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NIDOKA PROJECT

I SIDE PUMPING DIVISION

IDAHO

DEFINITE PLAN REPORT

VOLUME 1 GENERAL PLAN

FEBRUARY 1955

DEFINITE PLAN REPORT
MINIDOKA PROJECT
NORTH SIDE PUMPING DIVISION

- - -

REVISION SHEET

REVISION		PORTION OF REPORT AFFECTED	REVISION INSERTED*	
NO.	DATE		BY	DATE
3	12/59	A complete new Summary is herewith submitted for insertion in your copy or copies of the report. The underlying report has not been revised to incorporate these revisions. Revised sheets retained and marked superseded 12/59	MLM	1-5-60

* To be filled in by recipient of Revision Sheet

Date: December 30, 1959

Signature M. B. Austin
Regional Director

SUMMARY

MINIDOKA PROJECT - NORTH SIDE PUMPING DIVISION

LOCATION: Idaho, in Minidoka County near Rupert and lying in crescent shape generally north of the Minidoka Irrigation District.

AUTHORIZED: Public Law 864, 81st Congress, 2nd Session; approved September 30, 1950.

PLAN

The plan of development provides for the distribution of water lifted by an electrically-powered pumping plant from the Snake River, and from ground-water sources. The total area included in the plan embraces 78,596 irrigable acres lying in two units; 13,842 in Unit A, and 64,754 in Unit B. Unit A would be served by pumping from the Snake River. Water would be stored for Unit A in both the existing American Falls Reservoir and in the Palisades Reservoir, now under construction. A single pumping plant would lift water for Unit A from the river to a distribution system; five small relift pumps would serve 1,564 acres above the gravity distribution system. Unit B would be served by some 182 wells tapping the ground water, and the distribution would be accomplished by a separate lateral system for each well. Over 90 percent of the land in both units is Government-owned and will be subdivided into homestead units averaging about 120 irrigable acres each. A total of 655 farms is contemplated.

CONSTRUCTION COST (Cost data taken from PF-2 dated 12/23/59)

Unit "A"	
Main Pumping Plant	$ 834,601
Main Canal	108,541
Laterals	692,453
Drains	153,622
Pumping Substations	15,962
Unit "B"	
Deep Wells	5,162,736
Laterals	2,154,421
Drains	990,751
Pumping Substations	1,433,587
General Property	672,045
Settlers Assistance	52,509
Total Project Cost	$12,254,689
Deferred O&M Costs	57,466
Total Cost	$12,312,155

Summary - Minidoka Project, North Side Pumping Division

BENEFITS AND COSTS

	Annual Project Benefits		
	Direct	Indirect	Total
Irrigation 1/	$2,458,700	$3,189,000	$5,647,700
Fish and wildlife	--	--	28,300
Total			$5,676,000

1/ Adjusted for a 5-year development period, 100-year period of analysis. For a 50-year period of analysis the irrigation benefits would be Direct - $2,404,500; Indirect - $3,118,700; Total - $5,523,200.

Annual Equivalent Costs

	50-Year	100-Year
Construction cost	$12,254,689	$12,254,689
Less cost of investigation	250,000	250,000
Plus interest during construction ...	860,000	860,000
Net Federal investment	$12,864,689	$12,864,689
Annual equivalent cost	453,609	351,335
OM&R	839,183	839,183
Total annual costs	$ 1,292,792	$ 1,190,518

BENEFIT-COST RATIOS

	50-Year	100-Year
Project - Direct benefits	1.86 to 1.00	2.06 to 1.00
- Total benefits	4.39 to 1.00	4.77 to 1.00
Irrigation - Direct benefits	--	2.06 to 1.00
- Total benefits	--	4.74 to 1.00
Fish and Wildlife - Total benefits	--	1/

1/ Development of the project will result in benefits to wildlife but no costs are allocated to this function.

Summary - Minidoka Project, North Side Pumping Division

ALLOCATION AND ASSIGNED COSTS

Allocated	
Irrigation	$12,312,155
Assigned (Irrigation)	
American Falls Storage	71,000
Palisades Storage	698,000
Total irrigation cost	$13,081,155

REPAYMENT

Total irrigation cost	$13,081,155
Less credits	430,576
Irrigation repayment obligation	$12,650,579

	Annual	Per Acre
Irrigation installment (50 years)	$ 253,012	$ 3.22
Operating costs 1/	839,183	10.68
Total	$1,092,195	$13.90

1/ Annual costs projected on basis of current prices rather than a percentage thereof as used in the February 1955 Definite Plan Report.

IRRIGATION

Unit A

Land Class	Irrigable Acres	Payment Capacity 1/	Water Charge Acre	OM&R Acre	Construction Charge Acre
1	9,712	$16.11	$13.90	$10.68	$3.22
2	3,277	11.47	13.90	10.68	3.22
3	853	6.67	13.90	10.68	3.22
Subtotal	13,842	-	-	-	-

Unit B

1	26,907	$16.11	$13.90	$10.68	$3.22
2	23,412	11.47	13.90	10.68	3.22
3	14,435	6.67	13.90	10.68	3.22
Subtotal	64,754	-	-	-	-
TOTAL	78,596	$15.00	$13.90	$10.68	$3.22

1/ Payment capacity based on 1939-44 price level as presented in February 1955 D.P.R. The payment capacity for class 3 lands was re-evaluated in November 1955 on basis of actual land usage which showed these lands could pay up to $13.85 an acre on annual project costs (215 price level).

IRRIGATION (continued)

Full water supply to 78,596 acres.
Average frost-free period - About 130 days - 5/17 to 9/26.
Growing season - About 190 days - 4/15 to 10/22.
Irrigation season - April to October.
Elevation of project area - 4,100 to 4,300 feet.
Consumptive use requirement - 2.0 acre-feet per acre.
Effective precipitation - 0.2 foot
Diversion requirement - 4.33 acre-feet per acre on Unit A lands and 3.68 acre-feet per acre on Unit B lands (13,842 and 64,754 acres, respectively, of productive land).
Date first water applied - 1949 irrigation season.
Date all lands to be irrigated - 1962 irrigation season.

POWER AND MUNICIPAL WATER

Not included as project functions.

DISTRIBUTION SYSTEMS

Unit A Pumping Plant

Capacity ..... 240 second feet
Total dynamic head ..... 168 feet
Number of pumping units 5
Motors - three 1,500 horsepower, horizontal, synchronous
one 1,000 horsepower, horizontal, synchronous
one 500 horsepower, horizontal, synchronous
Pumphouse ..... 40 feet by 102 feet

Unit A Relift

Pumps ..... Vertical shaft turbine type
Pumping head ..... 20 feet
Estimated average discharge ..... 5.2 c.f.s.
Number of pumps 5
Motors - Vertical induction outdoor type, no housing required.
Starting equipment - Across the line type, protection against voltage irregularities, lightning and motor bearing overheating.

Unit A Main Canal
Length ..... 4.4 miles
Capacity ..... 240 second feet

DISTRIBUTION SYSTEMS (continued)

Unit A Laterals

Type ..... Open earth
Structures ..... Concrete
Total length ..... 45 miles
Capacity range ..... 2.5 c.f.s. to 75 c.f.s.

Unit B Pumps, Motors and Starting Equipment

Deepwells
Pumps ..... Line shaft vertical turbine
Estimated average pumping head ..... 198 feet
Estimated average discharge ..... 5.6 c.f.s.
Number of pumps 192
Motors - vertical, hollow shaft, induction outdoor type, no housing required
Starting equipment - across the line type, protection against voltage irregularities, lightning and motor bearing overheating.

Relifts

Pumps ..... Vertical shaft turbine type
Pumping head ..... 33.1 feet
Discharge ..... 3.1 c.f.s.
Number of pumps 7
Motors - Vertical induction outdoor type, no housing required.
Starting equipment - Across the line type, protection against voltage irregularities, lightning and motor bearing overheating.

Unit B Laterals

Type ..... Open earth
Structures ..... Concrete
Total length ..... 165 miles
Capacity range ..... 1.5 c.f.s. to 10.5 c.f.s.

Drains ..... 373 miles

Summary - Minidoka Project, North Side Pumping Division

HYDROLOGY

An adequate supply of water would be available for Unit A from natural flow of the Snake River, augmented by 47,000 acre-feet of storage in American Falls Reservoir and 90,000 acre-feet of space in Palisades Reservoir. In 1959 there were 186 deep wells developed which furnished a full water supply to over 74,642 acres. The operation of these wells together with a hydrological program being carried on through observation wells indicates that there is ample ground water for full irrigation of Unit B. The ground-water supply is believed to have its source from deep percolation losses from the Snake River and tributaries, and from irrigation in the Upper Snake River Basin to the northeast.

REMARKS

Although the exclusion of Group 8 wells decreased project acreage from 80,972 to 78,596, in several instances, the amount of land in a specific land class exceeds the acreage of that land class shown in the land classification certification. This situation results from the refinements in land classification in the process of setting up farm units. All lands scheduled for development are covered by land classification certification.

DERIVATION OF IRRIGATION BENEFITS

MINIDOKA PROJECT - NORTH SIDE PUMPING DIVISION, IDAHO

Item	Benefits-1939-44 Price Level 1/			Benefits - 250/265 Price Level 2/		
	Direct	Indirect	Public	Direct	Indirect	Public
	dollars	dollars	dollars	dollars	dollars	dollars
Local sales	--	59,000	--	--	91,000	--
Local and nonlocal processing	--	360,000	--	--	1,222,300	--
Increased expenses	--	575,000	--	--	999,600	--
Net farm income	--	--	--	3,388,800	--	--
Family living	560,000	--	--	--	--	--
Payment capacity	1,056,000	--	--	--	--	--
Farm investment	155,000	--	--	--	--	--
Settlement opportunities	--	--	700,000	- 808,900	--	808,900
Community services	--	--	122,000	--	--	224,400
Total	1,771,000	994,000	822,000	2,579,900	2,312,900	1,033,300
Adjusted 5-year development period (100-year factor-- .953)				2,458,700	2,204,300	984,700

1/ Benefits based on 77,650 acres in Definite Plan Report.
2/ Benefits based on 78,596 acres--the present anticipated project development.

Taylor

superseded 12/59

DEFINITE PLAN REPORT
MINIDOKA PROJECT
NORTH SIDE PUMPING DIVISION

REVISION SHEET

REVISION		PORTION OF REPORT AFFECTED	REVISION INSERTED*	
NO.	DATE		BY	DATE
2	9/58	Summary Add new summary pages i through vii. You may not wish to remove old pages i through iv because the new material has not been carried through the report.	ab	12/3/58

* To be filled in by recipient of Revision Sheet

Date: September 25, 1958

Signature H. T. Nelson
Regional Director

Superseded 12/59

SUMMARY

MINIDOKA PROJECT - NORTH SIDE PUMPING DIVISION

LOCATION: Idaho, in Minidoka County near Rupert and lying in crescent shape generally north of the Minidoka Irrigation District.

AUTHORIZED: Public Law 864, 81st Congress, 2nd Session; approved September 30, 1950.

PLAN

The plan of development provides for the distribution of water lifted by an electrically-powered pumping plant from the Snake River, and from ground-water sources. The total area included in the plan embraces 80,980 irrigable acres lying in two units; 13,650 in Unit A, and 67,330 in Unit B. Unit A would be served by pumping from the Snake River. Water would be stored for Unit A in both the existing American Falls Reservoir and in the Palisades Reservoir, now under construction. A single pumping plant would lift water for Unit A from the river to a distribution system; five small relift pumps would serve 1,564 acres above the gravity distribution system. Unit B would be served by some 192 wells tapping the ground water, and the distribution would be accomplished by a separate lateral system for each well. Over 90 percent of the land in both units is Government-owned and will be subdivided into homestead units averaging about 120 irrigable acres each. A total of 673 farms is contemplated.

CONSTRUCTION COST (Cost data taken from PF-2b dated 8/15/58)

Unit "A"	
Main Pumping Plant	$ 815,260
Main Canal	108,185
Laterals	664,000
Drains	150,987
Pumping Substations	16,834
Unit "B"	
Deep Wells	4,737,445
Laterals	2,095,457
Drains	918,560
Pumping Substations	1,540,191
General Property	960,859
Settlers Assistance	70,000
Future Year Capacity Provisions	55,000
Total Project Cost	$12,132,778

Superseded 12/59

Summary - Minidoka Project, North Side Pumping Division

BENEFITS AND COSTS

	Annual Project Benefits		
	Direct	Indirect	Total
Irrigation 1/	$2,815,200	$3,027,500	$5,842,700
Fish and wildlife	--	--	28,300
Total			$5,871,000

1/ Adjusted for a 5-year development period, 100-year period of analysis. For a 50-year period of analysis the irrigation benefits would be Direct - $2,756,200; Indirect - $2,963,900; Total - $5,720,100.

Annual Equivalent Costs

	50-Year	100-Year
Construction cost	$12,132,778	$12,132,778
Less cost of investigation	250,000	250,000
Plus interest during construction ..	857,400	857,400
Net Federal investment	$12,740,178	$12,740,178
Annual equivalent cost	449,218	347,934
OM&R	839,183	839,183
Total annual costs	$ 1,288,401	$ 1,187,117

BENEFIT-COST RATIOS

	50-Year	100-Year
Project - Direct benefits	2.14 to 1.00	2.37 to 1.00
- Total benefits	4.44 to 1.00	4.94 to 1.00
Irrigation - Direct benefits	--	2.37 to 1.00
- Total benefits	--	4.92 to 1.00
Fish and Wildlife - Total benefits	--	1/

1/ Development of the project will result in benefits to wildlife but no costs are allocated to this function.

Superseded 12/59

Summary - Minidoka Project, North Side Pumping Division

ALLOCATION AND ASSIGNED COSTS

Allocated	
Irrigation	$12,132,778
Assigned (Irrigation)	
American Falls Storage	71,000
Palisades Storage	698,000
Total irrigation cost	$12,901,778

REPAYMENT

Total irrigation cost	$12,901,778
Less credits	430,576
Irrigation repayment obligation	$12,471,202

	Annual	Per Acre
Irrigation installment (50 years)	$ 249,424	$ 3.08
Operating costs 1/	839,183	10.36
Total	$1,088,607	$13.44

1/ Annual costs projected on basis of current prices rather than a percentage thereof as used in the February 1955 D.P.R.

IRRIGATION

Land Class	Irrigable Acres	Payment Capacity 1/	Water Charge Acre	OM&R Acre	Construction Charge Acre
Unit A					
1	9,960	$16.11	$13.44	$10.36	$3.08
2	3,030	11.47	13.44	10.36	3.08
3	660	6.67	13.44	10.36	3.08
Subtotal	13,650	-	-	-	-
Unit B					
1	27,419	$16.11	$13.44	$10.36	$3.08
2	25,655	11.47	13.44	10.36	3.08
3	14,256	6.67	13.44	10.36	3.08
Subtotal	67,330	-	-	-	-
TOTAL	80,980	$15.00	$13.44	$10.36	$3.08

1/ Payment capacity based on 1939-44 price level as presented in February 1955 D.P.R. The payment capacity for class 3 lands was re-evaluated in November 1955 on basis of actual land usage which showed these lands could pay up to $13.85 an acre on annual project costs (215 price level).

Rev. 9/25/58

Superseded 12/59

IRRIGATION (continued)

Full water supply to 80,980 acres.
Average frost-free period - About 130 days - 5/17 to 9/26.
Growing season - About 190 days - 4/15 to 10/22.
Irrigation season - April to October.
Elevation of project area - 4,100 to 4,300 feet.
Consumptive use requirement - 2.0 acre-feet per acre.
Effective precipitation - 0.2 foot
Diversion requirement - 4.33 acre-feet per acre on Unit A lands and 3.68 acre-feet per acre on Unit B lands (12,830 and 63,290 acres, respectively, of productive land).
Date first water applied - 1949 irrigation season.
Date all lands to be irrigated - 1962 irrigation season.

POWER AND MUNICIPAL WATER

Not included as project functions.

DISTRIBUTION SYSTEMS

Unit A Pumping Plant

Capacity ..... 240 second feet
Total dynamic head ..... 168 feet
Number of pumping units 5
Motors - three 1,500 horsepower, horizontal, synchronous
one 1,000 horsepower, horizontal, synchronous
one 500 horsepower, horizontal, synchronous
Pumphouse ..... 40 feet by 102 feet

Unit A Relift

Pumps ..... Vertical shaft turbine type
Pumping head ..... 20 feet
Estimated average discharge ..... 5.2 c.f.s.
Number of pumps 5
Motors - Vertical induction outdoor type, no housing required.
Starting equipment - Across the line type, protection against voltage irregularities, lightning and motor bearing overheating.

Unit A Main Canal
Length ..... 4.4 miles
Capacity ..... 240 second feet

Superseded 12/59

DISTRIBUTION SYSTEMS (continued)

Unit A Laterals

Type	Open earth
Structures	Concrete
Total length	45 miles
Capacity range	2.5 c.f.s. to 75 c.f.s.

Unit B Pumps, Motors and Starting Equipment

Deepwells

Pumps	Line shaft vertical turbine
Estimated average pumping head	198 feet
Estimated average discharge	5.6 c.f.s.
Number of pumps	192

Motors - vertical, hollow shaft, induction outdoor type, no housing required

Starting equipment - across the line type, protection against voltage irregularities, lightning and motor bearing overheating.

Relifts

Pumps	Vertical shaft turbine type
Pumping head	33.1 feet
Discharge	3.1 c.f.s.
Number of pumps	7

Motors - Vertical induction outdoor type, no housing required.

Starting equipment - Across the line type, protection against voltage irregularities, lightning and motor bearing overheating.

Unit B Laterals

Type	Open earth
Structures	Concrete
Total length	165 miles
Capacity range	1.5 c.f.s. to 10.5 c.f.s.

Drains ..... 373 miles

Superseded 12/59

Summary - Minidoka Project, North Side Pumping Division

HYDROLOGY

An adequate supply of water would be available for Unit A from natural flow of the Snake River, augmented by 47,000 acre-feet of storage in American Falls Reservoir and 90,000 acre-feet of space in Palisades Reservoir. In 1958 there were 158 deep wells developed which furnished a full water supply to over 56,000 acres. The operation of these wells together with a hydrological program being carried on through observation wells indicates that there is ample ground water for full irrigation of Unit B. The ground-water supply is believed to have its source from deep percolation losses from the Snake River and tributaries, and from irrigation in the Upper Snake River Basin to the northeast.

Superseded 12/59

DERIVATION OF IRRIGATION BENEFITS

MINIDOKA PROJECT - NORTH SIDE PUMPING DIVISION, IDAHO

Item	Benefits-1939-44 Price Level 1/			Conversion Factors	Benefits - 250/265 Price Level 2/		
	Direct	Indirect	Public		Direct	Indirect	Public
	dollars	dollars	dollars	dollars	dollars	dollars	dollars
Local sales	--	59,000	--	Derived	--	80,700	--
Local and nonlocal processing	--	360,000	--	Derived	--	1,101,900	--
Increased expenses	--	575,000	--	Derived		985,900	--
Family living	560,000	--	--	Derived	1,034,400	--	--
Payment capacity	1,056,000	--	--	Derived	1,653,600	--	
Farm investment	155,000	--	--	Derived	266,100	--	
Settlement opportunities	--	--	700,000	Derived	--	--	829,800
Community services	--	--	122,000	Derived	--	--	178,400
Total	1,771,000	994,000	822,000	--	2,954,100	2,168,600	1,008,200
Adjusted 5-year development period (.953)					2,815,300	2,066,700	960,700

1/ Benefits based on 77,650 acres in D.P.R.
2/ Benefits based on 80,980 acres--the present anticipated project development.

DEFINITE PLAN REPORT
MINIDOKA PROJECT
NORTH SIDE PUMPING DIVISION

- - -

REVISION SHEET

REVISION		PORTION OF REPORT AFFECTED	REVISION INSERTED*	
NO.	DATE		BY	DATE
1a	3-55	Revise in Ink Change page number of page 136 to 137 Change page number of page 137 to 136 Change order of pages to conform to new numbering (These pages inadvertently transposed in Rev. No. 1, dated 2-55)	ru	3/23/55

*To be filled in by recipient of Revision Sheet

Date: March 18, 1955

Signature Wm H Tuller
Acting Regional Director

DEFINITE PLAN REPORT
MINIDOKA PROJECT
NORTH SIDE PUMPING DIVISION
- - -

REVISION SHEET

REVISION		PORTION OF REPORT AFFECTED	REVISION INSERTED*	
NO.	DATE		BY	DATE
1	2-55	This is a revision of the Definite Plan Report of August 1952 and completely supersedes that report.		

*To be filled in by recipient of Revision Sheet

Date: February 28, 1955

(Signature) Regional Director

UNITED STATES DEPARTMENT OF THE INTERIOR

DOUGLAS MCKAY, Secretary

BUREAU OF RECLAMATION

WILBUR A. DEXHEIMER, Commissioner

REGION 1

H. T. NELSON, Regional Director

M I N I D O K A P R O J E C T

N O R T H S I D E P U M P I N G D I V I S I O N

DEFINITE PLAN REPORT

Volume I - General Plan

Boise, Idaho
February-1955

SUMMARY

MINIDOKA PROJECT - NORTH SIDE PUMPING DIVISION

LOCATION: Idaho, in Minidoka County near Rupert and lying in crescent shape generally north of the Minidoka Irrigation District.

AUTHORIZED: Public Law 864, 81st Congress, 2nd Session; approved September 30, 1950.

PLAN

The selected plan of development involves the distribution of water lifted by an electrically-powered pumping plant from the Snake River, and from ground-water sources. The total area included in the plan embraces 77,650 irrigable acres lying in two units; 13,650 in Unit A, and 64,000 in Unit B. Unit A would be served by pumping from the Snake River. Water would be stored for Unit A in both the existing American Falls Reservoir and in the Palisades Reservoir, now under construction. A single pumping plant would lift water for Unit A from the river to a distribution system; five small relift pumps would serve 1,564 acres above the gravity distribution system. Unit B would be served by some 175 wells tapping the ground water, and the distribution would be accomplished by a separate lateral system for each well. Over 90 percent of the land in both units is Government-owned and will be subdivided into homestead units averaging about 110 irrigable acres each. A total of 695 farms is contemplated.

PHYSICAL FEATURES

Unit A Pumping Plant

Capacity	240 second feet
Total dynamic head	168 feet
Number of pumping units	5
Motors - three 1,500 horsepower, horizontal, synchronous	
one 1,000 horsepower, horizontal, synchronous	
one 500 horsepower, horizontal, synchronous	
Pumphouse	40 feet by 102 feet

Unit A Main Canal

Length	4.4 miles
Capacity	240 second feet

Summary - Minidoka Project, North Side Pumping Division

Unit A Laterals

Type	Open earth
Structures	Concrete
Total length	45 miles
Capacity range	2.5 c.f.s. to 75 c.f.s.

Unit B Pumps, Motors and Starting Equipment

Pumps	Line shaft vertical turbine
Estimated average pumping head	198 feet
Estimated average discharge .	5.6 c.f.s.
Number of pumps	175

Motors - vertical, hollow shaft, induction outdoor type, no housing required

Starting equipment - across the line type, protection against voltage irregularities, lightning and motor bearing overheating

Unit B Laterals

Type	Open earth
Structures	Concrete
Total length	150 miles
Capacity range	1.5 c.f.s. to 10.5 c.f.s.

HYDROLOGY

An adequate supply of water would be available for Unit A from natural flow of the Snake River, augmented by 47,593 acre-feet of storage in American Falls Reservoir and 90,000 acre-feet of space in Palisades Reservoir. Advance planning investigations and initial development indicate there would be ample ground water for full irrigation of Unit B. A hydrological program is being carried on by use of observation wells to indicate the supply. The ground-water supply is believed to have its source from deep percolation losses from the Snake River and tributaries, and from irrigation in the Upper Snake River Basin to the northeast.

Summary - Minidoka Project, North Side Pumping Division

OFFICIAL ESTIMATE

American Falls Storage (net)	$ 71,000
Palisades Reservoir Storage	810,000
Pumping Plants Unit A	952,800
Deep Wells	3,472,114
Canals and Conduits	84,000
Laterals	2,098,000
Drains	355,500
Settler Assistance	700,000
Transmission Lines, Switchyards and Substations	744,186*
Pumping Substation	1,375,900
General Property	676,500
Transitional Irrigation Development	55,000
Total Official Estimate	$11,395,000

* Construction not contemplated.

ANNUAL PROJECT BENEFITS

Irrigation	$ 3,418,000
Fish and Wildlife	30,000
Total	$ 3,448,000

ALLOCATION OF COSTS

Official Estimate	$11,395,000
Total Cost Subject to Allocation	$11,395,000
Allocation to Irrigation	10,650,814
Allocation Transmission Lines	744,186
Total Allocation	$11,395,000

IRRIGATION REPAYMENT

Payments from Water Users	$10,220,238
Credits from Sale of Jackson Lake Space and Other Sources	430,576
Total Irrigation Repayment	$10,650,814

Summary - Minidoka Project, North Side Pumping Division

AVERAGE ANNUAL WATER CHARGE

	Division	Per Acre
Construction Cost	$203,800	$ 2.63
Operation and Maintenance	186,400	2.40
Power Cost	383,800	4.94
Reserve for Replacement	107,200	1.38
Totals (rounded)	$881,000	$11.35

Agricultural economy studies show that project farmers will be able to pay from $11.00 to $12.00 per acre for water and still maintain an adequate level of living. Essential to the payment of the water charge estimated for this project is the establishment and continuance of adequately sized farm units. The average size of farms contemplated on Class 1 land include 90 acres of irrigable land and those on Class 2 land, 113 acres.

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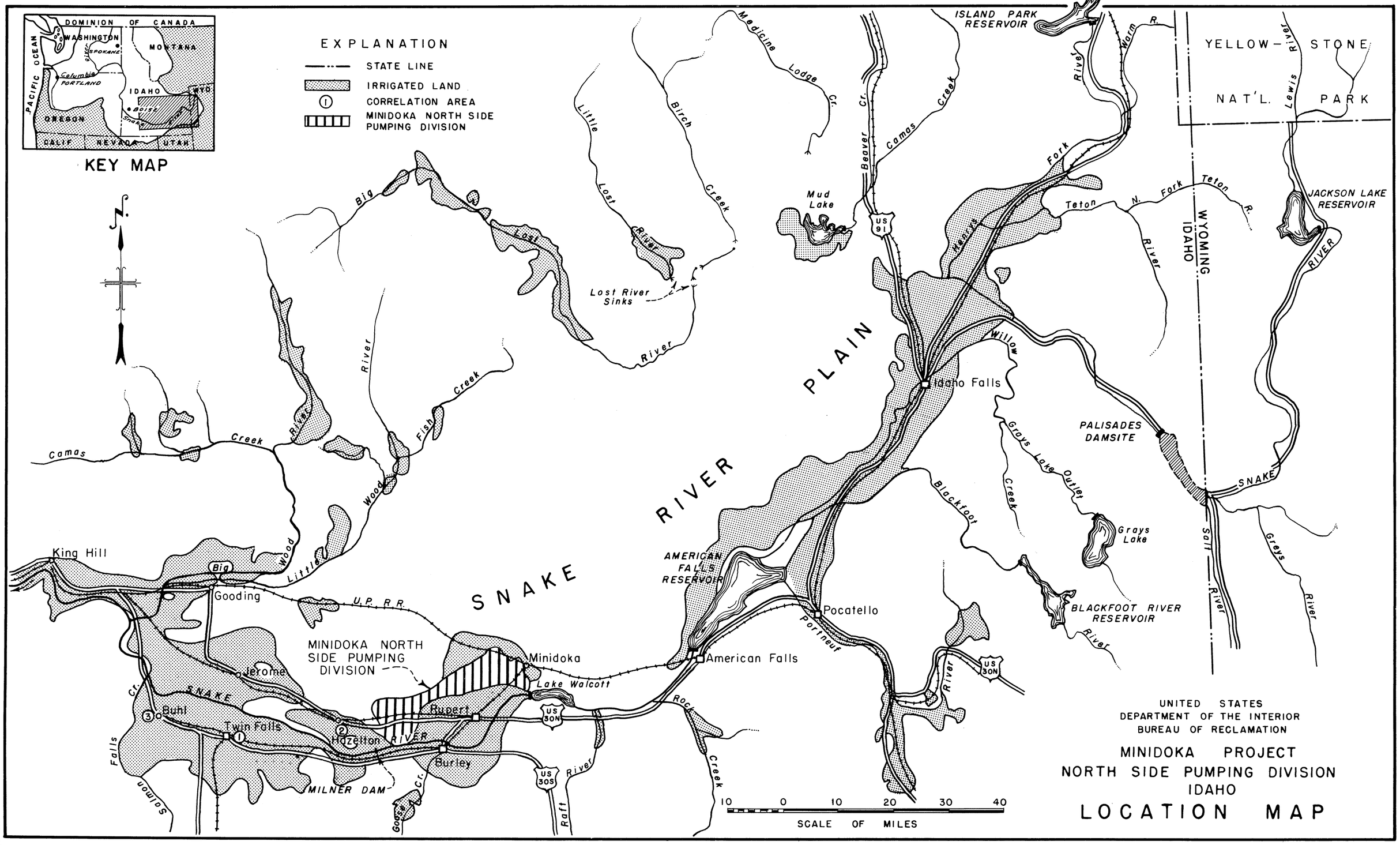
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MONTANA
PACIFIC OCEAN
Columbia
PORTLAND
IDAHO
WYO.
Boise
Snake
OREGON
CALIF.
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UTAH
EXPLANATION
STATE LINE
IRRIGATED LAND
CORRELATION AREA
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N.
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ISLAND PARK RESERVOIR
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WYOMING
IDAHO
Idaho Falls
PALISADES DAMSITE
Grays Lake
BLACKFOOT RIVER RESERVOIR
AMERICAN FALLS RESERVOIR
Pocatello
American Falls
Minidoka
Lake Walcott
Rupert
Burley
Hazelton
Twin Falls
Buhl
Jerome
Gooding
King Hill
MINIDOKA NORTH SIDE PUMPING DIVISION
MILNER DAM
U.P. R.R.
Mud Lake
Lost River Sinks
Big Lost River
Little Lost River
Birch Creek
Medicine Lodge Cr.
Beaver Cr.
Camas Creek
Henrys Fork
Teton River
N. Fork Teton R.
Warm R.
Lewis River
Willow
Grays Lake Outlet Creek
Blackfoot River
Portneuf River
Rock Creek
Raft River
Goose Cr.
Salmon Falls Cr.
Big Wood River
Little Wood River
Camas Creek
Fish Cr.
Snake River
Salt River
Greys River
US 91
US 30N
US 30S
10 0 10 20 30 40
SCALE OF MILES
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
MINIDOKA PROJECT
NORTH SIDE PUMPING DIVISION
IDAHO
LOCATION MAP

GPO 986770

CHAPTER I

THE AREA AND THE PROJECT

The North Side Pumping Division of the Minidoka Project would provide for the irrigation of 77,650 irrigable acres of potentially productive, dry sagebrush land on the Snake River Plain in southeastern Idaho. The lands of the Division share the physical characteristics which have made possible elsewhere in the Upper Snake River Valley one of the most successful irrigation developments in the United States.

Evaluated annual monetary benefits resulting from development of the North Side Pumping Division will be several times its annual cost. Moreover, full repayment of the reimbursable costs of the development seems assured. This repayment is in prospect within the 50-year repayment period provided for in the authorizing act, Public Law 864, 81st Congress, 2d Session, approved September 30, 1950. Repayment of the cost of irrigation facilities can be made entirely by the future residents of the project area.

Nearly 695 new farm units can be made available for settlement by development of the North Side Pumping Division. Almost all of them will be on Federal public domain and, consequently, would be made available for homestead entry. Under prevailing law, veterans of World War II and the Korean conflict would have preference in acquiring the new farms in this manner.

The plan presented in this report contemplates development of 77,650 acres of irrigable land. Of the total irrigable acreage, 13,650 would be supplied by pumping from Snake River and is designated as Unit A. The remainder of the Division, 64,000 irrigable acres, would be supplied from 175 wells tapping the great groundwater body underlying the area.

An integral part of the development plan is provision for storage space in the existing American Falls Reservoir and in Palisades Reservoir which is under construction.

Hydroelectric power for pumping would be obtained initially from the Minidoka and Anderson Ranch Powerplants and subsequently, when they are completed, from the Palisades and American Falls Powerplants.

GENERAL DESCRIPTION

Location

The lands of the North Side Pumping Division are located in Minidoka and Jerome Counties (see Location Map). The Minidoka Irrigation District (the Gravity Division of the Minidoka Project), comprising the prosperous farming area in the vicinity of the town of Rupert, borders the project on the south. West of the North Side Pumping Division are the irrigated farmlands of the Twin Falls North Side development and those of the Gooding Division of the Minidoka Project. North and east of the Division are wide, empty expanses of the Snake River Plain characterized by lava rock outcrops and shallow soils.

The project area is relatively compact; it ranges from two to seven miles in width and is about 30 miles long. It trends generally from east to west, forming a roughly crescent-shaped land body contiguous to the northern and western borders of the Minidoka Irrigation District.

Physical Features

The Snake River Plain, on which the North Side Pumping Division lies, was built up by a series of basaltic lava flows of unknown depth. The volcanic activity which gave rise to the lava flows took place at intervals over a long span of time, with long periods of quiescence between eruptions. Beneath the surface soils there is no uniformity in the rock structure. Old buried canyons of the Snake River, deposits of alluvium between flows, and brecciated contact zones, together with the cracks and crevices formed in the cooling lava, make up a very porous formation. Heavy deep percolation losses from surface flows in river channels and from irrigated lands of the upper valley form a tremendous ground-water body that moves westward and discharges into the Snake River between Milner Dam and King Hill, Idaho. (See Location Map).

Topography

The surface of the plain, although generally smooth, lacks a well defined drainage pattern because of its youthful stage of geologic development. In the project area, the irregular benches, pressure ridges, and depressions of the last lava flow have been covered with a mantle of wind-borne material. This deposit ranges in depth up to 45 feet and has had a smoothing effect on the topography.

Gentle, undulating slopes and large expanses of smooth benches are characteristic of the North Side Pumping Division. The general topography is well suited to irrigation farming because of the low gradients and smooth surface. The high permeability of the soil mantle and of the underlying rock provide excellent internal drainage, which offsets the lack of a distinct surface drainage pattern except in a number of very small areas.

The eastern portion of the Division has numerous, small, high areas which would complicate distribution of water from a main canal and lateral system. This topographic feature, however, will not affect water distribution from wells located on these high points. The central portion of the area has some enclosed basins or "potholes." Drainage of surface waste from these depressions will be accomplished with inverted drainage wells or sump wells drilled to crevices or highly porous zones in the underlying lava rock. The southwestern portion of the area is made up of flat to gently rolling land bodies surrounding a few large, high areas. In contrast to the eastern portion, it is well suited to the distribution of water from an ordinary canal system.

Soils

The soils on much of the Snake River Plain, including those on lands of the Division, have developed from wind-borne material deposited on the irregular surface of the lava flows. In general, the soils of the Division, described in detail in Chapter II of the report, are light-colored, free-working in the surface layer, and high in mineral nutrients. The subsoils have a high lime content and varying degrees of compactness. Typically, the soils are deep and friable, and have a high water-holding capacity. In texture, they range from silt loams to very fine sandy loams. Similar soils in nearby areas have proven to be very productive under irrigation.

Climate

The climate of the North Side Pumping Division, in common with that of most of the Snake River Plain, is arid. Precipitation, especially during the growing season, is very low; temperatures are high and humidities are low during the summer; and the growing season and frost-free periods are of moderate length. During the 41 years of record, the annual precipitation has averaged less than 10 inches. Most of the precipitation occurs as rainfall, but an average of about 26 inches of snowfall (equivalent to about 2.8 inches of rainfall) is received in the winter months. Growing-season rainfall (May to October) inclusive, averages only about 4.2 inches. The time and occurrence of the growing season rainfall is unpredictable, inasmuch as it is received from convectional showers which may bring almost half the 4.2 inches in a single month, and little or

none in other months. Hail falls occasionally but usually is not of sufficient intensity or extent to cause serious crop damage.

Temperatures in the Division are typically moderate in winter and high in summer. Average winter maxima and minima are about 45 and 20 degrees, respectively. Subzero winter temperatures occur occasionally in each of the winter months. During the summer months, days are hot and nights are cool. With sunshine prevailing about 70 percent of the daylight hours, daily maximum temperatures average about 85 degrees, but often reach 100 degrees. Summer nighttime minimum temperatures average slightly above 40 degrees, although readings in the 30's are not unusual. The high summer temperatures are accompanied by low humidity.

The growing season, when defined as the approximate period during which the more hardy agricultural crops will grow, is about 190 days, and extends from the latter part of April to latter part of October. The fluctuation in length of growing season from year to year is typically not great, but in exceptional years the season may be as long as 230 days or as short as 160 days. The frost-free period averages about 130 days and extends from about the middle of May to the latter part of September. In contrast with the length of growing season, the frost-free period, which commonly is marked at either or both ends by a light frost which does not damage hardy crops, has a relatively wide variation from year to year. Frost-free periods of more than 160 days and of less than 100 days have occurred at Rupert in the past.

Over the exposed areas of the Snake River Plain such as the North Side Pumping Division, winds frequently attain high velocities which are sustained for hours. Although winds of destructive force are of rare occurrence, velocities in excess of 45 miles per hour have been recorded. Winds are highest in late winter and early spring and are lowest during summer or autumn. The maxima recorded in the past, however, are in excess of 35 miles per hour in all months.

A summary of climatological data for Rupert, which is representative of climatic conditions in the North Side Pumping Division, is presented in table 1.

SETTLEMENT AND DEVELOPMENT

Historical Background

The Snake River Plain, endowed with an abundance of fertile, though arid land, and traversed by the Snake River, early provided an attractive setting for irrigation development. From a start about 1879, development was so rapid that virtually all of the land now

Table 1.--Summary of climatological data

Station at Rupert, Idaho (1907-47)

	Precipitation			Temperature		
	Mean Monthly	Max. yr. (1913-14)	Min. Yr. (1933-34)	Average Daily Mean	Average 1/ Daily Maximum	Average 1/ Daily Minimum
	inches	inches	inches	degrees F	degrees F	degrees F
October	0.94	0.64	0.06	49.2	63.9	32.8
November	1.00	2.16	0.32	36.9	49.7	24.0
December	0.97	1.88	1.00	27.7	37.0	16.0
January	1.06	2.27	0.74	24.6	35.5	14.4
February	0.95	0.94	1.26	29.8	40.7	20.2
March	0.78	0.20	0.49	38.3	51.4	26.0
April	1.02	2.02	0.39	47.0	61.8	31.5
May	1.01	0.89	0.20	55.3	70.5	38.7
June	0.84	2.06	0.38	63.1	79.2	42.1
July	0.41	0.26	0.06	71.9	88.7	53.3
August	0.41	0.63	0.41	68.6	85.8	50.2
September	0.56	1.30	0.16	58.8	75.6	40.4
Annual	9.95	15.25	5.47	47.6	61.6	32.5

1/ Period 1907-30

irrigated on the Plain upstream from the site of the Minidoka Project was under ditch by 1900. Development of the Minidoka Project and the North and South Side Twin Falls Projects was initiated shortly thereafter and the irrigated acreage brought essentially to its present proportions by 1920. The total area served by all existing irrigation developments in the Upper Snake River Basin are somewhat more than 1,500,000 acres.

The development of irrigated land years ago outran the supply of water available during summer from the natural flow of the Snake River, and a series of storage projects were undertaken. The storage, virtually all of it developed since 1900, has reached a total capacity of nearly 4,000,000 acre-feet. The Palisades Reservoir Project, now under construction, will add an additional 1,400,000 acre-feet of storage space and will make available a large portion of the remaining, unused water of the Snake River above Milner Diversion Dam. Thus, on the basis of present water use and rights, the Upper Snake River Basin is approaching full utilization of its surface water resources.

The North Side Pumping Division of the Minidoka Project has been a prospective part of the irrigation development in the Upper Snake River Basin for several decades. The circumstances which brought about prior development of other, nearby areas are discussed subsequently in connection with early investigations of the Division. Those other developments, with their flourishing agricultural communities, abundantly demonstrate the benefits to be achieved from development of the Division.

Local Economy

The government lands of the Division had no permanent residents, until opened to entry, and are dry, providing only occasional seasonal use as sheep range. Undeveloped privately-owned lands in the general area adjacent to the Division and former State school sections dispersed within the perimeter of the Division are rapidly being developed by deep well pumping from the same ground-water body underlying the Division. In the period 1947-1954, some 125 deep well pumps have been installed and approximately 35,000 acres have been placed under irrigation as shown on map titled Government and Private Irrigation Development. It is estimated that up to 25,000 acres of privately-owned lands adjacent to the project area remain for future development with ground water. Full development of the Division will tend to consolidate these isolated tracts into one economic unit, which will become an integral part of the adjacent larger area where successful irrigation agriculture is now established. The latter area provides a guide to the prospective use of Division lands and its existing towns will afford many of the basic services to be required by settlers on the Division.

Irrigation Agriculture

In the immediately adjacent Minidoka Irrigation District, and in the nearby Burley and Gooding Districts and North and South Side Twin Falls Projects, lands similar to those of the North Side Pumping Division are used with great success to support an intensive, diversified irrigation agriculture. Although hay, pasture, and grain produced largely for the dairy industry and for range livestock predominate in acreage, cash crops have a very important place in the farm economy. The area is famous for the quality and yield of its potatoes, beans, and onions, and other important cash crops include peas and sugar beets. In 1939, potatoes, sugar beets, and beans occupied more than one-fifth (140,000 acres) of the irrigated land (675,000 acres) of the six counties in which the developments noted above are located, and had a value ($8,675,000) equivalent to 38 percent of the total income in the area from all crops and livestock ($22,699,000).

Transportation

Rail transportation currently available to established communities will serve settlers on the Division. The main transcontinental line of the Union Pacific Railroad to Pacific Northwest points crosses the northernmost part of the Division; and branch lines, serving towns of the existing irrigated areas, run southward from a connection with the main line at Minidoka, a town near the northeast corner of the North Side Pumping Division.

United States Highway 30 passes through the existing irrigated areas south of the Division, and those areas are served by a well developed network of state and county roads. Extensions of the county network already provide the nucleus of a system to serve lands of the Division, although much new county road construction will be required to serve adequately the settlers on the lands to be developed.

Industry

Industrial and commercial activities in towns of the area are almost exclusively confined to the processing and handling of farm products and to the provision of other services and goods required by the local population. A sugar factory is located at the nearby town of Paul, and all other processing and warehousing facilities likely to be required by settlers on the Division are already established at reasonably accessible centers. These services can be expected to fill the needs of settlers on the Division, at least during earlier stages of development.

INVESTIGATIONS

The plan of development for the North Side Pumping Division, outlined briefly in the first section of this chapter, differs significantly from earlier, widely considered plans for irrigating lands of the Division, conceived more than 40 years ago, simultaneously with plans for developing other portions of the Minidoka Project. The circumstances that have occasioned the prior development of the other lands in the project, which have been in production for several decades, and the deferment of the North Side Pumping Division are of significance to the plan adopted for the project.

Early Plans for Development of the North Side Division

Although detailed investigations of facilities to deliver water to lands of the North Side Pumping Division were not made in the earlier years, when development of other divisions of the Minidoka Project was under way, some studies were made. Moreover, the provision of a water supply for the North Side Pumping Division lands was continually held in mind in connection with the development of storage facilities for the Minidoka Project as a whole.

Jackson Lake Reservoir

The development of storage for the Minidoka Project, as originally conceived and described in a Board of Engineers report dated March 21, 1904, contemplated the provision of 555,000 acre-feet of storage in Jackson Lake. Of this total, 216,000 acre-feet were estimated as adequate, in combination with unappropriated natural flows, to meet needs on 120,000 acres proposed for immediate development in the Gravity Division (now the Minidoka Irrigation District) and the South Side Pumping Division (now the Burley Irrigation District). The remaining storage capacity (339,000 acre-feet) was to be reserved for future "new divisions" of the Minidoka Project. A temporary dam built at the outlet of Jackson Lake during the period of 1906-07 provided 200,000 acre-feet of storage to meet the earliest need, and served as a cofferdam for a larger structure, completed in November 1911, which afforded storage capacity of 380,000 acre-feet. Construction of the Gravity Division was completed in 1907 and that of the South Side Pumping Division in 1909.

On March 18, 1908, the lands of the North Side Pumping Division were withdrawn from public entry by an order of the Secretary of the Interior, and in that same year a preliminary study of development of pumping from Lake Walcott was made. The Reclamation Record for November 1908 stated:

"A reconnaissance survey was made of 150,000 acres of high land on the North Side of the present project for the purpose of determining the feasibility of irrigating it by pumping."

Additional study of the Division was not undertaken until 1917. Costs for the North Side Pumping Division were prospectively higher than for lands of the other divisions, and development of the latter met immediate demands and needs. Moreover, attention was drawn to the need for additional storage for lands already settled and cultivated which had been demonstrated by irrigation experience and by final establishment of the natural flow rights of the Minidoka Project in the adjudication of Snake River water rights set forth in the Foster Decree of 1913.

Subsequently, two increases were made in the storage capacity of Jackson Lake Reservoir, and the storage space there was reallocated in favor of existing developments. Interest in the North Side Pumping Division, however, revived shortly thereafter. Detailed studies of it were made, and the plans formulated for storage in the American Falls Reservoir included provision for the North Side Pumping Division.

The first enlargement of the Jackson Lake Reservoir, made between 1913 and 1916, added 409,000 acre-feet to the then existing capacity of 380,000 acre-feet. The enlargement was financed by and the added space was allotted to the Kuhn Irrigation Canal Company, predecessor of the North Side Canal Company and the Twin Falls Canal Company, to serve lands previously developed by that company. At the same time (1916), a reallocation was made of the 380,000 acre-feet of storage for the Minidoka Project. The 216,000 acre-feet of space initially allotted to the Gravity and South Side Pumping Divisions was increased to 268,000 acre-feet, the space reserved for new divisions was reduced to 102,000 acre-feet and 10,000 acre-feet were allotted to the North Side Canal Company. Shortly afterward, in 1916 and 1917, the 102,000 acre-feet of space for new divisions was sold to 16 canal companies and irrigation districts in the upper valley, to meet urgent needs for additional water on their lands. The selling price was fixed at the then estimated cost of replacing the storage in the reservoir under consideration at American Falls. (See the discussion of credits to the North Side Pumping Division in the Financial Summary Chapter of this report.)

The second enlargement of the Jackson Lake Reservoir storage capacity, made between 1917 and 1919 by dredging the channel above and below the dam, added 58,000 acre-feet of capacity, and this increase was allotted to new divisions of the Minidoka Project. Subsequent to the start of construction on the American Falls Reservoir, (1925), in which provision was made for the North Side Pumping Division,

the 58,000 acre-feet of reserved Jackson Lake space was sold (1928) to the existing divisions of the Minidoka Project.

Renewed local interest developing in the North Side Pumping Division was evidenced in 1917 by the formation of an organization at Rupert, Idaho, seeking construction of the Division. This interest was reflected in the launching of detailed investigations for the Division in 1918. These investigations were continued into the year 1921.

The investigations made in the 1918-21 period included the detailed topographic mapping of 154,378 acres, and the retracing of the public land survey. In addition, preliminary canal lines were run and pumping plant sites surveyed. Land classification work during this investigation was limited to a rough reconnaissance. Subsequent to 1921, some preliminary studies were made of the pumping plants and canal system to serve the project area.

The project area and pump lift studies are described as follows in the 19th Annual Report of Reclamation Service (1919-20):

> "The North Side Pumping Unit of the Minidoka Project lies to the north and west of the present project and consists of about 150,000 acres of excellent land, of which about 115,000 acres can be irrigated with an average lift of 90 feet. Three stations between Minidoka and Minidoka Dam, pumping to a maximum of 120 feet above Lake Walcott in three steps of 40 feet each will serve 98,000 acres. One station below the west end of the present project will serve 9,000 acres with a total lift of 100 feet and 8,000 acres more with a total lift of 150 feet. * * * * "

No formal report covering the findings of these investigations and establishing the engineering and economic feasibility of the development was submitted to the Congress. The files of the Bureau, however, are replete with evidence that the feasibility of the undertaking was accepted, and its construction along the lines indicated was anticipated at the time of construction of the American Falls Reservoir.

American Falls Reservoir

The growing need for storage to meet requirements which were greatly expanded by a drought in 1919 led to the development of plans for the American Falls Reservoir as early as 1920, and the completion of its construction in 1927.

Development of the North Side Pumping Division was a primary consideration in obtaining the authorization to construct American Falls Reservoir; on court actions incident to condemnation of the reservoir right-of-way, including the relocation of the town of American Falls; and in the provision in the dam design for construction of a 30,000-kilowatt powerplant to supply pumping power. Tentative allocation of storage space in American Falls Reservoir was made for the Division, and it was included in the proposed 10-year reclamation development program released by Secretary Work in November 1926. The suggested allocation of space in American Falls Reservoir, as originally made by the Bureau of Reclamation and as furnished to the Appropriation Committee of the House of Representatives in statement of Dr. Elwood Mead, the then Commissioner of Reclamation, on November 23, 1926, was as follows:

Minidoka North Side Pumping Division	522,000 acre-feet
Irrigation Districts, etc.	790,000 acre-feet
Idaho Power Company, power rights	45,000 acre-feet
Unallotted	343,000 acre-feet

An alternative development called the Gravity Extension Division, now known as the Gooding Division of the Minidoka Project, however, found greater favor among congressional representatives of Idaho. As a result, construction of the Gravity Extension Division was initiated following congressional action in the Appropriation Act of January 12, 1927, and development of the North Side Pumping Division was postponed. Subsequently funds appropriated for that Division were transferred by the Congress in 1930 to further the construction of the Gravity Extension Division. Moreover, to meet water requirements of that Division, 400,000 of the 865,000 acre-feet of space reserved by the Federal Government in American Falls Reservoir (522,000 for the North Side Pumping Division and 343,000 unallotted) were assigned to the Gravity Extension Division. Sale of 32,000 acre-feet of storage space to Warren Act contractors prior to 1931 left a balance of 433,000 acre-feet reserved by the Federal Government. (The actual balance amounted to 433,593 acre-feet but rounded figures have usually been used in discussions.)

Basin Development Problems and Plans

Events of the years following 1930 contributed to a further delay in development of the North Side Pumping Division, and created problems which affected and required consideration within the entire Upper Snake River Basin before it was possible to establish the most desirable course with respect to the Division.

A drought which began in 1929 proved to be of unprecedented length and severity. To meet the emergency, all of the reserved

space in American Falls Reservoir was leased to the existing projects, beginning in 1931. Even with this aid, however, most of the projects suffered serious water shortages in 1931, 1934 and 1935.

The experience indicated that the then existing storage, developed on the basis of earlier water records, was inadequate to provide even a fully dependable supply for existing irrigation developments, and entirely inadequate to provide also a full supply for new land developments. From a physical standpoint, therefore, it became evident that, until additional storage could be provided for existing projects, the reserved space in American Falls Reservoir under lease could not reasonably be used for new land development. Investigations of additional storage possibilities led to the selection of the Palisades site, on the Snake River near Irwin, Idaho. The Palisades Dam Project was authorized in December 1941. The authorizing document, however, stipulated that construction of the dam and reservoir not be started until the water users to be benefited had given satisfactory assurance to the Secretary of the Interior that they would make available for storage in the reservoir at least 135,000 acre-feet of water being wasted by winter operation of canal systems for domestic and stock watering purposes.

Following the conditional authorization of the Palisades Project in 1941, the Bureau of Reclamation initiated an intensive investigation to determine (1) the areas where it was most practical to eliminate winter diversions, (2) the amount of water that could be saved thereby, and (3) the most desirable way to utilize the Palisades storage and the reserved American Falls storage to meet the overall irrigation needs of the valley. In connection with the latter, two plans for utilizing the 433,000 acre-feet of unsold American Falls space were studied in detail--one using it in conjunction with Palisades Reservoir to provide a supplemental supply for existing projects, and another using it for the development of new land in the North Side Pumping Division and on Michaud Flats. The latter area, which lies between Pocatello and American Falls, was included in the study because return flow from it can be re-used on projects above Milner Dam. On the other hand, return flow from water applied to lands of the Division would reach the Snake at points where it would not thus benefit existing developments.

The results of the water supply investigations, together with the Bureau's recommendations, are contained in a report entitled, "Water Supply for Palisades Reservoir Project, Idaho," published in 1946. This report formed the basis for an ensuing, lengthy negotiation between the several interests involved on the ultimate disposal of the reserved American Falls space.

The negotiations centered on the amount of that space to be used in connection with new land development versus the amount to be acquired by existing irrigation groups, now leasing the space, for purposes of supplementing their water supplies. The Bureau of Reclamation, anticipating that the needs of water users on existing projects would be satisfactorily met by the acquisition of space in the Palisades Reservoir, initially proposed that all of the reserved space in American Falls Reservoir be used for new land, with 210,000 acre-feet allotted to the Michaud Flats Project and 223,000 acre-feet to the North Side Pumping Division. The water users, however, holding in mind the losses experienced in 1934, even with full use of the reserved American Falls space, took the initial position that all of that reserved space should be sold to the interests now leasing it, in addition to space which those interests planned to acquire in the Palisades Reservoir. A tentative agreement was reached whereby 315,000 acre-feet of the reserved space would be sold to the canal companies and irrigation districts now leasing it, 71,000 acre-feet would be allotted to new land on Michaud Flats, and 47,000 acre-feet would be allotted to the North Side Pumping Division. (The actual tentative allotment was 47,593 acre-feet, but the rounded figure is used hereinafter in the report.)

The agreed-to allotment of American Falls space set definite limits on the acreage of land in the Division which could be developed with surface water because the yield of that space is the only remaining unappropriated surface supply in the Upper Snake River Valley that can be depended upon every year. This base supply can be augmented somewhat by natural flow diversions during wet cycles and by holdover storage water from Palisades Reservoir during dry cycles, but such possibilities are extremely limited by economic considerations and the risk of longer or more severe droughts occurring in the future.

Planning Report Investigations

With the limitations on the available surface water thus established, a study was made to determine the most desirable area on which to utilize this supply. The results of this study were set forth in a special reconnaissance report on the Minidoka North Side Pumping Extension in October 1947. This report tentatively established the area now considered as Unit A as the place where the 47,000 acre-feet of available space should be utilized, and recommended that investigation be made of the possibility of developing the remainder of the project from ground-water supplies. The subsequent studies and initial stages of development have demonstrated the soundness of these recommendations.

Numerous surveys and studies, additional to those previously made during the years 1917-1921, were carried out in connection with the project planning investigation. Topographic maps of approximately 10,000 acres previously covered only by reconnaissance mapping were prepared; detailed topography was taken of a pumping plant site on the north shore of the impoundment behind Milner Dam; and a preliminary location made for the canal to be served from the surface water supply. Initially, approximately 122,400 acres of land were classified in detail. In 1954 this detailed classification was extended to include about 8,400 additional acres, bringing the total to about 130,800 acres from which 77,650 irrigable acres were selected for overall project development.

Water supply studies made for the portion of the project to be provided with surface water (Unit A) were based on information developed in connection with studies for the Palisades Reservoir Project. An investigation of ground-water resources available for use in the Division was conducted and has been continued in collaboration with the Geological Survey, United States Department of the Interior. The report of the Survey is appended to the Project Planning Report. Water depths of all existing wells in the immediate vicinity of the Division were measured; control levels run to these wells; and a ground-water contour map prepared. On the basis of information provided by the map, three wells were drilled and tested at significant locations in the portion of the project to be served from ground-water sources (Unit B), and other sites were selected for subsequent drilling and testing.

The North Side Pumping Division, Minidoka Project planning report, dated April 1949, was submitted to Congress and resulted in H. R. 5506, 81st Congress, 1st Session. Hearings before the House Subcommittee and Special Subcommittee on Interior and Insular Affairs of the Senate, were held in August 1949. The bill included the reauthorization of Palisades Dam and Reservoir Project, authorization of American Falls Powerplant, and authorization of North Side Pumping Division of Minidoka Project. The bill was not enacted at that time and was again presented in 1950. A similar bill was passed and enacted into Public Law 864, 81st Congress, Chapter 1114, 2d Session, and approved September 30, 1950. The new bill provided that no allocation of cost on a nonreimbursable basis can be made by reason of fish and wildlife benefits, but extended the payout period on construction charges for the North Side Pumping Division from 40 to 50 years. It also provided that no transmission or distribution lines could be constructed unless such facilities are for interconnection of powerplants or for the delivery of power and energy for use in connection with construction, operation and maintenance of the projects therein authorized.

Advance Planning Investigations

At the close of investigations for the project planning report, the immediate need was recognized for continued progressive study and proving of the adequacy and extent of the ground-water supply. A section was organized under the Minidoka Project Office of the Bureau at Burley, Idaho, in July 1948 to carry on the investigations for the North Side Pumping Division. In October 1949, the section was moved to Rupert, Idaho, where an office, garage, and living quarters had been established. The activities of this branch office were directed toward the following objectives:

(1) Drill, equip, provide lateral systems for, and operate at least 10 irrigation wells in the preconstruction period to further establish evidence of the availability and adequacy of the ground-water supply.

(2) Drill, equip, and operate 4 observation wells for the purpose of obtaining overall drawdown of the ground water under continuous irrigation season pumping.

(3) Drill, equip, and operate a sufficient number of observation and exploratory wells in the vicinity of Lake Walcott to determine ground-water behavior in that area.

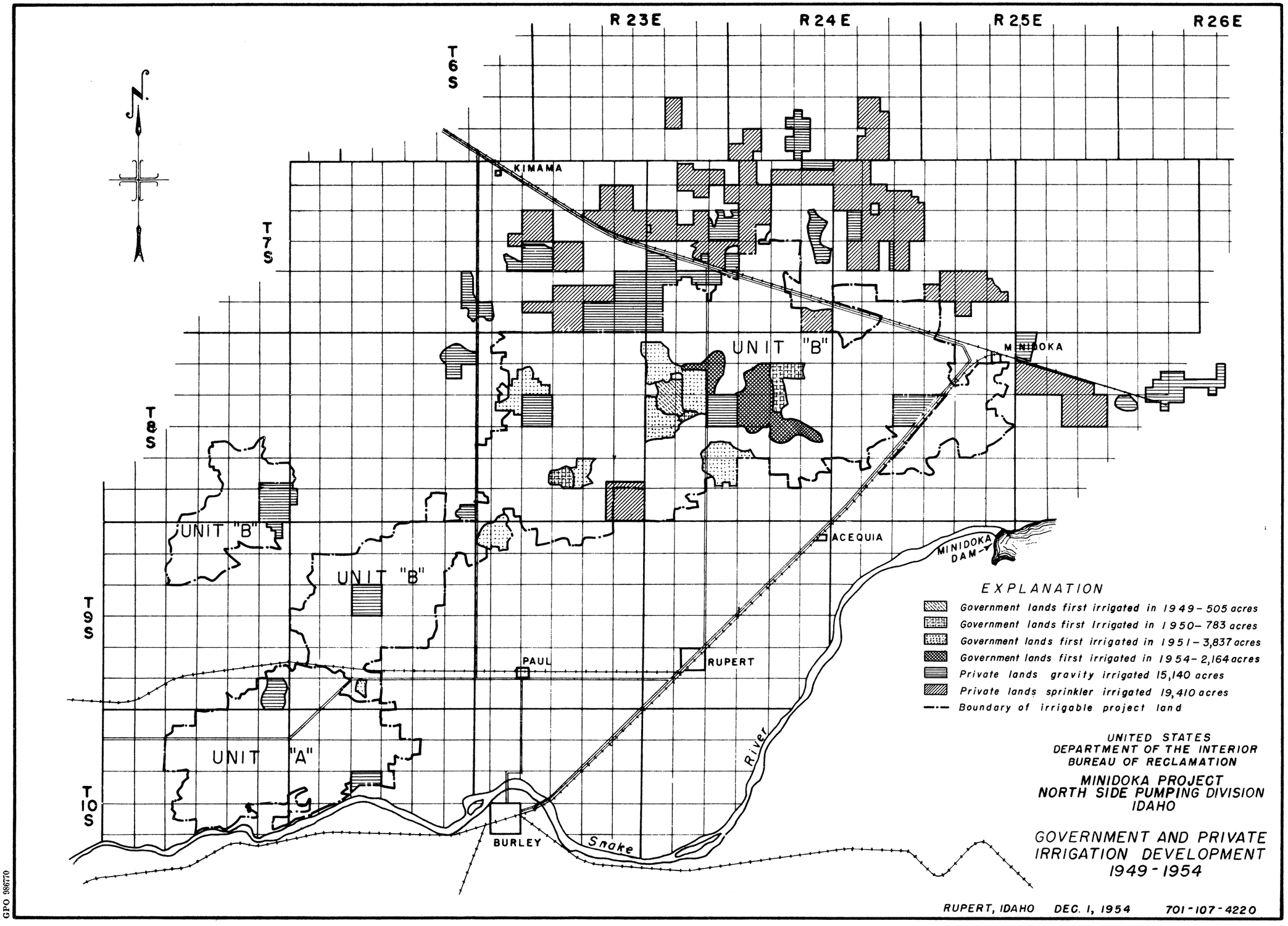
(4) Lease land under the irrigation production wells in order to make profitable use of the pumped water and supply information on ground-water depletion under continuous pumping, amount of water needed for irrigation, soil response to various crops, and information on crop yields, cropping and irrigation practices.

(5) Establish gaging stations and observe effect of pumping on the flow of ground-water springs downstream from Twin Falls, Idaho, and through Hagerman Valley.

(6) Complete land classification and establish a definite project acreage.

(7) Investigate more thoroughly the drainage system of the project and revise the estimated cost thereof.

The above program was started by equipping one well with a diesel-driven pump in the spring of 1949. A lateral system was constructed to irrigate 504 acres under the well and the land was leased to six operators. Water was delivered and crops were produced in the 1949 irrigation season. Two more irrigation wells were brought under production in the 1950 irrigation season, supplying water to an additional 730 acres under lease. Seven additional production wells


R 23E
R 24E
R 25E
R 26E
T 6 S
T 7 S
T 8 S
T 9 S
T 10 S
N
KIMAMA
MINIDOKA
UNIT "B"
UNIT "B"
UNIT "B"
UNIT "A"
ACEQUIA
MINIDOKA DAM
PAUL
RUPERT
BURLEY
Snake
River
EXPLANATION
Government lands first irrigated in 1949 - 505 acres
Government lands first Irrigated in 1950 - 783 acres
Government lands first irrigated in 1951 - 3,837 acres
Government lands first irrigated in 1954 - 2,164 acres
Private lands gravity irrigated 15,140 acres
Private lands sprinkler irrigated 19,410 acres
Boundary of irrigable project land
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
MINIDOKA PROJECT
NORTH SIDE PUMPING DIVISION
IDAHO
GOVERNMENT AND PRIVATE
IRRIGATION DEVELOPMENT
1949 - 1954
RUPERT, IDAHO DEC. 1, 1954 701-107-4220

GPO 986770

GROUP NO.	NO. OF WELLS	IRRIG. ACRES	NO. OF RELIFTS
1	16	7333.9	0
2	22	8783.9	0
3	30	10647.6	0
4	32	10897.4	0
Unit A	0	13650.0	5
5	30	10455.8	5
6	17	6934.3	3
7	28	8947.1	0
TOTAL	175	77650.0	13

GPO 986770

were drilled in 1949 and 1950. These were equipped and placed in operation in May 1951 to irrigate an additional 3,800 acres. A pump was installed in a well formerly operated for the Prisoner-of-War Camp, west of Paul, Idaho. This pump began operation in the 1951 irrigation season to irrigate 70 acres, of which about 30 acres are class 5 land. The 70 acres were leased for a period of 5 years to determine the response to irrigation of the class 5 land. Leased land in 1951 totaled 5,104 acres. Since that time, 26 additional wells have been drilled and 63 more wells placed under contract. In 1954, 15 irrigation wells were in operation that supplied nearly 25,000 acre-feet of water to 7,289 acres.

Four observation wells were drilled, automatic recorders were installed, and observation of water table fluctuations was started in August 1950. An additional eight observation wells were drilled in 1951, two of which were paid for by the Minidoka and Burley Irrigation Districts, and two observation wells were drilled and placed in operation in 1953. Field operation of the recorders is performed by the Bureau of Reclamation and the data are submitted to the United States Geological Survey for inclusion in its Idaho observation well data. The latter agency has the responsibility of observing downstream spring outflow and has established the required number of gaging stations and is operating them to ascertain the effect of ground-water pumping on vested spring flow water rights.

Observations have been made on ground-water behavior, and data have been collected and compiled on water use, water requirements, crops and other appurtenant elements of the project.

Detailed land classification which initially covered about 114,400 acres has now been expanded to about 130,800 acres.

Drainage studies were completed on selected areas of the project and drainage estimated costs were revised.

Continuation of Ground-water Observations

The irrigable acreage to which Unit B should be expanded has now been determined by land classification and will depend on subsequent evaluations of the ground-water supply as the draft is increased. Observations of ground-water behavior to the date of this report and an evaluation of the ground-water resources of the area indicate that the entire 64,000 irrigable acres proposed for Unit B can be developed. A continuing program of careful observation of the ground water will be maintained, however, throughout the period of project development and operation.

Cooperation and Acknowledgments

The cooperation and assistance of numerous individuals and organizations have provided valued contributions to the advancements of the investigations. Officials of several irrigation districts and many farmers within those districts helpfully provided data requisite for the correlation studies. Others who gave freely of their time and knowledge were the county agricultural agents of Twin Falls and Minidoka Counties and Dr. G. O. Baker of the University of Idaho, who assisted in setting up the land classification standards. Public records of the Weather Bureau, United States Department of Commerce, were utilized in all matters pertaining to climate.

Special acknowledgment is due Raymond L. Nace, District Geologist, Geological Survey, for his aid in the ground-water investigations. Mr. Nace prepared the report of the Survey, which, as noted, is appended to the project planning report. Free use was made of published and unpublished information prepared by the Geological Survey. Officials of the Fish and Wildlife Service were most helpful in preparing a report on the wildlife benefits of the proposed development, which is also appended to the project planning report. The Idaho State Department of Reclamation cooperated in the ground-water filing for the project, and also made data available on water rights.

NEED FOR DEVELOPMENT

Need for additional land development in south central Idaho, which the North Side Pumping Division would help fill, is evidenced in several ways. Recently, private interests have completed a number of developments near the project area, pumping from wells tapping the underground water resources. The success of these undertakings and the demand for land have prompted plans for further expansion. There were 4,645 applications from veterans under Public Notice No. 44 for 72 farm units in 1953 and 4,910 applications under Public Notice No. 45 for 85 farm units in 1954. Each opening of a project for homestead entry by the Bureau of Reclamation in recent years has been marked by applications from qualified veterans which exceeded many times the farm units available. A continuing flood of requests indicates that the need persists.

The North Side Pumping Division, composed principally of lands held by the Federal Government, would provide, as previously indicated, approximately 695 new farms, for which veterans would have preference. The experience on physically comparable areas nearby has demonstrated that release of this large block of public domain to individual enterprise would result not only in the creation of farm opportunities, but also would give rise to related commercial and industrial opportunities and to needed expansion of the economy and tax base of southern Idaho.

CHAPTER II

PROJECT LANDS

The lands of the North Side Pumping Division lie to the north and west of the North Side Gravity Division of the Minidoka Project and occupy a position somewhat higher in elevation. The project area of 77,650 irrigable acres has been selected from approximately 130,800 acres investigated for extension of the Minidoka Project. In view of an anticipated high cost for irrigation water, the land bodies selected for project development include only those areas which will have high farming value when placed under irrigation, and which have been shown to be economically suitable through comparison with correlation areas and by budget studies. About 83 percent of these lands have excellent soils and smooth, gently undulating slopes. In crop adaptability and yields, these lands should compare favorably with the best land now under cultivation in the Upper Snake River Basin. Some 17 percent of the area selected for development is somewhat limited in productivity or adaptability. The land-use value of these lands may be enhanced by close association within individual farm units with better lands, especially when slope is the limiting factor.

PHYSICAL LAND FEATURES

Within the Snake River plain there is a wide variation in land features. Bleak areas of barren lava rock adjoin extensive, fertile, rolling areas of sagebrush and sparse grasses. Near the river courses, alluvial plains adjoin areas where the surface is mantled with wind-blown material. Under the surface mantle of the alluvial plains are areas underlain with old lake deposits, deep stream deposits, massive sheets of lava rock, or lava rock that is creviced and permeable. In contrast to this diversity outside the project, soils of the Division are in an area underlain with creviced, broken lava rock where wind-blown and air-borne mantles of very fine sandy loam and silt loam--sometimes water stratified locally--range from a few inches up to known depths of 45 feet.

The area, in general, is underlain by a series of basaltic lava flows of unknown thickness, which geologists say originated from sources generally to the north, which gave rise to a series of irregular benches, pressure ridges, depressions, and breaks. In some cases, there is a brecciated zone between the flows, and there is evidence of the lava contracting on cooling to form a pattern of cracks and crevices separating the lava into blocks of varying size. Subsequently, the area became covered with air-borne and wind-blown material. This deposit is known to range up to 45 feet in thickness and has had a smoothing effect upon the topography of the area, which,

however, later became modified by erosion. At present, approximately 15 percent of the lands appears to be in the initial stage of modification, and the drainage is very indefinite; whereas, the balance is apparently in the early youth stage and has a fairly well-defined drainage pattern.

Soils

The soils of the project area naturally fall into two main categories, those without root restrictions in the profile and those with root restrictions within a depth of five feet.

Soils with No Root Restrictions in the Profile

The major portion of the soils of the upland area have no zones or layers which restrict root penetration in the profile. They are generally characterized by a leached silt loam surface soil to an average depth of 16 inches. This layer grades into a calcareous subsoil of silt loam with slight to medium compaction which continues to a depth of 30 to 40 inches. The more or less unmodified loessal parent material below is loose and floury and sometimes contains small, soft nodules in the upper part. The roots of the sagebrush now covering the area, are generally confined to the zone above the medium compaction; however, when irrigation water is applied, experience has shown that this layer softens and roots of cultivated crops readily enter this horizon.

A small part of these soils occupy low-lying areas of relatively small extent. Here the soils are noncalcareous, colloidally stained, and range in texture from heavy silt loam to clay loam. The subsoils have pronounced blocky to columnar structure.

Soils with Root Restrictions in the Profile

Soils with restricting layers or zones in the profile are limited to a relatively small portion of the project lands. Generally, the surface soils are silt loams, but in contrast to the soils with no restriction in the profile, they have a variety of profile features which may be detrimental to normal root development under irrigation. Below, these different soils are described in relation to their distinguishing features or restrictions:

(1) Soils with subsoils of weakly cemented or very compacted calcareous silt loam which may be nodular or platy. Partial root restriction is evident where cementation is more strongly developed. Corrective measures by subsoiling do not appear practicable but the lime layers are permeable to water and soften under irrigation.

(2) Soils with a thin, limy, fractured caliche-like layer in the subsoils which, as observed, stops the downward growth of roots somewhat. Soils of this type are permeable to water and the lime layers soften under irrigation. Even though these soils usually have 24 inches of soil over the restricting layer, this condition may limit their use where subsoiling is not practicable.

(3) Soils with an indurated hardpan which may be nodular or platy or may have a series of thin, limy cappings with softer material between. These layers, as observed in the field, are only partially penetrable to roots. No corrective measures appear practicable.

(4) Soils with an indurated lime hardpan known as caliche. This hardpan layer, except where fractured, stops root penetration but is slowly permeable to water and softens under irrigation. Corrective measures, such as subsoiling, would be impracticable in most cases.

(5) Soils underlain, at depths of less than 54 inches, by creviced basalt bedrock which stops roots. Corrective measures are impracticable.

(6) Soils which are very shallow to basalt bedrock, caliche or indurated hardpan and which are unquestionably nonarable lands.

Topography

The topography of the project area is generally well suited to irrigation farming. The eastern portion of the area, except for somewhat more rolling parts along the northeast edge, is made up of large, smooth to undulating land bodies, separated by natural drainage courses. These drains always are broad and flat in their upper reaches, but generally become steeper in gradient, rougher and more deeply incised toward the lower ends where they enter enclosed basins or the river valley along the south boundary of the area. Basalt reefs and sand dunes are prominent features at the eastern extremity of the project area.

The north central part has topography very similar to that described above, except that depressions or enclosed drainage basins are an important feature, especially in T. 8 S., R. 23 E., where they are quite numerous.

The southwestern part of the project, being composed chiefly of broad expanses of land with gentle slopes, has nearly ideal

topography for farming. It consists of a compact body, and is broken by rough terrain only where it merges with nonarable lands along the east and south borders.

The extreme northwestern part is characterized by fairly large stretches of land with gentle to undulating slopes separated by long, rocky ridges and rock-bordered drainageways.

Drainage

The North Side Pumping Division of the Minidoka Project should remain comparatively free of drainage problems. Over large parts of the Division the combination of fractured, open basalt and relatively uniform aeolian soil mantle with excellent internal drainage characteristics make it very unlikely that waterlogging of soils will occur. Even where caliche developments exist extensively as along the northeast edge these occur as more or less fractured layers with loose floury material between and are therefore permeable to water. Drainage in relation to project development is treated in detail under that heading elsewhere in this report. Here the subject is discussed in relation to the classification of the project lands.

In connection with the classification work, data on drainage were collected during the field operations. This was mainly on the drainage characteristics of the upper five feet of soil. Subsequently, deep borings were made to secure information on the material between the top five feet of soil and the underlying basalt bedrock.

The Surface Five Feet

During the progress of the land classification survey, borings were made to a depth of five feet at intervals of one-fourth mile, or less, over the entire project.

Infiltration studies were made in areas where representative soil conditions and profile characteristics were known to exist. In addition, certain problem areas, such as those having high salinity and slickspots, were chosen for infiltration studies. This work was done to determine the permeability characteristics of the upper five feet of the soil profile. Laboratory analyses were made on samples taken in the problem areas. A study of these data showed that in general the project lands have excellent internal drainage characteristics and that downward movement of water is not significantly retarded in most areas where subsoil caliche layers occur.

The Deep Understrata

Twenty-four deep borings were made over the project to determine the nature of the soil material between the surface five feet and the basalt bedrock. The coverage on this study included approximately one deep boring in each township and extra borings where special problems were anticipated. This work was done by a hand-operated soil auger 4 inches in diameter. During the progress of this work, no layer above the lava rock was encountered which could not be readily penetrated by this method. Representative samples from these borings were analyzed in the laboratory to determine the permeability and other characteristics of the material. An evaluation of all the data collected shows that except for an area along the northeast edge and small occasional areas elsewhere where lime cemented layers occur in the subsoil and substratum, loose, floury, very fine sandy loams and silt loams make up the soil mantle overlying the basalt. This loose floury soil should have good internal drainage and it appears that elsewhere the caliche layers are sufficiently permeable to permit adequate internal drainage in the subsoil and substratum.

The Bedrock

The basalt bedrock which underlies the project lands and adjacent area to the north and west is generally permeable. This is evident from examination of basalt exposures adjacent to the project and from the high deep-percolation losses in the Milner-Gooding canal. This canal was, to a large extent, blasted out of basalt along the west side of the project. Exposed lava swells and ridges nearly surround the division. These outcrops are all very permeable, owing to large pressure cracks and cooling joints. Some of these cracks give evidence of extending to considerable depth and of being part of a labyrinth of fissures and caverns in the lava rock. This is manifest by a sucking and blowing phenomena of some of these cracks, caused by changes in atmospheric pressure.

The free movement of water from the soil mantle into the underlying basalt was demonstrated by a study in a pothole area near well 27C823. An acreage adjacent to this pothole had been irrigated for two seasons and the surface waste had accumulated in the closed basin during this period. Five borings, 12 to 17 feet deep to the underlying basalt, were made in rather close proximity to the pond which had formed from runoff irrigation water. One of these holes was within 20 feet of the standing water. Although the soil immediately above the basalt approached saturation, no free water appeared in any of the holes.

While it is probable that the basalt is solid in local areas, and may restrict downward movement of water, it is unlikely that these

areas are of such extent as to result in a perched water table. The depth of soil ranging to more than 40 feet, the generally moderate to high rate of lateral movement of water through the soil, and the necessity for rigid economy in water use are factors which preclude the danger of developing a high perched water table.

Experience to Date

At the present time about 35,000 acres are irrigated on or adjacent to Unit B of the Division, some of these lands having been irrigated for eight seasons. So far there have been no indications of any local development of high water tables or other serious drainage problems. Drainage problems to date are confined principally to that of collection and removal of irrigation waste water. One Division inverted drainage well has been used for four seasons and has operated satisfactorily.

Saline and Alkali Soils

Salinity and alkali are minor problems in the area selected for project development. The soils are generally deep, permeable, and have few foreseeable drainage restrictions even where the loose floury subsoil and substratum soil material is bedded with caliche layers. However, these lime-cemented layers often contain appreciable though not serious concentrations of salt. Because of the undulating to rolling topography where these higher concentrations occur, the danger of a high water table developing appears remote and salts should leach out rather than become concentrated.

The most common problem of the area involves "slick spots" that are found scattered over the project. These, however, in most instances are not thought to constitute a serious permanent problem.

The slick spots are small areas of solonetz-like soil, ranging from a few square yards to several square rods in size, that are practically impermeable to water and impenetrable to roots. Occasionally, this condition affects areas of several acres in size. These spots are always saline-alkali in character. Some visible variations exist, such as whether the salts are near the surface and the B horizon is granular, or whether the salts are below a well-developed, columnar B horizon.

Reclaimability of the slick-spot areas is based largely on the depth that the saline-alkali condition has penetrated the profile and the concentration of the spots within a given delineation. Spots that occur on the better upland soils probably will require no special attention, as land preparation and deep tillage operations evidently destroy them. Other upland soils, that have platy

structures (frequently referred to as laminations) in the subsoil, have heavier concentrations of more deeply developed slick spots that are much more likely to be permanent. Thus, in evaluating the land for agricultural purposes, both permanence and concentration of slick spots must be considered.

In addition to the general occurrence of slick spots, salinity and alkali principally of the subsoil and substratum, are common to several thousand acres of land. About 900 acres of the land initially classified consist of saline areas with no visible surface indication of salt but some may contain numerous slick spots. For the most part, these 900 acres of saline and saline-alkali soils are scattered widely over the Division in tracts which generally do not exceed 100 acres. In other instances, combinations of salinity and occasional high pH are found in the subsoil and substratum. This is a soil condition that occurs extensively along the northeast edge of the Division in combination with high concentrations of lime in the subsoil and substratum.

There are 434 acres in one body five miles west of Paul, Idaho, astride State Highway 25. This area can be characterized as having a very slowly permeable, moderately heavy, thick, platy lower subsoil that is high in exchangeable sodium and generally has a salt content above 0.2 percent. The understrata are typical of the rest of the project area. The upper subsoil is fairly permeable and usually saline-alkali. Due to the good surface soils of this area, the land is now productive, but future deterioration, as affected by subsoil conditions, is a possibility. Test plots have been established in the area to observe changes in the salt and alkali contents in various horizons, so that its suitability for permanent agricultural use can be established. This investigation will be completed this year. Indications are that these lands are reclaiming satisfactorily under irrigation.

Most of the project area is underlaid by a thick substratum of floury silt loam that is almost without exception high in exchangeable sodium and generally moderately saline. Inasmuch as this substratum is well below the root zone, and there are no known drainage restrictions, this condition is not likely to affect the quality of the land or the repayment ability of the settler. Numerous tests have shown that the exchangeable sodium in these understrata is quickly removed by leaching, alone. In correlation areas where similar lands have been under irrigation for about 45 years, no evidence of alkali damage from the understratum has developed.

LAND CLASSIFICATION

The selection of the project area was the result of an integrated analysis of lands based on both physical and economic factors, as evaluated in terms of comparable developed lands, and of requirements for this specific project. An arability classification was accomplished by a field study of the physical conditions, correlated with factors of economic productive capacity. A further determination of irrigability then was made by correlating additional economic considerations.

On the western extremity of the North Side Pumping Division and adjacent to the Milner-Gooding canal is an area which is physically separated from the rest of the project. A detailed land classification, based upon the same standards and specifications as was used previously for the balance of the project lands, was completed on this area in the summer of 1950. An additional area of about 8,400 acres along the northeast edge of the Division in the vicinity of Minidoka was classified in detail in 1954. This was the last of the remaining Reclamation withdrawn lands to be included in the plans for project development.

Correlation Areas

As an aid in setting up the land classification standards, and to coordinate the land classification and economic investigations, areas in neighboring agricultural communities having similar lands, climate, and anticipated types of farming were studied. The correlation areas chosen were (1) an area immediately east of Twin Falls, Idaho, (2) the area east of Hazelton, Idaho, and (3) the area in the vicinity of Buhl, Idaho. The land of the Twin Falls area is directly comparable with the high-quality (class 1) lands of the North Side Pumping Division. The soils of the two areas are very similar. This is substantiated by their both being identified as deep Portneuf silt loams by the United States Department of Agriculture Soil Surveys. The lands of the Hazelton area are comparable to the medium-quality lands (class 2 and 3), while the lands of the Buhl area are comparable to the lower-quality lands (class 3 and 4P). The soils in the Hazelton area consist almost totally of Minidoka silt loam such as occur extensively in the northeast part of the Division. A further discussion of the correlation areas is presented in the Agricultural Economy Chapter of this report.

Classification Specifications

Minimum specifications for soil, topography, and drainage factors were established on the basis of a correlation of these physical

conditions with similar conditions in adjacent irrigated areas. The specifications adopted for the survey (table 2) follow closely the general overall specifications set up from past experience of the Bureau of Reclamation.

In the field land classification made with these specifications, the areas regarded as arable were separated from those considered nonarable, and, in turn, the arable lands were separated into classes.

As classified according to the minimum specifications, class 1 land was at least required to meet all these requirements, and usually was of better quality than indicated by table 2. Class 2 lands were deficient in only one or two of the requirements specified for class 1, and these deficiencies met the requirements of class 2 lands as indicated in the specifications. If, however, the lands were near the minimum for more than one of these requirements indicated for class 2, the land was placed in the next lower class. A similar procedure was followed in the placing of lands in classes 3 and 4P.

Description of Land Classes

Classification of the lands under the specifications established land classes with characteristics as follows:

Class 1

Soils of class 1 lands are deep, permeable, and medium-textured, without restrictions to root growth. Surface layers are generally more than 14 inches deep over a slightly compact calcareous zone. All soils are 54 inches deep, or more, over the creviced basalt; most are 20 feet, or more, in depth over the rock. They occupy gently-sloping smooth uplands or, to a minor extent, the broader drainageways or delta-like bottoms of the area. The lands may range up to three percent in general gradient, but the slopes commonly are one-half to two percent. Most of the class 1 lands lie in large bodies. A large number of farms will consist almost entirely of class 1, inasmuch as whole sections and, in places, several contiguous sections, of land are composed mainly of this class. The lands are free from harmful accumulations of salts and have no drainage problems.

As indicated, the class 1 lands are of exceedingly high quality, are well adapted to all crops grown in the area, and are capable of sustained yields under common agricultural practices. They can be prepared for irrigation at relatively low cost.

Class 1 lands total 48 percent of the irrigable acreage of the Division.

Table 2.--Minimum land classification specification

Minidoka Project, North Side Pumping Division

Land Characteristics	Class 1 "Arable"	Class 2 "Arable"	Class 3 "Arable"	Class 4P "Limited Arable"
		SOILS		
Texture	Sandy Loam to Friable Clay Loam	Loamy Sand to Very Permeable Clay	Loamy Sand to Permeable Clay	Loamy Sand to Permeable Clay
Depth: To sand, gravel of cobble.	36" plus good free working soil of fine sandy loam or heavier; or 42" of sandy loam.	24" plus--good free working soil of fine sandy loam or heavier or 30"-36" of sandy loam to loamy sand.	18" plus--good free working soil of fine sandy loam or heavier or 24"-30" of lighter textured soils.	
To crevices or basalt or indurated nodular or silty platy, cemented hardpan. (Impenetrable to roots, but slightly permeable to water).	54" plus	42" plus	30" plus	24" plus
To impervious indurated caliche hardpan.	60" plus	48" plus	36" plus	24" plus
To highly calcareous very compact (semi-permeable hardpan).	60" plus	36" plus	24" plus	12" plus
To penetrable lime zone	14" plus with 54" penetrable			
Alkalinity	pH not to exceed 8.6.	pH not to exceed 9.0.	pH not to exceed 9.0 unless soil is calcareous; total salts are low.	pH not to exceed 9.0.
Salinity 1/	Total salts not to exceed 0.2%.	Total salts not to exceed 0.3%.	Total salts not to exceed 0.5%. May be higher in open permeable soils and under good drainage condition.	If salt content exceeds 0.5%, must be under conditions where it can be controlled.
		TOPOGRAPHY		
Slopes	Smooth slopes up to 3% in general gradient in reasonably large bodies sloping in the same general plane.	Smooth slopes up to 7% in general gradient in reasonably large bodies sloping in the same plane; or rougher slopes which are less than 3% in general gradient.	Smooth slopes up to 12% in general gradient in reasonably large sized bodies sloping in the same plane; or rougher slopes which are less than 7% in general gradient.	Smooth slopes up to 18% in general gradient in reasonably large sized bodies; or rougher slopes which are less than 12% in general gradient.
Surface	Even enough to require only small amount of leveling and no heavy grading.	Moderate grading required, but in amounts found feasible at reasonable cost in comparable areas.	Heavy and expensive leveling required in spots, but in amounts found feasible in comparable irrigated areas.	Surface condition such that crop adaptability is very limited and management problems would be very complex.
Cover (loose rocks and vegetation)	None	Insufficient to modify productivity or cultural practices; or clearing costs small.	Sufficient to reduce productivity and interfere with cultural practices. Clearing required but at moderate costs.	Present in sufficient amounts to cause specific limited crop adaptability.
		DRAINAGE		
Soil and topography	Soil and topographic conditions such that no specific farm drainage requirement is anticipated.	Soil and topographic conditions such that some farm drainage may be required and if required, reclamation by artificial means is feasible at reasonable cost.	Soil and topographic conditions such that significant farm drainage may probably be required and if required, reclamation by artificial means may be expensive but feasible.	Soil and topographic conditions such that significant farm drainage may probably be required, and if required by artificial means, surface drainage is at least feasible.

CLASS 5--NONARABLE

Include lands which will require additional economic and engineering studies to determine their irrigability and lands reclassified as temporarily nonproductive pending construction of corrective works and reclamation through application of these works.

CLASS 6--NONARABLE

Includes lands which do not meet the minimum requirements of the next higher class, and small areas of arable land lying within larger bodies of nonarable land.

1/ Average for Root Zone and must be under soil, water and drainage conditions such that concentration will not become greater.

Class 2

Most of the class 2 lands occur in large bodies. They are generally smooth and gently rolling, and in outward appearance resemble class 1 lands. However, in places, the surface soils are shallower (10 to 12 inches of topsoil over the compact lime horizon) and in other places the lands contain slick spots. In small areas, the soils contain sufficient salines to temporarily decrease yielding capacities and require heavier water applications to ameliorate this condition.

A small portion of the class 2 lands are steeper than three percent but under seven percent slope, or are sufficiently uneven to interfere with efficient irrigation. This decreases the value of class 2 lands for irrigation below that of the class 1 lands because application costs will be greater. In the areas of uneven surface, the cost of leveling also reduces land values. The soils of these lands not only include the deep soils with no restrictions in the profile, but also a small percentage of the medium-deep soils which have some restrictions limiting root penetration or slowing down of water percolation. Surface drainage of class 2 land is good.

Crop adaptation of class 2 lands after reclamation is as wide as that of class 1 lands, but the general level of fertility and cost of reclamation are the basic reasons for placing them in a lower class. Class 2 lands, however, are of high quality, as is shown by similar lands having unquestionably a high agricultural value, on nearby projects.

The class 2 lands comprise about 35 percent of the total irrigable land of the Division.

Class 3

The class 3 lands are found in large bodies in some sections, and in relatively small bodies in other sections. Soils are mostly shallow over compacted or weakly cemented subsoils, have hardpans, or are underlain with creviced bedrock at 24 to 54 inches depth. In places, however, the soils are deep but contain salts or penetrable calcium concentrations near the surface.

A considerable portion of the class 3 land has slopes of eight or nine percent, or has lesser slope but uneven surface. These features reduce the desirability of the lands for row crops and reduce yields because of cultural difficulties. A few large land bodies have good topography, but shallow soils or fairly numerous slick spots. Extensive areas with favorable undulating to somewhat rolling topography but with high lime subsoil concentrations and considerable salt in places occur in the northeast part of the Division. However, only occasional slick spots occur in this area.

In nearby areas, lands like those of class 3 have proven satisfactory for development under reasonable water charges. Their use has, though not necessarily so limited, been particularly successful where they comprise only a portion of the farm and are used to produce forage and cereal crops.

The lands were placed in class 3, due to the existence of a variety of factors influencing the cost of preparation, the crop adaptability and fertility. These factors may be found singly or in combination. In addition to the normal factors of soil, topography, and drainage, they may have been placed in this class because of the presence of soluble salts, slick spots, or shallowness to the penetrable lime zone. When numerous slick spots are found in combination with fairly high concentrations of soluble salts, the resultant class 3 will be the lowest quality of the project lands, and if there is any choice in the selection of class 3 for farm units, these lands should be the last considered for inclusion.

Only 17 percent of the Division acreage is comprised of class 3 lands. As discussed in Chapter VII of this report, limitations were originally placed upon the use of class 3 in the farm unit layout. Later it was agreed with State and other Federal agencies that with adequate upward adjustment in acreage, class 3 land could make up the farm unit where this became necessary.

Class 4P

The class 4P lands occupy the steeper slopes ranging up to 18 percent in general gradient when the slopes are smooth, or up to 12 percent where rougher slopes are prevalent. The soil depths may be 16 to 24 inches over creviced basalt, caliche, or other impermeable layers. The soils of this class are mainly the shallower lands with soils which have horizons that limit the productivity.

These lands were originally mapped for pasture lands, but the high cost of water and the small total acreage led to their exclusion from the assessable acreage.

Class 5

This category designates temporarily suspended problem areas requiring special studies to determine irrigability. This consists of an area set aside for testing possibilities of subsoil salt removal. This 434-acre tract was placed in class 5, pending completion of these tests, programed for continuance through 1955, and is the only remaining class 5 area in the Division. Preliminary studies indicate that these lands are suitable for irrigation.

Class 6

The class 6 nonarable lands are those which do not meet the qualifications for any of the above classes, and include lands with shallow soils, a high percentage of slick spots, unfavorable topography, basaltic rock outcrops, excessively hilly terrain, gully areas, and enclosed drainage basins which are too small in extent to justify drainage works.

IRRIGABILITY CLASSIFICATION

In the process of choosing the irrigable lands to be included for development from the arable lands of the area investigated, some areas were rejected, while others were suspended from present inclusion. These are outlined on the Land Classification Map and are designated "X", followed by a number. Such lands were suspended or rejected for the reasons stated below.

In Unit A, there remains some question as to the feasibility of relifting the water to an arable area of about 750 acres of isolated high land. Because of this, they have not been included in the irrigable area. Such areas have been designated as X-2a.

State or privately-owned lands consisting principally of school sections (indicated as X-1 on the Land Classification Map) were not considered a part of the immediate project lands of Unit B. The source of water for Unit B lands will be from wells located on topographically desirable points within the unit. When the individual owners of these lands have made water-right filings, the arable lands of these tracts will be considered for inclusion in the project if the owners so desire.

The X-2 areas include scattered lands which, because of their position or their shape, make them unsuitable as part of an economic farm unit. Other areas eliminated from the irrigable area and designated X-2 are those which overlap into established irrigation systems.

Several areas of predominantly low-quality land, designated as X-3 and X-4, have been excluded from the irrigable area. Since entire farms would be composed of a combination of class 3 and 4 lands in these areas and because in some cases they are cut up with scattered rock outcrops (class 6), it is not desirable under present economic relationships to recommend their inclusion in the project development.

The X-5 body of land on the eastern end of the area investigated forms the transition between the high-quality lands included in the project and the rocky wasteland north of Lake Walcott. The small stringy areas of good land interspersed with the sand dunes and lava

outcrops are not of sufficient size to make up farm units, and further, this land would be hard to irrigate and would be subject permanently to the danger of moving sand. This entire area was rejected from the project lands.

The Selected Project Lands

The lands selected for project development are divided into two units, on the basis of the source of water supply. Unit A has 13,650 irrigable acres and will receive its water by pumping from the Snake River. Unit B has 64,000 irrigable acres and will receive its water from wells. Unit A is adapted to development in a single block, but Unit B is better adapted to step-by-step development. Both are shown on the Land Classification Map in this chapter and the acreage of the units by land class is shown in table 3.

Unit A.

The fact that the water for Unit A is to be pumped from the Snake River made it desirable to select this unit near the stream bank, keeping in mind the quality of the land and anticipated costs of constructing and operating the unit. Unit A comprises a total of 13,650 acres of irrigable land.

The determination of the total acreage and the particular area included in this unit was based on water supply and engineering considerations, in addition to quality and position of the land. The allocation of 47,000 acre-feet of storage space in American Falls Reservoir was basic in setting the maximum acreage that could be served. Engineering consideration involving relift pumps to higher areas and the relative economy of well development in the lower areas established the final acreage in this unit.

Unit A, lying on the southwest end of the project, is a compact area characterized by very high quality lands (73 percent class 1) in broad, gently sloping bodies ideally suited for irrigation development. The lands of this unit are higher in elevation than the surrounding areas. To the north, they merge into Unit B lands. The undulating topography, with well-defined drainageways and deep penetrable soils over creviced basalt, minimize drainage problems.

Unit B

Unit B comprises a total of 64,000 acres of irrigable land. The unit has four natural development areas. The first area includes the eastern portion of the unit and comprises a large expanse of high-quality lands suited to intensive agricultural development. It has a fairly well-defined drainage pattern which differentiates it from the

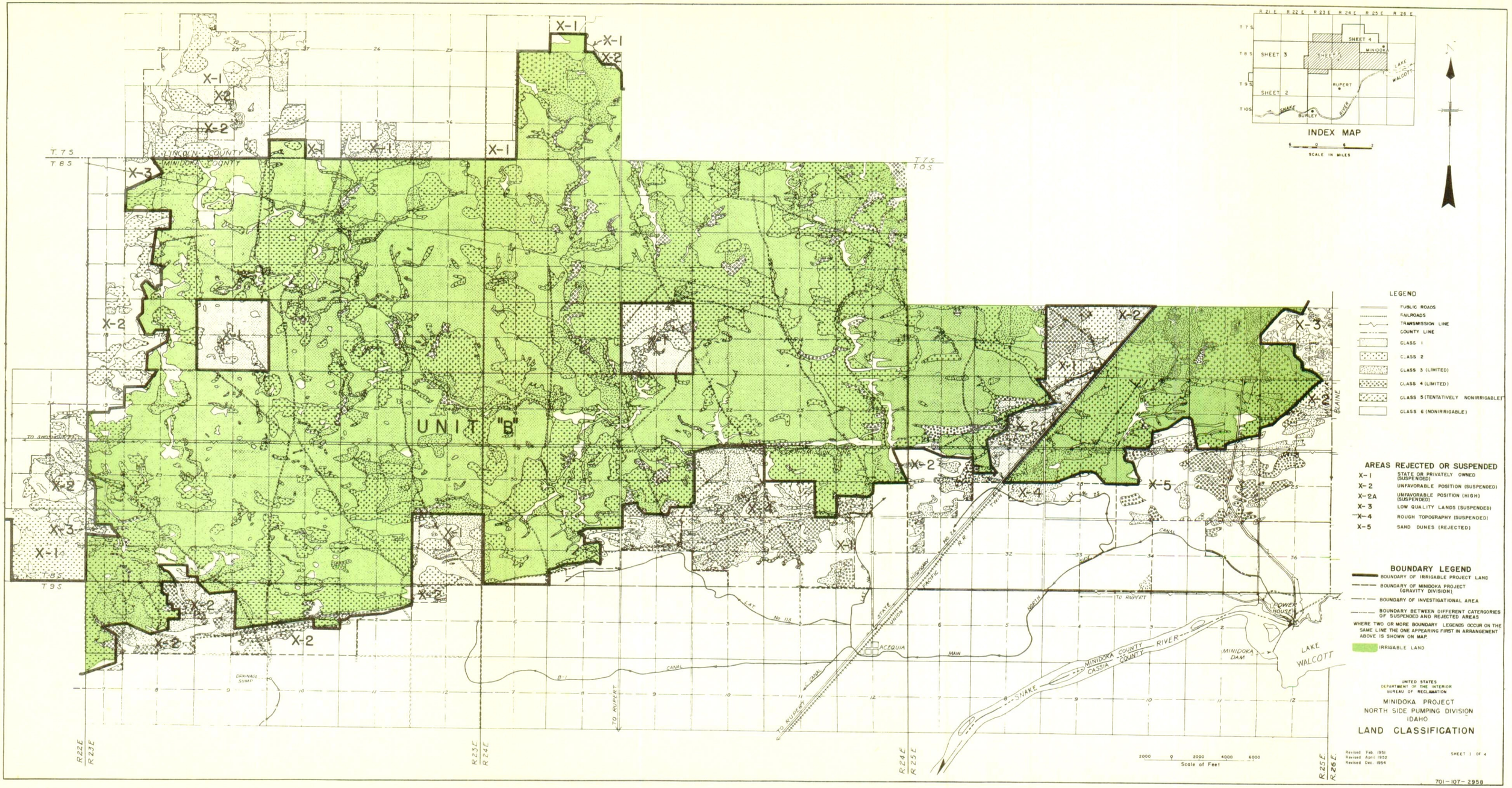
Table 3.--Land Classification Summary

North Side Pumping Division
Minidoka Project, Idaho

	Arable (Acres)	1/ Irrigable (Acres)	2/ Productive (Acres)
Unit A			
Class 1	10,375	9,960	9,360
Class 2	3,150	3,030	2,850
Class 3	690	660	620
Subtotals	14,215	13,650	12,830
Unit B			
Class 1	28,135	27,000	25,380
Class 2	24,678	23,700	22,280
Class 3	13,857	13,300	12,500
Subtotals	66,670	64,000	60,160
TOTALS	80,885	77,650	72,990

1/ Arable less 4 percent for additional rights-of-way.

2/ Irrigable less 6 percent for farmsteads, farm roads, and farm ditches.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BURLEY
SNAKE RIVER
LAKE WALCOTT
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LINCOLN COUNTY
MINIDOKA COUNTY
CASSIA COUNTY
BLAINE
TO SHOSHONE
TO RUPERT
ACEQUIA
POWER HOUSE
MINIDOKA DAM
MAIN CANAL
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DRAINAGE SUMP
UNION PACIFIC R.R.
STATE HIGHWAY No. 15
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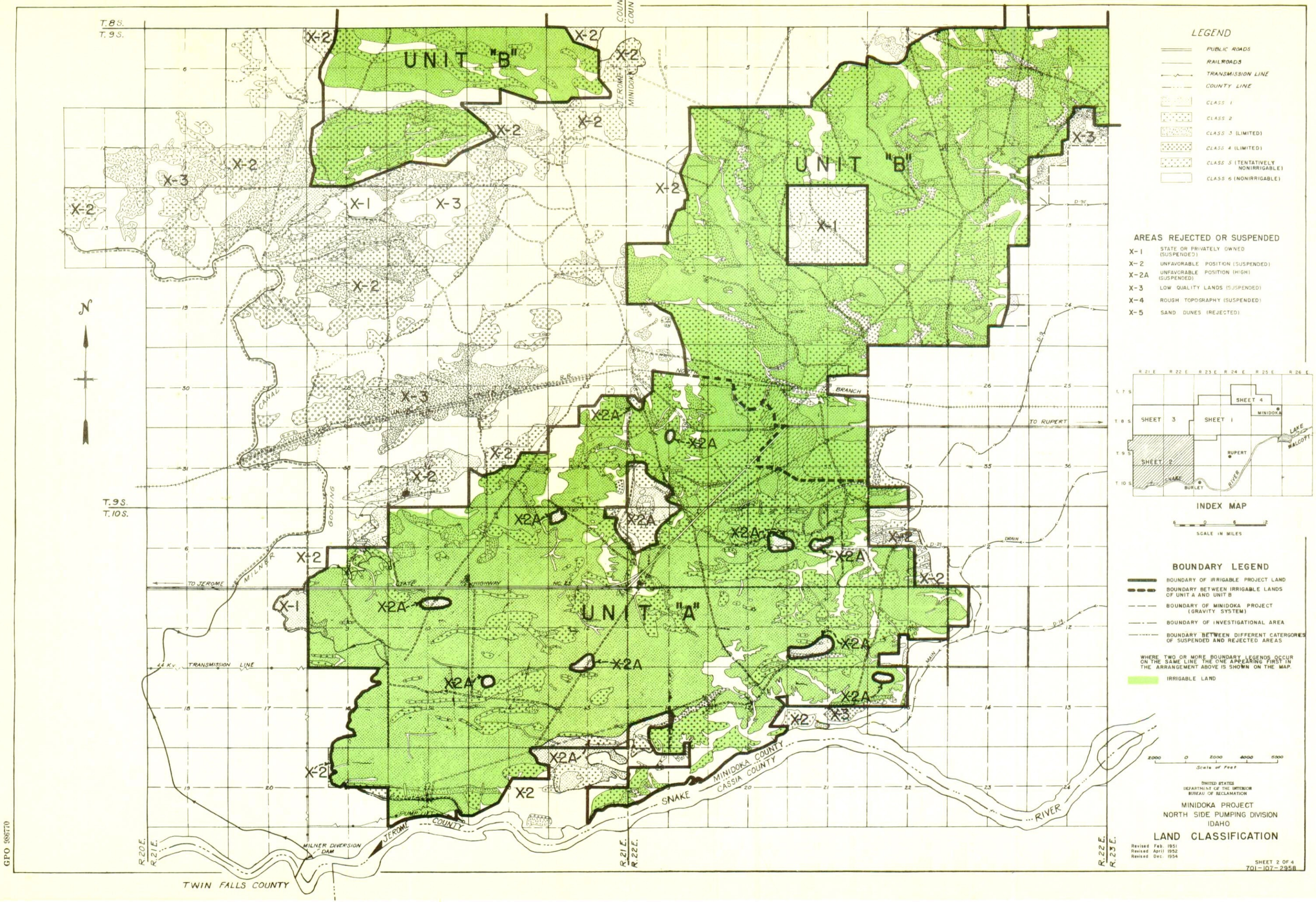
CLASS 5 (TENTATIVELY NONIRRIGABLE)
CLASS 6 (NONIRRIGABLE)
AREAS REJECTED OR SUSPENDED
X-1 STATE OR PRIVATELY OWNED (SUSPENDED)
X-2 UNFAVORABLE POSITION (SUSPENDED)
X-2A UNFAVORABLE POSITION (HIGH) (SUSPENDED)
X-3 LOW QUALITY LANDS (SUSPENDED)
X-4 ROUGH TOPOGRAPHY (SUSPENDED)
X-5 SAND DUNES (REJECTED)
BOUNDARY LEGEND
BOUNDARY OF IRRIGABLE PROJECT LAND
BOUNDARY OF MINIDOKA PROJECT (GRAVITY DIVISION)
BOUNDARY OF INVESTIGATIONAL AREA
BOUNDARY BETWEEN DIFFERENT CATEGORIES OF SUSPENDED AND REJECTED AREAS
WHERE TWO OR MORE BOUNDARY LEGENDS OCCUR ON THE SAME LINE THE ONE APPEARING FIRST IN ARRANGEMENT ABOVE IS SHOWN ON MAP.
IRRIGABLE LAND
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
MINIDOKA PROJECT
NORTH SIDE PUMPING DIVISION
IDAHO
LAND CLASSIFICATION
Revised Feb. 1951
Revised April 1952
Revised Dec. 1954
SHEET 1 OF 4
Scale of Feet
701-107-2958
GPO 988770


UNIT "B"
UNIT "A"
LEGEND
PUBLIC ROADS
RAILROADS
TRANSMISSION LINE
COUNTY LINE
CLASS 1
CLASS 2
CLASS 3 (LIMITED)
CLASS 4 (LIMITED)
CLASS 5 (TENTATIVELY NONIRRIGABLE)
CLASS 6 (NONIRRIGABLE)
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X-5 SAND DUNES (REJECTED)
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Scale of Feet
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
MINIDOKA PROJECT
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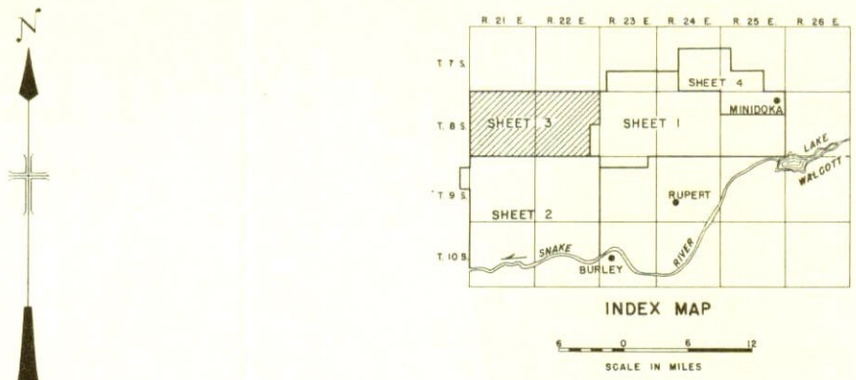
SHEET 2 OF 4
701-107-2958
TO JEROME
TO RUPERT
MILNER DIVERSION DAM
TWIN FALLS COUNTY
JEROME COUNTY
MINIDOKA COUNTY
CASSIA COUNTY
SNAKE RIVER
GPO 986770



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- PUBLIC ROADS
- RAILROADS
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- CLASS 1
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- CLASS 3 (LIMITED)
- CLASS 4 (LIMITED)
- CLASS 5 (TENTATIVELY NONIRRIGABLE)
- CLASS 6 (NONIRRIGABLE)

AREAS REJECTED OR SUSPENDED

X-1	STATE OR PRIVATELY OWNED (SUSPENDED)
X-2	UNFAVORABLE POSITION (SUSPENDED)
X-2A	UNFAVORABLE POSITION (HIGH) (SUSPENDED)
X-3	LOW QUALITY LANDS (SUSPENDED)
X-4	ROUGH TOPOGRAPHY (SUSPENDED)
X-5	SAND DUNES (REJECTED)

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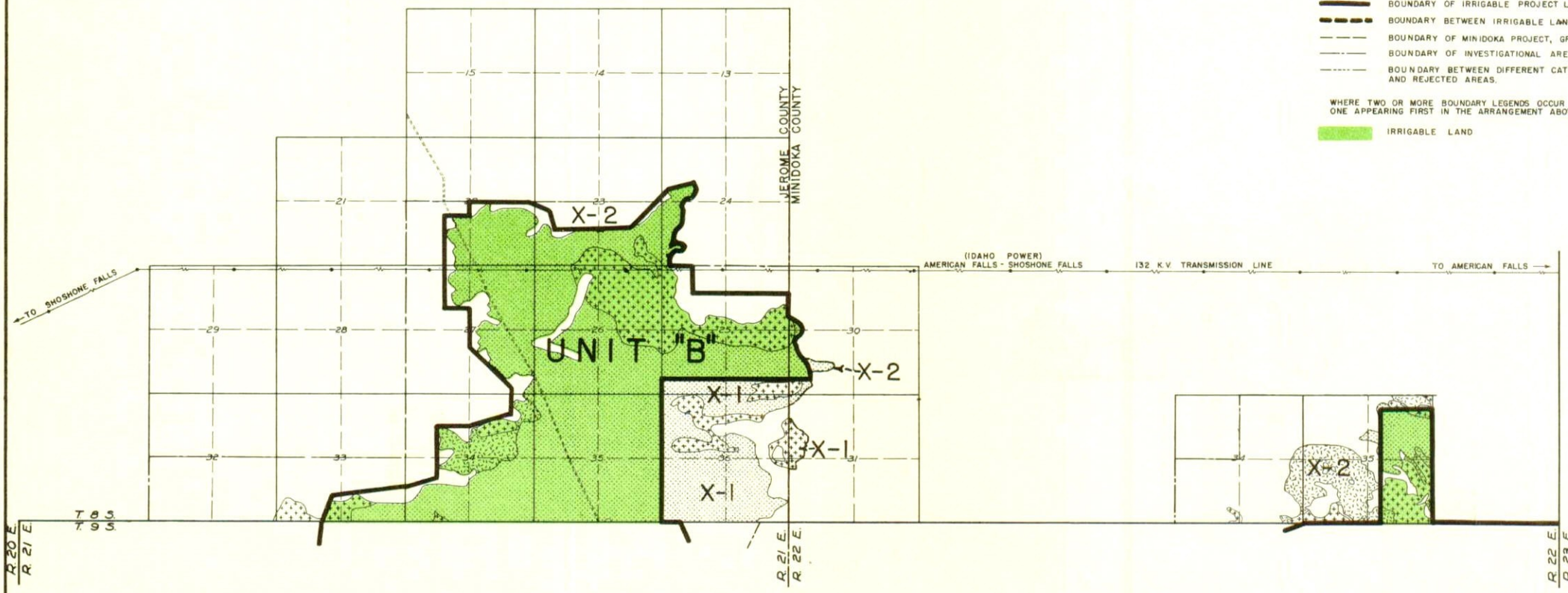
- BOUNDARY BETWEEN IRRIGABLE LANDS OF UNIT A AND UNIT B
- BOUNDARY OF MINIDOKA PROJECT, GRAVITY DIVISION
- BOUNDARY OF INVESTIGATIONAL AREA
- BOUNDARY BETWEEN DIFFERENT CATEGORIES OF SUSPENDED AND REJECTED AREAS.

WHERE TWO OR MORE BOUNDARY LEGENDS OCCUR ON THE SAME LINE THE ONE APPEARING FIRST IN THE ARRANGEMENT ABOVE IS SHOWN ON THE MAP

- IRRIGABLE LAND



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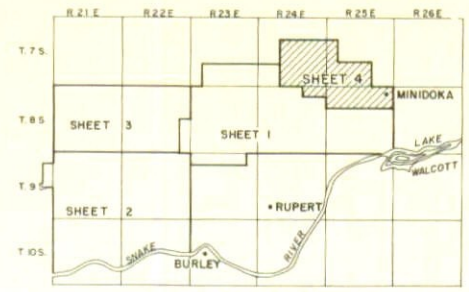
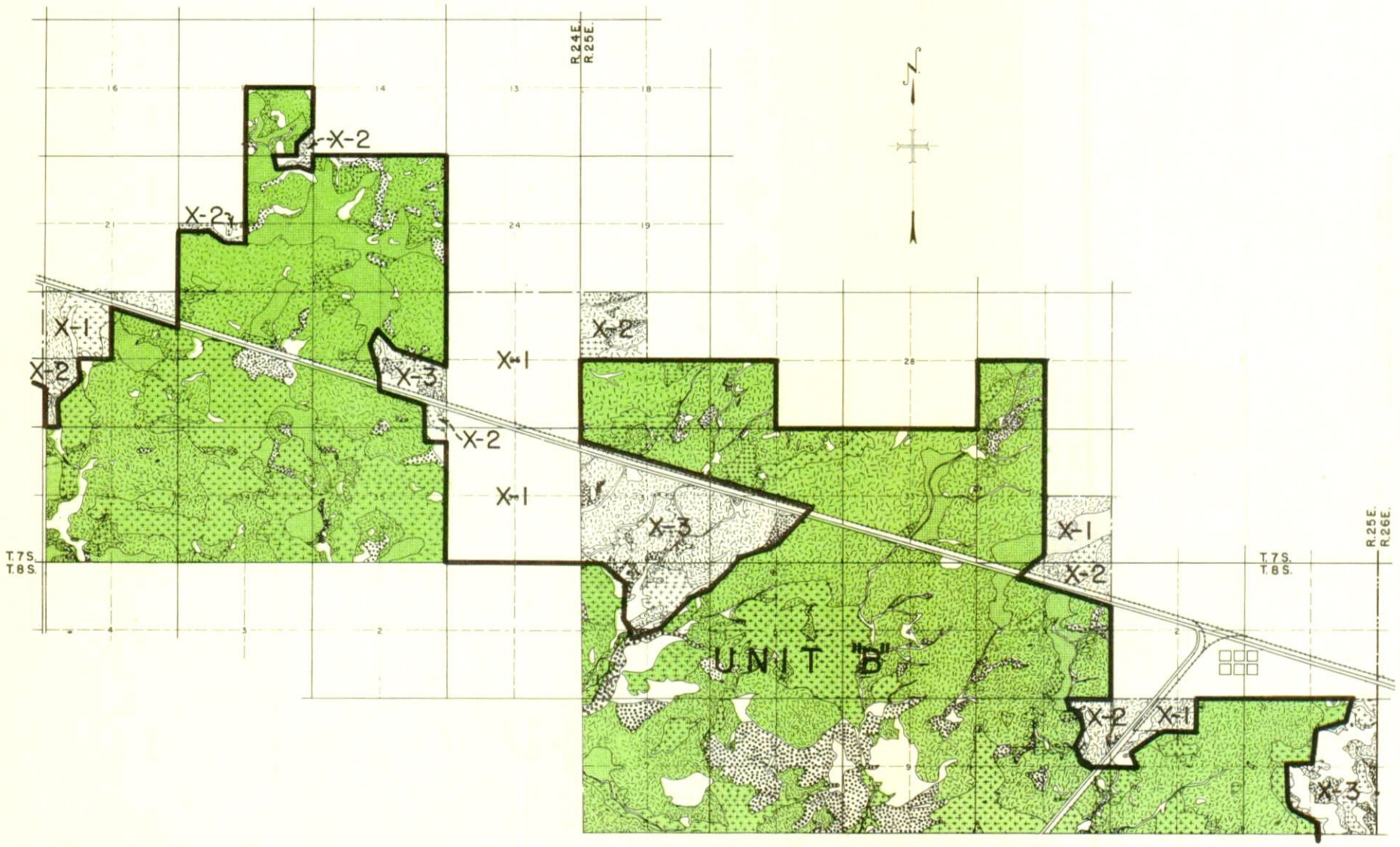


INDEX MAP

SCALE IN MILES



Scale of Feet

LEGEND

- PUBLIC ROADS
- RAILROADS
- TRANSMISSION LINE
- COUNTY LINE
- CLASS 1
- CLASS 2
- CLASS 3 (LIMITED)
- CLASS 4P (LIMITED)
- CLASS 5 (TENTATIVELY NONIRRIGABLE)
- CLASS 6 (NONIRRIGABLE)

AREAS REJECTED OR SUSPENDED

X-1	STATE OR PRIVATELY OWNED (SUSPENDED)
X-2	UNFAVORABLE POSITION (SUSPENDED)
X-2A	UNFAVORABLE POSITION (HIGH) (SUSPENDED)
X-3	LOW QUALITY LANDS (SUSPENDED)
X-4	ROUGH TOPOGRAPHY (SUSPENDED)
X-5	SAND DUNES (REJECTED)

BOUNDARY LEGEND

- BOUNDARY OF IRRIGABLE PROJECT LAND
- BOUNDARY OF MINIDOKA PROJECT (GRAVITY DIVISION)
- BOUNDARY OF INVESTIGATIONAL AREA
- BOUNDARY BETWEEN DIFFERENT CATEGORIES OF SUSPENDED AND REJECTED AREAS

WHERE TWO OR MORE BOUNDARY LEGENDS OCCUR ON THE SAME LINE THE ONE APPEARING FIRST IN ARRANGEMENT ABOVE IS SHOWN ON MAP

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second area adjoining it on the west. The second area also contains fairly large expanses of high-quality lands; however, the presence of enclosed basins and scattered, high isolated areas gives rise to some development problems, especially in regard to the disposition of surface runoff water, which is discussed in the Drainage Chapter of this report. This area adjoins the north edge of Unit A, and it is bounded on the north and west by a fairly large body of rocky wasteland. The third area adjoining Unit A on the northwest was covered, for the most part, only by a reconnaissance survey during the project planning investigation. The subsequent completion of the land classification disclosed a preponderance of low-quality land, which resulted in exclusion of most of this area from the irrigable land. The fourth area occupies the western extremity of the Division lands. This area is characterized by a preponderance of high-quality land, most of which is in a single tract. It is separated from the larger portion of Unit B by an area of rough topography and shallow soils over basalt bedrock, interspersed with rock outcrops. This area should be developed last, owing to the greater average depth to ground water than in the rest of Unit B.

DEVELOPMENT

Unit A lends itself to development in one block because of its compactness and the fact the water supply will be derived from one central pumping plant. Unit B obtains water from a large number of wells and has been and continues to be developed by natural areas, starting near the east end of the Division and progressing to the westward, with the exception of the land in the northeast part classified in 1954 which will be developed last.

Lands placed in lower classes than 1 because of shallow soil over penetrable lime zone should not be deeply graded to eliminate surface irregularities. Smoothing these lands with a float or land plane should be done without exposing the calcareous layer, and deep cuts should be avoided, as stripping the topsoil from this layer will result in an excess of calcium in the root feeding zone, causing a reduction of available nutrients to plants, restriction of bacterial activity, and restriction of normal root development. Heavy applications of manure over a long period would be required to alleviate this condition.

Surface soils of the Division lands are largely very fine textured and light, and since high winds are common, care must be taken to prevent excessive wind erosion after clearing. After crops have been established, the wide diversification possible will aid in halting or minimizing wind erosion. Careful water application on the rolling lands will help prevent water erosion.

An early increase in organic matter content in the topsoil by plowing under straw, green manure crops and barnyard manure will materially assist in stabilizing the soil and hasten the period of full crop production.

In selecting the Division area, lands with major drainage problems were excluded. In general, the area is undulating to rolling, and the permeable subsoils, underlying parent material, and creviced basalt provide good internal drainage; however, in localized areas some provision for drainage must be made. In T. 8 S., R. 23 E., and to a lesser extent in R. 24 E., the construction of waste ditches or connecting drains will be necessary to provide drainage and permit re-use of water or disposal of it through inverted drainage wells or into the distribution and drainage system of the Minidoka Irrigation District.

CHAPTER III

D R A I N A G E

The sage-covered desert area of the Division, like thousands of acres of the Snake River Plain, has yielded virtually no surface runoff from precipitation during the past half-century. Four factors contribute to this condition--the highly permeable soils and underlying fractured lava rock, the general flatness of the lands, the absence of hilly or mountainous areas to contribute cross-drainage flows, and the low hourly precipitation rates which accompany even the most severe storms. Fourteen percent of the Division drains into enclosed basins or depressions within its boundaries. In the remaining 86 percent, shallow drainage courses are established leading out of the Division. In their upper reaches these courses are flat swales connecting shallow basins; in their lower reaches the drains form a readily discernible dendritic pattern. Even in the most prominent of these drainageways, however, there is virtually no evidence of runoff.

DRAINAGE INVESTIGATIONS

Investigations to determine the amount and occurrence of surface waste from irrigation and the probable precipitation runoff after agricultural development of the Division included infiltration tests of surface soils, deep borings through the understrata, examination of existing drainage networks, and assembly of data on permeability of the basalt beds. Information obtained was employed in designing the drainage system. The designs and related costs were based on the drainage works required for two areas selected as representative of the two types of topography (as relating to drainage) of the Division. The first area, in T. 7 and 8 S., R. 23 and 24 E., contains 6,240 acres, with a natural external drainage network (referred to hereinafter as the dendritic drainage pattern area). The second area in T. 8 S., R. 23 E., totaling 2,550 acres, contains medium-sized bodies of agricultural lands interspersed with various-sized shallow enclosed basins. Natural drains leading to the basins are indistinct.

Infiltration Tests

Soil profile data and tests of representative soils indicate generally high surface infiltration rates and highly permeable soils to 5-foot depths on almost all of the Division's arable lands. The investigation revealed that less permeable soils occur only on upland "slick spots," on areas with caliche development, and on small areas of low-lying lands without distinct surface drainage patterns.

Drainage

As stated in the Project Lands chapter, only lands with a moderate density of slick spots have been included in the area selected for development. The low permeability condition of these spots commonly is ameliorated by the mixing which occurs during land preparation.

Infiltration and permeability tests on the largest of the areas with undeveloped surface drainage and apparently the least permeable of the Division's soils showed that irrigation water will readily pass through the top five feet of soil and continue downward into the deep permeable understrata.

Infiltration and permeability tests in areas with caliche layers in the subsoil and substratum showed some slowing down in vertical water movement but, for the most part, no serious internal drainage problems are indicated. This is due to the high infiltration rate in the loessal surface soil and the general fractured character of the caliche layers bedded in silty and very fine, sandy material.

Deep Borings

Exploration of the deep subsoil and underlying parent material at 18 representative locations indicated these materials are sufficiently permeable for fairly rapid downward movement of water. Future difficulty from perched water tables within any significant area of the Division, therefore, is improbable.

Two holes near the Prisoner-of-War Camp site were bottomed at 43 feet in heavy lacustrine clay; in a third, located three-fourths mile from the two, basalt was encountered at 29 feet. These borings and logs of nearby wells mark this fringe of the Division, in common with some lands of the adjacent gravity division, as immediately underlain by the Burley lakebeds instead of the fractured basalt which underlies the remainder of the pumping division and part of the gravity division. However, the lakebed clay is well below the depth at which it would hinder drainage of this small area of the pumping division.

Five holes bored to basalt in a closed basin where waste water from irrigation was ponded accumulated no free water in spite of the permeable soil material and the apparent large quantity of water percolating downward. Lack of such accumulation signifies that the basalt is extremely permeable and that the porous overlying substrata would permit rapid lateral movement of water if the basalt were locally impermeable, thereby preventing waterlogging in the root zone.

EXTENT OF SURFACE RUNOFF

Drainage works for the Division must dispose of surface flows of irrigation waste and precipitation runoff. Amounts of irrigation waste and rates of flow from the Division's experimental farms can be measured and compared with those recorded on operating projects, but precipitation runoff is not subject to direct evaluation. Under native conditions the area has never been known to yield any significant runoff.

Experience on the test farms and in adjacent irrigated areas indicates that drainage needs of the Division can be met adequately by a system capable of handling the estimated surface waste from irrigation, plus a reasonable allowance for precipitation runoff. The entire capacity would be available for storm runoff during the non-irrigation season, as there will be no surface or seepage inflow of irrigation waste when the production wells are shut down.

The determination of the return flow which will enter the drainage system, presented in Chapter IV, establishes irrigation surface waste as an estimated 16 percent of the 3.5 acre-feet farm delivery requirement on Unit B. During periods of peak farm-water requirement, the average delivery rate is one cubic foot per second to each 65 irrigable acres. Return flows anticipated from these peak deliveries amount to about one cubic foot per second from 400 acres of irrigated land. From the 6,240-acre typical area, return flow carried in the drains would total nearly 16 cubic feet per second. Measurements of runoff for 1951-54 from an area of 3,860 acres, over half of which was irrigated, support this estimate.

To carry storm runoff during the irrigation season, additional capacity for one cubic foot per second from each square mile of drainage area has been provided. The design capacity for the 6,240-acre area thus is 25 cubic feet per second, or 2.6 cubic feet per second per square mile. Almost all the waste water from an estimated 39,000 irrigated acres from Units A and B will be reused by relifting to high areas or by the Minidoka Irrigation District.

REQUIRED DRAINAGE FACILITIES

Calculation of runoff disposal requirements for the Division was based, as noted previously, on needs of the two areas which typify, respectively, (1) areas totaling 66,850 acres on which a dendritic drainage pattern has developed to the extent that runoff, where not obstructed by irrigation works of the gravity division, is naturally tributary to the Snake River, and (2) acres totaling 11,200 acres where the runoff drains into enclosed basin or "potholes" and is dissipated by seepage and evaporation. Per-acre figures derived from

designs and estimates for these typical areas, extended to the represented acreages, provided the estimates of overall drainage structure requirements.

The facilities needed consist of channels constructed for the most part in natural drainageways and leading to inverted drainage wells which will discharge into the permeable basalt. Channelization of drainageways on the 66,850-acre portion would require only a small amount of excavation to provide adequate capacities for conveying runoff to wells drilled or dug at outlets along the southern boundary of the Division. On the 11,200-acre "pothole" area, ditches connecting a number of smaller basins would concentrate runoff in several large depressions for disposal through inverted drainage wells. Right-of-way for these facilities is being reserved in advance of settlement openings, and arrangements made for drainage installations prior to the establishment of fences, roads, and other improvements which would interfere with such installations.

It is anticipated that much of the runoff and irrigation waste will reach the regional water table by natural percolation through the permeable soils. The purpose of the inverted wells is to dispose of any water that has been collected by surface ditches that does not reach the water table by normal seepage. The wells will be located chiefly near the margin of the Division, except for the "pothole" area, and will be drilled as their need becomes apparent.

Inverted Drainage Wells

Inverted drainage wells have been used successfully since 1910 on adjacent lands of the North Side Gravity Division to dispose of water accumulating in shallow depressions. Lands drained by these wells are similar, drainage-wise, to those of the pumping division, in that both areas are underlain by creviced basalt.

Extension of typical area estimates indicates that a maximum of 79 inverted drainage wells, approximately 100 feet deep, with appurtenant settling basins and intake protection, may be required for the Division. The plan provides for 57 12-inch diameter and 22 8-inch diameter wells with estimated minimum discharge capacities of five second-feet and one second-foot, respectively. Fewer wells might be required if the capacities of wells to remove water exceed these estimates. Well locations, for the most part, would utilize class 6 lands. Design details are presented in the Plans and Estimates chapter.

The first project inverted drainage well was constructed in the SW 1/4 sec. 27, T. 8 S., R. 23 E. The well disposes of waste water draining from an irrigated area of about 250 acres and has functioned satisfactorily for three seasons.

Typical Drain Sections

Runoff from the 66,850-acre portion will be conveyed to the wells through drains with capacities ranging from five second-feet, or less, in the upper reaches of the system to main channels of adequate sizes for the areas served. The channels would be excavated in natural drainageways, and the sections would range from V-type drains with 1.5 feet minimum depth to typical trapezoidal sections with the same minimum depth.

In the 11,200-acre portion, runoff accumulating in the smaller depressions would be drained to the larger basins through channels with trapezoidal sections and 2-foot base widths. Channel capacities would vary according to topography and number and sizes of basin areas contributory to each inverted drainage well.

Approximately 10 miles of these surface drains, with necessary culverts, have been constructed thus far and have operated satisfactorily.

Quantities and costs of the required structures are itemized in the Plans and Estimates chapter.

ALTERNATIVE METHODS

An alternative method for disposal of irrigation waste from a part of the Division lands is to re-use it for irrigation--either by pumping to higher lands on the Division or by collecting it in the existing distribution or drainage system of the Minidoka Irrigation District.

A discussion of the proposed re-use of return flow on the Division lands is presented in Chapter IV, Water Requirements. The Minidoka Irrigation District has expressed a willingness to accept return flow from parts of Units A and B in its present system west of Paul. That district's canal No. 20 is presently supplied by pumping from its main drain and operation of that pump, located in the SW 1/4 sec. 2, T. 10 S., R. 22 E. could be curtailed or eliminated under such a plan.

CHAPTER IV

WATER REQUIREMENTS

The combined unit costs for construction, operation and maintenance, and power for the project will be high. For this reason, it is of primary importance that water conservation and economic utilization practices be carried out to the fullest extent practicable. The water requirements for the project, as determined in the following discussion, are premised on the assumption that a vigorous and effective program along these lines will be carried out. It is indicated in the "Project Lands" chapter of this report that the majority of the lands included in the project are of higher quality for irrigation purposes than many of the lands in nearby projects. Because of this, the project will be capable of making much more effective use of its irrigation water than a number of the projects in the vicinity. The water requirements determined herein are designed to provide adequate irrigation water for economic production of crops on the maximum possible acreage. All discussion of water requirements in this chapter, unless otherwise specified, is based on the productive acreage as shown in table 3, at the close of Chapter II.

CONSUMPTIVE USE OF WATER

Consumptive use of water by crops and through evaporation from the croplands is the basic requirement in irrigation. Determination of diversion requirements must provide not only for this use but also for farm waste and percolation losses, as well as canal distribution system losses.

Consumptive use of water on irrigation projects has been estimated by various methods, two of which have been used in this study. The two methods show reasonable agreement in results.

Lowry-Johnson Method

Consumptive use of water, estimated on the basis of maximum daily temperatures during the growing season according to a method devised by Robert L. Lowry and A. F. Johnson ("Consumptive Use of Water for Agriculture" - Transactions, American Society of Civil Engineers Vol. 107 (1942), page 1243), is 2.30 acre-feet per acre per year. Experiments by Steward and Paul on the Mason Creek area of the Boise Project indicate that about 87 percent of the annual consumptive use occurs during the irrigation season. Thus the irrigation season consumptive use is estimated at 2.00 acre-feet per acre.

Water Requirements

Climatological data are available for four stations in the vicinity of the project. Average annual consumptive use and average April-September precipitation were computed for the ten years of least precipitation at each of these four stations. Results are summarized in table 4.

Table 4.--Consumptive use data

North Side Pumping Division
Minidoka Project, Idaho

Station	Elevation	Period of Record	Average Growing Season	Ave. Annual Consumptive Use Per Acre	Ave. Prec. (10 min. yrs) April-September
				(Acre-Feet)	(Inches)
Rupert	4204	1907-1947	Apr. 15-Oct. 19	2.26	2.83
Burley	4180	1904-1914 1918-1947	Apr. 11-Oct. 26	2.30	3.23
Milner Dam	4200	1927-1946	Apr. 20-Oct. 26	2.30	3.38
Hazelton	4060	1918-1947	Apr. 13-Oct. 16	2.35	3.07
Average	--	--	Apr. 15-Oct. 22	2.30	3.13

Consumptive Use Per Unit Yield

The method of estimating consumptive use per unit yield utilizes information as to (1) the expected yields from each crop in the anticipated cropping program and (2) the consumptive use of water per unit of yield for each crop. Estimates of consumptive use for various crops were developed in Problems 4 and 5 of the Columbia Basin Joint Investigations, and consumptive use by crops of Class 1 lands described therein are considered to be applicable to Unit A. These values, used with the crop distribution and yields expected on this project, described in the Chapter on "Agricultural Economy," result in a weighted consumptive use for the project of 1.95 acre-feet per acre as shown in table 5.

Table 5.--Estimated farm delivery water requirement
(By consumptive-use-per-unit-yield method)

Unit A
North Side Pumping Division
Minidoka Project, Idaho

Crop	Estimated Crop Distribution	Average Yield Per Acre	Consumptive Use Per Ton	Consumptive Use Per Acre	Farm Irrigation Efficiency	Farm Delivery Per Acre
	(Percent)	(Tons)	(Ac-Ft.)	(Ac-Ft.)	(Percent)	(Ac-Ft.)
Wheat	7	1.40	1.00	1.40	59	2.37
Barley	6	1.47	1.00	1.47	59	2.49
Potatoes	15	9.08	0.17	1.52	45 3/	3.38
Sugar Beets	11	17.20	0.12	2.15	56	3.84
Beans	12	0.96	--	1.50 1/	60 1/	2.50
Peas	2	0.86	--	1.50 1/	60 1/	2.50
Alfalfa	31	4.60	0.50	2.30	66	3.48
Clover	5	1.80	--	2.30 2/	66 2/	3.48
Pasture	9	--	--	2.30 2/	60 1/	3.83
Miscellaneous	2	--	--	2.00 1/	60 1/	3.22
Total	100	Weighted Average		1.95	60	3.26

1/ Estimated.

2/ Estimated to be the same as alfalfa.

3/ Estimated in line with irrigation practice in the area, which is to maintain extremely high soil moisture to insure quality potatoes.

WATER REQUIREMENTS - UNIT A

Farm Delivery Requirements - Unit A

Records of water deliveries to farms on two existing projects in the vicinity of the North Side Pumping Division were analyzed to determine their applicability to Unit A. A discussion of the water deliveries to these projects is made in the following paragraphs, together with reasons why it is considered desirable, in view of the high pumping head and consequent high operation cost, to recommend a lower farm delivery rate. The recommended farm delivery is further substantiated by three independent estimates which are also discussed in this section.

Analysis of Recorded Diversions to Existing Projects

P. A. Lateral System of the North Side Twin Falls Project.--This system serves a net irrigable area of about 3400 acres adjacent to Unit A on the west and is served by a pumping lift of about 40 feet. The lands are somewhat more rolling and of slightly lower quality than those of Unit A and so would be expected to be less efficient in water use. Records of diversions to this system for the period 1935-1941 indicate irrigation-season farm deliveries of 3.46 to 3.84 acre-feet per acre with an annual average delivery of 3.70 acre-feet per acre. The lands served by the P. A. system experienced no water shortages during this period except for possible slight shortages during periods of peak demand because of limited pump capacity. It is understood that it is planned to increase the pump capacity by about 15 cubic feet per second to permit a greater peak load during parts of July and August. The present pumping system is capable of discharging about 60 cubic feet per second. With the installation of this new pump, the P. A. Lateral System would probably deliver about 4.00 acre-feet per acre to the farm. The watermaster and several farmers in the area stated that the need for increased deliveries after many years of successful operation with existing equipment is due to the fact that high prices in recent years have encouraged farmers to plant more row crops in preference to grain. The July and August water requirement for row crops is considerably higher than that for grain.

In the past the pumping plant of this system has been operated, as a general rule, at or near full capacity throughout the irrigation season. This is probably due to several factors, among which are: a reasonably low pumping lift, reasonable power rates under such a plan of operation, and a very inexpensive and abundant supply of irrigation water by virtue of good natural flow and storage rights. The quantities of water pumped are considerably in excess of the minimum needed for economic production of crops, especially at the beginning and end of the irrigation season. Estimates based on seasonal distribution of diversions to other successful projects in the area indicate that this delivery in excess of actual crop requirements could easily exceed 15 percent of the total recorded farm delivery. Thus it is concluded from these data that farm delivery of about 3.25 acre-feet per acre should be quite adequate for Unit A.

South Side Pumping Unit, Minidoka Project.--Records of diversions to this unit appear particularly suitable for use in estimating the farm delivery requirements for Unit A. This is one of the first large pumping developments undertaken by the Bureau of Reclamation. The major part of its construction was completed in the period 1907-09. Practically all of the lands were under cultivation by 1920. This unit has a net irrigable area of approximately 43,000

acres on the south side of Snake River. It extends east for approximately 15 miles from a point directly south of the eastern part of Unit A. It utilizes pumped water exclusively with a weighted mean lift of 70 feet. The pumping system consists of a number of pumps which provide sufficient flexibility to conform quite closely to actual crop water requirements in making deliveries.

Recorded farm deliveries to lands of the South Side Pumping Unit for the period 1937-46 (all years of adequate water supply) ranged from 3.52 to 4.10 and averaged 3.76 acre-feet per acre. The present cropping program is similar to that anticipated for Unit A. The lands of this unit are not as effective in use of irrigation water as are those of Unit A because of porous soil and shallowness to sand and gravel. Furthermore, the South Side Pumping Unit has been favored with a low annual charge for water compared to the cost for water on Unit A. Consideration of these differences indicate that the farm irrigation efficiency will be much higher on Unit A lands because of the deeper soils with higher water-holding capacity and, secondly, because the high cost of water will provide the impetus to adoption of irrigation practices more economical of water use. Based on evaluation of these factors, it is concluded that 3.25 acre-feet per acre farm delivery on Unit A would be adequate.

Rate and Frequency of Application Method

An estimate of farm delivery requirement was made by consideration of the practical application requirements of the various crops which are expected to be grown and of the physical characteristics of the soils. The applications, as to both depth and frequency, are based on the general irrigation practice in the area and consequently reflect to some extent the water use practices on projects where operation costs are low enough to permit somewhat freer use. The results of the study are shown in table 6.

Consumptive Use Modified by Efficiency-of-Application Method

As developed previously, the consumptive use of water during the irrigation season for the expected crop distribution on Unit A is estimated at 2.00 acre-feet per acre. Growing season precipitation, although small, would provide some of this requirement and thereby reduce irrigation requirements slightly.

Table 6.--Estimated farm delivery water requirement
(By crop-rate and frequency of application method)

Unit A
North Side Pumping Division
Minidoka Project, Idaho

Crop	Estimated Crop Distribution	Irrigation Applications Per Season	Amount Per Application	Farm Delivery Requirement Per Acre
	(Percent)	(Number)	(Acre-inches)	(Acre-Feet)
Grain	13	4	6	2.00
Potatoes	15	10	4	3.33
Sugar Beets	11	10	4	3.33
Beans and Peas	14	8	4	2.67
Alfalfa & Clover	36	8	6	4.00
Pasture	9	12	4	4.00
Miscellaneous	2	10	3	2.50
Total	100	Weighted Average		3.35

The combination of deep loessal silt loams and smooth gentle slopes found in Unit A would make possible higher farm irrigation efficiencies than on nearby operating projects where water is cheaper than it will be under the high pumping lifts in Unit A. It is concluded that farm irrigation efficiency of 60 percent (approximately that developed in the report on Problem 4 of the Columbia Basin Joint Investigations for similar lands) should be used. In the above-named report average farm irrigation efficiencies of 66 and 61 percent were recommended for water-duty subclasses A-1 and A-2, respectively, with crop distribution similar to that anticipated on Unit A; namely, with forage - 45 percent, grain - 13 percent and row crops - 42 percent.

With an efficiency of 60 percent, the required farm delivery to provide for the estimated 1.8 acre-feet per acre of irrigation consumptive use would be 3.00 acre-feet per acre. Table 5 shows approximately the farm delivery that should be made to various crops according to estimates of crop requirements for expected yields. It should be noted that no account has been taken in table 5 for effective irrigation season precipitation.

Recommended Farm Delivery - Unit A

In summary of the foregoing discussions, it appears that, while it is estimated that a 3.00 acre-feet per acre farm delivery would

adequately meet the consumptive use requirements of crops to be grown on the project together with reasonably high farm surface waste and percolation losses, some recognition should be given to the fact that existing practices on nearby projects will undoubtedly have a direct bearing on irrigation practices on Unit A. Thus it is concluded that a farm delivery of 3.25 should be provided to Unit A.

Distribution System Losses - Unit A

Canal and lateral losses on Unit A were determined on the basis of a comparison with the losses recorded for the P. A. Lateral System, which, as noted, borders the project to the west. The losses on the P. A. Lateral averaged 29 percent of the total diversion for the period 1921-40. Observation of flow in this system of canals indicates that velocities are rather low, which, combined with a comparatively long, winding main canal, would result in higher losses than on Unit A.

Unit A canals will serve 12,830 acres in comparison to 3,400 acres in the P. A. Lateral System. Moreover, Unit A is an area better blocked out for economical distribution. The materials through which the Unit A canal would be constructed and the steeper canal gradients which make possible better design in canal sections will tend towards lower seepage losses on Unit A. It is, therefore, estimated that an allowance of 25 percent for canal and lateral losses and operational waste would be amply conservative.

Diversion Requirement - Unit A

Combination of the above-described farm delivery and distribution system losses results in an estimated diversion requirement of 4.33 acre-feet per acre for Unit A.

Monthly Distribution

The anticipated crop distribution on Unit A is, in general, similar to that on the South Side Pumping Unit of the Minidoka Project. During the period 1937-46, adequate water supplies were available in all years for that unit. Because of the expected similarity in cropping practices on that unit and Unit A, it is concluded that the monthly distribution of diversion requirements for Unit A would be the same as for the South Side Pumping Unit. The distribution is shown in table 9 along with the distribution for Unit B.

The fact that the May requirement slightly exceeds that for June is somewhat unusual; however, it is typical of the surrounding areas. Examination of the long-term average diversions in the area, with controlled and adequate water supply, indicates the same general practice. This distribution resulting from local irrigation experience has proven most effective, as is evidenced by the excellent crop yields obtained in the surrounding area; hence, it has been adopted.

Peak Demand

During periods of extreme drought such as would result from a combination of low precipitation, high wind movement, and high temperatures, the demand for irrigation water will exceed the diversion requirements of 1.04 acre-feet per acre per month determined for average July and August conditions (table 9). An allowance of 10 percent is made in the capacity of the pumping plant, canals, and distribution system to provide for these periods of high water requirement. The system, therefore, is designed to divert 1.14 acre-feet per acre during a 31-day period or with capacity of one cubic foot per second per 54 acres of productive land.

Under maximum water delivery conditions the percent of canal and distribution system loss will be less than the average seasonal canal loss of 25 percent and is estimated at 22 percent of the water diverted. Thus, under peak operating conditions 0.89 acre-foot per acre or 10.7 inches depth of water could be delivered to the farms in a 31-day period. This amount is in agreement with the maximum demand indicated in the basic data for determination of farm delivery by the Crop-Rate and Frequency of Application Method as shown in table 7.

WATER REQUIREMENTS - UNIT B

Farm Delivery Requirements - Unit B

The farm delivery requirements for Unit B are based on a comparison of the physical properties of its lands with those in Unit A. There is only a very slight difference in the anticipated cropping programs. The only significant difference which would affect the farm delivery is in the distribution of land classes. The percentage distribution of the various land classes is indicated in table 8.

Table 7.--Farm delivery during peak water demand period (period of 31 days)

Unit A
North Side Pumping Division
Minidoka Project, Idaho

Crop	Crop Distribution	Irrigations	Depth Per Irrigation	Total Depth During Period
	(Percent)	(Number)	(Inches)	(Inches)
Grain	13	1	6	6
Potatoes	15	4	4	16
Sugar Beets	11	2	4	8
Beans and Peas	14	2	4	8
Alfalfa & Clover	36	2	6	12
Pasture	9	3	4	12
Miscellaneous	2	2	3	6
Total	100	Weighted Average		10.7

Table 8.--Percentage distribution of land classes

North Side Pumping Division
Minidoka Project, Idaho

Land Class	Distribution	
	Unit A	Unit B
	(Percent)	(Percent)
1	73	42
2	22	37
3	5	21
Total	100	100

Many of the Class 2 and 3 lands included in Unit B are characterized by more or less permanent deficiencies such as shallowness to a lime zone, surface roughness, comparatively steep slopes,

or combinations of these factors. These deficiencies will result in increased water requirements because of lower farm irrigation efficiencies. Because of the greater occurrence of such lands, it is concluded that the farm delivery requirement on Unit B will be higher than on Unit A. It is estimated that this increase in average farm delivery will be about 0.25 acre-foot per acre. The average annual farm delivery requirement for Unit B is therefore set at 3.50 acre-feet per acre.

Distribution Losses - Unit B

On the average, five farm units will be served from each well in Unit B. As a result of the grouping of farms about the wells, the length of canal required to make delivery will be very short. The average well will require not more than one mile of canal with a capacity of 5.6 cubic feet per second to make its deliveries. In such a canal system, regulation of deliveries to agree with irrigation demand should present no problem; consequently, there should be little operational waste in the canal. Generally, the materials to be traversed by these short canals are deep, loessal, silt loam soils. The percolation rate in such soils is moderate. On this basis, canal losses in Unit B were estimated to average about 5 percent of the total diversion requirement at the well. The resulting average annual diversion requirement is 3.68 acre-feet per acre.

Pumping Requirement - Unit B

Monthly Distribution

The monthly percentage distribution of water to the farm headgates is estimated to be the same on Unit B as previously indicated for Unit A. The percentage of diversion by months, however, is slightly different, owing to adjustment for canal and lateral losses. These losses, estimated at 5 percent, on Unit B will be uniform throughout the season as the well pumps will be operated at or near full capacity, adjustment to the seasonal demand being obtained by periods of pump shut-down; whereas, on Unit A water will be distributed continuously through the canal and lateral system, adjustments to seasonal demand being accomplished by varying the number of pump units operated. Under this mode of operation, the loss will be 2 or 3 percent less than the average for the season during the periods of peak demand in July and August. The average pumping season for both Units A and B is expected to extend from April 20 to October 20. The monthly distribution of the average annual diversion requirement for both Units A and B is shown in table 9.

Table 9.--Diversion requirements

North Side Pumping Division
Minidoka Project, Idaho

Month	Unit A - 12,830 Acres			Unit B - 60,160 Acres		
	Distribution of Annual Requirement	Diversion Requirement		Distribution of Annual Requirement	Diversion Requirement	
		Per Acre	Total		Per Acre	Total
	(Percent)	(Acre-feet)	(Acre-feet)	(Percent)	(Acre-feet)	(Acre-feet)
April	1	.04	500	1	.04	2,600
May	17	.74	9,500	17	.62	37,300
June	16	.69	8,900	16	.59	35,500
July	24	1.04	13,300	25	.92	55,300
August	24	1.04	13,300	25	.92	55,300
September	14	.61	7,800	13	.48	28,900
October	4	.17	2,200	3	.11	6,600
Total	100	4.33	55,500	100	3.68	221,300
		Rounded	56,000		Rounded	221,000

Peak Demand

To provide for adequate delivery of water to the farms during periods of extreme drought, the well pumps and lateral systems in Unit B are designed to provide a 10 percent greater diversion than the 0.92 acre-foot per month determined for average July and August conditions (table 9). The system then will provide 1.01 acre-feet per acre at the pumps or 0.96 acre-feet per acre at the farm headgates during a 31 day peak demand period. This amounts to a design capacity for the pumps and lateral systems of one cubic foot per second per 61 acres of productive land.

Unit B consists of a number of small, semi-independent irrigation systems, each of which is dependent for its water supply on a single well or small group of wells with interconnected lateral systems. Although the percentages of different quality land varies widely in each of these individual systems, the average requirement is applicable in determining the design capacity of the wells. While irrigation efficiencies will be lower on the Class 2 and 3 lands than on Class 1, resulting in a higher farm delivery requirement for a particular crop on these lands, the differences in percentage of various crops that it is anticipated will be grown on the various classes of land will result in substantially the same average of farm delivery per acre to the service areas of individual wells or groups of wells with interconnected lateral systems.

Water Requirements as Indicated by Test Wells

One of the main objectives during the pre-construction period was to operate at least 10 irrigation wells under seasonal pumping to determine effects on the ground water supply and to confirm water requirements as set forth in the Project Planning Report. The first test well, 7B824, was operated in the 1949 irrigation season by a diesel driven pump. In the 1950 irrigation season two additional wells, 11A824 and 27C823, were operated with electric driven pumps and the diesel engine was replaced by an electric motor on well 7B824. In the 1951 irrigation season eight additional new wells, 8A823, 27A823, 6A824, 8A824, 18A824, 21A824, 6A923, and 33A922, were operated with electric driven pumps. All of the eleven pumps were operated in the ensuing irrigation seasons with five additional wells, 15A824, 10A824, 10B824, 14A824 and 4B824, placed in operation during the 1954 season.

The findings of the Project Planning Report were used to establish pump capacities for the above pumps. With allowance of 10% over the maximum month average water requirement, the capacities are established at one cubic foot per second for 65 irrigable acres, or one cubic foot per second for 61 productive acres.

The diesel operated pump could be throttled to any desired discharge, but the two electric driven pumps in wells 11A824 and 27C823 did not have throttle valves during the 1950 irrigation season. The farmers were required to use the largest flow possible in periods of low demand so that a given irrigation could be completed and the pumps could be closed down in order to save power costs. This was not entirely successful because irrigation could not be coordinated to the extent that all irrigators finished at the same time, and considerable water was wasted. This problem of matching water delivery to irrigation requirements is being solved in part by equipping all pumps with valves for regulating discharges; by interconnecting the lateral system of two or more pumps wherever possible; and by drilling dual or "paired" wells to permit variations in water delivered without throttling the pump discharges. These dual wells are drilled approximately 50 feet apart and discharge into a common stilling basin. The wells are equipped with pumps having capacities of about one-third and two-thirds of the peak delivery requirement for the irrigable acreage served from this stilling basin. This arrangement permits operation of either one or both pumps to match the water delivery more closely to the irrigation demand curve.

In this connection, it is pointed out that the monthly water requirements per acre shown in the foregoing table 9 are ideal, based on consumptive water use. It will be difficult to follow the demand curve on table 9 on Unit B because of the constant speed pumps, but it is believed that the curve can reasonably be followed in the future by using dual and interconnected wells, by throttling the pumps where required, and by using large flows in periods of low demand and coordinating irrigations. The total quantity of water pumped per season is expected to be about the same as the totals shown in the table; however, the efficiency of the pumps will be lowered due to throttling, and power cost per acre-foot pumped will be greater than it would be if the pumps were allowed to operate without throttling. In estimating power costs under Chapter VI, Plans and Estimates, allowance was made for inefficiencies in following the irrigation demand curve.

Water was delivered by Government ditch riders, and water measurements were made by the use of permanently installed Cipolletti weirs. Table 10 summarizes in detail the quantities of water pumped, water delivered to the farm headgates, and lateral system losses for the irrigation seasons 1949, 1950 and 1951.

The capacity of the pumps is believed to be adequate, and there is no reason at the present time to change the water requirements as set forth in the Project Planning Report and discussed in this report.

Table 10.--Summary of water pumped and delivered and lateral system losses

Well No.	Total Cropped Acres	Total Pumped Ac.Ft.	Total Pumped Ac.Ft./ac	Total Farm Delivery Ac.Ft.	Total Farm Delivery Ac.Ft./ac	Operational Waste Ac.Ft.	Lateral System Seepage and Evaporation Loss in % of total pumped
1949							
7B824	369.5	1,334	3.61	1,195	3.23	21	8.9
1950							
7B824	429.8	2,110	4.91	1,637	3.81	331	6.7
11A824	420.9 4/	1,848	4.39	1,429	3.39	208	11.4
27C823 1/	239.3	1,196	5.00	941	3.93	--	--
Total	1,090.0	5,154	4.73	4,007	3.68	539	8.9
1951 3/							
7B824 1/	481.6	1,494	3.10	1,330	2.76	--	--
11A824	486.0 4/	1,825	3.76	1,336	2.75	299	10.4
27C823	259.0	871	3.36	807	3.12)	30	4.5
27A823	251.0	749	2.98	710	2.83)		
18A824 1/	578.5	1,087	1.88	1,291 2/	2.23	--	--
6A923 1/	362.0	1,438	3.97	1,262	3.48	--	--
21A824	604.5	1,784	2.95	1,677	2.77	33	4.1
6A824	640.3	1,967	3.07	1,845	2.88	65	2.9
8A823	536.0	1,160	2.16	1,077	2.01	39	3.8
8A824	515.0	1,460	2.84	1,319	2.56	105	2.5
33A922 1/	68.0	219	3.22	219	3.22	--	--
Total	4,781.9	14,054	2.94	12,873	2.69	571	4.8

1/ Waste data not available.

2/ Farm deliveries total more than amount pumped due to water delivered from 6A824 & 7B824 interconnection.

3/ All pumps equipped with control valves during 1951.

4/ 166 acres sprinkler irrigated.

RETURN FLOW

Inasmuch as the natural drainageways are, for the most part, well above the ground-water table, deep percolation losses are not expected to appear in appreciable quantities in the surface drains. Consequently, the major portion of return flow collecting in surface drains will be irrigation waste water, which is estimated to be about 14 percent of the farm delivery requirement on Unit A and 16 percent on Unit B. These surface flows will be decreased somewhat by deep percolation losses from the drains and by consumptive use along these drains by native vegetation. Because these surface wastes lack the uniform flow characteristics of return flow originating from deep percolation losses, they would not constitute a particularly desirable source of irrigation water unless available in fairly large quantities.

For the most part, the natural drainage pattern in the project is in a youthful stage. In general, it consists of a number of short, steep-sided gullies which leave the project after draining only relatively small areas or which drain isolated basins and terminate in pothole areas. Because of this condition, the only significant flows of waste water generally will occur near the borders of the project.

For the above reasons return flow has not been considered as a source of irrigation water for project lands except for small areas adjacent to major drainageways. At the present time it is planned to irrigate approximately 1300 acres on Unit B with a flow of approximately 20 c.f.s. of waste water. The amount of waste water that will be available for relifts on Unit B is being estimated at 10% of the farm delivery requirement. The majority of this water will be relifted with pumps along major drainageways. A small area of 133 acres on Unit A will also be served with 2.3 c.f.s. of return flow water.

DOMESTIC AND STOCK WATER REQUIREMENTS

Domestic and stock water requirements were estimated on the basis of the monthly consumption of several typical farms in the vicinity of Twin Falls, as indicated by meter readings over a period of several months. The average monthly consumption per farm was estimated to be 28,000 gallons or 0.86 acre-feet. The peak hourly consumption was estimated to be 100 gallons. Assuming the ultimate development of the project to include about 695 farms, the total annual consumption of water for stock and domestic purposes will be about 770 acre-feet. This consumption is insignificant in comparison with the project irrigation demand on ground water and with the potential supply available. Domestic and stock water will be obtained from small wells serving one or more farmsteads. These wells are not included as a project feature.

CHAPTER V

WATER SUPPLY

Surface flows of the Snake River and ground water beneath the Snake River Plain constitute the potential source of irrigation water for development of the North Side Pumping Division of the Minidoka Project. Surface water will be delivered to Unit A by pumping from the backwaters of Milner Diversion Dam, while the land in Unit B will be irrigated by pumping from wells which tap the ground-water reservoir underlying this portion of the Snake River Plain. In order to avoid confusion as to sources, the water supply for each unit will be treated separately in the paragraphs which follow.

WATER RESOURCES - UNIT A

The surface water resources of the Snake River and its tributaries above Milner Dam are now highly developed. This fact is evidenced by runoff statistics which show that the main stream and its tributaries discharged onto the eastern edge of the Snake River Plain an average of 6,300,000 acre-feet annually during the period from 1931 to 1940, whereas during the same period the flow over Milner Dam averaged only 575,000 acre-feet annually. During the critical drought period from 1931 to 1935, the entire flow was fully controlled and utilized for irrigation except that released to fill established rights below Milner Dam. Hence, on the basis of established water use and rights, the opportunities for expanding the acreage of land irrigated from this source are extremely limited.

Present Water Use in the Snake River Valley

The irrigated area served by canals diverting from Snake River and its tributaries at and above Milner Dam includes about 1,200,000 acres. Diversions to these lands during the irrigation season range from five acre-feet per acre on pumping projects to as high as 15 acre-feet per acre in areas where subirrigation is practiced. In years of abundant water supply, a total of about 7,500,000 acre-feet of water is diverted to these lands. In addition, about 700,000 acre-feet of water are diverted into the canal systems during the non-irrigation season for domestic and stock watering purposes and to maintain ground-water levels in subirrigated areas. A substantial amount of the diverted water returns to the river, however, and is re-used during the same season or is stored in American Falls Reservoir during the winter for irrigation use during the following season. Deep percolation losses are usually large because most of the irrigated

land is situated on a very porous foundation of either deep gravel deposits or lava fields.

Although the increase in the area irrigated by diversion of surface flows during the last 30 years has been slight, there has been an ever-increasing demand for more storage water. This need for storage water is attributed in part to the use of increased acreage for row crops which require more late-season water, but mostly to the increased frequency of drought years beginning about 1919 and culminating in 1934 in the lowest recorded runoff in 50 years of record. To cope with this situation, the Bureau of Reclamation constructed two reservoirs in the Henrys Fork watershed with a combined capacity of 142,000 acre-feet and the American Falls Reservoir on the Snake River with a capacity of 1,700,000 acre-feet. All storage works constructed to date in the watershed by private interests and by the Federal Government provide slightly more than 3.2 million acre-feet of active storage space. This extensive storage system would have been inadequate to supply the demand of existing projects for storage water during the drought period from 1931-35, even though it could have completely regulated the surface flow of the river above Milner Dam during that period. Recognition of this fact after the close of the 1931 irrigation season brought demands from the water users for construction of another large reservoir on the main stream which could be operated to capture surplus flows during wet cycles and carry them over for irrigation use during dry cycles.

Palisades Reservoir now under construction, with a joint use storage capacity of 1,201,600 acre-feet is designed primarily to serve this purpose. In addition to providing the needed hold-over storage, it will control fully all floods similar to those recorded in the past, develop a substantial block of electric power, and provide space for storage of the 135,000 acre-feet of water to be saved annually by shutting off canals in the upper valley during the winter. The water saved during the winter will be stored to the credit of and delivered to the water users who make the savings possible. Hence, this firm yield will not be available for general allotment.

Surface Water Available for Unit A

The natural flow of the Snake River during periods of below-average runoff has been entirely appropriated for use on established projects. In fact, the stream flow was not sufficient to fill all of the decreed natural flow rights during the drought from 1931-35. During wet years, however, enough runoff is available in the spring to fill all reservoirs, including the Palisades Reservoir, and in addition, the stream flow is sufficient to meet all irrigation

needs until late June or early July. In such years, an appreciable amount of natural flow could be diverted to Unit A, regardless of the priority date of its diversion right. Although it is desirable to make the fullest possible use of natural flow available for the unit this potential source of supply would have no value unless sufficient storage water is provided to meet the entire irrigation requirement during dry cycles. The use of natural flow whenever available will insure that the project's hold-over storage space will be full upon entering a dry cycle. The greatest value of the project's natural flow right can be realized in this way.

For all practical purposes, the development of Unit A with surface water as the source of supply is entirely dependent on securing an adequate supply of storage water. Furthermore, the reservoirs providing the supply of stored water must have sufficient firm yield to insure a base supply during dry cycles regardless of their length. The Palisades Reservoir alone could not guarantee such a base supply because its storage right is of such late priority that no water can be stored therein during drought periods such as 1931 to 1935. The hold-over storage available in Palisades upon entering a dry period can supplement a base supply from another source, but it cannot be depended on as the sole source of supply. The firm yield of the reserved space in American Falls Reservoir, therefore, is the only remaining dependable source of surface water for Unit A. It is proposed to use the yield of the 47,593 acre-feet, (rounded to 47,000 acre-feet in discussions of water supply) of space in American Falls Reservoir set aside for use on Unit A by Public Law 864 as a base supply for the unit and to supplement it with hold-over storage in Palisades Reservoir to the maximum extent considered practicable.

Quality of Surface Water

For over 80 years Snake River water has been used for irrigation in southeastern Idaho. The quality of the water has never been questioned since most of the lands irrigated have maintained a high level of productivity. Small areas affected by poor drainage do frequently become saline.

Twenty-six separate analysis of composited water samples collected over a period of two years (1948 and 1949) have been made by the University of Idaho Agricultural Experiment Station. These analyses are summarized on table 11, showing the nature of the water at maximum and minimum salinity and the average for the two-year period. The ratings are those now in use by the U.S. Salinity Laboratory.

In addition six samples of water were collected from drainage ditches on the operating project and analyzed. These results, also summarized on table 11, indicate that return flows will have little effect on quality of the water to be used on Unit A, as only two samples were saline enough to be classified as C3 - S1 water.

Table 11.--Summary of chemical analyses of surface water supply - Unit A

North Side Pumping Division
Minidoka Project, Idaho

	Snake River Water			Drainage Ditch Water - 6 Samples	
	Sp. C.		Average of 26 Samples	Sp. C.	
	Low	High		Low	High
Electrical Cond. Micromhos @ 25°C	350	500	410	540	770
Boron, ppm.	-	-	-	0.08	0.08
Residual Na_2CO_3 me./l.	none	none	none	none	none
Sodium Absorption Ratio (SAR)	0.52	0.75	0.64	0.65	1.31
Class	C2-S1	C2-S1	C2-S1	C2-S1	C3-S1

WATER RIGHTS - UNIT A

The water rights for Unit A are all concerned with the flows of the Snake River. A right to divert natural flow will have to be established, whereas the storage rights in reservoirs from which the unit will receive storage water are already established or initiated with the probability of being established in accordance with the existing filing.

Natural Flow

A filing on 8,000 cubic feet per second of natural flow of Snake River for development of future divisions of the Minidoka Project was made by the Bureau of Reclamation in 1921. The Gooding Division has since established a right to divert 1,700 cubic feet per second of natural flow with a priority fixed by the 1921 filing. Supposedly, a part of the remainder of that filing was to be proven at the time the North Side Pumping Division was developed. However, it now appears

that the filing has lapsed because the works required for putting the waters to beneficial use on the Division were not completed within the maximum time provided by state law. A right to divert natural flow to Unit A, therefore, will have to be established on the basis of a current filing.

Storage

The supply of storage water that Unit A will receive from American Falls and Palisades Reservoirs will depend on the yield of those reservoirs, which is in turn fixed by their locations and the priority of their storage rights. The American Falls Reservoir storage right was decreed by the court with a priority date March 30, 1921. Although this storage right is junior to those of Jackson Lake Reservoir and two smaller reservoirs in the headwaters, the strategic location of American Falls Reservoir below all major tributaries and half of the basin's irrigated area, together with its large volume of spring inflow, insures that it will fill in all except extremely dry years. The 47,000 acre-feet of American Falls space allotted to Unit A of the North Side Pumping Division, therefore, is a vital asset which will furnish the base supply of irrigation water for Unit A. The storage right for Palisades Reservoir is expected to be established with a priority date of July 28, 1939, on the basis of a filing made on that date. Since this storage right will be junior to that of American Falls Reservoir, it follows that no water can be stored in the Palisades Reservoir until American Falls Reservoir has been filled. Such a condition would have occured if a firm demand was to be met during a similar drought period in the future entirely from Palisades storage, sufficient space would be required in Palisades Reservoir to provide an adequate supply in all of the years from hold-over storage.

WATER UTILIZATION - UNIT A

As shown heretofore, the plans for developing the North Side Pumping Division with Snake River water have been coordinated with all other existing and proposed developments in the basin which are dependent on the surface flows of Snake River. This has been accomplished by means of engineering determinations of water supplies and water requirements and by negotiations with the present water users. This process has resulted in the allocation of 47,000 acre-feet of American Falls space to the North Side Pumping Division. (See Chapter I.) The purpose of the discussion which follows will be to show the basis for fixing the space requirements in Palisades Reservoir and to show the adequacy of the water supply under the proposed plans.

Stream Regulation and Storage

Any engineering determination of the amount of water that will be available for Unit A from the natural flow right to be acquired, from the 47,000 acre-feet of reserved American Falls space allotted to it, and from any given allotment of space in Palisades Reservoir,

is complex because it must take into account the many diverse and interrelated factors governing the administration and use of the surface flow of Snake River. Foremost among these is the multitude of natural flow and storage rights which have been adjudicated by the courts during the last four decades and now serve as the basis for distributing the available water supply each year. A comprehensive study of the operation of the Snake River system since 1918 was made by the Bureau of Reclamation for the purpose of determining (1) the maximum amount of water that could be conserved by elimination of the present winter operation of canals for domestic and stock watering purposes, (2) the yield of Palisades Reservoir with the maximum winter water-saving program, and (3) the water supply available for existing projects with and without the reserved space in American Falls Reservoir being used for development of new land. The results of this study, which were published in 1946, formed the basis for agreement on the extent of the winter water-saving program to be carried out at this time and on the division of the reserved American Falls space between existing projects and new-land projects.

Since reaching agreement with the present water users, the original operation studies have been revised to reflect the terms of the agreement and the current plans for operation of Palisades Reservoir and for development of new land. The period of study began with all reservoirs full on July 1, 1918, and extended through September 1947. This period includes two average wet cycles separated by the driest cycle of record in the upper Snake River Basin. The important criteria and assumptions used in making the reservoir operation studies are summarized below:

(1) The modified flow of the Henrys Fork River at its mouth, as shown by an operation study of that river system, and the computed natural flow of Snake River where it emerges onto the Snake River Plain near Heise, Idaho, were used as the original water supply available for regulation and use in the Snake River Valley. The inflow to American Falls Reservoir under future conditions was obtained by adjusting the recorded inflow to reflect the anticipated changes in water uses upstream resulting from operation of Palisades Reservoir and elimination of winter diversions. Using this modified inflow, the American Falls Reservoir was studied as being operated to meet the anticipated water requirements downstream for irrigation, domestic, and power purposes.

(2) It was assumed that no irrigation water would be drawn from Jackson Lake Reservoir until the downstream reservoirs had been emptied. Hold-over privileges would be allowed in that reservoir.

(3) The winter water-saving program would be confined to elimination of the present winter operation of canals in the upper valley and limiting the winter diversions by the North Side Twin Falls Canal Company to 126,000 acre-feet in years when the reservoirs are not filled. It was assumed that the canals serving the Minidoka Project will continue to be shut off in the future as they have been in recent years. Winter diversions to the South Side Twin Falls Project were assumed to be the same as recorded in the past.

(4) The 1,201,600 acre-feet of active storage space in Palisades Reservoir would be utilized to store the 135,000 acre-feet of water saved each winter in the upper valley and to store all flood flows in excess of those required to fill American Falls Reservoir. The 135,000 acre-feet of saved water would be delivered to the upper valley canals on the assumption that such water would be stored to the credit of those saving it and would not be available for general allotment. The bottom 200,000 acre-feet of space in Palisades Reservoir (155,300 acre-feet inactive and 44,700 acre-feet dead) would be reserved to maintain a minimum power head.

(5) Of the total of 433,000 acre-feet of reserved space in American Falls Reservoir, 315,000 acre-feet would be allotted to existing projects and the remaining 118,000 acre-feet of space would be allotted to new land. Unit A of the North Side Pumping Division would be allotted 47,000 acre-feet of space and 71,000 acre-feet of space would be allotted to new land on Michaud Flats. It was assumed that water would be delivered to the latter area by pumping from American Falls Reservoir.

The results of these reservoir operation studies, insofar as they are pertinent to the storage space requirements of the North Side Pumping Division, can be summarized briefly as follows:

(1) The American Falls storage right would have been filled in all years of the period of study except 1932, 1933, 1934, and 1935. During this drought period, the 47,000 acre-feet of space allotted to Unit A would have yielded 41,000 acre-feet in 1932, 40,000 acre-feet in 1933, 26,000 acre-feet in 1934, and 22,000 acre-feet in 1935.

(2) No water, other than the 135,000 acre-feet of water saved during winter in the upper valley, would have accrued to the Palisades storage right from 1931 to 1935, inclusive.

(3) Inasmuch as the right of the North Side Pumping Division to divert natural flow will be junior to the Palisades storage right, it follows that no natural flow could have been diverted to the Division lands during the period from 1931 to 1935, inclusive.

It is evident from the above results that the yield of the 47,000 acre-feet of American Falls reserved space must be supplemented by hold-over storage from Palisades Reservoir in order to insure a dependable water supply for Unit A during a drought period.

Space Required in Palisades Reservoir

The location and area of lands to be included in Unit A were determined primarily by the surface topography and depth to ground-water levels in the Division. The objective of delivering the available supply of surface water to lands where the depth to ground water is greatest, was attained by locating the unit in the southwestern end of the project. This location also afforded a compact body of the choicest land which could be served by a single pump lift of 163 feet with a relatively short discharge pipe. Approximately 12,100 irrigable acres can be served directly from the main pumping plant. Rapidly increasing costs of hold-over storage precluded further expansion of acreage except for five isolated areas totaling about 1,550 irrigable acres within the main body of land. For these reasons, therefore, the productive area to be served with surface water was limited to 12,830 acres.

On the basis of the diversion requirement of 4.33 acre-feet per productive acre established for Unit A, the 12,830 acres of land in Unit A will require an annual diversion of 56,000 acre-feet of water. As shown by the results of the reservoir operation studies, the space requirements in Palisades Reservoir are fixed by the drought period from 1931 to 1935 when no natural flow would have been available for diversion to Unit A and American Falls Reservoir would have failed to fill. During that period, the portion of the diversion requirement not met by American Falls storage would have had to be supplied from carry-over storage in Palisades Reservoir from 1930. The accumulation of drafts required from Palisades Reservoir during this critical period, allowing a 25 percent shortage in the last year, is shown in table 12.

Inasmuch as the entire storable flow in the stream would have been allotted to the American Falls storage right during this period, the 90,000 acre-feet of water needed for Unit A would have to be stored in the project's space in Palisades Reservoir at the beginning of the 1931 irrigation season. This condition, therefore, indicates that the unit's space requirement in Palisades Reservoir should be 90,000 acre-feet.

Table 12.--Storage water requirements during critical period.

Unit A
North Side Pumping Division
Minidoka Project, Idaho

(Units of 1,000 Acre-feet)

Water Year	Diversion Requirement	Available Natural Flow	Supplied from American Falls Reservoir	Required from Palisades Reservoir
1930	56	12	44	0
1931	56	0	47	9
1932	56	0	41	15
1933	56	0	40	16
1934	56	0	26	30
1935	56	0	22	20 1/
Total	336	12	220	90

1/ Shortage of 25 percent in the last year of the critical period.

Adequacy of Water Supply

Operation studies show that the allotment of 90,000 acre-feet of storage space in Palisades Reservoir, together with the available natural flow and American Falls storage water would have provided a full water supply for Unit A in every year since 1918 except in 1935, when a 25 percent shortage would have occurred. The results of the operation studies are summarized in table 13. An examination of stream flow and precipitation records during the period from 1896 to 1917 shows that these sources could have provided a full water supply for Unit A in every year of that period. The 25 percent shortage would have occurred only once (in 1935) in the past 50 years. Increasing the allotment of Palisades storage to mitigate such an infrequent shortage is not practicable.

It is recognized that the operation of Palisades Reservoir for flood control purposes may occasionally result in its failure to fill completely while the flood is receding because of errors in forecasting the volume of flood runoff. Experience on the Snake River and other watersheds with similar runoff characteristics indicates that such errors may range from 5 to 15 percent. Studies of the joint flood control and irrigation operation of Palisades reservoir from 1918 to date, however, show that 1930 would have been the only year in which failure to fill the reservoir could have affected the supply of irrigation water for Unit A. Failure to fill the reservoir

Table 13.--Water supply summary--1918-1947

Unit A
North Side Pumping Division
Minidoka Project, Idaho

(Units of 1,000 acre-feet)

Water Year	Natural Flow Diversions	Storage Water Delivered	Shortage	American Falls Reservoir		Palisades Reservoir	
				Allotment	Hold-over	Allotment	Hold-over
1918	21	35	0	47	12	90	90
1919	12	44	0	47	3	90	90
1920	0	56	0	47	0	90	81
1921	21	35	0	47	12	90	90
1922	21	35	0	47	12	90	90
1923	21	35	0	47	12	90	90
1924	3	53	0	47	0	90	84
1925	21	35	0	47	12	90	90
1926	3	53	0	47	0	90	84
1927	34	22	0	47	25	90	90
1928	21	35	0	47	12	90	90
1929	21	35	0	47	12	90	90
1930	12	44	0	47	3	90	90
1931	0	56	0	47	0	90	81
1932	0	56	0	41	0	81	66
1933	0	56	0	40	0	66	50
1934	0	56	0	26	0	50	20
1935	0	42	14	22	0	20	0
1936	0	56	0	47	0	19	10
1937	0	56	0	47	0	10	1
1938	0	56	0	47	0	66	57
1939	12	44	0	47	3	90	90
1940	0	56	0	47	0	90	81
1941	0	56	0	45	0	81	70
1942	0	56	0	47	0	90	81
1943	21	35	0	47	12	90	90
1944	21	35	0	47	12	90	90
1945	21	35	0	47	12	90	90
1946	3	53	0	47	0	90	84
1947	13	43	0	47	4	90	90
Average	10	45	1	--	--	--	--

in that year would have reduced the unit's supply of hold-over storage below 90,000 acre-feet and the effect thereof would have been felt in 1935. Since the chances of such an occurrence are rather remote, an increase in the allotment of Palisades space as a safeguard is not justified. Moreover, an increase in the shortage in 1935 resulting from flood control operations would not have been a serious matter because of its infrequency.

WATER RESOURCES - UNIT B

The major part of the surface waters of the Upper Snake River Basin are diverted for irrigation; however, of the 6.3 million acre-feet average annual discharge from the Snake and Henrys Fork Rivers, less than half (about 43 percent) can be accounted for as consumptive use on cropped lands and spills over Milner Dam. The remainder (about 57 percent) of the discharge, together with the discharge from other smaller streams tributary to the Snake River Plain, is lost through evaporation from other than cropped areas and through deep percolation not tributary to the Snake River above Milner Dam. Ground-water studies indicate that these deep percolation losses in the Upper Basin return to Snake River as spring inflow in the reach between Milner Dam and King Hill. The possibility of developing this underground source of water is of extreme importance to the ultimate development of the water resources of the Snake River.

Geology of the Snake River Plain

The Snake River Plain is a structural depression which has been filled by repeated lava flows and intercalated sediments. It seems likely that, prior to the volcanic eruptions, the Snake and Henrys Fork Rivers flowed west for some distance beyond Roberts and Ashton and joined in the vicinity of Mud Lake. Below this junction the main stream meandered southwesterly across the original depression until it reached the present Snake River channel in the vicinity of King Hill. The tributary streams flowing down from the mountains on both sides of the depression probably all joined the main stream and contributed surface inflow throughout the year. The many ensuing lava flows, which originated mostly from volcanic eruptions along the northern foothills, gradually filled the depression to its present level and obliterated the original drainage pattern. Successive lava flows filled the then existing river channel and forced the stream to cut a new channel farther to the southeast. The continuation of this process with each succeeding period of volcanic activity finally shifted the main channel to its present position and left a series of buried channels in its wake. Sedimentary beds of loess, clay, sand, and stream alluvium are

intercalated in the layers of lava throughout the Plain, indicating that there were long periods of quiescence between eruptions. Deep deposits of river wash and coarse alluvium have been laid down on top of the last lava flows in the upper valley by the flood waters of the Henrys Fork and Snake Rivers as they emerged onto the Snake River Plain. These older alluvial deposits and a considerable area of the exposed lava fields have been covered during the recent geologic period by fine loess and silt loam soils carried in by dust laden winds and by surface streams. Nearly half a million acres of the surface of the Snake River Plain still consist, however, of bare lava with practically no soil covering.

These diverse processes produced a great basin floored with relatively impermeable rock and filled with a variety of materials which are readily permeated by ground water. The volcanic processes were inherently catastrophic, intermittent, and irregular. As a result, both the behavior of ground water and the appraisal of surface water under changing conditions of irrigation development are extremely complicated. The porous fill material overlying the impermeable basement rock throughout the Plain acts as a mighty sponge which absorbs natural precipitation that falls on the surface of the Plain and takes water from all surface streams crossing or bordering it to maintain an immense underground reservoir and subterranean flow. Many of the old buried river channels connect directly with the present channels of the Henrys Fork and Snake Rivers between Ashton and American Falls and draw heavily on those streams. In spite of the heavy losses into the porous lava beds and buried stream channels, the Snake River, with its abundant water resources, has been able to maintain a surface flow of sufficient volume to cut the present canyons between Roberts and King Hill. The losses from the Henrys Fork and Snake Rivers above Blackfoot and from all streams entering the Plain from the north and the west, pass beneath the Plain to the west of Snake River and reappear in the form of springs in the present canyon below Milner Dam.

The losses under natural conditions from stream channels above Milner Dam have been heavily augmented by irrigation during the summer and by diversion of river flows into the canal systems during the winter. The percolation losses from the canals and from the irrigated land have built up relatively high water tables through most of the valley above American Falls. The influence of this percolation, however, reaches only a few miles into the lava fields to the west where the water table sinks rapidly. A portion of the unused water returns to the river above American Falls Dam from about half of the irrigated area upstream from the Dam, where water tables stand above the river level. The deep percolation losses from the remainder of this area and from all irrigated areas on the northwest side of the river below American Falls, except near Rupert, join the subterranean flow which pours an average of more than 4,000,000 acre-feet of water into the Snake River between Milner Dam and King Hill each year.

Water Supply

Ground-Water Investigations

A report on the Geology and Ground-Water Resources of the Snake River Plain compiled by H. T. Stearns, Lynn Crandall, and W. G. Steward was published by the Geological Survey in 1938 as Water Supply Paper No. 774. This report included a treatise in preliminary form on the ground waters under the Minidoka North Side Project.

Appended to the April 1949 project planning report for the North Side Pumping Division is a report of October 1948 prepared by Raymond L. Nace of the Ground-Water Branch of the Geological Survey, covering an investigation of the ground water of the project area. The investigation by Mr. Nace was carried on in collaboration with the Bureau of Reclamation to obtain more data concerning the source, movement, and quantities of ground water available for irrigation use in and around the North Side Pumping Division of the Minidoka Project. The conclusions drawn therefrom provided much information to guide both the initial program of well testing and the recommendations for further exploration.

Co-operative studies between the Geological Survey and the Bureau of Reclamation have been continuing since this initial report by the Survey and a summary report by the Survey is now being prepared.

The drilling of additional wells in and adjacent to the Division since 1948 has resulted in changing somewhat the configuration of the ground-water contours in areas where the data originally was very meager. The ground-water map accompanying this report shows the latest adjustment of the ground-water contour data.

Preliminary Well Drilling and Testing

Three 20-inch wells were drilled during 1948 in Unit B to obtain information regarding ground-water conditions within the project area and to make tentative evaluations of the yield and problems involved in developing production sized wells. These wells are shown on the Ground-Water Map and are designated as wells 11A824, 7B824, and 27C823, respectively. Ground-water data from these wells served materially to establish the ground-water conditions within the project area. The results obtained during the drilling of these first three test wells and from the next seven irrigation wells are shown in table 14. Since this initial drilling approximately 55 more wells have been completed and tested on Unit B.

Nonproject Ground-Water Development

The first use of ground water for irrigation in the area was by Julian Clawson Farms, Inc., a privately financed development just north of Unit B in T. 7 S., Rs. 23, 24 E. Although three wells were drilled in 1946, this water was first applied to the land in 1948,

LEGEND
B.of R. irrigation wells (observed)
Other irrigation wells (observed)
Other irrigation wells (not observed)
B. of R. observation wells
Other observation wells
(Water level measurements at all observed wells on file with Geological Survey)
Boundary of Irrigable Project Lands
DESIGNATION OF BUREAU OF RECLAMATION WELLS — Example: WELL-11A824
First number "11" refers to section.
Letter "A", to designation within section.
Last number "824", to Township and Range.
(Only the letter is plotted in the appropriate section on map)
GEOLOGICAL SURVEY DESIGNATION OF WELLS IN IDAHO-Example: WELL-"da1 in section16, T.8S., R.25E. is designated as WELL 8S, 25E-16da1
(Only the letters and serial number are plotted on the map)
Contour Interval = 5 ft. (10 ft. below elev 4050) Contours show position of water table or piezometric surface in Spring 1952 (Elevations shown are in feet above U.S.B.R. local datum. Subtract 50 ft. from these map elevations to convert to mean sea-level datum of 1929)
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
MINIDOKA PROJECT-IDAHO
NORTH SIDE PUMPING DIVISION
GROUND WATER MAP
Generalized Water-Table Contours
Spring-1952
DRAWN KEA
TRACED feg
CHECKED KEA
SUBMITTED
RECOMMENDED
APPROVED
RUPERT, IDAHO December 1954
701-107-4218
SCALE OF MILES
LAKE WALCOTT
(Avg. water surface elev. = 4245')
MINIDOKA DAM AND POWER HOUSE
(Average river elevation below Dam = 4196')
SNAKE RIVER
MINIDOKA COUNTY
CASSIA COUNTY
BLAINE COUNTY
JEROME COUNTY
LINCOLN COUNTY
UNIT "A"
UNIT "B"
UNIT
RUPERT
PAUL
ACEQUIA
MINIDOKA
BURLEY
HEYBURN SUBSTATION
MILNER DIVERSION DAM
PA LATERAL PUMPING PLANT
MINIDOKA PROJECT 34.5 Kv. TRANSMISSION LINES
TO SHOSHONE FALLS
TO AMERICAN FALLS
4 MILES TO HAZELTON
UNION PACIFIC R.R.
STATE HIGHWAY NO. 25
NORTH SIDE BRANCH
U.S. HIGHWAY 30 N.
CEMETERY ROAD
ROE'S CORNER
IDAHO POWER CO.
TRANSMISSION LINE
132 Kv.
4040
4050
4060
4070
4080
4090
4100
4110
4120
4130
4140
4150
4160
4170
4180

GPO 988770

when approximately 2,000 acres were partially irrigated. The corporation has developed additional wells since that date, and in 1950, approximately 4,000 acres were irrigated.

The S. A. Camp Farms Company of California purchased approximately 6,000 acres from the North Side Land Company and began development in the fall of 1950. They drilled 22 wells and pumped water to some 4,000 to 5,000 acres during the 1951 irrigation season. This land is located north of the Union Pacific Railroad track in Tps. 6 and 7 N., Rs. 24 and 25 E.

All of the state-owned lands lying within the boundaries of the North Side Pumping Division have been sold and are being developed.

There were approximately 34,000 acres irrigated from ground water in 1954 by private owners not included within the Division.

Available Ground Water

With the limitations on surface water available to the North Side Pumping Division of the Minidoka Project, the possibility of ground-water development was investigated with a view toward supplying as much of the area as practicable from that source. The magnitude of the underground flows passing through the underground reservoir in the Upper Snake River Basin each year is tremendous. The average annual discharge to Snake River through springs along the north wall of the canyon between Milner Dam and King Hill is in excess of 4 million acre-feet. Although maximum annual fluctuation during the period 1931-1945, as indicated by Geological Survey reports, was about 22 percent, the average deviation from the mean for the period was less than 5 percent. Seasonal fluctuations also are small in comparison with those of surface streams.

Depth to Ground Water

The depth to ground water in different parts of the project area has an important bearing upon the areas selected for service from surface water sources (Unit A) and from ground-water sources (Unit B). In the absence of much specific data on ground water in Unit A, the depth to water was estimated on the basis of well measurements outside the area to the west and northeast. The estimated average depth to water in the unit is 300 feet. The depth in individual wells would probably vary from a maximum of about 350 feet near the center of the unit to a minimum of about 230 feet near the northwestern edge of the unit. The average depth of 300 feet to water points up the fact that it is more economical to dev elop this area with surface water by pumping from the river through a lift of 163 feet. The estimates of depth to the

water table are useful, therefore, principally for the purpose of a tentative evaluation of ground waters beneath Unit A as a potential source of domestic and stock water.

Inasmuch as the topography of Unit B has been mapped, it is possible with the aid of the Ground-Water Map, to predict the approximate depth to water at any given location in the Unit. On the basis of the available data, it is estimated that the average depth to water in Unit B as a whole will be about 198 feet, although the depth to water in individual wells may vary from a minimum of approximately 120 feet near the eastern end of the unit to a maximum of approximately 310 feet near the western end. Data on possible draw-down were obtained from the 10 test wells and subsequent irrigation wells drilled and tested to date. These tests indicate that only a small draw-down is to be expected (table 14).

Direction and Movement of Ground Water

In general, the ground water moves westward under the Division. Investigations and studies made by the Geological Survey show that, during the period 1920-27, the existing Minidoka Project contributed an average of 240,000 acre-feet annually to the ground-water reservoir under the Snake River Plain. Most of this flow is assumed to originate in the North Side Gravity Division and probably augments the ground-water supply beneath parts of Unit B. However, recent studies made by the Geological Survey indicate that a large part of the ground water which passes beneath Unit B enters the project area from the east. This area is of critical hydrologic importance and needs continued study during the development of wells on Unit B. The question as to whether the seepage loss from Lake Walcott will be increased by heavy pumping in the North Side Pumping Division has been considered. Nine observation wells are now being operated in the immediate vicinity of Lake Walcott, in conjunction with the other continuing ground-water observations, to facilitate determining the effects, if any, on seepage losses from the lake attributable to Unit B development. Studies to date indicate that this effect is very insignificant.

Ultimate Yield from Ground Water

There is no question but that the quantities of ground water beneath the Snake River Plain are far in excess of the needs of the project. The irrigation diversion requirement of Unit B is only about 5.5 percent of the average ground-water discharge near King Hill; the irrigation consumptive use on Unit B is only about 2.7 percent of the ground-water discharge. The amount of water that can be developed by Unit B through pumping without excessive draw-downs, however, depends largely on the ability of the aquifers to transmit water from the ground-water body of the Snake River Plain to the local areas of withdrawal.

(Combines tables 14 and 15 of the 1952 report)
Table 14. - Data from first ten wells

Unit B
North Side Pumping Division
Minidoka Project, Idaho

Data	Wells									
	11A824	7B824	27C823	8A823	27A823	6A824	6A923	18A824	21A824	8A824
Depth (ft)	227	242	262	351	240	364	225	265	250	258
Diameter (in.)	20	20	20	24	20	20	24	24	24 to 20	20
Depth of overburden (ft.)	46	25	15	11	13	30	27	33	32	27
Casing length (ft.)	50.5	33.5	21	20	20	35	40	40	33	30
Casing inside diameter (in.)	19-5/8	19-5/8	19-5/8	24-3/8	21	21	25-1/8	25-1/8	25-1/8	20-7/8
Casing wall thickness (in.)	5/16	5/16	5/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16
Elev. ground surface (ft.)	4300.6	4289.3	4284.5	4336.4	4292.9	4345.8	4275.1	4297.5	4272.5	4301.9
Elev. top casing (ft.)	4304.1	4290.2	4284.9	4336.8	4293.3	4346.9	4276.0	4298.3	4274.6	4303.4
Depth to water (ft.)	166	171	182	233	186	229	175	181	141	176
Elev. static water level (ft.)	4138.1	4119.2	4102.9	4103.8	4107.3	4117.9	4101.0	4117.3	4133.6	4127.4
Yield during test (cfs)	4.7	4.8	4.7	6.0	6.7	6.4	7.9	8.2	8.2	6.4
Drawdown (ft.)	3.0	1.1	9.0	0.4	8.5	2.0	1.1	5.1	7.5	6.0
Max. operating capacity (cfs)	7.8	7.8	4.5	9.0	4.5	10.1	7.7	9.1	10.5	8.5
Temperature of water (°F)	55.0	55.0	56.0	55.4	56.3	55.4	56.0	56.3	56.0	56.3
Cost of drilling and casing	$3,607	$3,763	$4,014	$4,739	$3,220	$5,020	$3,245	$4,425	$3,514	$3,512
Cost of pumping test	872	875	872	928	538	792	538	1,038	322	538
Total field cost of well	$4,479	$4,638	$4,886	$5,667	$3,758	$5,812	$3,783	$5,463	$3,836	$4,050

Water Supply

From data available to date it appears that the ultimate rates at which water can be withdrawn from the regional ground-water body cannot be determined precisely in advance of actual development of wells. All information to date, however, points to the fact that there is ample ground water available and that the aquifer under Unit B is capable of yielding the desired quantities of water to individual wells as planned. The program of development on Unit B is to bring in new wells, by groups of from 20 to 30, under individual contracts. As these groups of wells are drilled, tested, and placed in production continuing observations on the behavior of ground water are being made.

Quality of Ground Water - Unit B

Water samples from 10 wells within the boundary of Unit B have been analyzed by the U.S.G.S. In nine of the wells the water was found to be similar in quality to the Snake River. A well at the Prisoner-of-War Camp has a higher salinity, presumably caused by contamination from nearby drainages which are moderately saline. A summary of these analysis is shown on table 15.

Table 15.--A summary of the chemical analysis of the ground water supply, based upon 10 wells, Unit B, North Side Pumping Division, Minidoka Project, Idaho

	Range for 9 wells	P.W. Camp Well
Electrical Conductivity Micromhos @ 25°C	338 - 654	984
Boron, ppm.	0.00 - 0.15	0.25
Residual Na_2CO_3 me./l	none	None
Sodium absorption ratio (SAR)	0.58 - 1.14	2.30
Class	C2 - S1	C3 - S1

Future Well Program

The following programs were outlined in the Project Planning Report and recommended as steps toward determining the most desirable plan for ground-water development of Unit B.

Test Wells to Determine Yield

It was recommended that seven additional production-sized test wells be drilled during the preconstruction period. Locations of these wells are indicated on the Ground-water Map and are shown as 21A824, 8A824, 6A824, 18A824, 27A823, 8A823, and 6A923. Three of these wells are located within a one-mile radius around well 7B824 for the purpose of determining the local effect of heavy pumpage on the water table. The other four wells are so located as to test the inferred ground-water conditions elsewhere on the Unit.

It was further recommended that these new test wells, as well as the three drilled in 1948, be test-pumped at discharge rates up to 6 or 7 cubic feet per second and also that they be pumped continuously for irrigation purposes at an early date.

Efforts during the preconstruction periods were directed toward fulfilling these recommendations. A Diesel driven pump was installed in well B, now designated well 7B824, and the pump was operated through the 1949 irrigation season, pumping 7.8 second-feet and irrigating 369.5 acres of the 504.8 acres under lease. In 1950 this pump was replaced with an electric motor driven pump of the same capacity. It operated with two other pumps placed in well A and well C, now designated 11A824 and 27C823. The three pumps furnished water to 1,090 acres of the 1,233 acres under lease.

Seven new wells were drilled in 1950 and were placed in operation in 1951, completing the requirements during preconstruction as set forth in the Project Planning Report. The land under these wells has been leased and in 1953 approximately 17,000 acre-feet of water was pumped to the 5,170 irrigable acres within the service area of these ten wells.

In addition to development of the above 10 wells, a pump, salvaged from Hunt Relocation Camp, was installed in well 33A922 designated in the Project Planning Report as well 9S 22E 33ad1. This well is located at the site of the Paul Prisoner-of-War Camp and has been used to irrigate 70 acres of land. The primary purpose of the operation of this well is to observe the response to irrigation of a small problem area within the unit. This land is affected by a saline-alkali condition and it is desired to ascertain if it can be successfully leached. Three test plots on this land are being observed under different methods of irrigation and the effects noted. The data collected will be valuable for determining the best leaching methods and extent of response to be expected from such treatment of other similar lands in the area.

The results of actual irrigation pumping of these initial wells serves toward substantiating the following:

(1) No effect has been detected in over-all drawdown caused by irrigation seasonal pumping by Government wells or nonproject wells.

(2) The most economical size of pump is a maximum size which will operate in a 20 to 24-inch diameter well. This will change the average acreage of productive land per pump from 194 in the 1949 Project Planning Report to 356 in this report.

(3) The design capacity of pumps of one cubic foot per second per 61 acres of productive land to be served, as estimated in the Project Planning Report is adequate to serve the area.

(4) The soils in the project area are very well suited to irrigation farming.

(5) The yield of individual wells has been found to be very high. Apparently any required yield, within limits set by pump size workable in the well, can be attained by extending the drilling. Large flows are encountered when a crevice in the water-bearing lava is intersected, and two high-capacity wells can be drilled in close proximity without appreciable water-level interference.

Observation Wells

As recommended in the Project Planning Report, four observation wells have been drilled and are operated with automatic recorders at strategic locations near the periphery of the project. The purpose of these wells is to furnish data on the general behavior of the ground water as Unit B is developed. The recorders were placed in operation in the fall of 1950. In addition, one of the existing wells in the Paul Prisoner-of-War Camp area, (Well 9S 22E 33ab1) has been reserved as a permanent observation well. This well has also been equipped with an automatic recorder since the fall of 1950.

In the immediate vicinity of Lake Walcott, where the effects of pumping in Unit B on the ground-water movement might be a limiting factor on the development, eight additional permanent observation wells are now operated by the Bureau of Reclamation. Operation of recorders on these wells began in 1951. Two of these wells were constructed by the Burley and Minidoka Irrigation Districts and the remaining six were constructed as part of the preconstruction work on the North Side Pumping Division. Two additional observation wells were drilled in 1953 north of Unit B, in the midst of nonproject irrigation, to observe ground-water fluctuations in that area.

Review of the observation well program with the Geological Survey indicates that the wells now in operation on the project and in the vicinity of Lake Walcott are adequate for the present. However, as pumping is increased on Unit B some additional observation wells may be necessary. It was estimated that two more observation wells, the locations of which will be determined on the basis of subsequent studies, should be adequate to meet future needs.

Water Supply

The Bureau of Reclamation is operating and servicing the recorders on all of these observation wells. The record charts and measurement data are being submitted to the Geological Survey for inclusion in their Idaho observation well data. From time to time, as the need may arise, the Geological Survey will collaborate in summarizing and analyzing the observation well data and determining the need for changes in the Unit B development program.

WATER RIGHTS - UNIT B

Idaho Law

The constitution and statutes of the State of Idaho recognize the right of appropriation of subterranean waters. Section 41-103, Idaho Code Annotated, 1948, provides for the acquiring of the right to the use of subterranean waters by appropriation, and such rights with reference to natural springs and artesian waters have been held to be valid. In 1951 the State Legislature enacted a Ground Water Code; Chapter 200, Session Law, Idaho, 1951. This code, which was amended in 1953, states that ground waters are public waters and are declared to be the property of the State. The code further provides for methods of appropriation of ground waters and goes on to state "All rights to the use of ground water in this State however acquired before the effective date of this Act are hereby in all respects validated and confirmed."

Ground Water Filing for Unit B

On September 9, 1948, the Bureau of Reclamation made application to the Department of Reclamation, State of Idaho, for a permit to appropriate sufficient ground water for full development of Unit B. A total of 1,333.28 cubic feet per second for a total arable area of 66,664 acres in Unit B was requested. This is based on the maximum rate generally allowed by the State--one cubic foot per second for 50 acres. This application was based on tentative well locations for 306 wells and specific locations for the three test wells A, B, and C drilled in 1948. Data developed as more wells are drilled will change these tentative well locations; however, such changes within the general boundary of Unit B will not affect the priority date of this permit. The application was approved by the State Reclamation Engineer on November 5, 1948, under Permit Number 20736. In the best interests of the Division as a whole, the permit is upon the basis that all the wells will, as a group, be appurtenant to all the lands of the entire Division, rather than being made appurtenant to a particular parcel of land. This would permit a more satisfactory distribution of water to lands and maximum over-all development.

The original permit approved by the State Reclamation Engineer was for a five-year period expiring November 5, 1953. This was subsequently

extended for two years to November 5, 1955 and the State Reclamation Engineer has indicated that further extension will be considered, if necessary, under the applicable regulations governing such extensions. At the present time it appears that one additional two-year extension to November 5, 1957 will be required to complete the proposed development in Unit B.

WATER UTILIZATION - UNIT B

The development of Unit B to utilize ground water exclusively means that the sufficiency of the water supply will be determined wholly by the influences of adjacent well developments and the ground-water supply.

Adequacy of Supply

All available evidence indicates that the ground-water supplies for Unit B are adequate to supply the productive area of 60,160 acres in the Unit. Actual proof of this supply will, of course be made progressively as the wells are put into operation. All irrigable land developed in the unit is expected to have a full supply of irrigation water in all years, inasmuch as the available supply varies but little from year to year and development within the unit will be kept within the limits of this supply.

The average annual discharge from the ground-water body underlying the Snake River Plain, of which Unit B is a part, is in excess of 4,000,000 acre-feet. The total irrigation diversion requirement of the 60,160 productive acres included in the unit is only about 5.5 percent of this total. The tributary ground-water area is so great and varied, and the mass movement of these waters is so relatively slow, that changes in climatic cycles from year to year are not significantly reflected in the ground-water supply. The effects of dry years and wet years on the available supply are believed to be negligible as the outflow from the over-all ground-water supplies in the springs and seeps along the north canyon wall of Snake River between Milner Dam and King Hill, however, has not fluctuated appreciably in heavy and light runoff years in the past. Hence, conditions appear favorable for the successful development of at least the small percentage of the total ground water in the region required for Unit B.

The water supply for Unit B will be pumped from ground water beneath the Unit by means of a number of deep wells ranging in capacity from about 0.8 to 10.6 cubic feet per second. The area served by each well will be so limited that all wells will be able to supply the maximum monthly requirement of their respective service areas. It is expected that the quantity of water pumped will be regulated to match the requirement during periods of less than maximum use by intermittent operation of the pumps at or near full capacity and, where practicable,

by interconnecting the lateral systems of two or more wells, or by drilling dual wells equipped with two sizes of pumps.

Depletion of Regional Ground Water

The irrigable area in Unit B is 64,000 acres of which 60,160 are productive acres which will be cropped. On the basis of an average irrigation season consumptive use of 1.80 acre-feet per acre, the average annual increase in consumptive use by this area will be about 108,000 acre-feet. The average annual increase in consumptive use along drainageways and ditchbanks in Unit B is estimated to be about 20,000 acre-feet. The resulting increase in the average annual depletion by consumptive use in Unit B is thus about 128,000 acre-feet.

For reasons presented in the discussion of re-use of return flow in Chapter IV, it is concluded that all irrigation water diverted to Unit B, but not consumptively used, will intermingle with ground waters in the area and be discharged into Snake River from springs along the north canyon wall between Milner Dam and King Hill; consequently, the average annual depletion of ground water by Unit B is estimated to be about 128,000 acre-feet.

All available ground-water data indicate that the deep percolation losses from Unit A will be tributary to the regional ground-water body. It is estimated that, of the total diversion requirement of 4.33 acre-feet per acre for lands of Unit A, about 1.9 acre-feet per acre will return to the ground-water body through deep percolation and drainage wells. On this basis, the average annual contribution to the regional ground water by Unit A will be about 26,000 acre-feet. This figure represents water which heretofore was not permanently assigned to, or used by any particular area and so could not be considered a firm contribution to the regional ground-water body in the past. Its use on Unit A on a permanent basis, however, does constitute a firm contribution to this body each year.

It follows that the average net depletion of ground water by the Division as a whole will be about 102,000 acre-feet annually. It is unlikely that this depletion will have any noticeable effect on the spring inflow to Snake River between Milner Dam and King Hill. On the basis of Geological Survey records and reports, the average annual discharge of these springs for the period 1931-45 was in excess of 4 million acre-feet. Since this average annual depletion is expected to be spread uniformly throughout the year, it is concluded that existing developments based on this ground-water flow will not be adversely affected by the development of the North Side Pumping Division.

DOMESTIC SUPPLIES

Ground water appears to be the most likely source of domestic water for both Units A and B. Chemical analysis of the ground water indicates that this supply is satisfactory from a chemical standpoint. Records of analyses made of ground water from wells in the area indicate the presence of some iron and some fluorides. The largest concentration of iron was 1.0 part per million in well 7S 23E 26ddl. In general, those samples that were analyzed for iron are considered satisfactory in that respect for farm and domestic use. The 0.9 parts per million of fluoride in the Rupert city well (9S 24E 29abl), the largest concentration of fluoride in any of the ground-water samples analyzed, is below the upper limits allowed by State and Federal Departments of Public Health.

The total hardness of the samples in the analysis of ground water range from 138 to 322 parts per million expressed as $CaCO_3$. The total hardness in a few of these samples is in excess of 250 parts per million, which is generally recognized as the maximum desirable upper limit for domestic use; however, this hardness can be reduced to more acceptable limits through use of various types of water softening equipment.

The total dissolved solids in these samples ranged from approximately 180 to 548 parts per million. The desirable upper limit prescribed in standards recommended by the United States Department of Public Health for drinking water of good chemical quality is 500 parts per million. Samples of water from each of the test wells 11A824, 7B824, and 27C823 were given the standard bacteriological tests for the presence of certain bacteria common to the digestive tracts of humans and other higher forms of animal life by the Idaho Department of Public Health. These samples were found safe for human consumption. Consequently, the ground water beneath the project constitutes a suitable source of potable domestic water.

With regard to the domestic water supply, great care must be taken in disposing of sewage to prevent contamination of these supplies in the future. The practice of disposing of raw sewage by dumping it into wells drilled into the lava rock, as is sometimes done in other areas along Snake River, should not be permitted. The cracks and crevices in this lava rock in many cases would transmit this sewage to the zone of saturation in a relatively short time and thereby constitute a serious hazard to this source of domestic water.

No doubt considerable irrigation water will penetrate the soil mantle to the lava rock and return to the zone of saturation. This return of irrigation water to the zone of saturation may be further increased by the use of drainage wells in certain parts of the project. Similar conditions have existed for many years in nearby areas without seriously affecting the potability of ground-water supplies. Some increase in hardness and total dissolved solids may result, but these increases should be small because of the relative magnitude of ground-water body in comparison with the amount of returning irrigation water.

CHAPTER VI

PLANS AND ESTIMATES

The engineering plan selected for the North Side Pumping Division provides for delivery of water to an irrigable area of 77,650 acres. Of this area, 13,650 acres will be supplied by pumping from the Snake River and 64,000 acres will be served by pumping from wells. The limited quantity of storage space in American Falls Reservoir available for this Division, the high cost and low yield of Palisades Reservoir space, and the proving of a substantial ground-water supply under the project area were the basic factors which determined the general features of the adopted plan. The area selected to be served with the available surface water supply was designated as Unit A. The unit is a compact block of good land which can be served with a single main pumping plant, five small relift plants, and an inexpensive distribution system. The area selected for development using ground water was designated Unit B. Data obtained on the ground water under this area indicate that a large supply is available at reasonable pumping depth. The topography of these lands and their remoteness from the Snake River made the use of the available surface water on any part of this area less desirable than its use on Unit A lands.

The project will be operated as a division of the Minidoka Project. Office Administration, while the Bureau of Reclamation is operating the project will be handled by the Bureau's existing Minidoka Project office at Burley, Idaho.

UNIT A - PLANS AND ESTIMATES

Determination of the Unit Area

Unit A was selected to be served with the available surface water because of the location of the lands near the Snake River and a lower pumping lift from the river than from ground water. The productive area that can be served economically by surface water amounts to approximately 13,000 acres. With this limitation established, the topography and ground-water data of the general area selected for service from surface water was studied. The height of pump lift at the main pumping plant was determined by the elevations of ridges and saddles which would be traversed by the main canal and laterals. The topographically isolated areas above the canal and laterals were then studied and cost of service to these areas was compared with cost of service by pumping from wells to areas along the northern fringe of the unit which could be served either from the Unit A distribution system or from ground water. On the basis of this study, five areas totaling approximately 1,564 acres were selected for service with automatic relift pumps within

Unit A. The location and elevation to which water will be raised at these five relifts are shown on the Unit A distribution system map.

Plan of Development

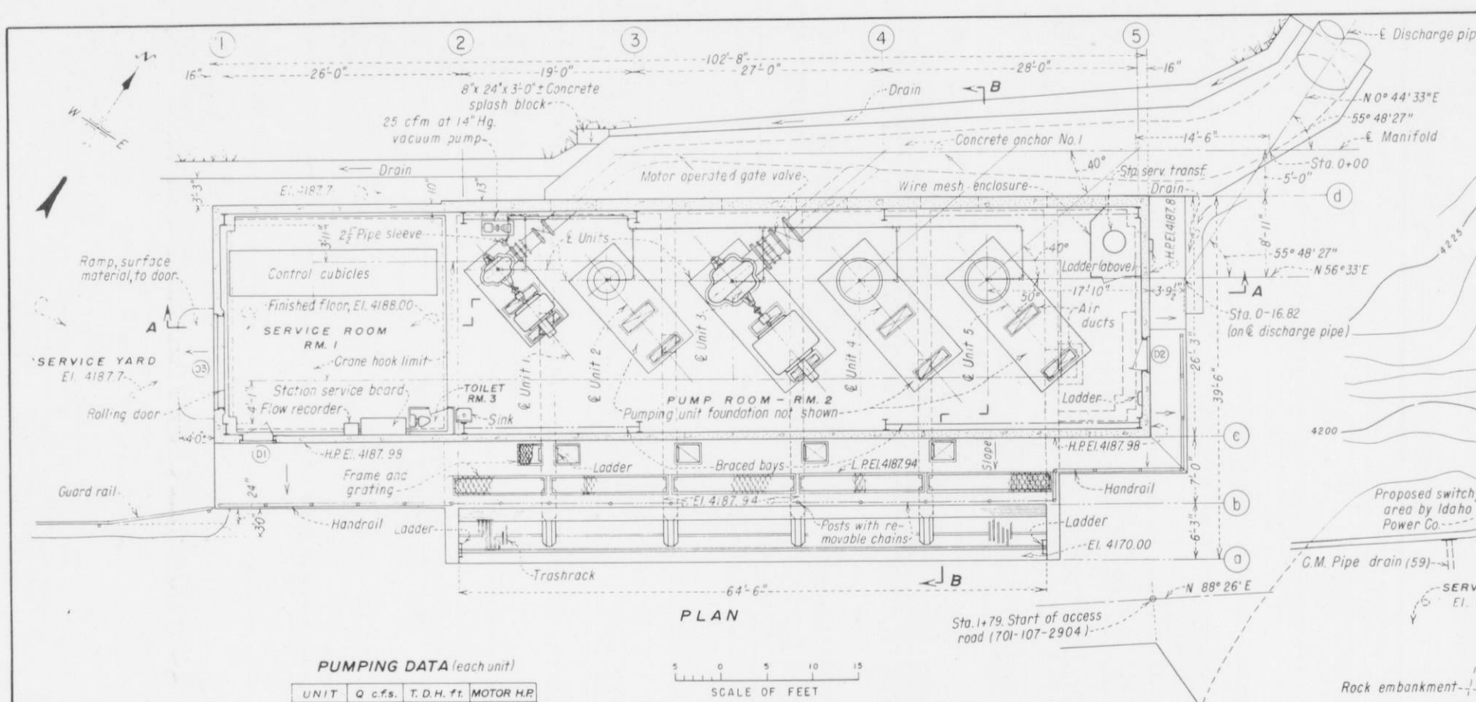
The principal source of water will be from storage in American Falls Reservoir, which will be augmented by hold-over storage in Palisades Reservoir and by such natural flow as is available. Stored water will be released down the Snake River as required. A pumping plant located on the north shore of the backwaters of Milner Diversion Dam will pump water against a static head of 163 feet into a gravity canal to serve lands within the unit. Automatic relift pumps will lift water from the canal onto the five included isolations.

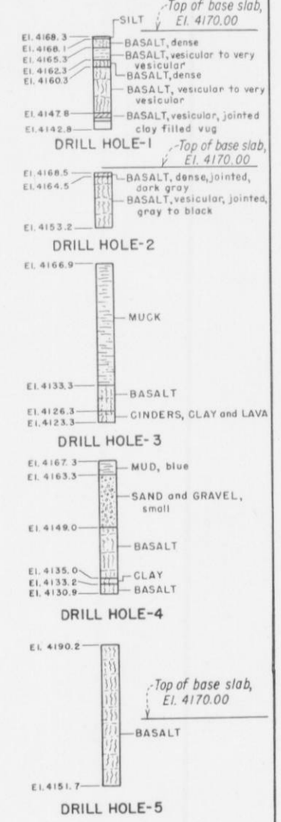
Rate of Delivery

The Unit A pumping plant and distribution system have been designed to deliver 240 cubic feet per second. This capacity is based on an average maximum monthly diversion requirement of 1.04 acre-feet per acre of productive land, plus a 10 percent allowance for meeting peak requirements during periods of extreme drought. The average seasonal distribution system loss is estimated at 25 percent. However, during the periods when the facilities are operating at full capacity, it is estimated this loss will be reduced to about 22 percent of the water diverted.

Storage

The storage space in American Falls Reservoir set aside for Unit A under Public Law 864 amounts to 47,593 acre-feet. On the basis of the original construction cost, $210,836 has been allocated for repayment from revenues derived from use of this space. Since the completion of American Falls Reservoir in 1926, the space reserved for new divisions of the Minidoka Project has been leased to other irrigation interests and has earned revenues which may be applied toward repayment of the above cost. The North Side Pumping Division's share of these earnings to December 31, 1951 amounts to $118,001. In addition, this space has participated in profits accruing to all owners of irrigation space in the reservoir resulting from sale of town lots in American Falls. The amount of this profit assignable to the Division's space is $2,956. In working out the equitable distribution of lease earnings from the reserved space as required under Public Law 864, allowance has been made for a replacement reserve creditable to the space set aside for the new lands on Unit A of the North Side Pumping Division and on the Michaud Project. The amount of this replacement reserve assignable to the Division is $18,906.





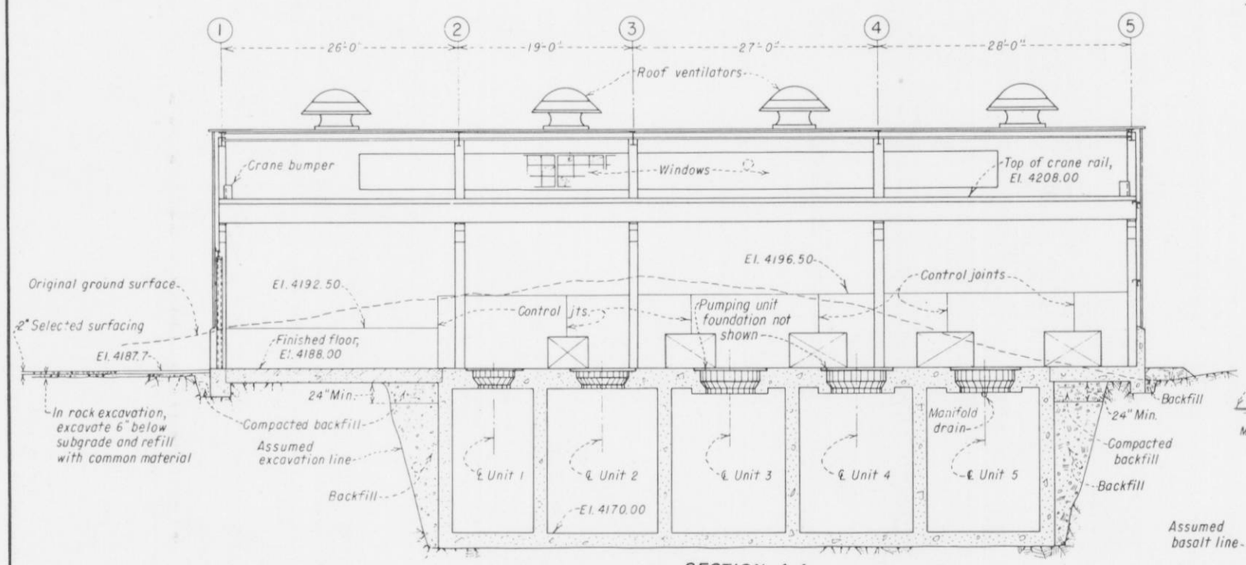
PUMPING DATA (each unit)

UNIT	Q c.f.s.	T.D.H. ft.	MOTOR H.P.
1	20	168	500
2	40	168	1,000
3, 4, 5,	60	168	1,500

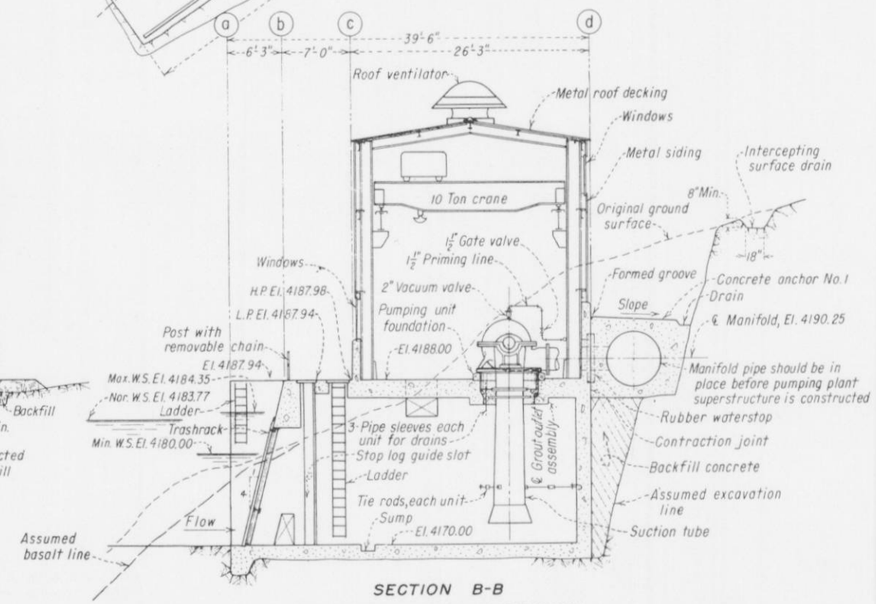
Total Q = 240 cfs

NOTES

For general notes and reference drawings, see 701-D-39.



SECTION A-A
(EQUIPMENT NOT SHOWN)



SECTION B-B
(PUMP ROTATED INTO PLANE OF SECTION)

1-5-55	D	N.A.A.	GENERAL REVISION AND TRACED
12-6-54	D	N.A.A.	GENERAL REVISION

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

MINIDOKA PROJECT
NORTH SIDE PUMPING DIVISION-IDAHO

UNIT A PUMPING PLANT
GENERAL ARRANGEMENT AND GENERAL PLAN

DRAWN E.E.O. SUBMITTED Samuel Dodel
TRACED V.M.M. RECOMMENDED
CHECKED S.P. A.T. APPROVED ASSOCIATE CHIEF ENGINEER

DENVER, COLORADO, JULY 30, 1954 — 701-D-1

GPO 986770

Relift No.	Irrigable Area (Acres)	Static Lift (Feet)	Discharge Capacity (c.f.s.)
6R1022	132	17.9	2.3
9R1022	730	33.9	12.8
9R1021	90	8.4	1.6
7R1022	384	8.9	6.8
15R1021	133	12.5	2.3

Operation and maintenance of these relift pumping plants would be the responsibility of the ditch rider; and repairs would be handled by personnel from the main pumping plant.

Main Canal

Unit A is a compact, elliptical-shaped land body. The main canal for this unit will be approximately 4.4 miles long, with an initial capacity of 240 cubic feet per second, which will decrease to 110 cubic feet per second through its length. It will follow the contour throughout most of its' length and will be built in open earth section. Two bridges, three checks, three lateral turnouts and twelve farm turnouts will be required along the 4.4 mile section of main canal.

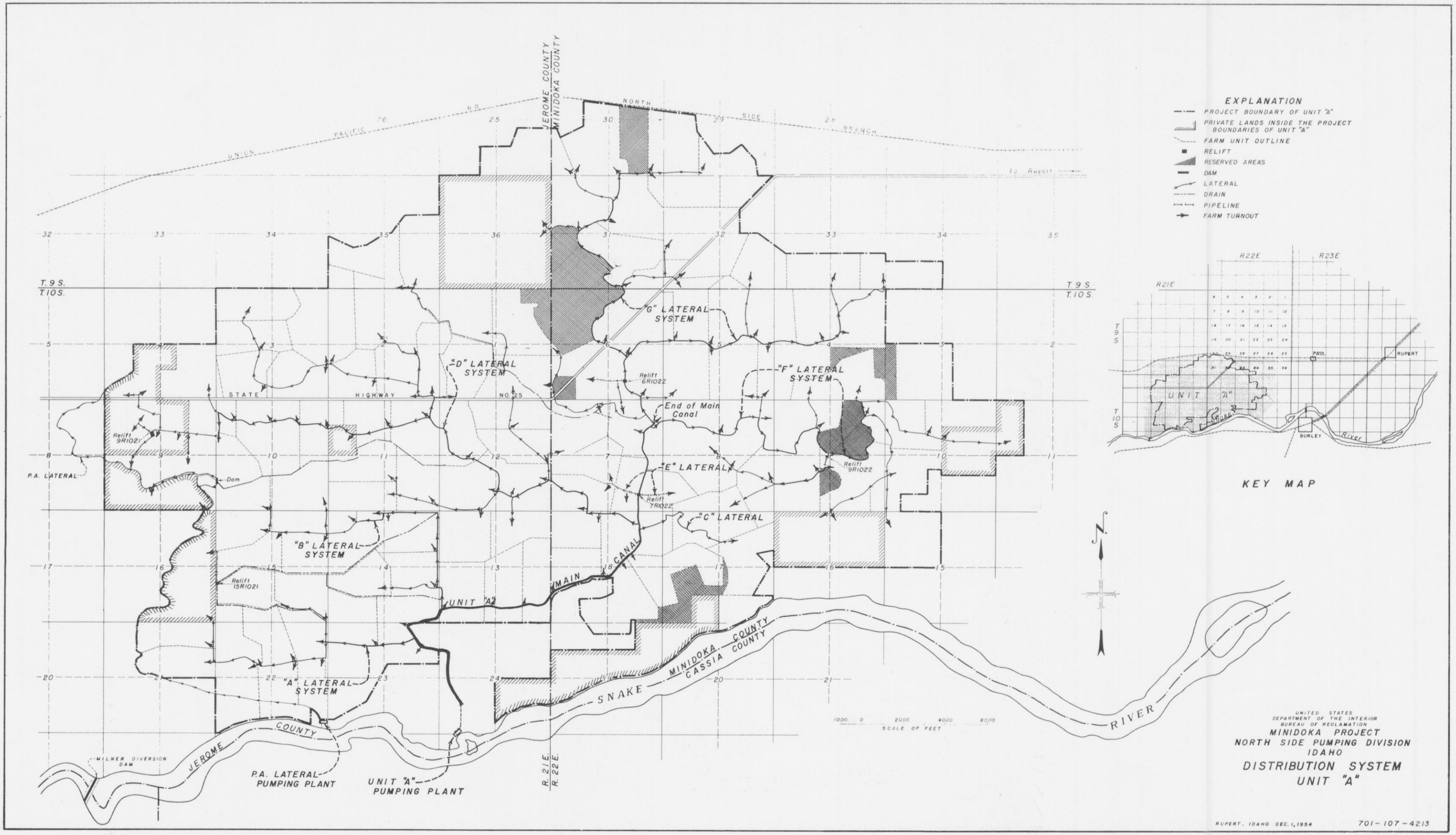
Lateral System

The Unit A area is such that construction of a distribution system will not be difficult. The deep soils and gentle slopes of the area make it possible to use open earth sections and to construct the laterals in relatively straight courses with a minimum number of control structures.

The original estimated cost for the lateral system of Unit A was derived by detailed analysis of lateral system requirements for representative areas and extending the costs on these areas to corresponding similar areas. In making this analysis and cost estimate, the Unit was divided into Area No. 1 and Area No. 2. In Area No. 1, the laterals follow the ridges and distribute water on either side. The laterals in Area No. 2 will, in general, be contour ditches.

The costs derived for the respective areas are based on preliminary layouts for ditches and structures on representative laterals in each area and extending these costs to the respective remaining laterals. The total cost of the lateral system for Unit A was then determined by summation of the costs under individual laterals and the costs of features not otherwise included.

The original cost was adjusted and brought up to date in this report by making a detailed analysis of lateral system requirements and costs taken from similar lateral systems constructed or being constructed in the Division.


EXPLANATION
PROJECT BOUNDARY OF UNIT "A"
PRIVATE LANDS INSIDE THE PROJECT BOUNDARIES OF UNIT "A"
FARM UNIT OUTLINE
RELIFT
RESERVED AREAS
DAM
LATERAL
DRAIN
PIPELINE
FARM TURNOUT
KEY MAP
R22E
R23E
R21E
T 9 S
T 10 S
PAUL
RUPERT
UNIT "A"
BURLEY
River
JEROME COUNTY
MINIDOKA COUNTY
CASSIA COUNTY
UNION PACIFIC R.R.
NORTH SIDE BRANCH
To Rupert
T. 9 S.
T. 10 S.
"G" LATERAL SYSTEM
"D" LATERAL SYSTEM
"F" LATERAL SYSTEM
"E" LATERAL
"C" LATERAL
"B" LATERAL SYSTEM
"A" LATERAL SYSTEM
STATE HIGHWAY NO. 25
Relift 6R1022
End of Main Canal
Relift 9R1021
Relift 9R1022
Relift 7R1022
Relift 15R1021
P.A. LATERAL
Dam
MAIN CANAL
UNIT "A"
SNAKE RIVER
MILNER DIVERSION DAM
P.A. LATERAL PUMPING PLANT
UNIT "A" PUMPING PLANT
R. 21 E.
R. 22 E.
N.
1000 0 2000 4000 6000
SCALE OF FEET
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
MINIDOKA PROJECT
NORTH SIDE PUMPING DIVISION
IDAHO
DISTRIBUTION SYSTEM
UNIT "A"
RUPERT, IDAHO DEC. 1, 1954
701-107-4213

GPO 986770

Drainage System

The drainage system for Unit A will consist of shallow, open ditches excavated in the natural drainage channels and leading to inverted drainage wells located near the border of the unit or into collecting channels for disposal into the distribution or drainage system of the Minidoka Irrigation District. This system is designed to dispose of irrigation surface waste and precipitation runoff amounting to 2.6 cubic feet per second from each square mile of irrigated land in the unit. (See Drainage, Chapter III). Because of the highly permeable soils and underlying creviced basalt, it is anticipated that all deep percolation losses from irrigation will move downward to the regional water table and therefore will not contribute any flow to the drains.

The drainage facilities included for Unit A are based on a detailed study of a 6,240-acre area with a dendritic drainage pattern located in Unit B. In extending the estimated requirements for drainage facilities from the study area to Unit A, the quantities of various construction items were carried into the estimate on the basis of relative acreage. Thus, while the estimate amounts to, more or less, a lump-sum provision to cover construction of drainage facilities as the need for this construction is demonstrated, it also includes a rough determination of the breakdown of costs between various construction items.

The basic items of work provided for in the estimate include excavation of drain ditches, installation of road culverts, and drilling and equipping of inverted drainage wells. The use and design of these wells is based on the successful operation of similar structures on the adjacent North Side Gravity Division. The inverted drainage wells will consist of a well drilled through the soil mantle and into the creviced basalt above the regional water table. Water entering the well will first pass through a settling basin. Entrance to the well will be through an inverted U-shaped pipe placed on top of the well casing, with the point of water entry well above the bottom of the settling basin. A hole drilled above the intake end of the pipe will break the siphon action and prevent floating debris from being drawn into the well.

UNIT B - PLANS AND ESTIMATES

Determination of the Unit Area

When investigation of the North Side Pumping Division was resumed in 1946, the plan was to irrigate the entire area by pumping from Lake Walcott. The influencing factors at that time were reasonable pumping lifts, topography, and a desire to serve generally the area of high quality lands. For the above reasons, a tentative project area was

selected and the lands classified. Through tentative agreements with the Upper Snake River water users, it became apparent that only a limited amount of surface water at an economic cost would be available to the project and additional water would have to be obtained elsewhere. Therefore, development of ground water was studied. Data obtained from experimental and other existing wells showed such development to be feasible. When the shift was made to a plan serving part of the area with ground water, the limitations originally imposed by the before-mentioned conditions were altered in many respects.

Ground-water information indicates that, although the depth to ground water increases to the west, the increased depth will not prevent economic development of any of the area included within the boundary of Unit B.

Use of available surface water on lands of Unit B is less desirable than use on Unit A. Unit B's remote location from the Snake River and more rolling topography would make the cost of irrigating a part of the area from available surface water greater than the cost of applying the surface water to Unit A.

Subdivision of the Area

Subdivision of land into farm units on the basis of topography, rather than by standard public land subdivision, is desirable on this project. The rolling topography and use of ground water on Unit B render it particularly advantageous on this unit. The points of diversion and well locations have been planned for this type of subdivision from consideration of topography and land classification. The Project Planning Report recommended wells to serve an average of three farm units, but experience in the preconstruction period indicates that wells should serve an average of four farm units. The Unit B area has been subdivided accordingly, and the well locations are shown on the General Map.

Plan of Development

The Unit B irrigable area of 64,000 acres will be served by some 175 wells drilled at strategic points. The capacity of the individual wells, as determined by their respective service areas, will range from 0.8 to 10.6 cubic feet per second and will average about 5.6 cubic feet per second. The average pumping lift will be about 198 feet. Experimental operations of the ten test wells and subsequent irrigation wells indicate that average draw-down at the wells should be considerably less than ten feet. Each well will have a small lateral system which will be interconnected, where practicable, with the lateral systems of wells serving contiguous areas. Other features of the irrigation

system for Unit B include drainage facilities to dispose of surface run-off and observation wells to determine the effects, if any, of project pumping on the regional water table.

Under the investigation and preconstruction programs, ten wells were drilled, equipped and operated, and one well was equipped with a pump and motor obtained from the Hunt Relocation Center. One well was placed in service during the irrigation season of 1949, two during 1950, and eight during 1951. In 1954, five additional irrigation wells were placed in service. During the irrigation seasons of 1949 to 1953, the lands served by the eleven wells were let on short-term leases to private operators to establish proof of the available water supply prior to permanent settlement and to determine the adequacy of preconstruction estimates concerning water requirements, structures and other irrigation works. The objectives of this leasing program have been reached and the program has now been discontinued except in one small borderline area where the quality of land was low and it was deemed advisable to continue farming operations to determine if the land was suitable for homestead entry.

Observation Wells

The project is estimated to require a total of 16 observation wells. Fourteen of these wells have been constructed and equipped with weekly and monthly recorders as part of the preconstruction program. In addition, one of the existing wells in the Paul Prisoner-of-War Camp area (well 9S 22E 33abl) has been reserved as a permanent observation well and equipped with a recorder. The remaining two observations wells estimated as necessary to meet future needs of the Division will be constructed as studies of the ground-water movement indicate the need for these additional facilities.

Rate of Delivery

The individual well pumping plants of Unit B will have adequate capacity to provide the respective service area appurtenant to each well with a full water supply. The capacity of the plants has been determined on the basis of providing the average maximum monthly diversion requirement (0.92 acre-foot per acre), plus a 10 percent allowance for peaking during extreme drought periods. The well installations then will have a capacity to provide 1.01 acre-feet per acre to their appurtenant service areas during a 31-day period. This amounts to a design capacity of one cubic foot per second per 61 acres of productive land, or 65 acres of irrigable land.

Irrigation Wells

The program of exploratory drilling and testing of wells on Unit B during the planning and preconstruction stages of the investigation has

furnished good basic data for refining the cost estimates and working out detailed designs of the irrigation facilities. The ten irrigation wells constructed under this program served 5,170 acres of land during the 1953 irrigation season.

From the data accumulated and assembled on the ground-water elevations and behavior within Unit B, a revised Ground-Water Map has been prepared. With this map and the topographic map of the area, it is possible to estimate very closely the depth to the ground-water table at each proposed well location. From the drilling experience on the ten experimental wells, it is estimated that the design flows can be obtained with very small drawdown by drilling the wells an average of 85 feet below the ground-water level. The wells will require casing down to solid rock, which it is estimated will average about 30 feet per well.

Provision is made for a minimum 12-hour pumping test on each irrigation well. Occasional wells will require deepening and retesting following the first test. The amount provided in the estimate for well testing is sufficient to cover the few retests which will be required.

At the top of the casing, a concrete slab will be provided to serve as a foundation for the pump and for the pump starting equipment.

A stilling basin is required at each well to reduce the velocity of the flow from the pump and for regulation of water deliveries to the individual laterals. Both concrete boxes and open pools formed with earth embankments have been used on the ten experimental wells. The stilling pool design adopted for future installations consists of a saucer-shaped open basin 33 feet in diameter and 7.5 feet deep, formed from earth embankment and lined with dry rock paving. Delivery of water from the pond is regulated with standard turnouts and checks which are part of the lateral system structures.

Pumps and Motors

One submerged-motor type pumping unit and fourteen surface-motor, long-shaft type pumping units are in service at the present time, pumping from the fifteen existing project wells.

The service history of submersible pumping units on the project has been very disappointing to date. The first 200 hp. unit installed in Well 7B824 in the spring of 1950 failed on July 29, 1952. This unit was replaced with a new 250 hp. unit that failed on August 3, 1953, after less than one year's operation. In light of the trouble experienced on the submersible-type pump, it is anticipated

that all pumping units will be of the surface-motor, long-shaft type. However, the submersible-motor type pumps are particularly adapted for use in crooked-shaft wells. Pumphouses will not be required and each pump will be equipped with a device for indicating the water surface elevation in the well. The pumps will be vertical-shaft deepwell, turbine type pumps directly connected to a vertical hollow shaft induction motor mounted above the ground surface. A standard pump speed of 1,200 r.p.m. is recommended, although higher speeds will be acceptable on the smaller pumps. The pump impellers will be bronze, enclosed and provided with bearings below the bottom impeller and a bearing above each impeller. For the long-shaft type pumps, a manually operated oiler will provide lubrication for all guide bearings in the pump column. The pump columns are made from standard steel pipe with screwed couplings not more than twenty feet apart.

All motors will be of the 3-phase, 60-cycle, vertical shaft, squirrel-cage induction type. The motors will be rated at either 2,300 or 440 volts, depending on the size, will be for across-the-line starting, and will be provided with slings for lifting and mounting in place, using an overhead crane. A thrust bearing in the motor will carry the entire weight of the rotating parts of the motor and pumps and the downward hydraulic thrust. The motors will be enclosed by a chain link fence.

The motors will be weatherproof, suitable for outdoor service, and of the hollow-shaft type. The hollow-shaft feature of the motor is important, in that it permits provision for adjusting the elevation of the pump impellers with reference to the pump casing. The motors will be provided with electric heaters of ample capacity to prevent condensation on the windings when the motor is idle. Heaters will operate on a single-phase, 60-cycle, 240-volt circuit. Bearing thermal relays were installed on the Group 1 pumps only.

The estimated cost of pumps and motors for Unit B was obtained by preparing a cost curve--kilowatt demand against cost--for the equipment purchased for groups 2 and 3 on 52 pumping units. The prices used were adjusted upward to handle contingencies. The estimated cost of each pump and motor unit was taken from the curve and totaled for the 175 wells.

The estimated cost of drilling for Unit B was obtained by computing the average drilling depth below the static water level and also the average cost per foot from bid prices received on Groups 1, 2, 3 and 4. The prices used were adjusted upward to handle contingencies.

Accessory Electric Equipment

The accessory electric equipment is divided into two categories, one includes the electrical equipment associated with the motor, such as the motor starter and necessary wiring materials, the other includes all electrical equipment associated with the substation for transforming from the distribution voltage to motor voltage.

A combination, full voltage, magnetic starter, providing short circuit, thermal overload, and single-phase protection with undervoltage release will provide the minimum requirements for starting, stopping, and protection of the pump motors. The undervoltage release feature will not be standard, due to the requirements of the irrigators. The time-delay feature of the undervoltage release is required to prevent outages on a momentary voltage dip. On loss of voltage for an appreciable time, it is desired that the pumps not restart on return of voltage until the reverse rotation of the pump motors, due to the falling water column, has stopped. If the interruption of power continues for an additional time, the water level in the laterals gradually recedes until a point is reached where the siphons into the fields will be broken. A timing device will be necessary to prevent restarting the pumps if the loss of voltage persists long enough to break the siphons into the fields. The starter will also be provided with an alarm circuit which will be closed only in event of automatic tripping of the starter by protective devices.

The housing for the control equipment will be suitable for outdoor installation and provided with gasketed doors and cover plates for the

exclusion of dust. The control equipment will be mounted on a concrete slab.

A substation will be provided at each stilling basin to serve the wells pumping into that particular stilling basin, and will transform from the distribution voltage of 34.5 kv to the motor utilization voltage of either 2300 or 480 volts. The substations will be two pole wood structures with an average transformer bank capacity of about 225 kv.-a. Hook-stick-operated disconnecting switches with primary fuses will serve for isolation and protection of the transformer bank. Lightning protection will consist of tank mounted lightning arresters on the high side and crossarm mounted lightning arresters on the low side. Provision for metering at each substation is required because the distribution system is also used for serving the domestic load in the area. Station service will be provided by a 2400/4160 Y to 120/240-volt single-phase transformer for the 2300-volt installations and a 480 to 120/240-volt single-phase transformer for the 480-volt installations. The transformers will be mounted on a concrete slab and the substation will be enclosed by a chain link fence. Pumping installations requiring 50 hp. or less than 50 hp. size motors will be served from 12.47 kv. to 220/440-volt single pole substations with pole mounted transformers.

The average capacitor installation required to obtain approximately unity power factor has been estimated at 100 kv.-a. for each well and is included in the cost of the substations.

The accessory electrical equipment will include the necessary electrical conductor, conductor connectors, conduit and conduit fittings.

Lateral System

One well will serve from one to seven farms with an average of four farms per well. Where topography permits, lateral systems will be interconnected so that the area under two or more wells can be served from one well in times of low water demand. This will permit more efficient operation during the early and late portions of the irrigation season. In nearly every case, one, and in many cases two, of the farms will divert their water directly from the stilling pools at the wells.

The estimated cost per acre of the lateral system for Unit B was derived by using as a basis the actual cost of the lateral systems for the first three groups containing approximately 26,800 acres. In making the adjustment of the cost to arrive at the cost per acre figure for all seven groups in Unit B, or a total of 64,000 acres, consideration was given to more costly construction. This was due to differences in the terrain of the other groups and anticipated upward changes in the construction costs since the award of contracts on the first three groups.

Drainage System

The drainage system for Unit B employs the same collection and disposal methods as previously described for Unit A. This system consists of shallow drains to pick up surface runoff, and inverted drainage wells to dispose of the collected runoff. The estimate of required drainage facilities is based on disposing of irrigation surface waste and precipitation runoff amounting to a peak flow of 2.6 cubic feet per second from each square mile of irrigated land in the unit (See Drainage, Chapter III). Because of the highly permeable soils and underlying creviced basalt, it is anticipated that all deep percolation losses from irrigation will move downward to the regional water table and, therefore, will not contribute any flow to the drains.

The drainage facilities required for Unit B have been estimated by extending the requirements for facilities in two study areas; one representing the area with a dendritic drainage pattern, and one representing the potholes area with closed basins, to the respective areas of the unit having similar topography. The dendritic drainage pattern study area comprised a 6,240-acre tract with a single outflow drain. The respective area in Unit B with a dendritic drainage pattern amounts to 52,800 acres. The potholes study area, comprising 2,550 acres, represented a corresponding area of 11,200 acres with comparable drainage requirements. In expanding the estimated requirements for drainage facilities from the study areas the quantities of various construction items were carried into the estimate on the basis of relative acreage. Thus, while the estimate is essentially a lump sum allowance to cover construction of drainage facilities as the need for the facilities is demonstrated, it also includes an approximate determination of the various construction items that will be required.

POWER SERVICE SYSTEM

The project plan originally proposed that power for irrigation pumping would be supplied from Bureau of Reclamation powerplants in southern Idaho over a federally owned transmission and distribution system. In lieu of building the transmission and distribution system, negotiations with the Idaho Power Company are in progress to wheel Palisades power and energy from the Bureau's Goshen substation to the deep well pumps, relift pumps and the Unit A pumping plant of the division over the company's transmission and distribution system.

Upon successful conclusion of these negotiations, the need will be removed for including an item for a power service system in the project plan. The Palisades powerplant will be the source of supply for the division's pumping power requirements. In the event that a

federal powerplant would be constructed at American Falls, the division requirements would be supplied from a combination of the two plants.

Power Requirements

The power requirement for irrigation pumping on the Division will be entirely seasonal, commencing in April and ending in October. At the beginning and end of the irrigation season, the load will be at a minimum, and it will be at a maximum during the months of July and August.

The average annual energy requirements at the pumps have been estimated to be 80,421,000 kilowatt-hours for the deep well and relift pumps, and 13,929,000 kilowatt-hours for the main pumping plant of Unit A. The total energy requirement for the Division at the pumps is 94,350,000 kilowatt-hours. The maximum demand at the pumps has been estimated to be 26,200 kilowatts for the deep well and relift pumps, and 4,900 kilowatts for the main pumping plant of Unit A. Total demand at the pumps amounts to 31,100 kilowatts. The distribution of the power and energy requirements by months is shown in table 16.

At the present stage of negotiations with the Idaho Power Company, it is planned that wheeled power will be delivered to the wells and relift pumps at the high side of the transformer at the well or pump and that power will be delivered to the Unit A main pumping plant at motor voltage.

Assuming 2% transformer losses at the deep well pumps and relift substations, 82,029,000 kilowatt-hours are required at the delivery points for wheeled energy. Thus, the total project requirement at delivery points for wheeled energy is 95,958,000 kilowatt-hours. Adding 4 percent losses for Unit A main pumping plant energy and 10 percent losses for wells and relift pump energy, the total project energy requirements at the high voltage side of the Bureau's Goshen Substation would be 104,718,000 kilowatt-hours.

The foregoing estimates of pumping power requirements for Unit B are based on pumping with reduction in flow by means of a throttling valve installed in the discharge line at each pump to meet the relatively smaller requirements in April and October. Under this method of operation, the average pumping energy cost per acre-foot of water pumped on Unit B is more than if the pumps were operated at full capacity for short periods only to supply the low requirements. The use of throttling valves to cut down the flow during periods of low requirement extends the pumping period accordingly, thus the cost for energy per acre-foot of water pumped increases considerably. The curve, "Pumping Power Costs," has been plotted on average values from test

PUMPING POWER COSTS

Effect of Reducing Flow From Deep Well Pumps by Means of Valves in Discharge Line

Based on 1951 test data for ten pumps now installed on the North Side Pumping Division - Minidoka Project

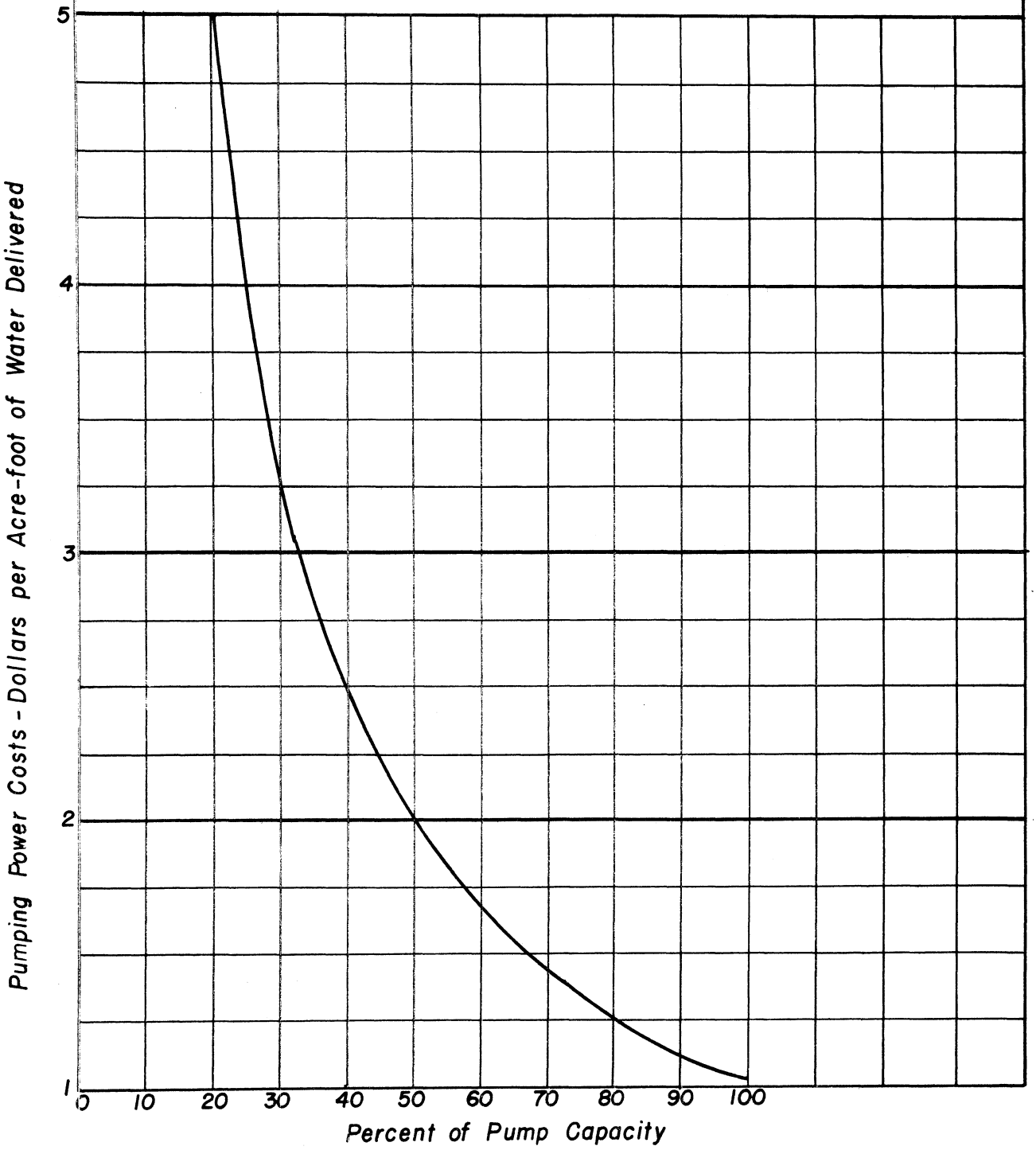


Table 16.-- Preliminary estimate of average pumping power requirements.

North Side Pumping Division

Minidoka Project, Idaho

	April	May	June	July	August	Sept.	Oct.	Total
Unit A - Main Pumping Plant								
Percent annual diversion requirement 1/	1	17	16	24	24	14	4	100
Power requirements (1,000 kw.-hr.)	139	2,368	2,229	3,343	3,343	1,950	557	13,929
Peak power requirement (kw.)	820	3,270	3,270	4,900	4,900	2,860	1,640	---
Ground Water & Relift Pumps								
Percent annual diversion requirement 2/	1	17	16	25	25	13	3	100
Power requirements (1,000 kw.-hr.) 3/	1,725	12,500	15,336	17,707	17,707	12,024	3,422	80,421
Peak power requirements (kw.)	17,400	26,200	26,200	26,200	26,200	18,900	17,400	---

1/ Allowing 25% canal loss.
2/ Allowing 5% canal loss.
3/ Power requirements reflect the effect of using throttling valves in the pump discharge line of each pump to obtain reduced water requirements in spring and fall.

data on the ten existing pumps and illustrates the effect of reducing the pump flow by means of throttling valves on comparative pumping power costs in dollars per acre-foot. It is expected that future pumps will have characteristics similar to those now installed, and the costs illustrated are, therefore, representative for the entire project.

Description of Power Facilities

In lieu of the plan for a project power transmission and distribution system, current negotiations contemplate a plan whereby the Idaho Power Company wheels power and energy from Bureau facilities at Goshen Substation to the project pumps and pumping plant. The only power facilities remaining in the current plan are transformation equipment provided at the deep well pumps and relift pumps.

Power Service Prior to Initial Generation at Palisades

Power for the operation of ten of the existing wells is supplied from the Bureau's Boise-Minidoka system and is wheeled over transmission and distribution facilities of the Idaho Power Company, as provided in the December 1950 contract with the Company. Power for one well 17C823 is furnished from facilities of the Minidoka Power System. Power for another five wells is purchased from the Idaho Power Company at the Company's published rate schedule. Power and energy for the next group of twenty-two wells (Group 2) will also be purchased from the Idaho Power Company through April 1, 1956. Negotiations are under way with the Bonneville Power Administration for a supply of power and energy required by Group 2 wells and the succeeding Group 3 wells during the 1956 irrigation season. This power would be wheeled over transmission and distribution facilities of the Idaho Power Company. It is presently estimated that all project requirements during the 1957 irrigation season will be met from the Palisades Powerplant.

CONSTRUCTION FACILITIES

Construction of the project works by construction contract minimizes the requirements for service facilities. The towns of Rupert, Burley, Paul and Hazelton are sufficiently close to the work to serve as bases for the construction operations.

The government buildings necessary for construction operations, plus the necessary transportation vehicles for use by the engineering staff during the construction period are estimated to cost $62,613.

GENERAL PROPERTY

The North Side Pumping Division will be organized into an irrigation district during the early stage of the development. It is contemplated that this district will take over operation and maintenance of all the project irrigation facilities soon after termination of the development period. Under the project plan, adequate buildings and maintenance equipment will be transferred to the district to operate and maintain the project without dependence on use of the reserved works at Minidoka Dam or use of facilities belonging to other divisions of the Minidoka Project.

The administrative center for operation of the project will be at Rupert, where a combination shop and warehouse, a garage and equipment shop, and a truck and equipment storage will be constructed and equipped.

Operation of the 175 pumps in Unit B presents some special problems which will require the ditch riders to live in the immediate area of their work. Of the approximately 15 ditch riders that will be required for the project, eight will be provided with residences at points to be selected on the project. The remainder will be hired out of the towns of Paul, Rupert and Acequia, which are within reasonable travel distance of nearly half of the area to be served. An additional feature considered necessary for operation of this project is radio communication between the headquarters office and ditch riders. Provision has been made in the estimate for this equipment.

Under existing regulations, it is not possible to control or limit the make of pumps and motors on which bids are awarded. Furthermore, the 175 wells vary both as to height of pump lift and required capacity. In consequence of this situation, it is estimated that three complete pump and motor units, ranging from 5 to 10 cubic feet per second in capacity, should be available for use as replacement units to minimize the requirements for stocking of spare parts and to assure prompt reinstatement of water deliveries in event of pump or motor breakdowns. Other essential work equipment which it is estimated will be required for operation of the project includes tractor and grading units for canal and lateral maintenance, a truck mounted hoist for removal and installing of well pumps, and a small component of trucks, pickups and passenger cars for use of the maintenance organization.

INVESTIGATIONS, ENGINEERING AND GENERAL EXPENSE

The investigation work for the North Side Pumping Division was initiated in 1918. The cost of this work prior to 1947 amounted to

$82,709.78. The investigation in 1947-1948 and preparation of a project planning report cost approximately $100,000. The subsequent additional investigation work incident to preparation of the Definite Plan Report and construction of the project has brought the estimated total cost for investigation up to $305,400.

This project has required expenditures for permanent installations of wells, pumps, and lateral systems as part of the investigation. Although these installations were experimental in nature when constructed, they are now considered as permanent project works. In the cost estimates for the project, they have been treated accordingly in anticipation that the present charges for these items made to investigations has been transferred to the respective construction accounts.

Costs for general services, settlers' assistance, engineering, and designs and specifications are estimated at $1,987,500. This cost exclusive of $700,000 for settlers' assistance has been distributed to the respective construction accounts in the Official Cost Estimate.

CONTROL SCHEDULE

A control schedule, Form PF-2, has been prepared to show the most expedient and economic construction of the project, consistent with due caution in respect to overappropriation of available ground water. Investigations concurrent with private development of some 35,000 acres has demonstrated that adequate ground water exists for full and expedient development of the project. The outlook for a sustained water supply is better than it was during early project investigations; accordingly, a faster rate of development is recommended herein. The following schedule of costs and funds required is presented to reflect the desired rate of development:

SCHEDULE OF COSTS AND ALLOTMENTS REQUIRED

Fiscal Years	Amount
Total to June 30, 1954	$ 2,146,000
1955	1,925,000
1956	2,200,000
1957	3,270,000
1958	115,000
1959	75,000
1960	86,000
1961	89,000
Thereafter	608,000
	$ 10,514,000

The difference ($881,000) between $11,395,000, the total project cost, and $10,514,000 is the net figure of nonappropriation transfers yet to be transferred to the project from Palisades and American Falls Reservoir.

The present program contemplates the completion of construction of all irrigation works by the close of the calendar year 1957 in accordance with the following schedule:

Well Group No.	No. of wells	No. of Farms	Total Acres	Year Irrigation is Available
1	16	72	7,334	1954
2	22	85	8,784	1955
3	30	94	10,648	1956
4 & Unit A	32	215	24,547	1957
5, 6 & 7	75	229	26,373	1958
	175	695	77,686	

There will be some drainage construction necessary after the close of calendar year 1957. At the present time 70 wells have been drilled of a total of 100 which have been placed under contract. It is contemplated to include the remaining 75 wells in contracts at the beginning of F.Y. 1956. This will allow drilling far enough in advance of the purchase of pumps and motors to facilitate prior tests for well capacity. In the past the pumps have been ordered for some of the wells before they were drilled. It should be noted that the capacity of individual wells is based on their respective service areas and not on anticipated well capability. Past experience shows that wells in the area are capable of any desired capacity, commensurate with the size of pumps that can be installed, when drilled to adequate depth.

The storage space in American Falls Reservoir set aside for Unit A under Public Law 864 is currently leased to establish irrigation enterprises. When Palisades Reservoir, which is now under construction, is completed, the leases covering this space will have terminated and space made available to the unit. The present construction schedule calls for termination of these leases at the close of the 1956 irrigation season. The pumping plants, canal, and laterals of Unit A are, therefore, scheduled for completion by the close of the first half of fiscal year 1957, allowing settlement of Unit A area of 13,650 acres in the fall of calendar year 1956.

OPERATION AND MAINTENANCE

In estimating the cost of operating and maintaining the irrigation facilities of the North Side Pumping Division, consideration has been

given to the current cost of operating the North Side Pumping Division and of operating comparable projects; the organization which will be required; and the type of facilities included in the project works. The organization contemplated will consist of a manager, watermaster, two operators for the main pumping plant in Unit A, approximately 15 ditch riders, and a maintenance crew. So far as practicable, employment will be on a year-round basis, utilizing men employed for operating functions during the irrigation season to repair and overhaul the pumping equipment during the winter months.

On the basis of the forecasted long-range price level currently employed in determining payment capacity of the project lands, it is estimated that average annual operation and maintenance costs of the irrigation facilities of the Division will be $2.40 per acre.

Power for irrigation pumping on the Division will be transmitted to the high-voltage side of Bureau substations at the pumps by the Idaho Power Company. Pending completion of negotiations with the Company the power cost is based on 4.0 mills per kw.-hr. The estimated average annual power requirement of the Division is 95,958,000 kilowatt-hours, which at the above estimated rate will cost $383,800, or an average of $4.94 per acre of irrigable land. This estimated average annual power cost is based on power requirements shown in table 16.

ANNUAL REPLACEMENT COSTS

Provision has been made in the estimate of annual operating costs to cover the average annual amount that would be required to replace the property items needing replacement during the payout period, table 17. This estimated annual cost is based on straight-line depreciation over the estimated life of the replaceable items. The annual amount estimated at current price levels has been adjusted to a long-range price level comparable with the price level used in the estimates of farm income.

TRANSITIONAL IRRIGATION DEVELOPMENT

Prior to the availability of Palisades power in 1957, energy for irrigation pumping will be provided as described in the second paragraph on page 91. Present indications are that energy from these sources will cost considerably more than Palisades power when it becomes available. The assessment of the full amount of annual operation and maintenance charges, during the initial years of project development,

Table 17.--Summary of average annual replacement costs

North Side Pumping Division
Minidoka Project

Feature	Average Annual Replacement Cost (Long-Range Price Level)
American Falls Reservoir	60
Palisades Reservoir	480
Pumping Plant - Unit A	8,000
Irrigation Wells	43,250
Main Canal - Unit A (Structures)	320
Lateral Structures	3,550
Drainage Structures	330
Pump Substations	30,200
General Property	21,300
Total	$ 107,490
Rounded to	107,500
Average Annual Cost Per Acre	$ 1.38

would result in excessively burdensome charges. In order to avoid this condition it is proposed to set the annual charges during the initial years of project operation at a level which will be consistent with the annual charges after Palisades power becomes available. This will leave an unpaid balance in the power account of $33,000 in F.Y. 1956 and $22,000 in F.Y. 1957 or a total of $55,000.

1.38
4.94
2.40
8.72

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
FORM PF-1 (REV. SEPT. 1952)

Prepared by: H. C. O'Bryan Approved by: M. S. Valley

OFFICIAL ESTIMATE

Project: Minidoka
North Side Pumping Division
Date of Estimate: February 1955

Uniform Cost Classification	DESCRIPTION	Quantity	Unit Cost	Total Estimate	Construction Contracts	Materials and Supplies	Labor	Construction Facilities	Other Costs	Previous Official Estimate
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	SUMMARY									
	UNIT A									
03.01	Main Pumping Plant			952,800	551,015	172,785		5,000	224,000	962,700
05.01	Main Canal			84,000	57,000			2,000	25,000	122,000
06.10	Laterals			536,000	364,000	11,000		1,000	160,000	590,000
07.02	Drains			59,000	12,400	14,800	15,800	2,000	14,000	59,000
14.08	Pumping Substations			20,000	8,000	10,600			1,400	20,000
	Subtotal - Unit A			1,651,800	992,415	209,185	15,800	10,000	424,400	1,753,700
	UNIT B									
04	Deep Wells			3,472,114	1,008,373	2,109,901	46,840	12,000	295,000	3,326,942
.01	Group 1, 16 wells			(342,634)	(69,924)	(211,071)	(31,239)	(1,200)	(29,200)	
.02	Group 2, 22 wells			(413,774)	(107,293)	(261,201)	(8,780)	(1,400)	(35,100)	
.03	Group 3, 30 wells			(523,300)	(164,000)	(312,000)	(1,200)	(1,800)	(44,300)	
.04	Group 4, 32 wells			(583,780)	(168,340)	(362,560)	(1,280)	(2,000)	(49,600)	
.05	Group 5, 30 wells			(592,310)	(185,400)	(353,210)	(1,200)	(2,100)	(50,400)	
.06	Group 6, 17 wells			(447,740)	(128,000)	(279,460)	(680)	(1,600)	(38,000)	
.07	Group 7, 28 wells			(552,685)	(174,600)	(328,265)	(1,120)	(1,800)	(46,900)	
.10	Observation wells			(15,891)	(10,816)	(2,134)	(1,341)	(100)	(1,500)	
06	Laterals			1,562,000	1,190,916	18,200	13,884	4,000	335,000	1,441,458
.01	Group 1			(229,221)	(166,071)		(13,650)	(600)	(48,900)	
.02	Group 2			(161,179)	(123,445)	(2,600)	(234)	(400)	(34,500)	
.03	Group 3			(198,000)	(155,000)			(500)	(42,500)	
.04	Group 4			(278,700)	(218,000)			(700)	(60,000)	
.05	Group 5			(278,700)	(210,200)	(7,800)		(700)	(60,000)	
.06	Group 6			(187,700)	(139,200)	(7,800)		(500)	(40,200)	
.07	Group 7			(228,500)	(179,000)			(600)	(48,900)	
07.01	Drains			296,500	69,800	60,900	95,800	8,000	62,000	296,500
14	Pumping Substations			1,355,900	357,350	894,128	5,822		98,600	1,287,000
.01	Group 1			(137,600)	(18,200)	(109,400)			(10,000)	
.02	Group 2			(141,200)	(16,240)	(108,938)	(5,822)		(10,200)	
.03	Group 3			(196,700)	(58,770)	(123,430)			(14,500)	
.04	Group 4			(229,600)	(71,100)	(141,900)			(16,600)	
.05	Group 5			(221,200)	(63,890)	(141,110)			(16,200)	
.06	Group 6			(192,300)	(63,700)	(114,800)			(13,800)	
.07	Group 7			(214,700)	(58,300)	(140,700)			(15,700)	
.09	Unit B Relifts			(22,600)	(7,150)	(13,850)			(1,600)	
	Subtotal - Unit B			6,686,514	2,626,439	3,083,129	162,346	24,000	790,600	6,351,900

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
FORM PF-1 (REV. SEPT. 1952)

Prepared by: _____ Approved by: _____

OFFICIAL ESTIMATE

Project: Minidoka
North Side Pumping Division
Date of Estimate: February 1955

Uniform Cost Classification	DESCRIPTION	Quantity	Unit Cost	Total Estimate	Construction Contracts	Materials and Supplies	Labor	Construction Facilities	Other Costs	Previous Official Estimate
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	JOINT USE FACILITIES									
13	Transmission Lines			744,186	744,186					1,177,900
15.01	General Property			676,500	300,000	304,000			72,500	617,500
	Subtotal - Joint Use Facilities			1,420,686	1,044,186	304,000			72,500	1,795,400
	TOTAL COST			9,759,000	4,663,040	3,596,314	178,146	34,000	1,287,500	9,901,000

The total costs shown above do not include the following costs:

Transitional Irrigation Development	$ 55,000
Settler Assistance	700,000
Storage Facilities	
American Falls Storage	71,000
Palisades Storage	810,000

These items bring the total estimate to $11,395,000 as authorized by P. L. 864, 81st Congress, 2nd Session.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
FORM PF-1 (REV. SEPT. 1952)

OFFICIAL ESTIMATE

Project: Minidoka
North Side Pumping Division
Date of Estimate: February 1955

Prepared by: _____ Approved by: _____

Sheet 3 of 6

Uniform Cost Classification	DESCRIPTION	Quantity	Unit Cost	Total Estimate	Construction Contracts	Materials and Supplies	Labor	Construction Facilities	Other Costs	Previous Official Estimate
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	UNIT A									
03	PUMPING PLANTS			952,800	551,015	172,785		5,000	224,000	962,700
.01	Main Pumping Plant - 240 c.f.s., 163 ft. head			952,800	551,015	172,785		5,000	224,000	
.33	Pumping Plant Structures			(327,700)	(250,000)			(1,700)	(76,000)	
.36	Waterways			(330,800)	(251,000)			(1,800)	(78,000)	
.40	Pumps and Prime Movers			(220,400)	(27,400)	(140,000)		(1,000)	(52,000)	
.48	Accessory Electrical Equipment			(53,300)	(8,280)	(30,720)		(300)	(14,000)	
.49	Miscellaneous Equipment			(8,200)	(4,035)	(2,065)		(100)	(2,000)	
.50	Access Road			(12,400)	(10,300)			(100)	(2,000)	
05	CANALS AND CONDUITS			84,000	57,000			2,000	25,000	122,000
.01	Main Canal			84,000	57,000			2,000	25,000	
.31	Timber Bridges			(7,050)	(4,850)			(200)	(2,000)	
.36	Unlined Canal			(50,800)	(34,500)			(1,200)	(15,000)	
.37	Checks and Turnouts			(26,150)	(17,550)			(600)	(8,000)	
06	LATERALS - 13,650 acres			536,000	364,000	11,000		1,000	160,000	590,000
.10	Unit A Laterals			536,000	364,000	11,000		1,000	160,000	
.33	Relift Structures			(32,100)	(22,000)			(100)	(10,000)	
.36	Waterways			(487,450)	(341,000)			(850)	(145,600)	
.49	Relift Pumps, etc.			(16,450)	(1,000)	(11,000)		(50)	(4,400)	
07	DRAINS			59,000	12,400	14,800	15,800	2,000	14,000	59,000
.02	Unit A Drains			59,000	12,400	14,800	15,800	2,000	14,000	
.36	Open Channels and Wells			(31,800)	(12,400)		(11,000)	(1,000)	(7,400)	
.39	Structures			(27,200)		(14,800)	(4,800)	(1,000)	(6,600)	
14	PUMPING SUBSTATIONS			20,000	8,000	10,600			1,400	20,000
.08	Relift Pumping Substations			20,000	8,000	10,600			1,400	
	Subtotal - Unit A			1,351,800	992,415	209,185	15,800	10,000	424,400	1,753,700

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
FORM PF-1 (REV. SEPT. 1952)

Prepared by: _____ Approved by: _____

OFFICIAL ESTIMATE

Project: Minidoka
North Side Pumping Division

Date of Estimate: February 1955

Uniform Cost Classification	DESCRIPTION	Quantity	Unit Cost	Total Estimate	Construction Contracts	Materials and Supplies	Labor	Construction Facilities	Other Costs	Previous Official Estimate
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	UNIT B									
04	DEEP WELLS			3,472,114	1,008,373	2,109,901	46,840	12,000	295,000	3,326,942
.01	Group 1 - 16 wells			342,634	69,924	211,071	31,239	1,200	29,200	
.02	Group 2 - 22 wells			413,774	107,293	251,201	8,780	1,400	35,100	
.33	Fencing			(3,480)		(2,200)	(880)	(100)	(300)	
.36	Drilling and testing			(111,970)	(96,059)	(3,811)	(2,200)	(400)	(9,500)	
.40	Pumps and motors			(238,260)	(11,234)	(204,626)	(1,200)	(800)	(20,400)	
.48	Control equipment			(60,064)		(50,564)	(4,500)	(100)	(4,900)	
.03	Group 3 - 30 wells			523,300	134,000	312,000	1,200	1,800	44,300	
.33	Fencing			(4,720)		(3,000)	(1,200)	(20)	(500)	
.36	Drilling and testing			(135,980)	(124,000)			(480)	(11,500)	
.40	Pumps and motors			(292,300)	(18,000)	(248,000)		(1,000)	(25,300)	
.48	Control equipment			(90,300)	(22,000)	(61,000)		(300)	(7,000)	
.04	Group 4 - 32 wells			583,780	168,340	362,560	1,280	2,000	49,600	
.33	Fencing			(5,000)		(3,200)	(1,280)	(20)	(500)	
.36	Drilling and testing			(136,880)	(125,000)			(480)	(11,400)	
.40	Pumps and motors			(355,700)	(19,200)	(306,000)		(1,200)	(30,300)	
.48	Control equipment			(85,200)	(24,140)	(53,360)		(300)	(7,400)	
.05	Group 5 - 30 wells			592,310	185,400	353,210	1,200	2,100	50,400	
.33	Fencing			(4,830)		(3,000)	(1,200)	(30)	(600)	
.36	Drilling and testing			(156,990)	(145,000)			(490)	(11,500)	
.40	Pumps and motors			(346,470)	(18,000)	(296,410)		(1,260)	(30,800)	
.48	Control equipment			(84,020)	(22,400)	(53,800)		(320)	(7,500)	
.06	Group 6 - 17 wells			447,740	128,000	279,460	680	1,600	38,000	
.33	Fencing			(2,800)		(1,700)	(680)	(20)	(400)	
.36	Drilling and testing			(114,150)	(105,000)			(450)	(8,700)	
.40	Pumps and motors			(276,540)	(10,200)	(242,260)		(880)	(23,200)	
.48	Control equipment			(54,250)	(12,800)	(35,500)		(250)	(5,700)	
.07	Group 7 - 28 wells			552,685	174,600	328,265	1,120	1,800	46,900	
.33	Fencing			(4,450)		(2,800)	(1,120)	(30)	(500)	
.36	Drilling and testing			(148,260)	(137,000)			(460)	(10,800)	
.40	Pumps and motors			(310,315)	(16,800)	(263,865)		(1,050)	(28,600)	
.48	Control equipment			(89,660)	(20,800)	(61,600)		(260)	(7,000)	
.10	Observation Wells			15,891	10,816	2,134	1,341	100	1,500	
.30	Drilling, casing and equipment			(15,891)	(10,816)	(2,134)	(1,341)	(100)	(1,500)	
06	LATERALS			1,562,000	1,190,916	18,200	13,884	4,000	335,000	1,441,458
.01	Group 1 - 7,334 acres			229,221	166,071		13,650	600	48,900	
.02	Group 2 - 8,784 acres			161,179	123,445	2,600	234	400	34,500	
.03	Group 3 - 10,648 acres			198,000	155,000			500	42,500	

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
FORM PF-1 (REV. SEPT. 1952)

OFFICIAL ESTIMATE

Project: Minidoka
North Side Pumping Division

Date of Estimate: February 1955

Prepared by: _____ Approved by: _____

Uniform Cost Classification	DESCRIPTION	Quantity	Unit Cost	Total Estimate	Construction Contracts	Materials and Supplies	Labor	Construction Facilities	Other Costs	Previous Official Estimate
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	JOINT USE FACILITIES									
13	Transmission Lines			744,186	744,186					1,177,900
15	GENERAL PROPERTY			676,500	300,000	304,000			72,500	617,500
.01	General Service Facilities and Equipment			676,500	300,000	304,000			72,500	
.33	Structures and Improvements			(350,000)	(300,000)				(50,000)	
.72	Office Furniture, etc.			(2,200)		(2,000)			(200)	
.73	Transportation Equipment			(43,000)		(41,000)			(2,000)	
.74	Warehouse and Equipment			(5,500)		(5,500)			(500)	
.75	Shop Equipment			(49,000)		(46,000)			(3,000)	
.77	Tools and Work Equipment			(215,300)		(199,500)			(15,800)	
.78	Communication Equipment			(11,000)		(10,000)			(1,000)	
	Subtotal - Joint Use Facilities			1,420,686	1,044,186	304,000			72,500	1,795,400
	TOTAL COSTS			9,759,000	4,663,040	3,596,314	178,146	34,000	1,287,500	9,901,000

The TOTAL COSTS shown above do not include the following costs:

Transitional Irrigation Development	$ 55,000
Settler Assistance	700,000
Storage Facilities	
American Falls Storage	71,000
Palisades Storage	810,000

These items bring the total estimate to $11,395,000 as authorized by P.L. 864, 81st Congress, 2d Session.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
FORM PF-1 (REV. SEPT. 1952)

OFFICIAL ESTIMATE

Project: Minidoka
North Side Pumping Division
Date of Estimate: February 1955

Prepared by: _____ Approved by: _____

Uniform Cost Classification	DESCRIPTION	Quantity	Unit Cost	Total Estimate	Construction Contracts	Materials and Supplies	Labor	Construction Facilities	Other Costs	Previous Official Estimate
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
.04	Group 4 - 10,807 acres			278,700	218,000			700	60,000	
.05	Group 5 - 10,492 acres			278,700	210,200	7,800		700	60,000	
.06	Group 6 - 6,954 acres			187,700	139,200	7,300		500	40,200	
.07	Group 7 - 8,947 acres			228,500	179,000			300	48,900	
08	DRAINS			296,500	69,300	60,900	95,800	8,000	62,000	296,500
.01	Unit B Drains			296,500	62,800	60,900	95,800	8,000	62,000	
.38	Open channels and wells			(182,600)	(69,800)		(65,300)	(5,000)	(38,000)	
.5	Structures			(113,900)		(60,900)	(26,000)	(3,000)	(24,000)	
14	PUMPING SUBSTATIONS			1,355,900	357,350	894,128	5,822		98,600	1,297,000
.01	Group 1			137,600	18,200	109,400			10,000	
.02	Group 2			141,200	16,240	108,938	5,822		10,200	
.03	Group 3			155,700	58,770	123,430			14,500	
.04	Group 4			229,600	71,100	141,900			16,600	
.05	Group 5			221,200	63,890	141,110			16,200	
.06	Group 6			192,300	63,700	114,800			13,800	
.07	Group 7			214,700	58,300	140,700			15,700	
.09	Unit B Relifts			22,300	7,150	13,850			1,600	
	Subtotal - Unit B			6,586,514	2,326,439	3,083,129	152,346	24,000	790,600	6,351,900

LEGEND: Types of Activity

Preconstruction | Construction

LINE NO.	CLASS AND ACCOUNT	PROGRAM ITEM	QUANTITY	UNIT	TOTAL ESTIMATED COST	COST TO JUNE 30,	FISCAL YEARS 1955	1956	1957	1958	1959	1960	1961	BALANCE TO COMPLETE	ESTIMATED COMPLETION DATE	LINE NO.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1		Irrigation Service Land, Full	77,650	Ac.		7,334	8,784	10,648	24,547	26,337						1
2		Irrigation Service Land, Supplemental	None													2
3		Power Development	None													3
4																4
5	108	CONSTRUCTION PROGRAM														5
6		UNIT A														6
7	.03	Main Pumping Plant			952,800	34,956	188,600	373,000	356,244							7
8	.05	Canals			84,000	13,839	57,500	5,000	7,661							8
9	.06	Laterals			536,000	9,030	20,000	255,000	251,970							9
10	.07	Drains			59,000	0			10,000	10,000	10,000	15,000	14,000			10
11	.14	Relift Pumping Substations			20,000	0		20,000								11
12		UNIT B														12
13	.04	Deep Wells			3,472,114	1,131,607	614,000	675,770	1,050,737							13
14	.06	Laterals			1,562,000	430,063	332,193	253,160	546,584							14
15	.07	Drains			296,500	33,463	26,000	40,000	40,000	70,000	10,000	30,967	26,070			15
16	.14	Pumping Substations			1,355,900	68,705	285,829	233,000	768,366							16
17		JOINT USE FACILITIES														17
18	.13	Transmission Lines			744,186	31,960								712,226		18
19	.15	General Property			676,500	0	280,977	171,750	223,773							19
20		TOTAL COSTS			9,759,000	1,753,623	1,805,099	2,026,680	3,255,335	80,000	40,000	45,967	40,070	712,226		20
21	130	Service Facilities				62,613	26,583	10,000	-37,335					-61,861		21
22	131	Stores				44,583	15,274	691	-50,000					-10,548		22
23	142	Project Investigations				11,097	15,000							-26,097		23
24	151	Transitional Irrigation Development Costs			55,000	0		33,000	22,000							24
25		Settler Assistance			700,000	197,739	134,041	129,629	80,000	35,000	35,000	40,000	48,591			25
26		Transfers, Credits & Other Expenditures				5,608								-5,608		26
27		TOTAL EXPENDITURES			10,514,000	2,075,263	1,995,997	2,200,000	3,270,000	115,000	75,000	85,967	88,661	608,112		27
28		Unliquidated Obligations				70,997	-70,997									28
29		TOTAL OBLIGATIONS		1/	10,514,000	2,146,260	1,925,000	2,200,000	3,270,000	115,000	75,000	85,967	88,661	608,112		29
30																30
31		Contributions														31
32		Allotments Available					1,925,000									32
33		Allotments Required						2,200,000	3,270,000	115,000	75,000	86,000	89,000	608,000		33

Notes: 1/ Excludes anticipated cost transfer of $881,000 for American Falls and Palisades storage allocations.

JCM 2-15-55

Recommended: M. L. Valley (Project Head) 12/21/54 (Date)

Recommended: Wm H. Tuller Acting (Regional Director) 1/7/55 (Date)

Recommended: (Director of Programs & Finance) (Date)

Approved: (Commissioner) (Date)

Revised: January 7, 1955 (Date) SHEET 1 OF 1 SHEETS

Form PF-2 Nov. 1948

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

CONTROL SCHEDULE
FOR THE
NORTH SIDE PUMPING DIVISION
MINIDOKA PROJECT
PROJECT OR UNIT

Burley, Idaho (OFFICE) 8/6/54 (DATE) 1 (REGION)

☐ GENERAL INVESTIGATIONS ☐ OPERATION & MAINTENANCE
☒ CONSTRUCTION ☐ OTHER

CHAPTER VII

AGRICULTURAL ECONOMY

A prosperous agricultural economy is in prospect on lands of the North Side Pumping Division, Minidoka Project, with irrigation development. Physical and cultural factors which will influence the agricultural economy of the new lands are remarkably favorable for successful establishment of a prosperous farming community.

As a division of the Minidoka Project, the lands of the North Side Pumping Division will become a part of an already successful farming area. Market, service, and community facilities are readily available at the towns of Rupert, Burley, and Paul, which are conveniently located with respect to the project area.

The project lands are now largely covered with sagebrush and are used only for seasonal grazing by bands of sheep en route to and from winter feeding grounds nearby and mountain ranges for spring and summer grazing.

Climate and crop adaptability of the North Side Pumping Division are, with certain exceptions, comparable to those on the nearby Minidoka, Burley, and Twin Falls irrigation districts, which have been successfully farmed under irrigation for many years. The principal exceptions to the similarity are (1) the North Side Pumping Division has a slightly shorter growing season than the Twin Falls area, and (2) fruit production on the Division may be endangered by late spring frosts, whereas this condition does not generally exist in the Twin Falls area. The soils of the North Side Pumping Division are, in large part, of high quality and are not a limiting factor in crop adaptability.

Approximately 695 full-time farms, it is anticipated, will be developed in the project. These farms will be devoted largely to cash crops with livestock as an important secondary enterprise. In size they will range from 80 to 155 irrigable acres, depending on the land class and type of farming to be practiced. Budget analysis shows that the operators of these farms will be able to pay annual operation, maintenance, replacement, and power costs; and to retire construction costs within a 50-year, interest-free repayment period.

PRESENT AGRICULTURAL ECONOMY

The basic analysis of the economics of this project was made for a feasibility report which was first submitted in 1948. Largely as a result of the findings of that investigation, a rapid development of the lands adjoining the project area has since taken place.

All of this development is based on pumping from deep wells which have been recently drilled, beginning in 1947.

Some privately-owned land, formerly State-owned, was irrigated in 1948. The Bureau leased the first land served in connection with the well-testing program in 1949. During the summer of 1951 nearly all of the privately-owned land in the Unit B area and 5,100 acres of leased Government land was under cultivation. Large scale development of privately-owned land lying north and east of Unit B is now under way with water supplied from deep wells.

Initially, almost all of the agricultural development was on a cash-crop basis with the land being leased for cash or on a cash plus share arrangement on private lands. To date, 157 of the farms located in the Unit B area have been filed on by veterans under the GI Bill of Rights. Cropping results thus far have revealed no facts that would operate to change the conclusions upon which this chapter is based.

There was, prior to 1948 when the first land was irrigated from a deep well, no tilled land within the project boundaries. As noted above, the lands were used largely for seasonal sheep range. About 4,000 acres adjoining the project on the north were dry-farmed to grain in 1947 and 1948 by a land development company. Yields were low; such dry-farming operations could not be economic except under circumstances of high prices and unusually good ground moisture conditions.

Land Ownership

Almost all of the project lands (over 98 percent) are Federal Public Domain. They were withdrawn from homestead entry by reclamation withdrawal in 1908. For this reason, only a relatively small acreage of private land lies within the project boundaries. State and private lands in Unit A are included in the project acreage but those in Unit B are not. As noted in previous sections of this report, the owners of private lands within the boundaries of Unit B will be provided an opportunity to be included in the project during the development stage.

The private lands, which constitute about 10 percent of Unit A are for the most part Idaho State school grants--sections 16 and 36 of each township--which have been sold by the State to individuals. The sale of these lands has occurred largely since 1946, when interest in developing irrigation from ground water was aroused by investigations of the Bureau of Reclamation and private developments such as the "Clawson" development enterprise.

Agricultural Economy

Grazing Value

The Bureau of Land Management of the United States Department of Interior administers the Federal lands of the project area. Because of the predominance of sagebrush cover over most of the area, it is estimated that 10 to 12 acres are necessary to provide one month's grazing for an animal unit. Since the use of these lands is limited by and large to seasonal grazing, their value for grazing is low.

A major value of the project lands has been as a trailway. When full project development occurs, use of the lands for this purpose will no longer be possible. The advisability of providing a stock driveway through project lands has been considered. It appears that this will be unnecessary since an existing county road will continue to link the river crossing below Milner Dam with rangeland some 6 miles due north. From this point, sheep will be able to trail and feed on public domain as at present.

County Finances

Minidoka County, which contains the major portion of the project area, is in good financial condition. It had an assessed valuation of approximately $9,000,000 for the year 1953. The tax rate has been about $4.00 per hundred dollars valuation. Roads, schools, and other public facilities are in average condition for the general area, which includes some of the most productive agricultural land in Idaho.

Private Finances

The general vicinity of the project is considered to be a desirable area in which to make loans. The Federal Land Bank, the Production Credit Corporation, the Farmers Home Administration, and private banks all operate in the area, making loans as required by farmers. Farm mortgage debt is not a disturbing factor to the economy of the area.

The Farmers Home Administration loaned approximately $925,000 for land development work on the 72 units homesteaded in 1954.

General Economic Outlook

The Upper Snake River Valley is a rapidly growing and prosperous area. The valley is known nationally for quality farm products and fertile lands, and it is the home of the famous Idaho potato. Idaho,

in 1949 was the fourth largest bean producing state and 87 percent of this $14,000,000 crop was grown in the five counties, Cassia, Gooding, Jerome, Minidoka, and Twin Falls, which are part of the Upper Snake River Valley. This is also a major beet sugar producing area with factories at Twin Falls and Paul.

The valley is also a recognized winter feeding center for sheep. The feeding of beef cattle is of growing importance as it offers an outlet for beet pulp, hay, and feed grains. Dairy products, while not of the dollar-value magnitude of a crop such as beans, were valued at nearly $5,000,000 in 1949 in the five counties named above. With markets already established locally for production such as this, it appears that the economic outlook for the project area is excellent.

Outlook for New Development

When maximum development of the North Side Pumping Division occurs under the proposed plans of the Bureau, including that of privately-owned land in the Unit B area and adjacent, surrounding private land, there will be a total of about 120,000 acres of new land brought into cultivation. This acreage is nearly double the presently irrigated acreage of Minidoka County, where 58,000 irrigated acres were reported in the 1950 Census of Irrigation.

The effect of increasing the irrigated land base by this large amount is difficult to predict, but it does appear that the economic stability of the county and region should be assured to an even greater degree than at present.

Existing Markets and Service Facilities

The towns of Burley and Rupert and the village of Paul, with populations, respectively, of 5,900, 3,000, and 600, are all within 10 miles of the project lands. Each of these towns is served by railroads and arterial highways. Moreover, each is situated for convenient service to separate parts of the project, yet is within reasonable travel range of the entire project area.

These three towns have available all necessary buying, selling, and community facilities. Upon development of the project, these facilities would need merely to be expanded to meet the new volume of business. It is not expected that any new towns will be developed in the area.

A sugar factory located at Paul has ample capacity to take care of any foreseeable increases in sugar beet production. This plant and the one at Twin Falls are owned by the Amalgamated Sugar Company,

and its operations are integrated to allow for shifts in beet-producing areas.

Employment Opportunities

The economy of the area rests entirely on agriculture. With the exception of the limited grazing of desert range and a very small acreage of dry-land grain, the dependence is on irrigated agriculture. Because of the agricultural base, employment is largely limited to seasonal work in fields and warehouses, and to usual service enterprises in the towns of the area. The sugar factory, a small potato starch factory, and a small flour mill are the only nearby processing plants.

From present indications it appears that substantial opportunities for seasonal employment will exist after development of the project. This will enable members of the farm operator's family not required for farm work to earn money from off-farm employment. The farmer himself, however, probably will not be free at the right times to take much advantage of these opportunities. The outlook for part-time farming, therefore, is not bright because opportunities for occasional labor will be confined largely to periods of the year when the part-time farmer would be occupied with his own farm work.

Attitude of Local People Toward the Project

There is tremendous local pressure for development of the Minidoka North Side Pumping Division. Popular since the turn of the century, this proposed development has the almost complete endorsement of the people in Minidoka and Cassia Counties. No doubt exists as to the favorable support for this project in the immediate areas.

ANTICIPATED AGRICULTURAL DEVELOPMENT

It is anticipated that some 130 farms will be developed on Unit A and 565 farms on Unit B. This large new farm community will arise from a sagebrush desert, now almost completely devoid of man-made improvements and developments.

Yields and Land Use

Correlation Areas

As a basis for predicting yields, farm types and sizes, cropping practices, and payment ability for water charges on the lands

of the North Side Pumping Division, a similar area now farmed was sought for study. A survey of the Snake River Basin showed that the soils and general climatic conditions of lands east of Twin Falls are sufficiently like the best project lands to be used as a base area for class 1 lands. An area just east of Jerome County and one near Buhl were selected to serve as bases for determinations on class 2, 3, and poorer lands of the project. The general location of these correlation areas is shown in the Location Map accompanying this report.

To obtain data on the correlation areas, farm records were obtained from 20 to 25 farmers in a designated 5- to 8-square mile area in each correlation area. These farms were selected by random sampling but included in each case over half of the land and of the farms in each area. The records were taken in the winter of 1946-47 by trained enumerators.

Crop Yields

Great care was exercised in setting up yield estimates, for it was very apparent from the beginning of the economic and land classification investigation that the North Side Pumping Division is an area of high potentiality. Inasmuch as the Twin Falls tract is not in a project of the Bureau of Reclamation, no crop census cards were available. The major sources of data were the results of the correlation area studies, and the data from the Federal Census of Agriculture. The yield data so obtained were adjusted to the project area, and the results were checked with the County Agricultural Agents of Twin Falls and Minidoka Counties and with farmers living near the project lands. Data used as a base for yield estimates are shown in table 18 along with estimated average yields for Unit A, Unit B, and the project average.

In establishing yield estimates by land class (table 20) all available data were utilized. The yields for class 1 lands were based on the census and correlation area data for the Twin Falls and Kimberly precinct area. Yields for other land classes were similarly based on comparable areas. Unit and project area yields shown in table 19 were arrived at by weighting yields by land class, and by the acreage of each land class in the unit and project as a whole.

Table 18.--Average crop yields on correlation areas compared to estimated project yields

North Side Pumping Division
Minidoka Project, Idaho

Crop	Unit of Yield	1/ Twin Falls Correlation Area	2/ Twin Falls County	3/ Kimberly Precinct	4/ Hazelton Correlation Area	5/ Buhl Correlation Area	North Side Pumping Division 6/ Average Unit A	7/ Average Unit B	8/ Project Average
Barley	Bu.	-	50.6	60.3	60.9	-	61.1	55.4	56.3
Wheat	Bu.	56.5	48.0	50.9	43.5	44.2	46.6	42.3	43.0
Potatoes	Cwt	196.7	179	175.4	164.8	151.0	181.5	177.3	178.[illegible]
Sugar Beets	Ton	22.7	20.4	-	10.1	14.9	17.2	16.3	16.5
Bean Commercial	Bu.	34.2	30.0	34.7	33.0	23.0	32.1	30.9	[illegible]
Peas	Bu.	40.9	22.8	26.7	30.1	17.5	28.8	27.7	27.9
Bean Seed	Bu.	30.7	-	-	20.0	-	27.3	27.0	27.1
Red Clover Seed	Bu.	-	4.1	-	-	4.1	4.3	4.0	4.0
Alfalfa Hay	Ton	5.7	3.4	4.7	2.9	2.7	4.6	4.2	4.3
Pasture	AUM	7.6	-	-	5.5	6.9	9.1	7.9	8.1
Red Clover Hay	Ton	3.0	1.0	-	0.8	0.8	1.8	1.5	1.5

(Footnotes on following page)

Footnotes to table 18.--Average crop yield on correlation areas compared to estimated project yields

1/ From 23 Farm Management Survey records for 1946.

2/ Unweighted average for 1939 and 1944, from census data for Twin Falls County.

3/ Weighted average 1934, 1939, and 1944, for Kimberly Precincts 1 and 2 from Minor Civil Division census data. These precincts cover same type of soil as Twin Falls correlation area.

4/ Farm management survey data from 21 records for 1946. This area averages Class 2 and 3 lands.

5/ Farm management survey data from 22 records for 1946. This area averages Class 3 and 4 lands.

6/ Area to be served by pumping 155 feet from Snake River. Total area 13,650 irrigable acres; 73% Class 1, 22% Class 2 and 5% Class 3 land.

7/ Area to be served, in part, by pumping from wells. Total area 24,000 irrigable acres; 42% Class 1, 37% Class 2, and 21% Class 3 land.

8/ Total project area of 77,650 irrigable acres; 48% Class 1, 34% Class 2, and 18% Class 3 land.

Table 19.--Anticipated average yields per acre of major irrigated crops by land class

North Side Pumping Division
Minidoka Project, Idaho

Crop	Unit of Yield	Yields by Land Class			
		Class 1	Class 2	Class 3	Class 4
Barley	Bu.	65	55	45	-
Wheat	Bu.	50	40	35	-
Potatoes	Cwt	185	165	-	-
Sugar Beets	Ton	18	14	-	-
Bean Commercial	Bu.	33	30	28	-
Peas	Bu.	30	25	-	-
Bean Seed	Bu.	28	25	-	-
Red Clover Seed	Bu.	4.5	4.0	3.5	-
Alfalfa Hay	Ton	5.0	4.0	3.0	-
Red Clover Hay	Ton	2.0	1.5	1.0	-
Pasture	AUM	10.0	8.0	6.0	6.0

Irrigated Land Use

The project lands are well adapted to the crops now grown under irrigation in the Upper Snake River Basin with the exception of fruits and some seed and truck crops susceptible to late spring frosts. The estimated distribution of crops in the project is shown in table 20 and is based on the normal crop distribution reported by farm operators in the three correlation areas. The adjustment from that shown in the correlation areas was made to provide a well balanced crop rotation designed to preserve soil fertility and to conserve irrigation water.

The crop distribution is based on the farmers' most likely selection of crops to be grown under "normal" conditions. This distribution is different from present practices in that farmers in the correlation areas have dropped potato and sugar beet production in favor of beans and peas; however, this shift is recent. In addition to the current high income from peas and beans, it probably also reflects the disease and insect problems that arise after a long history of potato and beet growing. The new project lands can be expected to grow high-value crops during most of the repayment period when need for high returns is greatest and before production problems become acute. In setting up farm budgets to determine repayment ability, however, a more conservative cropping system in line with that found in the correlation areas was followed.

Table 20.--Normal crop distribution

North Side Pumping Division
Minidoka Project, Idaho and Correlation Areas

	Correlation Areas			North Side Pumping Division		
	1/ Twin Falls	2/ Hazelton	3/ Buhl	Class 1	Class 2	Class 3
	Percent	Percent	Percent	Percent	Percent	Percent
Grain						
Barley	-	5.7	-	5.5	6.0	10.0
Wheat	3.0	11.5	12.6	6.5	7.0	10.0
Mixed Grain	2.2	1.3	2.4	-	-	-
Subtotal	5.2	18.5	15.0	12.0	13.0	20.0
Row Crops						
Potatoes	6.6	8.8	2.4	17.0	12.0	-
Sugar Beets	6.3	0.3	0.4	11.5	10.0	-
Beans Commercial	25.9	28.2	16.4	10.0	10.0	10.0
Peas	11.0	12.8	3.2	2.0	2.0	-
Subtotal	49.8	50.1	22.4	40.5	34.0	10.0
Seed Crops						
Bean Seed	8.6	1.9	-	2.0	2.0	-
Red Clover Seed	-	-	5.3	2.5	3.0	6.0
Subtotal	8.6	1.9	5.3	4.5	5.0	6.0
Forage Crops						
Alfalfa Hay	24.4	24.1	23.8	30.0	34.0	36.0
Red Clover Hay	4.0	1.2	4.7	2.5	3.0	6.0
Pasture	5.5	3.4	28.0	8.5	9.0	20.0
Subtotal	33.9	28.7	56.5	41.0	46.0	62.0
Miscellaneous Crops	2.5	0.8	4.1	3.0	3.0	3.0
Total Cropped Acreage	100.0	100.0	103.3	101.0	101.0	101.0
Less Duplicated Acreage	--	--	3.3	1.0	1.0	1.0
Net Cropped Acreage	100.0	100.0	100.0	100.0	100.0	100.0

1/ Normal crop distribution on 23 farm management survey records, approximates Class 1 land
2/ Normal crop distribution on 16 farm management survey records, approximate Class 2 and Class 3 land
3/ Normal crop distribution on 16 farm managements survey records, approximates Class 3 and Class 4 land

Anticipated crop distribution is shown in table 21. The list of crops presented in the table is by no means exhaustive, for it does not attempt to show all of the crops that are likely to be grown. A wide variety of garden, grass, and flower seeds as well as seed potatoes, onions, lima beans, green peas (for use fresh, canned, or frozen), and snap beans for canning could also be produced. With such a wide range of crops from which to choose, project farmers will be able to follow market trends and attain truly diversified farming. In the course of time, a pattern of cropping dictated by the crops found to be most profitable will emerge.

Livestock

The production of livestock and dairy products will have an important place in the economy of the new project. Because of the wide adaptability to cash crops and the high yields obtainable, it is improbable, however, that livestock will be a major enterprise on class 1 and 2 lands. In budgeting, at least six dairy cows are shown on each farm type. It is believed to be sound practice to have that many cows on every farm to consume at least a portion of the feed grown and to utilize available labor the year round.

Because alfalfa is a necessary crop in the rotation of these farms, more hay will be grown than will be consumed by livestock on the project. A good hay market exists, however, both for local use and for shipment out of the area. The feeding of livestock, both sheep and beef cattle, in the area at present is based on this surplus hay production. It appears likely that this type of business will increase in the future and offer an outlet for hay and grain produced on project farms.

Type of Farming

Cash-crop farming predominates on adaptable soils in the general vicinity of the project. In the Twin Falls correlation area, 73 percent of the farms are classified as cash-crop farms, and the balance are combination crop-livestock farms with a major source of income from crops but with an important livestock enterprise in addition. In the Hazelton correlation area, 84 percent of the farms covered in the survey are cash-crop farms, and the balance is a crop-livestock type. In the Buhl correlation area, which has largely class 3 and 4 lands, the farms are about equally divided between the crop-livestock and dairy types.

The indications are that the project farms will follow a pattern similar to that of the applicable correlation areas. On class 1 and class 2 land, about 80 percent of the farms are expected to be of the cash-crop type and 20 percent crop-livestock. On land inferior to class 2, dairy farms will predominate.

Table 21.--Anticipated Crop Distribution

North Side Pumping Division
Minidoka Project, Idaho

Crop	Unit A		Unit B		Entire Project	
	Acres	Percent	Acres	Percent	Acres	Percent
Grain						
Barley	750	5.8	3,980	6.6	4,730	6.5
Wheat	870	6.8	4,460	7.4	5,330	7.3
Row Crops						
Potatoes	1,930	15.0	6,990	11.6	8,920	12.2
Sugar Beets	1,360	10.6	5,150	8.6	6,510	8.9
Beans, Commercial	1,280	10.0	6,020	10.0	7,300	10.0
Peas	240	1.9	950	1.6	1,190	1.6
Seed Crops						
Bean Seed	240	1.9	950	1.6	1,190	1.6
Red Clover Seed	360	2.8	2,050	3.4	2,410	3.3
Forage Crops						
Alfalfa Hay	4,000	31.2	19,700	32.7	23,700	32.6
Red Clover Hay	360	2.8	2,050	3.4	2,410	3.3
Pasture	1,180	9.2	6,660	11.1	7,840	10.7
Miscellaneous Crops	390	3.0	1,800	3.0	2,190	3.0
Total Cropped Acreage	12,960	101.0	60,760	101.0	73,720	101.0
Less Duplicate Acreage	130	1.0	600	1.0	730	1.0
Net Irrigable Acreage	12,830	100.0	60,160	100.0	72,990	100.0
Farmsteads, ditches, etc.	820		3,840		4,660	
Total Irrigable Acreage	13,650		64,000		77,650	
Roads, R.O.W., etc.	565		2,670		3,235	
ARABLE ACREAGE	14,215		66,670		80,885	

Size of Farms

Practically all of the project land is publicly-owned and subject to the findings of the Secretary of the Interior as to the size of farm units which will be opened for settlement. The privately-owned land which is included in the Division will be subject to the 160-acre limitation unless special legislation is passed limiting size of farm on privately-owned land to that comparable with those on public land.

Two major criteria were applied to the determination of size of farms: (1) the situation in comparable areas, and (2) the size necessary, by land class, to make possible a net farm income high enough to permit reasonable returns to the farmer and to pay the estimated water charges of the project.

The average amount of land in irrigated farms in Twin Falls County in 1939, according to the Census of Irrigation, was 120 acres. The modal size (table 22) falls in the size range group of 70 to 99 irrigable acres. Disregarding farms of less than 30 acres as being part-time and subsistence units, it is found that 32 percent of the farms fell in the modal group in 1945. Twenty-four percent were smaller and 44 percent larger than the modal group. The modal groups in the correlation areas (table 22) are the same as for Twin Falls County.

Table 22.--Range in size of farms - correlation areas

North Side Pumping Division
Minidoka Project, Idaho

Range in Irrigable Acres	Twin Falls County Census Data 1/			Correlation Area Data 2/		
	1940	1945	1950	Twin Falls	Hazelton	Buhl
	(Number)	(No)	(No.)	(Number)	(Number)	(Number)
Under 9	259	383	244	0	0	0
10-29	235	217	174	0	1	1
30-49	411	376	300	4	2	4
50-69	154	152	134	5	1	0
70-99	690	723	692	6	8	7
100-139	333	348	340	1	5	3
140-179	315	309	313	3	0	2
180-499	258	284	335	3	2	0
500 and over	62	55	91	0	0	0
TOTAL	2,717	2,847	2623	22	19	17

1/ Census data include all farms in the county, but only 3 percent are not irrigated.

2/ These data do not include part-time farms.

Net farm income, and consequent ability to pay water charges varies with size of farm. If a certain level of income is necessary to provide an adequate standard of living and to pay water charges, the size of farm can be adjusted upward within reasonable limits, to compensate for poorer classes of land. In the farm budgets subsequently presented, farms of various sizes by land class and type of farm are presented.

Initial recommendations for determining size of farms by land class presented herein were based on the data shown above, farm budget data presented subsequently, and the findings of a special committee. This committee included representatives of the Branches of Operation and Maintenance and Project Planning of Region I of the Bureau of Reclamation, the Extension Service, and the Agricultural Experiment Station of the University of Idaho, and the Farmers Home Administration, Department of Agriculture. Those recommendations were:

1. Only full-time, family-size farms should be laid out on the North Side Pumping Division.

2. No farm should be composed entirely of Class 3 land.

3. If it is permitted by law, it would be desirable to include noncontiguous land in farm units in order to make proper use of Class 3 land.

4. When the topography and other factors are favorable, farm units should be laid out on the basis of the common rectangular survey. However, when advantages can be gained from the standpoint of farm organization or operation, departure should be made from the rectangular survey or regular subdivisions.

5. The average size of farm on Class 1 land should be approximately 80 arable acres. Individually they should not vary more than 5 percent below this size to 15 percent above.

6. The average size of farm on Class 2 land should be about 100 arable acres. Individually they should not vary more than 20 percent, either smaller or larger, from this size.

7. Where Class 3 lands are involved, they should be combined with at least 60 acres of Class 1 land, or the equivalent thereof in Class 2 (75 acres).

8. In combining various classes, 2 acres of class 3 may be substituted for 1 acre of class 1 and 1.25 acres of class 2 for 1 acre of class 1.

9. Class 4P lands should be excluded from a paying class and considered nonirrigable.

In 1954, the Size of Farm Committee met to reconsider, in light of operating experience, the recommendations set forth above. As a result of its re-evaluation, the Committee recommended that as a minimum, farm units to be laid out in the future should be not less than 90 acres in size in terms of class 1 acreage equivalents, and that in determining acreage equivalents, 1-1/4 acres of class 2 would continue to equal 1 acre of class 1, but that the acreage equivalent of class 3 lands should be reduced from 2 acres to 1-1/2 acres except where topography is a limiting factor. In such cases the individuals laying out the farm units and reviewing them should use judgment in determining suitable adjustments.

This new recommendation made by the Committee results in some significant changes from previous criteria followed. These changes are:

1. Increase in the minimum size of farm from 76 to 90 acres, class 1 equivalent.

2. Change in the conversion ratio of class 3 to class 1 from 2 acres to 1.5 acres.

3. A narrowing of the range of sizes between land classes.

4. Elimination of the requirement that class 3 land be combined with better classes of land in farm units and thereby make it possible to lay out farm units entirely comprised of class 3 land.

The method of implementing the recommendation was considered. It was pointed out that it would, of course, be impossible to change the size of the 157 units for which public notices have already been issued, and further that it would cause considerable delay if changes were made in the other 150 farm units already laid out.

For the balance of approximately 400 units that are not yet laid out, it was agreed that the recommendation would be followed. It was concluded that if problems were encountered in the layout of the balance of 400 units, the Bureau would review them with local representatives of the Farmers Home Administration and the University of Idaho and base action on the recommendation of the group.

Farm Development and Settlement

Farm Development

The process of converting raw, sagebrush-covered land to productive farm units is a difficult and costly task. Experience on nearby similar lands has been used, so far as possible, as a criteria in estimating development costs.

The sagebrush cover is thick on most of these lands. Experience has shown that it can be plowed and windrowed for burning satisfactorily for about $3.00 per acre. This low cost can be attained only by use of large power equipment on an extensive scale.

Even though much of the land will require only a small amount of leveling, it appears that some light grading will be necessary on most tracts to fit them for efficient irrigation. Through the use of grading equipment, a unit cost of $4.00 per acre average for the project should be sufficient.

Before the first crop is seeded, it will be necessary to replow or disc the land and to float it. The cost of this operation will vary by land subclass, but the cost should not exceed $8.00 per acre if it is done on an extensive scale on a contract basis throughout the project.

Farm ditches and irrigation control structures should be of good quality and adequate to insure efficient use of water. Indications are that this cost will vary from $5.00 to $15.00 per acre and will average about $10.00 per acre.

Land leveling, floating, and the placement of farm ditches and control structures will require accurate engineering surveys. The cost for this purpose and for contingencies was estimated at an average of $2.60 per acre in the report on Problem 2, Columbia Basin Joint Investigations. For the North Side Pumping Division these costs are estimated at $2.50 per acre.

The average costs, by items, for preparing the land for irrigation, as outlined above, are:

Clearing sagebrush.	$ 3.00 per acre
Light Grading	4.00 per acre
Plowing and floating	8.00 per acre
Farm ditches and structures	10.00 per acre
Engineering (Includes Contingencies). .	2.50 per acre
Total Cost	$27.50 per acre

The cost of developing a farm from sagebrush cover to full production is not confined to the items listed above. A very important cost is occasioned by the time it takes to clear, level, and bring into production the entire unit.

The North Side Pumping Division will have annual operating costs of about $8.72 per acre. Because of this high annual cost, it appears that these farms should be placed in full production as soon as possible. The faster such full production is attained, the less will be the cost to the settlers through unrealized income.

To speed up development as much as possible, to obtain the lower costs and greater efficiency of large power machines, to enable settlers to make fast and satisfactory progress, to make it possible for settlers to pay the high operation and maintenance costs, to aid the settler in meeting the cultivated-land requirement of the Homestead Law so that the land can be patented as soon as possible, and to shorten the period of farm development, it is believed that the Bureau of Reclamation should make every effort to aid settlers in the rapid development of their properties.

Opportunities for New Settlement

The ultimate development of the North Side Pumping Division will provide for approximately 695 new farms, 130 on Unit A and the balance on Unit B. This estimate is on the basis of full-time farms of the sizes recommended previously in this section. Assuming a farm family size the same as for the Minidoka Project in 1950 (4.0 persons per occupied dwelling), there will be 2,780 people living on the farms of the project, while until recently there were none.

Settlement Problem

It appears that the range of difficulties facing new settlers on the North Side Pumping Division will be similar to those faced on all reclamation projects. Marketing, purchasing, and social problems will be minimized because of nearby well-established towns such as Rupert and Burley.

Public services such as roads, schools, telephone service, and mail routes will have to be established. Power systems in addition to the trunk lines associated with the project also will have to be extended in some instances. The population of the area is expected to be sufficiently compact to make the provision of these services economically feasible by both public bodies and private utilities.

Domestic water will be a problem for each settler or group of settlers to solve individually. A common domestic water supply system for the project as a whole is not contemplated. It is believed

practical, however, for at least two families to share a common well. The high cost of drilling to the depth of potable water, 175 to 350 feet, makes such cooperation attractive if not imperative for new settlers.

A problem peculiar to lands which rest on lava beds, such as those of the North Side Pumping Division, is the facility with which the underground water supply can be contaminated. The soil mantle is shallow in many areas, and raw sewage can readily flow through cracks in the lava to the underground water supply. Septic tanks should be used for all domestic wastes, and no sewage should be disposed of by dumping into drainage wells.

The estimated capital requirements for several representative farms are shown in table 23. In addition to these requirements, settlers will need credit for farm production expenses and for family living during the development period when expenses are likely to exceed income.

The demand for adequate credit will be great on this project. All of the public land will be opened for settlement to qualified veterans of World War II. These men, of course, will have to possess the minimum amount of cash or equipment required by regulations to be promulgated by the Bureau of Reclamation, but they will probably not have acquired much more than the minimum amount of capital necessary to qualify since their average age will be low.

The lands, being newly homesteaded, will not be patented for at least one year and probably three years or more from time of first entry. Under Public Law 361, enacted by the 81st Congress, October 1949, it is now possible for entrymen on Bureau of Reclamation projects to obtain Federal assistance loans for buildings and improvements on entered land prior to proving-up on the land and receiving a patent.

Settler Qualifications

A major premise in this report on economic feasibility is the basing of yields, cropping program, net income, and ability to pay water charges on fully developed lands. The ability of the settler to bridge the gap between the raw land and the fully developed farm is a problem deserving major consideration.

The qualification of settlers varies from project to project and is set for each by an examining board. To protect both the settler and the irrigation district, the following suggestions are made:

1. That the usual qualifications regarding character, industry, health, and farm experience be required. Those

Table 23.--Estimated capital requirements for representative farm units

North Side Pumping Division
Minidoka Project, Idaho

Item of Investment	Capital Requirements for Selected Units 1/		
	60 Acre Dairy-Crop Farm (Budget 1-4) Class 1 Land	80 Acre Crop Farm (Budget 2-2) Class 2 Land	80 Acre Dairy-Crop Farm (Budget 2-3) Class Land
	Dollars	Dollars	Dollars
Land (Farm Development)	1,584	2,112	2,112
Domestic Water System	850	850	850
Dwelling	3,000	3,000	3,000
Barn	550	550	996
Other Farm Buildings	594	594	626
Fences	440	475	475
Original Cost of Machinery and Equipment	4,308	4,308	4,630
Livestock	637	637	1,734
Total Investment	11,963	12,526	14,423
Non-Cash Cost	1,532	1,806	2,236
Cash Cost	10,43	10,720	12,187

1/ Capital costs based on 1939-1944 average prices. These costs would be greatly increased if purchases are made during a period of high prices such as 1954.

called for in Public Announcement No. 7, Columbia Basin Project, Washington, November 21, 1951, are cited as a good example.

2. Capital requirements should be as high as practicable. At least $4,000 in net worth is believed to be necessary unless land development such as clearing and leveling has been performed, in which case $3,000 would suffice. This is a bare minimum and would need to be supplemented by adequate long-term credit.

The recommendation has been made in this report that various sizes of farms be provided. Because of this variation in size, which will have a strong effect on the type of farming to which the unit is adapted, it is believed best to give the successful applicants a free choice of units so far as practicable.

Farm Improvements

The cost of farm buildings and improvements will depend to a considerable extent on the time in the economic cycle when the building is done. For this report, the period 1939-44 has been used for all farm price and cost data. Another factor in determining the cost of farm improvements is the type of farming.

The total cost for farm buildings and fences varies in the budgets presented subsequently from about $5,500 to $6,200. Major items included are: house - $3,000; domestic water system (1/2 interest in a deep well) - $850; chicken house - $150; garage and machine shop - $450; barn - from $550 to $1,175; hog house - $75; and fence (for an 80-acre general crop farm) - $475.

The full line of improvements will come slowly on many farms but at mature development this project should, on the average, have adequate housing and farm buildings about as shown. One of the outstanding characteristics of the Twin Falls correlation area is the preponderance of neat, adequately built-up farmsteads. Houses and barns in that area are not large, but are well built and sufficient. They reflect the high income-producing ability of the land. Comparable improvements are expected on the lands of the North Side Pumping Division inasmuch as they are similar in productive capacity.

Representative Farms

The wide adaptability of cropping possible on the project lands, yield potentialities, size of farms, market outlets, and settlers' problems have been discussed. On the basis of the data presented, a number of farm budgets have been prepared for typical units on each of the three land classes. Various combinations of enterprise have

been used, and the effect of change of farm size has been shown on each class of land.

In selecting typical farms, a workable land-use program has been followed, including a desirable crop rotation designed to conserve soil and water. All livestock enterprises are keyed to the cropping program, and attention has been given to obtaining a reasonable use of operator and family labor.

Price and cost data are based on the 1939-44 average for comparable areas in Idaho. These data are largely from the Bureau of Agricultural Economics and the University of Idaho. Basic data were adjusted to anticipated conditions, where necessary, to achieve a reasonable balance between prices of different commodities. Anticipated prices, based on the 1939-44 average, are shown in table 24. All costs used in the farm budgets are based on the same period.

The following per-acre values have been used for the various classes of land: class 1, $100; class 2, $80; and class 3, $60. These values reflect the worth of the land at mature development during a period similar to the 1939-44 base price period. Moreover, they include development costs.

Allowance for debt service has been computed at the rate of 3 percent on the total value of the land and on the inventory value of buildings, machinery, livestock and feed on hand. The inventory value of buildings and machinery is considered to be 50 percent of new cost. Livestock is valued at the market price. Feed inventory is 25 percent of all feed fed on the farm.

Class 1 Land

All farms on this land class are expected to raise cash crops. About 80 percent of them will be devoted almost exclusively to cash crops while the other 20 percent are expected to be crop-livestock farms. Two sizes (60- and 80-acre units) of farms were budgeted for class 1 lands. Crop-livestock farms are expected to occur largely on the smaller units.

The variations in cropping programs, size of livestock enterprises, farm income, farm investment, and the amount of labor performed by the operator and his family on six typical farms on class 1 land are shown in table 25. A sample budget summary sheet showing details of the operation of the 60-acre crop farm (budget 1-4 is included as table 26).

Table 24.--Anticipated farm commodity prices

North Side Pumping Division
Minidoka Project, Idaho

Commodity	Unit	Average 1939-44 Price 1/	Anticipated Price	Condition of Commodity at Time of Sale 2/
		Dollars	Dollars	
Corn	Bu.	1.00	0.90	Bulk delivered
Wheat	Bu.	0.94	0.95	Bulk delivered
Oats	Bu.	0.46	0.47	Bulk delivered
Barley	Bu.	0.64	0.68	Bulk delivered
Alfalfa Hay	Ton	11.10 3/	10.00	Loose in stack
Clover Hay	Ton	9.55 3/	8.50	Loose in stack
Peas, dry	Cwt.	4.01	4.00	Bulk, cleaned and delivered
Beans, dry	Cwt.	4.12	4.00	Cleaned and sacked, delivered
Sugar Beets	Ton	6.89 4/	7.50 5/	Delivered to beet dump
Potatoes	Cwt.	1.27	1.00	Marketable potatoes, bulk at farm
Onions, dry	Cwt.	1.06	1.00	Marketable onions, bulk at farm
Red Clover Seed	Bu.	12.10	12.00	Cleaned and sacked, delivered
Beef:				
Grass Fat	Cwt.	8.58 6/	8.00	Delivered to car or to local packer
Feeders	Cwt.	7.92 7/	7.40	Delivered to car or to local packer
Cull Cows	Cwt.	5.94 7/	5.50	Delivered to car or to local packer
Veal	Cwt.	10.00	9.30	Delivered to car or to local packer
Sheep:				
Lambs	Cwt.	9.78	8.90	Delivered to car or to local packer
Cull Ewes	Cwt.	5.20	4.75	Delivered to car or to local packer
Wool	Lb.	0.35	0.30	Sacked and delivered
Hogs:				
Barrows & Gilts	Cwt.	10.02	9.50	Delivered to car or to local packer
Packer Sows	Cwt.	7.41	7.00	Delivered to car or to local packer
Chickens:	Lb.	0.169	0.17	Delivered to local processor
Eggs	Doz.	0.255	0.26	Delivered to local buying station
Butterfat:				
In Whole Milk	Lb.	0.52 8/	0.45	Fluid and factory milk, delivered
In Sweet Cream		0.39 9/	0.38	Delivered at creamery

(Footnotes on following page)

Footnotes to table 24.--Anticipated farm commodity prices

1/ Except where otherwise noted 1939-1944 average prices were developed from published and unpublished materials of the U. S. Department of Agriculture, Agricultural Statistics Division, Bureau of Agricultural Economics, Boise, Idaho.

2/ "Delivered" means hauled by the farmer to the usual place of sale, such as warehouse, elevator, or railroad car.

3/ Prices of various kinds of hay were estimated with "all tame hay" price and the proportion of each kind produced as a basis. In Idaho approximately 86 percent of all tame hay is alfalfa, the other 14 percent being almost equally divided between clover and grain hay.

4/ Includes War Food Administration payments made to growers in 1943 and 1944. Does not include annual payments made under the 1937 Sugar Act. If the latter were included the 1939-1944 average price would be $9.10.

5/ Assumed to include government payments.

6/ "All beef" price as published by U. S. Department of Agriculture, Division of Agricultural Statistics, Bureau of Agricultural Economics. In Idaho, the "all beef" price centers around the grass fat price.

7/ The spread between grass fat, feeder, and cull cow beef prices was based on data in Problem 2, Columbia Basin Investigations.

8/ Calculated from U. S. Department of Agriculture price per hundred weight for whole milk using 3.95 percent butterfat. Does not include wartime subsidy.

9/ U. S. Department of Agriculture "all cream" price is used as the sweet cream price, because a very small percentage is sour cream. Does not include the wartime subsidy.

Table 25.--Farm organization and financial summary for farms on class 1 land

North Side Pumping Division
Minidoka Project, Idaho

Item	Unit	Class 1 Land					Dairy-Crop Farm
		Crop-Dairy Farms					
		1-1	1-2	1-3	1-4	1-5	1-6
Arable Farm Acreage	Ac.	80.0	80.0	80.0	60.0	60.0	60.0
Roads, right-of-way, etc.	Ac.	3.2	3.2	3.2	2.4	2.4	2.4
Irrigable Farm Acreage	Ac.	76.8	76.8	76.8	57.6	57.6	57.6
Farmsteads, ditches, etc.	Ac.	4.8	4.8	4.8	3.6	3.6	3.6
Net Irrigable Farm Acreage	Ac.	72.0	72.0	72.0	54.0	54.0	54.0
Irrigated Crops:							
Potatoes	Ac.	20.0	-	10.0	7.4	-	-
Sugar Beets	Ac.	-	10.0	-	-	7.4	7.1
Beans	Ac.	10.0	20.0	20.0	14.8	14.8	14.1
Grains	Ac.	10.0	10.0	10.0	7.4	7.4	7.1
Alfalfa	Ac.	27.4	27.4	27.4	19.8	19.8	16.7
Pasture	Ac.	4.6	4.6	4.6	4.6	4.6	9.0
Livestock:							
Dairy Cows	No.	6	6	6	6	6	16
Brood Sows	No.	-	-	-	-	-	1
Financial Summary:							
Gross Farm Income	Dol.	6,522	5,144	5,464	4,071	3,834	4,341
Farm Expenses 1/	Dol.	3,752	3,166	3,263	2,654	2,574	2,839
Net Farm Income	Dol.	2,770	1,978	2,201	1,417	1,260	1,502
Farm Privileges	Dol.	402	402	402	402	402	420
Net Family Farm Earnings	Dol.	3,172	2,380	2,603	1,819	1,662	1,922
Debt Service 2/	Dol.	393	390	393	335	332	385
Net Family Farm Equity Earnings 3/	Dol.	2,779	1,990	2,210	1,484	1,330	1,537
Average Farm Inventory 4/	Dol.	13,090	12,992	13,090	11,166	11,058	12,836
Labor by Operator and Family	Days	276	254	266	227	219	329

(Footnotes on following page)

Footnotes to table 25.--Farm organization and financial summary for farms on class 1 land

1/ Includes irrigation water charge of $11.00 per acre on the "Irrigable Farm Acreage."

2/ Assumed to equal 3 percent interest on the "Average Farm Inventory."

3/ Return to the farm family for labor and management and for its equity in the farm after paying assumed water charges of $11.00 per acre. This amount would be available for family living, savings, and related purposes.

4/ "Average Farm Inventory" consists of the following items:
(1) Land value. (See discussion in text of report.)
(2) The depreciated value of all farm buildings, including the farm water system (based on 50 percent of original cost).
(3) The depreciated value of machinery and equipment (based on 50 percent of original cost).
(4) The estimated value of feeds on hand (based on 25 percent of all feeds produced and fed on the farm).
(5) The normal value of all livestock.

FARM BUDGET ANALYSIS

TABLE 26

Farm Budget Summary

Land Class 1, Acres 60.0, Type Crop-Dairy

Crops	Land acres	Irrigation: Water req. (ac. ft.)	Irrigation: Times irrigated	Man work days	Production: Unit	Production: Yield or weight	Production: Total production	Disposal of products grown: Sold: Amount	Sold: Price	Sold: Value	Farm use
Potatoes	7.4			24	Cwt	185.0	1,369	1,369	$1.00	1,369	-
Beans, Commercial	14.8			34	Bu	33.0	488	488	2.40	1,171	-
Wheat (Nurse)	7.4			12	Bu	50.0	370	294	0.95	279	76
Alfalfa	19.8			32	Ton	5.0	99	62.4	10.00	624	36.6
Pasture	4.6			5	AUM	10.0	46	-	-	-	46
Farmsteads, Etc.	3.6			-	-	-	-	-	-	-	
Roads, Right-of-Way	2.4			-	-	-	-	-	-	-	
Etc.											
Livestock	No.	Product									
Dairy Cows, milked	6	Butterfat		84	Lbs	240	1,440	1,232	0.45a	554	208b
Dairy Cows, sales	0.8	Dairy-beef		-	Cwt	11	8.8	8.8	5.00	44	-
Heifers, over 2 yrs	1	Replacement		1	-	-	-	-	-	-	-
Heifers, under 1 yr	1	Replacement		2	-	-	-	-	-	-	-
Horses	2	Work horses		10	-	-	-	-	-	-	-
Laying Hens	25	Eggs		9	Doz	8.5	212	62	0.26	16	150
Chickens	50	Poultry		-	Lbs	3.6	180	80	0.17	14	100

Current Farm Expenses	
State and County taxes	$ 112
Water charges ($ 11 per ac)	634
Farm share of electricity	18
Seed	270
Fertilizer	103
Contract machine work	251
Other crop expense	90
Purchased feed	6
Other livestock expense	51
Labor, day and month	
Labor, Contract	116
Tractor (gas, oil, repairs)	133
Auto (gas, oil, repairs)	90c
Repairs: Bldg. and fences	84
Repairs: Mach. and equip.	106
Farm insurance	
Depreciation on buildings	147
Dep. on mach. and equip.	210
Depreciation on tractor	76
Depreciation on auto	48c
Misc. farm expense	109
Total Current Expense	2,654

Average Farm Investment	
Land	$ 5,767
Farm bldg. and imp.	572
Machine and equip.	1,542
Tractor	425
Auto (farm share)	188
Livestock	637
Feed and supplies	110
Water system	425
Dwelling	1,500
Permanent improvements	
Total	11,166

Farm Work: Item	Days
Crops	107
Livestock	106
Miscellaneous	14
Total	227e
Work by:	
Operator	200
Family	27
Hired	0e

Family Living	
Net farm income	$ 1,417
Less debt service 3%	335d
Available for family living,	402
capital accumulation, etc.	1,082

Payment Capacity	
Net farm income	1,484
Plus assumed water charges	
Less investment allowance 5%	
Less family living allowance	
Payment capacity: Total	
per acre	

Financial Summary: Receipts:	$
Crop sales	3,443
Livestock sales	58
Livestock prod. sales	570
Miscellaneous receipts	-
Total Cash Farm Receipts	4,071
Value of farm privileges	402
Gross farm income	4,473
Current farm expense	2,654
Net Farm Income	1,819
Interest on investment 5%	558
Family labor earnings	1,261

(Footnotes on following page)

Footnotes to table 26.--Farm budget summary, 60-acre crop-dairy farm, land class 1.

a/ Butterfat sold in whole milk.

b/ Two hundred pounds for family use and balance in whole milk fed to calves.

c/ Farm share only.

d/ Assuming three percent interest on average farm inventory will pay interest on farm indebtedness.

e/ Does not include approximately 20 days of labor hired on a piecework basis.

Class 2 Land

The types of farming anticipated on class 2 land are similar to those of class 1 land. Yields are expected to be somewhat lower, and costs of developing and handling the land will tend to be greater. The effect of this combination of circumstances will be reflected in differences of income per acre for like crops rather than in a shift in cropping as between class 1 and class 2 land.

Five budgets are summarized in table 27 to show the income-producing ability of various sizes and types of farms on class 2 land. It will be noted that no 60-acre farms are shown, but that two budgets for 100-acre farms have been prepared. This shift in farm size is due to the need for larger units of class 2 land to return sufficient income to make possible the payment of annual water charges and at the same time return to the farmer a satisfactory level of living after all costs are paid.

Detailed data on organization, income, and expenses of an 80-acre-crop-livestock farm on class 2 land (budget 2-3) are shown in table 28. It is expected that only about 20 percent of the farms on class 2 land will be of the crop-livestock type, but the organization is typical of this type on all classes of land.

Class 3 Land

As noted above in the recommendations regarding the size of farm, there will be relatively few farm units composed entirely of class 3 land, since only about 17 percent of the total arable land in the entire project is class 3. It is widely scattered and does not occur in blocks of any great size, except in the extreme northeastern portion of Unit B. Four budgets have been prepared for farms on this land class (table 29). An additional budget (No. 2, 3-1) is also presented to show the effect of substituting 20 acres of class 3 land for a like amount of class 2 land.

Class 4P Land

Class 4P lands were mapped in the original classification. However, since that time, as noted above, it has been recommended that such lands be excluded from farm units. Therefore, such lands will be considered as nonirrigable and a water supply will not be provided for them.

Combination of Land Classes

It is roughly estimated that, for the project as a whole, about 40 percent of the farms will be almost entirely composed of class 1 land, 20 percent of class 2 land, and 5 percent of class 3 land. The

Table 27.--Farm organization and financial summary for farms on Class 2 land

North Side Pumping Division
Minidoka Project, Idaho

Item	Unit	Class 2 land				Dairy-Crop Farms
		Crop-Dairy Farms				
		2-1	2-2	2-4	2-3	2-5
Arable Farm Acreage	Ac.	80.0	80.0	100.0	80.0	100.0
Roads, rights-of-way, etc	Ac.	3.2	3.2	4.0	3.2	4.0
Irrigable Farm Acreage	Ac.	76.8	76.8	96.0	76.8	96.0
Farmsteads, ditches, etc.	Ac.	4.8	4.8	6.0	4.8	6.0
Net Irrigable Farm Acreage	Ac.	72.0	72.0	90.0	72.0	90.0
Irrigated Crops:						
Potatoes	Ac.	20.0	9.9	12.4	-	-
Sugar Beets	Ac.	-	-	-	9.5	11.8
Beans	Ac.	10.0	19.7	24.9	18.9	23.8
Grain	Ac.	10.0	9.8	12.4	9.5	11.8
Alfalfa	Ac.	27.4	26.6	34.3	23.1	28.6
Pasture	Ac.	4.6	6.0	6.0	11.0	14.0
Livestock:						
Dairy Cows	No.	6	6	6	16	18
Brood Sows					1	2
Financial Summary:						
Cross Farm Income	Dol.	5,636	4,673	5,863	4,747	5,851
Farm Expenses 1/	Dol.	3,676	3,168	3,807	3,316	4,010
Net Farm Income	Dol.	1,960	1,505	2,056	1,431	1,841
Farm Privileges	Dol.	402	402	402	420	420
Net Family Farm Earnings	Dol.	2,362	1,907	2,458	1,851	2,261
Debt Service 2/	Dol.	347	347	393	397	452
Net Family Farm Equity Earnings 3/	Dol.	2,015	1,560	2,065	1,454	1,809
Average Farm Inventory	Dol.	11,565	11,554	13,093	13,224	15,083
Labor by Operator and Family	Days	273	262	284	354	389

(Footnotes on following page)

Footnotes to table 27.--Farm organization and financial summery for farms on Class 2 land.

1/ Includes irrigation water charge of $11.00 per acre on the "Irrigable Farm Acreage".

2/ Assumed to equal 3 percent interest on the "Average Farm Inventory".

3/ Return to the farm family for labor and management and for its equity in the farm after paying assumed water charges of $11.00 per acre. This amount would be available for family living, savings, and related purposes.

4/ "Average Farm Inventory" consists of the following items:

(1) Land Value. (See discussion in text of report).
(2) The depreciated value of all farm buildings, including the farm water system (based on 50 percent of original cost).
(3) The depreciated value of machinery and equipment (based on 50 percent of original cost).
(4) The estimated value of feeds on hand (based on 25 percent of feeds produced and fed on the farm).
(5) The normal value of all livestock.

FARM BUDGET ANALYSIS

TABLE 28

Farm Budget Summary

Land Class 2, Acres 80.0, Type Dairy-Crop

Crops	Land acres	Irrigation: Water req. (ac. ft.)	Irrigation: Times irri-gated	Man work days	Production: Unit	Production: Yield or weight	Production: Total prod-uction	Disposal of products grown: Sold: Amount	Sold: Price	Sold: Value	Farm use
Sugar Beets	9.5			21	Ton	14.0	133	133	7.50	998	-
Bean, Commercial	18.9			44	Bu	30.0	567	567	2.40	1,361	-
Wheat (Nurse)	1.8			3	Bu	40.0	72	29	0.95	28	43
Barley (Nurse)	7.7			12	Bu	55.0	424	47	0.68	32	377
Alfalfa	23.1			35	Ton	4.0	92.4	8.5	10.00	85	83.9
Pasture	11.0			11	AUM	8.0	88	-	-	-	88
Farmsteads, etc.	4.8			-	-	-	-	-	-	-	-
Roads, Right-of-Way	3.2			-	-	-	-	-	-	-	-
Etc.											
Livestock	No.	Product									
Dairy Cows, milked	16	Butterfat		170	Lbs	270	4,320	4,086	0.45a	1,839	234b
Dairy Cows, sales	2.2	Dairy-beef		-	Cwt	11.0	24.2	24.2	5.00	121	-
Dairy Cows, sales	1.3	Dairy cows		-	No.	-	1.3	1.3	75.00	98	-
Heifers, over 2 yrs	4.0	Replacement		4	-	-	-	-	-	-	-
Heifers, under 1 yr	4.2	Replacement		8	-	-	-	-	-	-	-
Sow, 1 brood	.25	Pork		8	Cwt	4.0	1.0	1.0	7.00	7	-
Market hogs	8.8	Pork		-	Cwt	2.0	17.6	15.6	9.50	148	2.0
Horses	2	Work Horses		10	-	-	-	-	-	-	-
Laying Hens	25	Eggs		9	Doz	8.5	212	62	0.26	16	150
Chickens	50	Poultry		-	Lbs	3.6	180	80	0.17	14	100

Current Farm Expenses	
State and County taxes	$150
Water charges($ 11 per ac)	845
Farm share of electricity	28
Seed	130
Fertilizer	127
Contract machine work	373
Other crop expense	71
Purchased feed	67
Other livestock expense	98
Labor, day and month	27
Labor, contract	259
Tractor (gas, oil, repairs)	170
Auto (gas, oil, repairs)	
Repairs: Bldg. and fences	93
Repairs: Mach. and equip.	125
Farm insurance	
Depreciation on buildings	169
Dep. on mach. and equip.	238
Depreciation on tractor	76
Depreciation on auto	48c
Misc. farm expense	132
Total Current Expense	3,316

Average Farm Investment	
Land	$ 6,154
Farm bldg. and imp.	811
Machine and equip.	1,703
Tractor	425
Auto (farm share)	188
Livestock	1,734
Feed and supplies	284
Water system	425
Dwelling	1,500
Permanent improvements	
Total	13,224

Farm Work: Item	Days
Crops	126
Livestock	209
Miscellaneous	26
Total	361e
Work by:	
Operator	290
Family	65
Hired	6e

Family Living	
Net farm income	$ 1,431
Less debt service 3%	397d
Available for family living,	420
capital accumulation, etc.	1,034

Payment Capacity	
Net farm income	1,454
Plus assumed water charges	
Less investment allowance 5%	
Less family living allowance	
Payment capacity: Total	
per acre	

Financial Summary: Receipts:	$
Crop sales	2,504
Livestock sales	388
Livestock prod. sales	11,855
Miscellaneous receipts	-
Total Cash Farm Receipts	4,747
Value of farm privileges	420
Gross farm income	5,167
Current farm expense	3,316
Net Farm Income	1,851
Interest on investment 5%	661
Family labor earnings	1,190

(Footnotes on following page)

Footnotes to table 28.--Farm budget summary 80-acre dairy-crop farm, land class 2

a/ Butterfat sold in whole milk

b/ Two hundred pounds for family use and balance in whole milk fed to calves.

c/ Farm share only.

d/ Assuming three percent interest on average farm inventory will pay interest on farm indebtedness.

e/ Does not include approximately 43 days of labor hired on a piecework basis.

Table 29.--Farm organization and financial summary for farms on Class 3 land

North Side Pumping Division
Minidoka Project, Idaho

Item	Unit	Class 3 Land				Mixed Land Class
		Crop-Dairy		Dairy-Crop		Dairy-Crop
		3-2	3-4	3-1	3-3	2,3-1 1/
Arable Farm Acreage	Ac.	80.0	120.0	80.0	120.0	100.0
Roads, right-of-way, etc	Ac.	3.2	4.8	3.2	4.8	4.0
Irrigable Farm Acreage	Ac.	76.8	115.2	76.8	115.2	96.0
Farmsteads, ditches, etc	Ac.	4.8	7.2	4.8	7.2	6.0
Net Irrigable Farm Acreage	Ac.	72.0	108.0	72.0	108.0	90.0
Irrigated Crops:						
Sugar Beets	Ac.	-	-	-	-	9.2
Beans	Ac.	22.7	34.7	21.3	32.1	24.1
Grain	Ac.	11.3	17.3	10.7	16.0	12.0
Alfalfa	Ac.	30.0	48.0	24.0	36.2	27.7
Pasture	Ac.	8.0	8.0	16.0	23.7	17.0
Livestock:						
Dairy Cows	No.	6	6	12	18	18
Brood Sows	No.	-	-	1	2	2
Financial Summary						
Gross Farm Income	Dol.	2,985	4,522	3,226	4,975	5,530
Farm Expenses 2/	Dol.	2,543	3,557	2,703	3,906	3,868
Net Farm Income	Dol.	442	965	523	1,069	1,662
Farm Privileges	Dol.	402	402	420	420	420
Net Family Farm Earnings	Dol.	844	1,367	943	1,489	2,080
Debt Service 3/	Dol.	294	364	332	426	450
Net Family Earnings 4/	Dol.	550	1,003	611	1,063	1,632
Average Farm Inventory 5/	Dol.	9,789	12,129	11,054	14,207	15,004
Labor by Operator and Family	Days	252	288	314	391	387

(Footnotes on following page)

Footnotes to table 29.--Farm organization and financial summary for farms on Class 3 land

1/ Farm consists of 80 acres Class 2 land and 20 acres Class 3 land.

2/ Includes irrigation water charge of $11.00 per acre on the "Irrigable Farm Acreage".

3/ Assumed to equal 3 percent interest on the "Average Farm Inventory".

4/ Return to the farm family for labor and management and for its equity in the farm after paying assumed water charges of $11.00 per acre. This amount would be available for family living, savings, and related purposes.

5/ "Average Farm Inventory" consists of the following items:

(1) Land Value. (See discussion in text of report).
(2) The depreciated value of all farm buildings, including the farm water system (based on 50 percent of original cost).
(3) The depreciated value of machinery and equipment (based on 50 percent of original cost).
(4) The estimated value of feeds on hand (based on 25 percent of all feed produced and fed on the farm).
(5) The normal value of all livestock.

remaining 35 percent of the farms will have varying proportions of the three land classes considered as irrigable. The amount of such class 3 land included in combination with other land will depend upon the amount required to meet the recommendations regarding size of farm. In combining various land classes in farm units, it has been agreed that 1-1/2 acres of class 3 land will equal 1 acre of class 1; and that 1-1/4 acres of class 2 will equal 1 acre of class 1.

ANTICIPATED CAPACITY FOR PAYMENT OF WATER CHARGES

Capacity for payment of water charges, as presented in this report, is the residual of net farm equity earnings after a reasonable deduction has been made as an allowance for family living. The amount so determined is available for water payments without encroaching on normal operating costs and debt service payments, or on a reasonable level of living for the operator and his family.

Family Living Allowance

Bureau of Reclamation procedure specifies that $1,500 be earmarked for family living out of net family farm earnings before payment capacity is computed. This amount includes farm family privileges such as farm-produced foods, livestock and livestock products used in the home, and an allowance in lieu of rent for the dwelling. Farm privileges are expected to average about $400 on the North Side Pumping Division, leaving $1,100 cash for living costs and savings. This amount, based on prices and costs of the period 1939-44, is believed to be a minimum for the types of farms which will be developed on this project. Cash-crop farmers must expect an average return of at least this much to compensate for the risks involved.

Payment Capacity

Payment capacity in the amount available for water charges under defined "normal" conditions. The amount varies by size and type of farm and by land class (table 30). Many other variables, of course, can affect it, but, under "normal" conditions, a farmer with average managerial ability can achieve the results shown.

On class 1 lands payment capacity varies from $27.66 per acre to $8.06 per acre. The highest return would be on a cash-crop farm growing potatoes 2 years in a 7-year rotation. It is not expected that many farmers will elect to use as high a proportion of their land for this rather speculative crop as is shown in budget 1-1. The lowest returns budgeted were on a cash-crop 60-acre farm. Operators of farms of this size may be expected to farm more intensively

Table 30.--Capacity for payment of water charges, by land class and type of farm

North Side Pumping Division
Minidoka Project, Idaho

Land Class Representative Farms	1/ Farm Budget	2/ Net Farm Equity Earnings Per Farm	Family Living Allowance Per Farm	Payment Capacity Per Farm	Payment Capacity 3/ Per Acre
	Number	Dollars	Dollars	Dollars	Dollars
Land Class 1					
80 Acre Crop-Dairy	1-1	3,624	1,500	2,124	27.66
80 Acre Crop-Dairy	1-2	2,835	1,500	1,335	17.38
80 Acre Crop-Dairy	1-3	3,055	1,500	1,555	20.25
60 Acre Crop-Dairy	1-4	2,118	1,500	618	10.73
60 Acre Crop-Dairy	1-5	1,964	1,500	464	8.06
60 Acre Dairy-Crop	1-6	2,171	1,500	671	11.65
Land Class 2					
80 Acre Crop-Dairy	2-1	2,860	1,500	1,360	17.71
80 Acre Crop-Dairy	2-2	2,405	1,500	905	11.78
80 Acre Dairy-Crop	2-3	2,299	1,500	799	10.40
100 Acre Crop-Dairy	2-4	3,121	1,500	1,621	16.89
100 Acre Dairy-Crop	2-5	2,865	1,500	1,365	14.22
Land Class 3					
80 Acre Dairy-Crop	3-1	1,456	1,500	-44	- -
80 Acre Crop-Dairy	3-2	1,395	1,500	-105	- -
120 Acre Dairy-Crop	3-3	2,330	1,500	830	7.20
120 Acre Crop-Dairy	3-4	2,270	1,500	770	6.68
Land Class Mixed					
100 Acre Dairy-Crop	2,3-1	2,688	1,500	1,188	12.38
80 Acre Class 2 & 20 Acre Class 3					

1/ Details on individual budgets shown in following tables: Class 1, Table 26; Class 2, Table 28; Class 3, Table 30.

2/ Before payment of water charges.

3/ Payment capacity computed on Irrigable Acres.

than is shown in this budget or to engage in dairy production. Data for these types of farms on 60-acre units are shown in budgets 1-4 and 1-6.

The five budgets prepared on class 2 lands show substantially the same results by size and type of farm as do those of class 1 lands. Because of the lower productivity, somewhat larger acreages are required to attain comparable payment capacities. This differential in potential payment capacity has been recognized in the recommendations made previously that the average farm on class 1 land include 90 acres compared to an average of 112 acres on class 2 land.

The payment capacity of farms on class 3 land is less than on the two better classes, averaging about $7.00 per acre annually for 120-acre units. The manner in which class 3 land occurs on the project, however, will make it possible to lay out the farm units so that most of the class 3 land can be consolidated with better lands in the required proportions, except in the extreme northeastern portion of Unit B.

To measure the difference in payment capacity when Class 3 land is substituted for Class 2, budget No. 2, 3-1 was prepared. The farm depicted is identical to that shown in budget No. 2-5--an 18-cow dairy with 2 sows plus cash crops--except that 20 acres of Class 3 land was substituted for 20 acres of class 2 land. The farm with class 3 land has an annual payment capacity of $12.38 per acre compared with $14.22 for the farm with all class 2 land.

The farm sizes and types suggested in this report result in a wide range in payment capacity. On the assumption that a uniform charge for all land classes will be used in this project, as recommended herein, the maximum payment capacity is largely determined by the poorest land class. However, since it is expected that most of such lands (class 3) will be farmed in combination with better lands, the maximum payment capacity is about $11 to $12 per acre annually. If it became necessary to meet substantially higher payments, the maximum payment capacity could be increased by varying construction charges by land classes. Through this procedure and, depending upon the size of farms established, the average annual maximum payment capacity could be increased to $14 or $15 per acre.

Development Period

The possibility and feasibility of collecting an annual water charge of 10 or 11 dollars per acre depends in large measure on keeping land values closely correlated with the power of the land to return adequate net farm incomes after both full water charges and a return on the investment in land have been paid. A development period during which net incomes exceed those to be anticipated later, when full water charges are collected, can be expected to set false

standards upon which excessive land values will be based. The shortest practicable period during which water charges are less than they will ultimately be is, for reason mentioned above, strongly advocated for this project.

Except for about 5,000 acres which have been operated under the experimental well testing program, the lands will be homesteaded with native sagebrush cover. Even so, however, it is not expected that it will take long to get the farm units cleared and in production. During the initial years of heavy demand for farm credit, however, it is not expected that the operators will be able to meet the full operation and maintenance cost, including power and reserve for replacements. A 10-year development period is provided in order that the deficit in operation and maintenance incurred during the first few years can be paid up during the last years of the 10-year period.

CHAPTER VIII

F I N A N C I A L A N A L Y S I S

The economic justification and financial feasibility are approximately the same as shown in the Project Planning Report dated April 1949. Such changes as have occurred are the result of modifications in plans and methodology of analysis. Changes in plan have resulted from the terms of the authorization act as well as the advance planning studies leading to the preparation and revision of the definite plan report. The authorization eliminated the allocation to fish and wildlife and extended the payout for irrigation to 50 years. The private power company serving the area has announced its intention to install the necessary distribution lines and is now engaged in such a construction program. In addition, discussions are being held with the company regarding wheeling of power from Goshen to the Project area. As a result of these conditions, the cost of the distribution lines has been eliminated from the cost estimate. An amount of $744,186 is retained in the estimate for transmission lines, but if a satisfactory wheeling arrangement can be agreed upon, this amount can be subtracted from the cost estimate.

Perhaps of greater significance than changes in the plan have been changes in methodology. The project was originally justified on the basis of benefits designed to measure contributions to National income. The present benefit analysis was based upon procedures issued from the Commissioner's Office, June 27, 1951, and modified in March 1952. The overall effect of these changes, both in plan and methodology, has been to reduce the benefit-cost ratio from 6.87 to 1 to 3.56 to 1, and to change the annual irrigation charges per acre from $9.51 to $11.34.

ECONOMIC JUSTIFICATION

The benefit-cost ratio has been reworked on the basis of current procedures. In doing this, farm budgets which were based on the 1939-1944 price level were used. However, interest was allowed at 5 percent as now provided in existing procedures. The analysis resulted in the following irrigation benefits.

Direct benefits--

a.	Increase in family living	$ 560,000
b.	Increase in payment capacity	1,056,000
c.	Equity in farm investment	155,000

Indirect benefits--

a.	Benefit from sales to local wholesale and retail trade	59,000
b.	Benefit from sales for local and nonlocal processing, marketing, etc.	360,000
c.	Benefits from purchases for family living and production expenses	575,000

General welfare--

a.	Settlement opportunities	700,000
b.	Community facilities and services	122,000

Grand total $3,587,000

Actually, inasmuch as some time will be involved in project development, such benefits will not accrue immediately upon the completion of construction. In order to convert them to a comparable time basis, it has been assumed that a 5-year development period would be involved. A corresponding factor of 95.3 has been applied to the total benefit to secure an adjusted annual irrigation benefit of $3,418,000. Other sections of this report have indicated that a 10-year development period is used in order that the operation and maintenance collections during that period can be used to eliminate the deficit in operation and maintenance resulting from the first few years' operations. It is expected that the project will reach full production a very few years following construction. For that reason, so far as benefits are concerned, a factor for the 5-year development period rather than the 10-year development period recommended elsewhere in this report was used.

The Fish and Wildlife Service has estimated that the development of the project will result in annual benefits to wildlife amounting to $0.35 per acre. This benefit, multiplied by the 77,650 acres involved, results in an annual benefit to that function of $27,000. Thus the total benefit, including both irrigation and fish and wildlife, amounts to $3,445,000.

The annual costs, to use in the benefit-cost ratio, are secured by amortizing the project cost in 100 years at 2-1/2 percent and adding the annual operating costs associated with power, operation and maintenance, and replacements. The cost of transmission facilities ($744,186) is subtracted from the total project cost ($11,395,000) to secure an adjusted project cost of $10,650,814. The cost of transmission is included in the power cost considered in the annual operating costs.

Financial Analysis

The adjusted project cost of $10,650,814 amortized over 100 years at 2-1/2 percent interest results in an annual equivalent cost of $290,894. The annual replacements for the irrigation works, excluding the transmission system, amount to $107,500. The annual operation and maintenance for all items except the transmission system is estimated at $186,500. In addition to these costs of irrigation works strictly, there is the additional cost referred to above of $383,800 for power. This includes an amount for the amortization of the investment in transmission facilities. The summation of these costs results in a total annual cost of $968,694.

The comparison of the annual benefits ($3,445,000) to the annual costs ($968,694) resulted in a ratio of benefits to costs of 3.56 to 1. Therefore, even though there have been some changes in the plan and procedures, the project as now planned and under current procedures has a favorable benefit-cost ratio.

COST ALLOCATION

The official cost estimate for the Division is $11,395,000. Since it is proposed to treat the cost of transmission facilities as an annual operating cost by making appropriate adjustments in the rate, the adjusted cost becomes ($11,395,000 - $744,186) $10,650,814. This is the cost that is subject to repayment by the acreage charge and is allocated to irrigation.

In the authorization, the Congress eliminated the allocation to fish and wildlife, formerly proposed in the project planning report.

REPAYMENT

The total project cost can be paid out under terms consistent with the authorization. Under the terms of the authorization act, the allocation to irrigation is repayable in 50 years without interest. The Regional Counsel has concluded that a 10-year development period in addition to the 50 years for payoff may also be provided. The irrigation allocation will be repaid through credits that have accrued to the project, rental receipts and water users' payments.

In addition to the credits accruing to the American Falls Reservoir space assigned to the North Side Pumping Division and already discussed in the Plans and Estimates Chapter, certain other credits have also accrued and should be taken into account in connection with the total repayment of the irrigation obligation. As previously noted, the development of the North Side Pumping Division has been under consideration since 1904. Storage space in Jackson Lake Reservoir, completed in 1911, was originally allotted to lands of the Division.

When these lands remained undeveloped, the space allotted to the Division was sold to canal companies serving other lands, then irrigated in the Upper Snake River Valley. The plan was to provide space in American Falls Reservoir for the North Side Pumping Division in lieu of the space allotted to it in Jackson Lake. The sale price, established as the estimated cost of providing equivalent space in American Falls, was more than the amount needed to repay an appropriate share of the cost of Jackson Lake allotted to "new divisions" of the Minidoka Project. The surplus was $307,908. It is available as a credit to the cost of the North Side Pumping Division.

Space originally allotted to the North Side Pumping Division in the Jackson Lake and American Falls Reservoirs was leased to canal companies serving irrigated lands in the valley during many of the years before the space was sold. A total of $44,627 of the rentals collected from lessees of the Jackson Lake space has been credited to development of the Division. During some years the space originally reserved in American Falls Reservoir for the North Side Pumping Division was leased for power production purposes. Revenues received from this source, credited to the North Side Pumping Division, total $22,619.

Certain public domain lands were withdrawn from homestead entry in 1908 in connection with proposals for development of the North Side Pumping Unit. In the 44 years since that withdrawal, rentals from use of such lands for grazing purposes totaling $23,036 have accrued. These receipts are also properly creditable to development of the Division.

Other miscellaneous receipts totaling $2,640 have accumulated since 1904 to the credit of the North Side Pumping Division.

Besides the credits noted above and those taken into account in the Plans and Estimates Chapter, it is estimated that between January 1, 1952, and December 31, 1956, the space reserved for the North Side Pumping Division in the American Falls Reservoir will continue to be leased. It is estimated that the future revenues from the leasing of this space will amount to $29,746.

Sale of Jackson Lake Storage	$307,908
Water Rental from Jackson Lake	44,627
Rental of American Falls Space for Power	22,619
Rental of Grazing Lands	23,036
Estimated Future Rental of American Falls Space .	29,746
Miscellaneous	2,640
	$430,576

The subtraction of these credits ($430,576) from the adjusted project cost ($10,650,814) leaves a balance of $10,220,238. To repay this in

50 years will require an annual payment of $204,400, or $2.63 per acre for the 77,650 acres included in the project.

In addition to the construction component, the annual operating costs are estimated as follows: Operation and maintenance on the irrigation facilities $2.40; replacement reserve on the irrigation facilities, $1.38; power costs per acre, $4.94; which total $8.72.

Thus, on the basis of present estimates, annual irrigation charges amounting to $11.35 per acre are in prospect. It is proposed that this charge be uniformly applied over the entire project after the 10-year development period has been completed.

Since the North Side Pumping Division will be largely used for general farming purposes, which is characterized by relatively stable income, and since about 75 percent of the annual cost is represented by annual operating costs, it has not been considered necessary to recommend variation in the annual payments on construction to reflect changes in farmers' income.