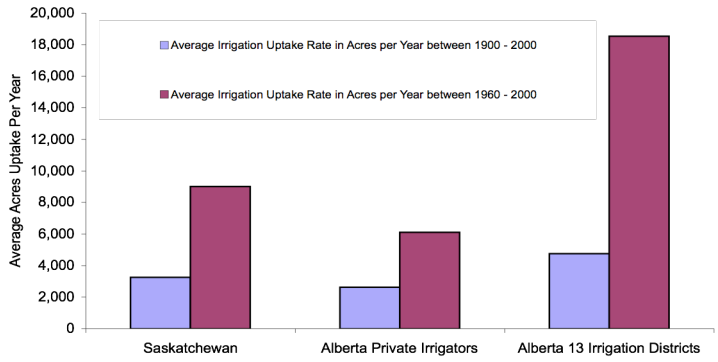
The five projects have been combined to provide for the implementation of all five projects over a twenty capital construction and operation schedule. While the construction of the projects lasts for twenty years the full implementation of all of the projects takes much longer based on the uptake rate in converting dryland to irrigated agriculture. Figure 24 shows the schedule of construction for the five projects.

Figure 24 - Capital Construction Schedules for Five Irrigation Infill & Development Projects in the Lake Diefenbaker Area

Irrigation Project	Years																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
South Saskatchewan Irrigation District																				
Riverhurst																				
Luck Lake																				
Qu'Appelle																				
Westside																				

Figure 25

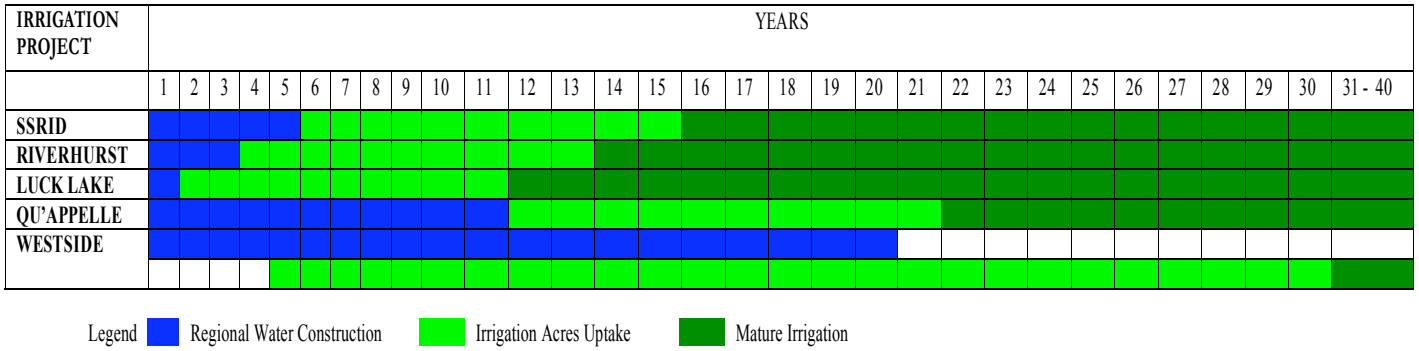
Irrigation Uptake Rates Saskatchewan & Alberta Between 1900 & 2000



The speed of irrigation development following the construction of regional water supply and distribution systems is limited to some degree by the rate of adoption of irrigation by dryland farmers. This rate of uptake can vary widely. Figure 25 shows a comparison of the irrigated acreage uptake rates for irrigation in Alberta and Saskatchewan between 1900 and 2000 and 1960 and 2000. Uptake rates have been twice as fast in Alberta as in Saskatchewan. On the basis of this comparison an uptake rate of ten years was adopted for the comprehensive irrigation development in the Lake Diefenbaker Area.

The schedule of expansion of irrigated acreage is shown in Figure 26 with the regional water construction schedules, the uptake of the irrigated acres followed by the mature irrigation economy. As irrigated acres cumulate the value added processing based upon the increased irrigated production becomes possible.

Figure 26 - Schedule of Project Construction and Irrigation Uptake, Lake Diefenbaker Projects



As the regional water works associated with each irrigation project are completed, irrigated farming can commence and additional set of expenditures is incurred. Off-farm there are annual operating costs associated with the regional water works. On-farm there are capital investments in water distribution and supply, new capital equipment for the irrigated farm operations and increased operating costs. These capital and operating expenditures grow with the completion of the regional water works and the expansion of irrigated acreage. Table 35 shows these expenditures accumulating over the forty year period to reach over $13 billion. The $2.9 billion capital investment in regional water works immediately leads to well over four times the investment in operating and on farm expenditures.

Table 35 - Cumulative Capital and Operating Cost Expenditures for Five Irrigation Infill and Irrigation Projects, Lake Diefenbaker

CAPITAL AND OPERATING COST EXPENDITURE ITEM	Cumulative Expenditures by Decade in Millions of Dollars			
	10	20	30	40
Regional Water Works				
Regional Water Capital Costs	$1,816	$2,867	$2,867	$2,867
ID Water Operating Costs	$1.441	$8.173	$20.858	$37.017
On Farm Investments				
On Farm Pivot Capital Costs	$86.448	$205.198	$287.917	$338.711
On-Farm Pivot Op & Maintenance Costs	$1.550	$10.498	$33.434	$67.968
On Farm Production Capital Costs	$2.676	$3.952	$4.886	$6.001
On-Farm Production Costs	$1,470.2	$3,531.4	$6,463.9	$9,717.7
Total Cumulative Costs	$3,378	$6,626	$9,678	$13,034

Building Blocks in An Irrigation Value Chain

The expansion of the irrigated acreage in the Lake Diefenbaker Irrigation Development Area can provide the supply requirements for several irrigation value chains. For the purpose of evaluation five value chains were developed. These were:

- A Beef Cattle Livestock Value Added Chain developing on a growing forage acreage to support initially cow-calf operations, small and large feedlots and eventually meat packing plants.
- A Hog Livestock Value Added Chain evolving from hog barns to slaughtering and meat processing.
- A Dairy Value Chain to produce fresh and industrial milk and cheese.
- A Vegetable Value Added Chain built around potato production, storage and processing.
- An Energy Value Added Chain based upon the supply of crop and livestock products and bi-products into ethanol facilities.

The capital costs associated with the central building blocks associated with each of these value chains are summarized below. In total these value added building blocks will add over $50 million to the capital costs of the projects and $15 million of annual operating costs.

Table 36 - Irrigation Value Added Building Blocks

Irrigation Value Chain	Number	Estimated Capital Costs	Estimated Annual Operating Costs
Beef Livestock	Producing 420,000 new cattle annually Capacity to Process 544,000	$233,203,600 $80,000,000	$341,161,800 $387,522,136
Pork Livestock	Producing 186,120 hogs annually Capacity to Process 500,000 annually	$50,367,030 $22,679,750	$26,250,660 $59,947,322
Dairy	Producing 17,344,800 liters of milk annually Producing 25 mil pounds/11.3 mil kg's cheese and 1.65 mil lbs/0.74 mil kg's whey protein products	$32,970,000 $19,200,000	$18,237,210
Vegetable	Processing 1,242,000 cwt's potatoes annually	$30,000,000	$13,308,000
Energy	Producing 20 million litres of ethanol annually	$24,656,226	$2,713,722

Irrigation value added building blocks are phased into the economy with the completion of the regional water works and the expansion of irrigated acreage. The full impact of the irrigation acreage expansion and the irrigation building blocks is not experienced until forty years after the commencement of investment and construction on the initial irrigation project.