NEBRASKA
Good Life. Great Water.
DEPT. OF NATURAL RESOURCES

Pete Ricketts, Governor

Date: January 20, 2022

RE: USBR Project Costs Estimate for the South Divide Canal Project

The United States Bureau of Reclamation (USBR) at the request of the Nebraska Natural Resources Commission (NRC) conducted an engineering study in 1982 to evaluate potential costs associated with construction of a canal system that Nebraska could develop to divert and store South Platte River water (attached). The USBR evaluation also identified multiple sites for reservoir storage with various sizes and configurations within the canal system. As noted in the USBR report, the canal extent and reservoir storage evaluated likely exceeds the necessary components of a final system design.

Given the considerations identified above the full build out of the elements contained in the USBR engineering study likely represents a **high-end estimate of costs**, in 1982 dollars. **The final design would likely require storage capacities less than those evaluated in the USBR report and an alternative canal configuration.** These modifications to the USBR evaluation would be expected to reduce the overall costs estimate associated with the project. The USBR report served as a surrogate to guide cost development for elements and components located in and benefiting the Platte River Basin using the South Divide Canal Project (aka, the Perkins County Canal) that fit today's engineering design standards and probable cost estimation procedures.

Thomas E. Riley, P.E., Director

Department of Natural Resources

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United States Department of the Interior
BUREAU OF RECLAMATION
NEBRASKA-KANSAS PROJECTS OFFICE
P.O. BOX 1607
GRAND ISLAND, NEBRASKA ~~68801~~ 68802

IN REPLY REFER TO: G-700
520.

OCT 5 1982

Mr. Dayle Williamson
Nebraska Natural Resources
  Commission
301 Centennial Mall South
P.O. Box 94876
Lincoln, NE 68509

Dear Mr. Williamson:

Enclosed is the engineering study on the South Divide Canal which your office requested by letter on December 28, 1981. Mailed under separate cover is the engineering supporting data.

The study indicates there are six potential reservoir sites. South Platte River water can be diverted and carried via a supply canal to the reservoir sites.

Two potential problem areas which require more study are: (1) ice buildup in the canal and at the diversion dam during a combination of low flows and low air temperatures; (2) water losses due to seepage in the reservoir areas.

The capacity of the six potential reservoirs is more than the water available from the water right in the South Platte River Compact. The information in the appended material was prepared in segments to permit assigning cost to any selected alternative scheme. One alternative scheme is estimated in the appended material on page 13 as an example.

If you have any questions about the study, contact Roger Andrews of my staff at (308) 381-1538.

Sincerely yours,

MARION B. THACKER

ACTING FOR Robert D. Kutz
Project Manager

Enclosures - Separate Cover

cc: Mr. Kent Miller
Manager, Twin Platte NRD
P.O. Box 1347
North Platte, NE 69101
(w/copy of enclosures)

Note: Under separate cover, we are also sending you a set of the 7-1/2 minute quad maps. The diversion dam, canals, and reservoirs are located on these maps.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SUPPORTING DATA

PURPOSE AND SCOPE

This report summarizes subappraisal-level cost estimates on dams and main supply canals to divert and store South Platte River water.

In a letter dated December 28, 1981, the Nebraska Interagency Water Coordinating Committee requested the Bureau of Reclamation's assistance in developing preliminary appraisal information, through the Technical Assistance to States Program, on the potential for diversion of South Platte River waters referred to in the South Platte River Compact. The compact identifies the project as the "Perkins County Canal" (sometimes known as the "South Divide Canal").

DESCRIPTION OF PLAN

The plan would divert water from the South Platte River near Ovid, Colorado. Supply canals would carry water to six potential damsites located in Keith County, Nebraska. See frontispiece for the location of these features.

The Ovid Diversion Damsite is located on the South Platte River about 1 mile west of the small community of Ovid, Colorado. It would divert water into the South Divide Canal, First Section.

The South Divide Canal, First Section, a 24-mile-long concrete-lined canal, would carry water east to the Keith County, Nebraska, county line and discharge into the South Divide Canal, Second Section.

The South Divide Canal, Second Section, a 32-mile-long earth canal, would carry water east following the high ridge along the southern border of Keith County. This canal would discharge directly into the Riverview West and Roscoe Draw Reservoirs and into three subcanals.

The subcanals are designed to carry water in both directions. They carry water from the South Divide Canal, Second Section, to the reservoirs for storage. The water is pumped from the reservoirs into the subcanals and carried back to the South Divide Canal, Second Section.

The Riverview No. 2 Subcanal, a 2.3-mile-long earth canal, would carry water between the Riverview No. 2 Reservoir and the South Divide Canal, Second Section.

The Riverview No. 4 Subcanal, a 3.3-mile-long canal, would carry water between the Riverview No. 4 Reservoir and the South Divide Canal, Second Section. This canal also supplies water to the Riverview East Subcanal. The first 1.5 miles of the Riverview No. 4 Subcanal capacity would be 1,000 ft^3/s.

The Riverview East Subcanal, a 0.9-mile-long earth canal, would carry water between the Riverview East Reservoir and the Riverview No. 4 Subcanal.

The Happy Hollow Subcanal, a 2.0-mile-long earth canal, would carry water between the Happy Hollow Reservoir and the South Divide Canal, Second Section.

The reservoirs are filled by gravity flow from canals except for the Riverview West high damsite. Pumping plants located at each damsite would pump water from the reservoir back to the canals.

The Riverview West Damsite is located 4 miles south and 6 miles west of Brule, Nebraska. This damsite is capable of storing water to elevation 3511 feet. To fill this reservoir to capacity, the top 16 feet would require pumping. Two cost estimates and area capacity tables were prepared for this damsite, one using maximum site capacity by pumping the top 16 feet of water into the reservoir and one using site capacity that would fill by gravity.

The Riverview No. 2 Damsite is located 4 miles south of Brule, Nebraska. Riverview East Damsite is located 5 miles south and 5 miles west of Ogallala, Nebraska. Riverview No. 4 Damsite is located 4 miles south and 4 miles west of Ogallala, Nebraska. Happy Hollow Damsite is located 2 miles south and 1 mile east of Ogallala, Nebraska.

Roscoe Draw Damsite is located 3 miles south and 1 mile east of Roscoe, Nebraska. Two cost estimates were made on this damsite, one at maximum storage capacity and one at about 50 percent of storage capacity.

The physical data for each dam, reservoir, and pumping plant is shown on table 1. Table 2 shows a comparison of the reservoir on a cost per acre-foot of conservation capacity.

DESIGN CRITERIA

The South Platte River Compact states that 500 ft^3/s of water, less 35,000 acre-feet reserved for Colorado, may be diverted when available between October 15 and April 1 of each year. There is no way to compute the actual capacities of the canals and pumping plants without knowing the location of the arable lands that would be irrigated and operation studies made on the reservoirs. Therefore, canal and pumping plant capacities were designed and cost estimates made for each canal and pumping plant at a capacity of 500 ft^3/s. The South Divide Canal, First Section, and 3 miles of the South Divide Canal, Second Section, to the Riverview West Damsite were also designated and cost estimated at 1,000 ft^3/s capacity.

A 250 ft^3/s capacity canal was designed and cost estimated from Roscoe Draw Damsite east to Lake Maloney. This canal is intended to recharge the ground water between Sutherland and Maloney Reservoirs. The first 19 miles were concrete lined as it parallels near the South Platte River.

The compact states that the canal alinement may run along or near the line of survey of the formerly proposed "Perkins County Canal" ("South Divide Canal"). About 2 miles of canal were relocated due to the construction of Colorado Interstate 76. Other canal alinements were selected

Table 1--Physical Data

	Riverview West (gravity)	Riverview West (pumped)	Riverview #2	Riverview East	Riverview #4	Happy Hollow	Roscoe Draw	Roscoe Draw Low
STORAGE DAM								
Location	T12N, R41W, S9,10	T12N, R41W, S9,10	T12N, R40W, S4,5	T13N, R39W, S31,32	T13N, R39W, S27,28	T13N, R38W, S20,21	T13N, R37W, S21,22	T13N, R37W, S21,22
Stream	---	---	---	---	---	Happy Hollow	Roscoe Draw	Roscoe Draw
Type	Zoned earth	Zoned earth	Zoned earth	Zoned earth	Zoned earth	Zoned earth	Zoned earth	Zoned earth
Height (ft)	64	80	70	72	90	70	105	90
Crest elevation (ft ab. m.s.l.)	3,504	3,520	3,470	3,450	3,410	3,350	3,300	3,275
Crest length (ft)	6,100	7,500	4,400	4,800	3,800	4,900	6,800	6,000
Volume embankment (yd^3)	1,985,902	3,366,859	1,541,860	1,608,797	1,849,300	1,360,260	5,154,176	2,727,063
Spillway capacity (ft^3/s)	15,120	15,120	4,640	10,720	11,280	8,480	34,125	34,125
River outlet capacity (ft^3/s)	900	900	685	803	770	700	2,370	1,440
RESERVOIRS								
Maximum water surface el. (m.s.l.)	3,497	3,511	3,461	3,441	3,401	3,342	3,287	3,266
Top of active conservation el. (m.s.l.)	3,495	3,510	3,460	3,440	3,399	3,340	3,286	3,265
Water surface area - top of active (acres)	646	907	391	768	669	453	4,883	2,627
Active conservation capacity (acre-feet)	13,962	25,549	8,898	18,025	14,838	9,112	149,518	72,407
Inactive and dead capacity (acre-feet)	1,292	1,292	267	992	547	530	1,688	1,688
Total reservoir capacity (acre-feet)	16,578	27,757	9,562	19,795	16,721	10,575	156,067	74,095
Surcharge capacity (acre-feet)	1,324	916	396	778	1,337	932	4,940	2,663
Stream inundation (miles)	1.6	2.0	2.1	1.95	3.30	1.7	7.2	5.5
PUMPING PLANTS								
Capacity (ft^3/s)	550	550	550	550	550	550	550	550
Inflow pump (ft^3/s)		550						
Static head (ft)	40	40	65	55	110	70	145	145
Inflow pump (ft)		16						
Discharge pipeline length (ft)	3,250	3,250	2,000	1,900	1,600	2,300	3,700	3,700
Inflow pump (ft)		32						

Table 2--

COST COMPARISON

Cost Per Acre-Foot

Name of Dam and Reservoirs	Total Cost	Active Conservation Pool	Cost Per Acre-Foot
Riverview West			
Gravity	$20,000,000	13,962 AF	$1,432
Pumped	$35,000,000	25,550 AF	$1,370
Riverview No. 2	$15,500,000	8,898 AF	$1,742
Riverview East	$17,000,000	18,025 AF	$ 943
Riverview No. 4	$19,500,000	14,838 AF	$1,314
Happy Hollow	$14,000,000	9,112 AF	$1,536
Roscoe	$50,000,000	149,518 AF	$ 334
Roscoe Low	$34,000,000	72,407 AF	$ 470

using USGS 7-1/2 minute quadrangular maps. The locations were selected so the canals could be used as a main distribution system canal and supply water to the reservoir sites.

The diversion dam and canal structures were designed for winter flows. However, there may be periods each year when a combination of low flows and low air temperatures would cause serious ice problems in the canal and at the diversion structure.

Canals were designed using standard canal sections. Concrete-lined canals were used from the diversion dam to the Keith County line to keep seepage losses at a minimum outside of the project area. Earth canals were used in the project area as seepage losses would recharge the ground water and are not as costly as concrete-lined canals. The subcanals and the last 8 miles of the South Divide Canal were designed with no slope and extra freeboard so it could carry water in both directions.

Dams and reservoirs were designed to use maximum capacity at each damsite. The storage capacity of the six reservoirs is greater than the annual available water supply as stated in the compact. As more definite plans are made for this project, the reservoir sizes may be decreased or some dams eliminated.

The dams would be zoned earth structures with soil cement slope protection on the upstream face. Figure 1 shows a sketch of the structure. The spillways and river outlet works were designed from current Bureau of Reclamation design standards.

Pumping plants were located and designed to lift water from the reservoir river outlet works to the subcanals. Required capacity was assumed at 500 ft^3/s with 10 percent added for normal wear to arrive at design capacity.

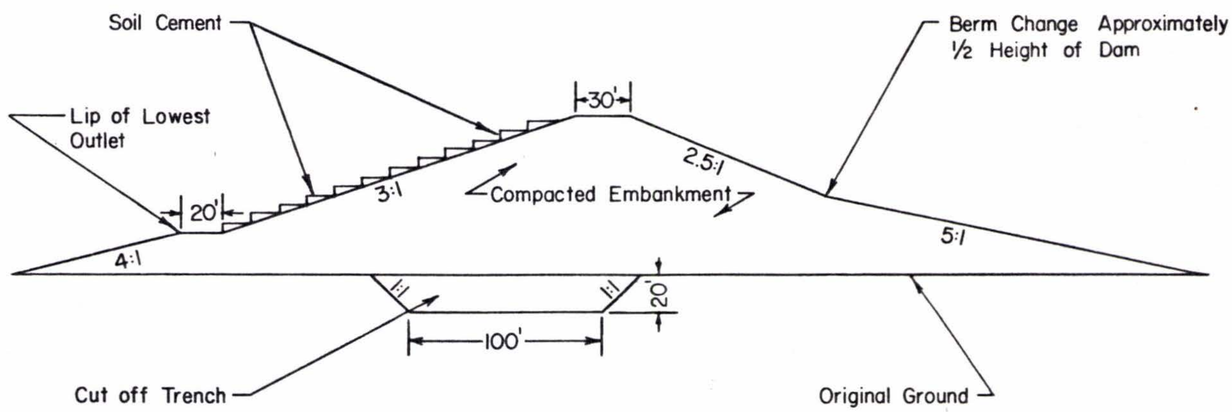
Transmission lines and substation capacities were designed to operate the pumping plants.

GEOLOGY

REGIONAL GEOLOGY

The Twin Platte Project lies in the western portion of the Great Plains region drained by the South Platte River. The project area lies on the northern reaches of an extensive tableland whose northern extent is limited by the South Platte River. The dam and reservoir sites are located in the valley wall transition zone between the flat upland tablelands and the broad South Platte Valley. This valley wall transition area consists of north-draining intermittent tributaries that lose their pronounced identity upon entering the valley floor. The drainage or valleys formed by these tributaries are broad and relatively shallow, having a maximum valley relief of 100 feet or less.

TYPICAL DAM SECTION
SOUTH DIVIDE CANAL PROJECT



SCALE 1" = 100'

Geologically, the project area is an area of Tertiary-aged Ogallala Formation continental deposits which have depositional and structural dip to the east. These poorly to moderately indurated sediments consist of silts, clays, sandstone, sand, and gravel and are thinly mantled with residual soils and loess.

The Ogallala Formation has a thickness of generally in excess of 200 feet and is underlain by the following descending sequence: Brule Formation (Oligocene), a massive pinkish-brown silt/siltstone which is generally considered to be relatively impermeable; Chadron Formation (Oligocene), a grayish-green clay which may have sand and gravel beds at its base; Pierre Shale (Cretaceous), an impervious plastic clay-shale.

Mesozoic and Paleozoic sedimentary rocks underlie the Pierre Shale. Crystalline pre-Cambrian rock occurs at an estimated depth of 5,000 feet.

The Ogallala Formation will form the foundation of all storage dam and reservoir sites and, with the exception of its thin mantle of unconsolidated deposits, is the only formation having significance in the discussion of the project. The Ogallala Formation consists of fluvial deposits of Pliocene-aged eastward-flowing streams which originated in the Rocky Mountains to the west. The final major uplift of the Rocky Mountains resulted in these streams eroding east-trending valleys into the land surface of that time, the Brule Formation. As these streams became overloaded with sediments, they overflowed these valleys and, during this tremendous aggrading cycle, formed a broad plain of shifting, coalescing flood plains. The sediment load of these streams accounted for the hundreds of feet of thickness of the Ogallala Formation. The Ogallala Formation is not divided into members of this general area, but the basal portion is considered to contain the sand and gravel which serve as a major high-yield aquifer.

Overlying the Ogallala Formation is 0-20± feet of silt, clay, and reworked sand and gravel. Silt is the primary material and is generally loessial. Colluvium in the tributary floors and residual soils make up the remainder. The thickest occurrence of these deposits are the upland tables and the valley floors. Hillsides and valley walls generally have the thinnest deposits with occasional outcroppings of the Ogallala Formation.

The Ogallala Formation consists of beds of poorly to moderately indurated silt/siltstone, sand/sandstone, and sand and gravel. The harder or more indurated zones are often lime cemented. The thickness of these beds ranges from 1 to 2 feet to in excess of 50 feet. The beds have some horizontal continuity as would be associated with channel and flood plain deposits. The general gradient of the deposits is to the east because of the structural uplift occurring to the west and the normal east-flowing gradient of the streams.

Seismology: The project lands fall within the areas defined by Algermissen and Perkins (1976) as having a 90 percent probability of not having ground shaking with a horizontal acceleration exceeding 0.04 g (gravity) in a

50-year period. This probability for maximum horizontal ground acceleration is equivalent to a source earthquake having a return period of 475 years. The area is considered to have low seismicity.

No faulting is known to have surface expression in this area of Nebraska. Undoubtedly, minor displacements occur at depths within the Mesozoic and Paleozoic sediments and possibly within the Tertiary-Oligocene deposits. Southern Keith County lies near the centerline of the broad synclinal trough of the Julesburg Basin. The Cambridge Arch, an anticlinal feature that trends northwest across west central Nebraska, is 30 miles east of the project area.

DIVERSION DAMSITE

The proposed diversion site is on the South Platte River in the Southeast Quarter of Section 6 and Northeast Quarter of Section 7, Township 11 North, Range 45 West, approximately 1 mile west (upstream) of Ovid, Colorado. The South Platte River at this location is the typical braided stream having a wide, poorly defined stream channel with a sand and gravel surface. The sand and gravel exposed in the channel floor are granitic in origin, have a high permeability as indicated by the grain sizes, and is estimated to have a depth of 30-60 feet before an impermeable bedrock unit occurs.

The permeable and noncohesive subsurface conditions indicate that sheet piling or some type of partial cutoff will be required to protect the structure against undercutting of the foundation. A second concern is the prevention of high flows from flowing around the ends of the diversion structure. Should this happen, it is conceivable that a new stream channel could be formed beyond either end of the structure.

DAMSITE AND RESERVOIR GEOLOGY

As geologic and topographic conditions are similar at the six potential storage sites and the only subsurface data available are drillers' logs of irrigation wells in the vicinity of the sites, a generalized discussion will be made on the storage sites as a group.

The damsites are located in the broad, shallow, trough-shaped valleys which have eroded into the south valley wall of the South Platte River. The streams are intermittent, flowing only in times of surface runoff.

All six damsites are located in the valley wall/upland tableland transition. Here the intermittent tributaries have eroded a series of north-flowing, broad, shallow valleys into the Ogallala Formation. The Ogallala Formation will serve as the dam's foundation at all six sites. No defined stream sections of unconsolidated Pleistocene and recent deposits are thought to exist at the sites. A thin mantling of silt (loessial and residual) mantles the abutments and valley center of the sites. The unconsolidated sediments occurring in the lower portion of the valley section may contain layers of sand and gravel due to the transporting power of the flows concentrated in the center of the valley. These deposits would undoubtedly be severed by foundation trenches included in the design of the dams.

At all sites, the Ogallala Formation has a thickness in excess of 200 feet. Approximately one-third of the material encountered by irrigation wells in the vicinity of the damsites was described as sand and gravel with the other two-thirds being units of clay. The sand and gravel beds range in thickness from a few feet to in excess of 50 feet with most being 10 to 30 feet thick. The sand and gravel occurrences are scattered throughout the portions of Ogallala Formation penetrated by the drill holes. The clay units have similar variances in thicknesses.

The foundations at all sites would appear to be adequate to support the weight of the dam or any appurtenant structures without requiring specialized treatment.

The apparent high permeability of the sand and gravel units of the Ogallala Formation does create foundation problems that would require treatment by one or a combination of treatments including blanketing upstream of the dam, slurry trenches, and positive cutoff trenches. Subsurface exploration by core holes would be required to provide data for actual design concepts to be formulated.

The apparent high permeability of the Ogallala Formation is based on several facts: (1) the abundance of high gallonage (2,000+ gpm) irrigation wells; (2) the occurrence of sand and gravel (well drillers' logs) in 1/3± of the Ogallala Formation thickness; (3) the specific capacity of the 19 irrigation wells ranging from 18 to 86 gallons per minute per foot of drawdown.

Geologic conditions of the reservoirs are expected to be similar to those of the damsite. Thin deposits of silt mantle the Ogallala Formation. Outcrops of the Ogallala Formation may be common along reservoir shorelines, and often the outcrops may be the permeable sand and gravel units. Reservoir water losses are expected to be high and possibly excessive to the point of not being able to fill a reservoir to its normal level. The normal ground-water mound which would be formed under each reservoir, coupled with the gradient associated with high permeability and extreme (100+) depth to ground water, create conditions for high reservoir losses.

CANAL GEOLOGY

A 56-mile-long canal will connect the diversion site to the reservoir storage sites. The canal will traverse stream alluvium for its first 24 miles, then gradually encroach on the valley wall and traverse the upland tableland.

The material to be encountered by the canal will be silts and silty sands within the river valley and the clays and sand and gravels of the Ogallala

Formation over most of the remainder of the alinement. The material encountered by the canal will generally have one of the two shortcomings. The silts and silty sand have no or low cohesion and could be subject to erosion by the water of the canal; and, when the canal excavation is within the permeable sands and gravels of the Ogallala Formation, it could suffer high seepage losses.

One project concept calls for extending the canal system on to Lake Maloney. Much of this canal extension would be placed within sand dune, which could be subject to erosion and canal seepage.

GROUND WATER

A regional ground water occurs under the project area and is tributary to the South Platte River except for the summer months when irrigation pumpage dewaters the upper portion of the aquifer in the South Platte Valley. The ground-water surface slopes to the east-northeast, with only minor deviations due to the South Platte River, at a gradient of about 8 feet per mile.

The ground water occurs within the Ogallala Formation under the upland tableland of which 200± feet are saturated and within the valley alluvium adjacent to the South Platte River. Depths to ground water are in excess of 100 feet under the uplands and only a few feet adjacent to the river. The USGS Water Supply Paper 848 mentions the reporting of local areas of perched ground water. Basal barriers of the perched zones are often impermeable caliche layers.

Irrigation wells are readily obtained from saturated portions of the Ogallala Formation. Small yield domestic and stock wells may utilize the perched ground-water occurrences as their water source.

The installation of the numerous irrigation wells in the project area has resulted in a dramatic lowering of the ground-water level. In some locations, this lowering is in excess of 30 feet with the decline expected to continue.

MATERIALS

Impervious

The uplands in which the dams and reservoir are located are mantled with loessial silts and residual soils of silt. No field explorations have been conducted, but sufficient quantities of the impervious no to low plasticity material should occur within or adjacent to the reservoirs.

Concrete Sand and Pervious

These materials are readily available from active quarries located along the South Platte River. The sand contains deleterious material and will required the use of low alkali Type II cement and limestone coarse aggregate.

Concrete Coarse Aggregate

This material is not available locally and will require importation. Possible sources would be the Greeley-Denver area and the limstone quarries in eastern Nebraska.

Riprap

Suitable rock for use as riprap is not available. The closest sources would be quarries in eastern Wyoming, central Colorado, southwestern South Dakota (Black Hills), and eastern Nebraska.

Soil Cement

Silt, sand, and gravel for use in soil cement embankment protection should be readily available at all dam and reservoir sites. Silts mantle the area around all sites, and it is expected that adequate deposits of sand and gravel crop out or have a minimum amount of surficial cover at all locations for the coarse fraction of the soil cement.

HYDROLOGY

The SCS method of determining design floods for the proposed reservoirs was used as recommended in the USBR publication "Design of Small Dams." This method for the large drainage area of the Roscoe Reservoir site results in overly conservative (large) floods. Therefore, the cost of the spillway may be greater than necessary. The topography obtained from 7-1/2 minute topographic maps revealed several areas of poorly defined drainage and potholes; therefore, the contributing area instead of actual area was used in the calculations for Roscoe Reservoir. The predominant soil type was taken to be the Dawes silty loam, classified as Hydrologic Soil Group C. Antecedent Moisture Condition II was used in estimates of runoff. Using the designated rainfall, triangular hydrographs were plotted to represent the runoff for each interval of the storm event. These hydrographs were then graphically added to produce a total hydrograph which reveals the peak discharge and the volume of the storm event.

In these calculations, a reduction was made from the maximum probable flood in accordance with Assumption B of the SCS method. Due to the nature of the basins which drain into each of the proposed reservoirs and the lack of development below them, the reduction in the maximum probable flood appears warranted.

Table 3 shows drainage area, design flood peak, design flood volume, maximum water surface, and maximum capacity.

Table 3--Reservoir Capacities and Hydrology

Reservoirs	Drainage Area Square Miles	Elevation of Reservoir Maximum Water Surface	Total Capacity Maximum Water Capacity Acre-Feet	Design Flood Peak ft^3/s	Design Flood Volume Acre-Feet
Riverview West (Gravity)	13.3	3495	16,577	18,900	4,494
Riverview West (Pumped)	13.3	3511	27,757	18,900	4,494
Riverview No. 2	4.0	3461	9,562	5,800	1,410
Riverview East	8.94	3441	19,795	13,400	3,160
Riverview No. 4	9.92	3401	16,722	14,100	3,510
Happy Hollow	6.77	3342	10,575	10,600	2,390
Roscoe Draw (High)	96.2*	3287	156,067	45,500	17,060
Roscoe Draw (Low)	96.2*	3266	76,758	45,500	17,060

The Ovid Diversion Damsite southwest of Ovid, Colorado, is capable of supplying water to the six reservoir sites. The top 16 feet ± of Riverview West Reservoir may have to be pumped to use the total capacity.

If only Roscoe Draw Reservoir site was used, a diversion damsite 2-1/2 miles west of Brule, Nebraska, could be used, therefore greatly reducing the miles of canals required.

*Only the contributing area of 63.0 square miles was used in calculations of inflow design flood.

The calculations for these studies are included in the Hydrology Supporting Data.

COST ESTIMATES

Cost estimates are subappraisal level which reflect a high level of uncertainty. Three of the areas of uncertainty are the foundation geology for major structures, the availability of construction materials for earth embankments, and the water-holding ability of the reservoir sites.

The cost estimates are based on January 1982 price levels. The project cost includes indirect costs ranging from 13 to 40 percent. Operation, maintenance, replacement, and pumping energy costs were not estimated for this study. A detailed account of how the construction costs were arrived at is included in the Engineering Supporting Data.

Table 4, Construction Cost Estimates, shows the estimated cost for all features investigated in the study.

ALTERNATIVE SCHEME

One alternative scheme that could be used to divert and store South Platte River water is the Riverview West Dam and Reservoir (gravity) and Roscoe Low Dam and Reservoir.

This alternative would include the South Divide Canal, First and Second Sections; diversion dam located near Ovid, Colorado; Riverview West Dam and Reservoir (gravity); and, Roscoe Low Dam and Reservoir.

Riverview West Dam and Reservoir (gravity) have an active storage capacity of 13,962 acre-feet. Roscoe Low Dam and Reservoir have an active storage capacity of 72,407 acre-feet.

Total cost of this alternative scheme without a distribution system is $115,000,000 (see table 5 for cost of alternative scheme).

7-1452 (5-72)
Bureau of Reclamation
Formerly Basic Estimate DC-1

INSTRUCTIONS FOR USE OF THIS FORM ARE CONTAINED IN CHAPTER 6, PART 152 OF THE RECLAMATION INSTRUCTIONS

TABLE 4

CONSTRUCTION COST ESTIMATE

OFFICE PREPARED BY:

PROJECT Twin Platte
Date of Estimate January 1982
Prices as of January 1982

Sheet of

PROPERTY CLASS	IDENTIFIED PROPERTY	PLANT ACCOUNT	PAY ITEM	DESCRIPTION	QUANTITY	UNIT	LABOR AND MATERIALS BY CONTRACTOR Unit Price	LABOR AND MATERIALS BY CONTRACTOR Amount	LABOR AND MATERIALS BY GOVERNMENT Unit Price	LABOR AND MATERIALS BY GOVERNMENT Amount	FIELD COST Plant Account	TOTAL FIELD COST Identified Property	OTHER COSTS Identified Property	TOTAL COST Identified Property
1				2	3		4		5		6	7	8	9
				DAMS AND RESERVOIRS										
				Ovid Diversion Dam 1,000 cfs capacity				4,700,000				4,700,000	1,200,000	5,900,000
				Ovid Diversion Dam 500 cfs capacity				4,300,000				4,300,000	1,100,000	5,400,000
				Riverview West (gravity)				16,000,000				16,000,000	4,000,000	20,000,000
				Riverview West (pumped)				28,000,000				28,000,000	7,000,000	35,000,000
				Riverview #2				12,500,000				12,500,000	3,000,000	15,500,000
				Riverview East				13,500,000				13,500,000	3,500,000	17,000,000
				Riverview #4				15,500,000				15,500,000	4,000,000	19,500,000
				Happy Hollow				11,000,000				11,000,000	3,000,000	14,000,000
				Roscoe Draw (High)				40,000,000				40,000,000	10,000,000	50,000,000
				Roscoe Draw (Low)				27,000,000				27,000,000	7,000,000	34,000,000
				PUMPING PLANTS										
				Riverview West, 550 cfs, static head 40 ft, TDH 50 ft				8,600,000				8,600,000	3,400,000	12,000,000
				Riverview #2, 550 cfs, static head 65 ft, TDH 75 ft				9,300,000				9,300,000	3,700,000	13,000,000
				Riverview East, 550 cfs, static head 55 ft, TDH 65 ft				8,800,000				8,800,000	3,700,000	12,500,000
				Riverview #4, 550 cfs, static head 110 ft, TDH 125 ft				11,500,000				11,500,000	4,500,000	16,000,000
				Happy Hollow, 550 cfs, static head 70 ft, TDH 100 ft				9,900,000				9,900,000	4,100,000	14,000,000
				Roscoe Draw, 550 cfs, static head 145 ft, TDH 175 ft				14,500,000				14,500,000	5,500,000	20,000,000
				CANALS										
				South Divide, 1st Section, 500 Q, concrete lined, 24.0 mi				18,000,000				18,000,000	7,000,000	25,000,000
				South Divide, 1st Section, 1,000 Q, concrete lined, 24.0 mi				24,000,000				24,000,000	10,000,000	34,000,000
				South Divide, 2nd Section, 500 Q, earth, 32.0 mi				21,000,000				21,000,000	8,000,000	29,000,000
				South Divide, 2nd Section, 1,000 Q, earth, 3.0 mi				3,100,000				3,100,000	1,200,000	4,300,000
				Riverview #2 Subcanal, 500 Q, earth, 2.3 mi				1,650,000				1,650,000	650,000	2,300,000
				Riverview East Subcanal, 500 Q, earth, .9 mi				1,000,000				1,000,000	400,000	1,400,000
				Riverview #4 Subcanal, 500 Q, earth, 3.3 mi				2,800,000				2,800,000	1,100,000	3,900,000
				Happy Hollow Subcanal, 500 Q, earth, 2.0 mi				1,750,000				1,750,000	650,000	2,400,000
				Roscoe, 250 Q, 18.9 mi concrete lined - 31.8 mi earth				9,500,000				9,500,000	4,000,000	13,500,000
				TRANSMISSION LINES AND SUBSTATIONS										
				34.5 kV, 12.0 miles, 6 substations				5,700,000				5,700,000	2,000,000	7,700,000
				GENERAL PROPERTY										
				O&M headquarters and equipment				1,435,000				1,435,000	365,000	1,800,000
				Office, shop, and garage				865,000				865,000	235,000	1,100,000

Table 5--

ALTERNATIVE SCHEME COST

Riverview West Dam and Reservoir (gravity)	$ 20,000,000
Roscoe Low Dam and Reservoir	34,000,000
Diversion dam	5,400,000
South Divide Canal, First Section 24.0 miles, concrete lined	25,000,000
South Divide Canal, Second Section 32.0 miles, earth canal	29,000,000
TOTAL COST	$113,400,000
ROUNDED	$115,000,000

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PERKINS COUNTY CANAL
FUTURE CONDITION WATER SUPPLY STUDY - SOUTH PLATTE NEAR JULESBURG

DIVERTIBLE FLOW WITH 1000 CFS CANAL (KAF/MO) CURVE B

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1941	6.3	10.7	5.6	0.0	0.0	0.0	0.0	0.0	0.0	3.4	13.2	13.6	52.8
1942	14.9	14.6	15.9	0.0	0.0	0.0	0.0	0.0	0.0	10.4	23.2	18.6	97.5
1943	27.3	32.6	34.1	0.0	0.0	0.0	0.0	0.0	0.0	2.6	6.1	12.8	115.5
1944	15.7	16.2	17.4	0.0	0.0	0.0	0.0	0.0	0.0	2.2	10.2	19.5	81.2
1945	19.9	18.6	15.6	0.0	0.0	0.0	0.0	0.0	0.0	11.5	21.1	7.0	93.6
1946	27.8	27.4	16.8	0.0	0.0	0.0	0.0	0.0	0.0	3.4	15.5	18.6	109.5
1947	13.1	15.4	.7	0.0	0.0	0.0	0.0	0.0	0.0	5.3	26.4	25.7	86.5
1948	18.9	23.9	26.6	0.0	0.0	0.0	0.0	0.0	0.0	3.8	19.2	19.4	111.8
1949	4.2	28.4	26.0	0.0	0.0	0.0	0.0	0.0	0.0	10.3	23.6	20.1	112.6
1950	20.7	21.3	20.8	0.0	0.0	0.0	0.0	0.0	0.0	3.9	17.4	19.5	103.6
1951	17.9	16.5	12.3	0.0	0.0	0.0	0.0	0.0	0.0	9.9	20.9	20.5	98.0
1952	24.3	14.4	27.1	0.0	0.0	0.0	0.0	0.0	0.0	3.4	12.2	17.5	98.8
1953	21.2	15.0	19.1	0.0	0.0	0.0	0.0	0.0	0.0	2.0	11.6	18.1	86.9
1954	16.7	13.5	14.2	0.0	0.0	0.0	0.0	0.0	0.0	.9	2.0	5.7	53.0
1955	5.9	11.1	13.2	0.0	0.0	0.0	0.0	0.0	0.0	.5	4.3	6.3	41.3
1956	7.2	10.3	7.7	0.0	0.0	0.0	0.0	0.0	0.0	1.0	4.5	4.1	34.8
1957	1.1	6.4	3.4	0.0	0.0	0.0	0.0	0.0	0.0	6.5	19.7	17.5	54.6
1958	18.7	17.9	17.5	0.0	0.0	0.0	0.0	0.0	0.0	5.3	17.9	18.8	96.1
1959	15.9	15.7	11.1	0.0	0.0	0.0	0.0	0.0	0.0	3.8	11.1	16.0	73.6
1960	12.7	15.4	13.6	0.0	0.0	0.0	0.0	0.0	0.0	2.0	5.4	12.4	61.5
1961	14.2	12.5	12.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	19.6	24.3	84.6
1962	25.7	14.8	20.2	0.0	0.0	0.0	0.0	0.0	0.0	9.2	19.7	16.8	106.4
1963	12.9	16.6	22.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	12.4	12.8	81.7
1964	15.2	14.3	11.5	0.0	0.0	0.0	0.0	0.0	0.0	.8	2.9	4.3	49.0
1965	5.3	8.2	6.5	0.0	0.0	0.0	0.0	0.0	0.0	7.5	16.2	27.7	71.4
1966	10.5	18.4	28.7	0.0	0.0	0.0	0.0	0.0	0.0	3.2	10.9	13.8	85.5
1967	14.2	12.2	5.5	0.0	0.0	0.0	0.0	0.0	0.0	3.0	10.0	14.0	58.9
1968	17.7	17.9	7.3	0.0	0.0	0.0	0.0	0.0	0.0	3.4	11.3	14.0	71.6
1969	17.0	14.2	13.6	0.0	0.0	0.0	0.0	0.0	0.0	4.2	4.4	13.2	66.6
1970	30.8	22.0	12.6	0.0	0.0	0.0	0.0	0.0	0.0	8.8	9.7	10.7	94.7
1971	1.9	17.4	11.8	0.0	0.0	0.0	0.0	0.0	0.0	3.1	18.5	11.7	64.3
1972	0.0	12.2	6.8	0.0	0.0	0.0	0.0	0.0	0.0	2.6	8.4	4.9	34.9
1973	4.2	14.2	12.4	0.0	0.0	0.0	0.0	0.0	0.0	11.5	21.8	12.6	76.7
1974	27.6	27.6	15.1	0.0	0.0	0.0	0.0	0.0	0.0	3.0	5.5	10.0	88.8
1975	10.2	13.1	8.1	0.0	0.0	0.0	0.0	0.0	0.0	3.5	9.9	12.5	57.3
1976	13.9	17.4	9.4	0.0	0.0	0.0	0.0	0.0	0.0	2.3	3.8	4.0	50.8
1977	4.0	11.1	12.3	0.0	0.0	0.0	0.0	0.0	0.0	2.4	4.8	6.1	40.7
AVERAGE	14.5	16.5	14.5	0.0	0.0	0.0	0.0	0.0	0.0	4.5	12.8	14.2	76.9

STUDY NO. 1

PERKINS COUNTY CANAL
FUTURE CONDITION WATER SUPPLY STUDY - SOUTH PLATTE NEAR JULESBURG

82/07/09.

DIVERTIBLE FLOW WITH 500 CFS CANAL (KAF/MO) CURVE B

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1941	6.3	10.7	5.6	0.0	0.0	0.0	0.0	0.0	0.0	3.4	13.2	13.6	52.8
1942	14.9	14.2	15.5	0.0	0.0	0.0	0.0	0.0	0.0	9.3	19.8	17.3	91.0
1943	22.2	24.6	26.1	0.0	0.0	0.0	0.0	0.0	0.0	2.6	6.1	12.8	94.3
1944	15.4	15.4	16.5	0.0	0.0	0.0	0.0	0.0	0.0	2.2	10.2	17.8	77.5
1945	18.1	16.7	15.3	0.0	0.0	0.0	0.0	0.0	0.0	9.9	18.6	7.0	85.6
1946	22.4	21.5	16.1	0.0	0.0	0.0	0.0	0.0	0.0	3.4	15.1	17.3	95.8
1947	13.1	14.7	.7	0.0	0.0	0.0	0.0	0.0	0.0	5.3	21.5	21.4	76.7
1948	17.5	19.9	21.8	0.0	0.0	0.0	0.0	0.0	0.0	3.8	17.5	17.8	98.2
1949	4.2	22.1	21.5	0.0	0.0	0.0	0.0	0.0	0.0	9.2	20.0	18.2	95.2
1950	18.6	18.3	18.8	0.0	0.0	0.0	0.0	0.0	0.0	3.9	16.3	17.6	93.5
1951	16.8	15.4	12.3	0.0	0.0	0.0	0.0	0.0	0.0	9.0	18.5	18.4	90.4
1952	20.6	14.2	22.1	0.0	0.0	0.0	0.0	0.0	0.0	3.4	12.2	16.6	89.0
1953	18.9	14.5	17.6	0.0	0.0	0.0	0.0	0.0	0.0	2.0	11.6	17.0	81.5
1954	16.1	13.5	14.2	0.0	0.0	0.0	0.0	0.0	0.0	.9	2.0	5.7	52.4
1955	5.9	11.1	13.2	0.0	0.0	0.0	0.0	0.0	0.0	.5	4.3	6.3	41.3
1956	7.2	10.3	7.7	0.0	0.0	0.0	0.0	0.0	0.0	1.0	4.5	4.1	34.8
1957	1.1	6.4	3.4	0.0	0.0	0.0	0.0	0.0	0.0	6.5	17.8	16.6	51.8
1958	17.3	16.3	16.6	0.0	0.0	0.0	0.0	0.0	0.0	5.3	16.7	17.4	89.6
1959	15.5	14.9	11.1	0.0	0.0	0.0	0.0	0.0	0.0	3.8	11.1	15.6	72.0
1960	12.7	14.9	13.6	0.0	0.0	0.0	0.0	0.0	0.0	2.0	5.4	12.4	61.0
1961	14.2	12.5	12.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	17.7	20.6	79.0
1962	21.4	14.3	18.3	0.0	0.0	0.0	0.0	0.0	0.0	8.6	17.8	16.1	96.4
1963	12.9	15.5	19.3	0.0	0.0	0.0	0.0	0.0	0.0	5.0	12.4	12.8	77.9
1964	15.1	14.1	11.5	0.0	0.0	0.0	0.0	0.0	0.0	.8	2.9	4.3	48.7
1965	5.3	8.2	6.5	0.0	0.0	0.0	0.0	0.0	0.0	7.5	15.6	22.4	65.5
1966	10.5	16.6	22.9	0.0	0.0	0.0	0.0	0.0	0.0	3.2	10.9	13.8	77.9
1967	14.2	12.2	5.5	0.0	0.0	0.0	0.0	0.0	0.0	3.0	10.0	14.0	58.9
1968	16.7	16.5	7.3	0.0	0.0	0.0	0.0	0.0	0.0	3.4	11.3	14.0	69.2
1969	16.3	13.9	13.6	0.0	0.0	0.0	0.0	0.0	0.0	4.2	4.4	13.2	65.6
1970	24.1	18.7	12.8	0.0	0.0	0.0	0.0	0.0	0.0	8.3	9.7	10.7	84.3
1971	1.9	16.0	11.8	0.0	0.0	0.0	0.0	0.0	0.0	3.1	17.0	11.7	61.5
1972	0.0	12.2	6.8	0.0	0.0	0.0	0.0	0.0	0.0	2.6	8.4	4.9	34.9
1973	4.2	13.9	12.4	0.0	0.0	0.0	0.0	0.0	0.0	10.0	19.0	12.6	72.1
1974	22.3	21.6	15.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	5.5	10.0	77.4
1975	10.2	13.1	8.1	0.0	0.0	0.0	0.0	0.0	0.0	3.5	9.9	12.5	57.3
1976	13.9	16.2	9.4	0.0	0.0	0.0	0.0	0.0	0.0	2.3	3.8	4.0	49.6
1977	4.0	11.1	12.3	0.0	0.0	0.0	0.0	0.0	0.0	2.4	4.8	6.1	40.7
AVERAGE	13.3	15.0	13.4	0.0	0.0	0.0	0.0	0.0	0.0	4.3	12.0	13.4	71.4

STUDY NO. 1

PERKINS COUNTY CANAL
FUTURE CONDITION WATER SUPPLY STUDY - SOUTH PLATTE NEAR JULESBURG

82/07/09.

TOTAL FUTURE CONDITION FLOW (KAF/MO)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1941	6.3	10.7	5.6	4.8	2.7	7.6	2.2	2.3	1.3	6.7	13.2	13.6	77.0
1942	14.9	14.6	15.9	0.0	42.3	5.3	25.3	2.6	5.1	20.7	23.2	18.6	188.5
1943	27.3	35.6	30.4	16.5	4.1	12.6	3.5	1.2	1.3	5.1	6.1	12.8	162.9
1944	15.7	16.2	17.4	10.1	11.2	5.0	10.7	1.9	1.8	4.3	10.2	19.5	124.0
1945	19.9	18.6	15.6	10.6	3.2	15.9	2.9	9.2	4.7	22.9	21.1	7.0	151.8
1946	27.8	27.6	16.8	6.0	3.9	1.6	1.1	1.4	5.6	6.8	15.5	18.6	135.1
1947	13.1	15.4	.7	11.1	.6	0.0	64.8	4.0	8.3	10.5	26.4	25.7	180.6
1948	18.9	23.9	26.6	6.4	1.7	7.0	10.0	2.5	2.2	7.5	19.2	19.4	145.3
1949	4.2	29.2	26.0	19.0	7.3	10.5	17.2	6.1	12.2	20.5	23.6	20.1	195.9
1950	20.7	21.3	20.6	10.6	3.9	2.2	3.4	7.1	7.1	7.8	17.4	19.5	142.0
1951	17.9	16.5	12.3	6.2	9.0	16.6	6.0	1.1	10.5	19.6	20.9	20.5	161.3
1952	24.3	14.4	27.1	20.1	5.1	13.4	2.5	2.2	3.5	6.7	12.2	17.5	149.0
1953	21.2	15.0	19.1	13.6	7.1	2.7	2.6	2.2	1.6	3.9	11.6	16.1	118.9
1954	16.7	13.5	14.2	5.3	3.4	1.4	.9	.7	1.2	1.8	2.0	5.7	66.8
1955	5.9	11.1	13.2	4.5	3.9	5.6	1.3	1.1	1.0	1.0	4.3	6.3	59.2
1956	7.2	10.3	7.7	2.4	1.8	2.9	1.3	.6	.9	1.9	4.5	4.1	45.6
1957	1.1	6.4	3.4	11.2	12.9	17.9	1.5	2.1	1.0	13.0	19.7	17.5	107.7
1958	16.7	17.9	17.5	11.4	0.0	15.4	13.5	1.4	1.1	10.6	17.9	18.8	144.2
1959	15.9	15.7	11.1	6.9	5.1	10.1	1.5	1.2	1.2	7.5	11.1	16.0	103.3
1960	12.7	15.4	13.6	8.7	5.3	10.5	2.2	.9	.8	4.0	5.4	12.4	91.9
1961	14.2	12.5	12.0	11.0	0.0	4.4	7.9	4.8	.3	4.0	19.6	24.3	115.0
1962	25.7	14.6	20.2	7.7	6.8	22.3	6.9	10.0	4.1	18.3	19.7	16.8	173.3
1963	12.9	16.6	22.0	7.3	2.7	2.7	2.0	1.5	1.9	10.0	12.4	12.8	104.8
1964	15.2	14.3	11.5	7.9	3.6	3.0	2.6	.9	.6	1.5	2.9	4.3	68.3
1965	5.3	6.2	6.5	2.9	2.6	62.2	2.0	2.8	4.4	14.9	16.2	27.7	155.9
1966	10.5	18.4	20.7	12.9	3.5	6.4	4.4	2.7	4.4	6.4	10.9	13.8	123.0
1967	14.2	12.2	5.5	2.2	2.1	31.7	18.1	2.4	2.0	6.0	10.0	14.0	120.4
1968	17.7	17.9	7.3	6.1	5.8	5.8	1.8	50.3	8.3	6.8	11.3	14.0	155.1
1969	17.0	14.2	13.6	4.9	4.4	15.9	27.5	2.5	2.2	8.4	4.4	13.2	128.2
1970	31.4	22.0	12.6	25.5	5.4	0.0	14.8	3.1	2.3	17.5	9.7	10.7	155.2
1971	1.9	17.4	11.6	0.0	2.4	10.7	4.1	1.3	.6	6.1	18.5	11.7	86.5
1972	0.0	12.2	6.6	4.6	5.9	5.5	2.0	2.4	7.6	5.1	8.4	4.9	65.6
1973	4.2	14.2	12.4	15.9	36.5	40.0	6.2	7.3	3.0	23.0	21.8	12.6	197.1
1974	27.6	26.0	15.1	10.1	6.3	5.4	1.7	1.7	2.6	6.0	5.5	10.0	120.0
1975	10.2	13.1	8.1	16.1	5.5	9.5	4.8	4.8	5.7	6.9	9.9	12.5	107.1
1976	13.9	17.4	9.4	7.1	5.7	3.0	1.4	1.1	2.3	4.6	3.8	4.0	73.7
1977	4.0	11.1	12.3	15.0	9.0	7.9	2.4	3.3	2.8	4.8	4.8	6.1	83.5
AVERAGE	14.5	16.6	14.5	9.4	6.6	10.6	7.8	4.2	3.4	9.0	12.8	14.2	123.9

INITIAL VALUES AND CONSTANTS

PERKINS COUNTY CANAL DIVERSION SCHEDULE

1.000	1.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	.500	1.000	1.000

STUDY NO. 1 | PERKINS COUNTY CANAL | 82/07/09.

HISTORIC CONDITION WATER SUPPLY STUDY - SOUTH PLATTE NEAR JULESBURG

DIVERTIBLE FLOW WITH 1000 CFS CANAL (KAF/MO) CURVE B

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1941	6.4	10.8	6.6	0.0	0.0	0.0	0.0	0.0	0.0	4.3	14.9	16.3	59.3
1942	17.6	17.2	56.3	0.0	0.0	0.0	0.0	0.0	0.0	13.3	24.9	39.1	168.4
1943	49.1	38.0	45.6	0.0	0.0	0.0	0.0	0.0	0.0	2.7	6.2	13.0	154.6
1944	16.9	20.7	19.2	0.0	0.0	0.0	0.0	0.0	0.0	2.5	12.4	21.3	92.9
1945	21.9	19.6	17.1	0.0	0.0	0.0	0.0	0.0	0.0	14.3	24.1	33.6	130.6
1946	47.3	36.9	32.6	0.0	0.0	0.0	0.0	0.0	0.0	3.6	17.5	19.8	157.7
1947	19.3	20.5	29.2	0.0	0.0	0.0	0.0	0.0	0.0	9.6	30.9	32.5	142.0
1948	32.3	50.3	60.7	0.0	0.0	0.0	0.0	0.0	0.0	3.9	19.4	20.5	187.1
1949	26.6	39.2	28.3	0.0	0.0	0.0	0.0	0.0	0.0	11.6	24.1	20.5	150.3
1950	21.6	26.4	33.9	0.0	0.0	0.0	0.0	0.0	0.0	4.6	18.5	20.5	125.5
1951	19.7	17.0	13.3	0.0	0.0	0.0	0.0	0.0	0.0	10.8	22.5	21.5	104.8
1952	27.9	30.9	40.8	0.0	0.0	0.0	0.0	0.0	0.0	3.5	12.6	16.9	134.6
1953	23.5	17.6	20.1	0.0	0.0	0.0	0.0	0.0	0.0	3.0	12.5	19.1	95.9
1954	17.8	14.3	15.2	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.5	6.2	58.2
1955	6.5	12.1	14.4	0.0	0.0	0.0	0.0	0.0	0.0	1.5	5.9	7.0	47.4
1956	8.0	11.2	8.5	0.0	0.0	0.0	0.0	0.0	0.0	1.0	11.0	6.6	46.3
1957	5.6	7.3	4.2	0.0	0.0	0.0	0.0	0.0	0.0	6.0	22.4	29.3	76.8
1958	45.4	36.8	41.2	0.0	0.0	0.0	0.0	0.0	0.0	6.2	18.9	20.1	168.6
1959	17.2	17.2	26.9	0.0	0.0	0.0	0.0	0.0	0.0	4.6	11.4	17.3	94.6
1960	16.5	23.2	40.8	0.0	0.0	0.0	0.0	0.0	0.0	2.2	5.6	12.6	100.9
1961	14.6	13.1	13.9	0.0	0.0	0.0	0.0	0.0	0.0	26.7	54.9	54.3	177.5
1962	53.5	52.4	53.9	0.0	0.0	0.0	0.0	0.0	0.0	10.5	20.6	19.0	209.9
1963	17.5	31.5	39.7	0.0	0.0	0.0	0.0	0.0	0.0	6.2	12.6	13.3	120.8
1964	15.4	14.5	11.9	0.0	0.0	0.0	0.0	0.0	0.0	.8	2.9	4.6	50.1
1965	5.5	8.7	7.3	0.0	0.0	0.0	0.0	0.0	0.0	25.9	45.6	45.9	138.9
1966	40.5	43.8	35.3	0.0	0.0	0.0	0.0	0.0	0.0	4.3	11.2	14.1	149.2
1967	14.5	12.7	8.1	0.0	0.0	0.0	0.0	0.0	0.0	3.2	10.4	16.2	65.1
1968	23.6	18.6	20.7	0.0	0.0	0.0	0.0	0.0	0.0	4.2	12.0	14.8	93.9
1969	18.0	14.8	15.2	0.0	0.0	0.0	0.0	0.0	0.0	5.2	39.7	47.6	140.5
1970	58.9	47.6	35.1	0.0	0.0	0.0	0.0	0.0	0.0	13.1	32.5	35.1	222.3
1971	40.1	44.2	44.6	0.0	0.0	0.0	0.0	0.0	0.0	10.7	25.0	26.1	190.9
1972	24.4	33.8	27.4	0.0	0.0	0.0	0.0	0.0	0.0	3.0	9.6	19.8	118.0
1973	36.9	42.0	44.3	0.0	0.0	0.0	0.0	0.0	0.0	28.3	45.2	36.3	233.0
1974	53.6	45.3	48.1	0.0	0.0	0.0	0.0	0.0	0.0	4.1	7.9	19.3	178.3
1975	28.9	29.6	15.1	0.0	0.0	0.0	0.0	0.0	0.0	4.2	11.8	26.6	116.4
1976	33.5	25.9	30.5	0.0	0.0	0.0	0.0	0.0	0.0	2.3	3.8	7.4	103.4
1977	9.9	12.8	25.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	5.1	6.4	62.2
1978	7.9	10.1	11.6	0.0	0.0	0.0	0.0	0.0	0.0	2.7	5.0	6.3	43.8
1979	9.5	28.6	14.9	0.0	0.0	0.0	0.0	0.0	0.0	8.5	30.9	42.3	134.7
1980	51.0	56.3	57.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	164.6
AVERAGE	25.1	26.4	27.9	0.0	0.0	0.0	0.0	0.0	0.0	7.0	17.6	21.3	125.2

STUDY NO. 1

PERKINS COUNTY CANAL
HISTORIC CONDITION WATER SUPPLY STUDY - SOUTH PLATTE NEAR JULESBURG

82/07/09.

DIVERTIBLE FLOW WITH 500 CFS CANAL (KAF/MO) CURVE B

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1941	6.4	10.8	6.6	0.0	0.0	0.0	0.0	0.0	0.0	4.3	14.7	15.8	58.6
1942	16.6	15.9	30.7	0.0	0.0	0.0	0.0	0.0	0.0	10.9	20.7	28.7	123.5
1943	30.7	26.9	30.6	0.0	0.0	0.0	0.0	0.0	0.0	2.7	6.2	13.0	110.1
1944	16.2	18.2	17.7	0.0	0.0	0.0	0.0	0.0	0.0	2.5	12.4	18.9	85.8
1945	19.3	17.3	16.3	0.0	0.0	0.0	0.0	0.0	0.0	11.4	20.3	25.8	110.4
1946	30.7	26.5	25.3	0.0	0.0	0.0	0.0	0.0	0.0	3.6	16.4	18.0	120.5
1947	17.7	17.8	23.1	0.0	0.0	0.0	0.0	0.0	0.0	8.9	24.0	25.2	116.7
1948	25.1	28.8	30.7	0.0	0.0	0.0	0.0	0.0	0.0	3.9	17.6	18.4	124.5
1949	21.8	27.2	22.7	0.0	0.0	0.0	0.0	0.0	0.0	10.0	20.3	18.4	120.4
1950	19.1	20.9	26.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	17.0	18.4	106.0
1951	17.5	16.2	13.3	0.0	0.0	0.0	0.0	0.0	0.0	9.6	19.4	19.0	95.0
1952	22.5	23.9	29.4	0.0	0.0	0.0	0.0	0.0	0.0	3.5	12.6	17.5	109.4
1953	20.2	16.2	18.2	0.0	0.0	0.0	0.0	0.0	0.0	3.0	12.5	17.6	87.6
1954	16.8	14.0	15.1	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.5	6.2	56.8
1955	6.5	12.1	14.4	0.0	0.0	0.0	0.0	0.0	0.0	1.5	5.9	7.0	47.4
1956	8.0	11.2	8.5	0.0	0.0	0.0	0.0	0.0	0.0	1.0	11.0	6.6	46.3
1957	5.6	7.3	4.2	0.0	0.0	0.0	0.0	0.0	0.0	7.8	19.3	23.2	67.4
1958	30.6	28.5	29.5	0.0	0.0	0.0	0.0	0.0	0.0	6.2	17.3	16.2	128.3
1959	16.4	15.9	22.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	11.4	16.5	86.8
1960	15.9	19.5	29.4	0.0	0.0	0.0	0.0	0.0	0.0	2.2	5.6	12.6	85.1
1961	14.6	13.1	13.9	0.0	0.0	0.0	0.0	0.0	0.0	15.4	29.8	30.7	117.5
1962	30.7	27.8	30.7	0.0	0.0	0.0	0.0	0.0	0.0	9.4	18.3	17.5	134.4
1963	16.6	24.0	28.9	0.0	0.0	0.0	0.0	0.0	0.0	6.2	12.6	13.3	101.6
1964	15.2	14.3	11.9	0.0	0.0	0.0	0.0	0.0	0.0	.8	2.9	4.6	49.7
1965	5.5	8.7	7.3	0.0	0.0	0.0	0.0	0.0	0.0	15.4	29.7	30.6	97.1
1966	29.2	27.8	26.8	0.0	0.0	0.0	0.0	0.0	0.0	4.3	11.2	14.1	113.4
1967	14.5	12.7	8.1	0.0	0.0	0.0	0.0	0.0	0.0	3.2	10.4	15.7	64.6
1968	20.2	18.9	16.6	0.0	0.0	0.0	0.0	0.0	0.0	4.2	12.0	14.8	86.7
1969	16.9	14.3	15.1	0.0	0.0	0.0	0.0	0.0	0.0	5.2	28.5	30.7	110.7
1970	30.7	27.8	26.7	0.0	0.0	0.0	0.0	0.0	0.0	10.8	25.0	26.7	147.7
1971	29.1	27.8	30.5	0.0	0.0	0.0	0.0	0.0	0.0	9.5	20.7	21.6	139.2
1972	20.7	25.5	22.2	0.0	0.0	0.0	0.0	0.0	0.0	3.0	9.6	18.0	99.0
1973	27.7	27.7	30.4	0.0	0.0	0.0	0.0	0.0	0.0	15.4	29.7	27.4	158.3
1974	30.7	27.8	30.7	0.0	0.0	0.0	0.0	0.0	0.0	4.1	7.9	17.7	118.9
1975	23.0	23.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2	11.8	21.8	98.8
1976	25.8	20.9	23.9	0.0	0.0	0.0	0.0	0.0	0.0	2.3	3.8	7.4	84.1
1977	9.9	12.8	21.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	5.1	6.4	58.2
1978	7.9	10.1	11.8	0.0	0.0	0.0	0.0	0.0	0.0	2.7	5.0	6.3	43.8
1979	9.5	22.3	14.9	0.0	0.0	0.0	0.0	0.0	0.0	8.1	24.1	29.9	108.8
1980	30.7	28.8	30.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	90.2
AVERAGE	19.3	19.7	20.8	0.0	0.0	0.0	0.0	0.0	0.0	5.7	14.7	17.5	97.7

STUDY NO. 1

82/07/09.

PERKINS COUNTY CANAL
HISTORIC CONDITION WATER SUPPLY STUDY - SOUTH PLATTE NEAR JULESBURG

TOTAL HISTORIC FLOW (KAF/MO)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1941	6.4	10.8	6.6	6.1	2.8	9.5	4.0	4.1	3.0	8.5	14.9	16.3	93.0
1942	17.6	17.2	85.4	145.2	505.4	232.2	37.6	2.9	9.3	26.5	24.9	44.8	1149.0
1943	64.7	45.3	57.0	28.3	30.9	51.7	3.6	1.3	1.4	5.3	6.2	13.0	308.7
1944	16.9	20.7	19.2	27.7	107.9	5.6	12.4	2.8	2.2	4.9	12.4	21.3	254.0
1945	21.9	19.6	17.1	12.4	6.2	33.3	6.6	44.9	6.2	26.6	24.1	35.6	256.5
1946	60.6	43.2	34.2	15.9	4.7	3.3	1.3	1.4	5.9	7.2	17.5	19.8	215.0
1947	19.3	20.5	29.2	21.2	10.4	249.6	143.4	6.4	8.4	19.2	32.0	34.0	593.6
1948	33.6	72.1	106.6	51.1	17.7	23.5	11.9	2.5	2.4	7.7	19.4	20.5	371.0
1949	26.6	47.5	20.3	21.6	14.9	397.6	41.0	6.5	17.0	23.1	24.1	20.5	668.7
1950	21.6	26.4	30.1	17.6	4.4	2.5	3.5	7.7	8.1	9.2	18.5	20.5	176.3
1951	12.9	17.6	13.3	6.5	10.1	18.1	10.2	23.0	25.4	21.6	22.5	21.5	210.9
1952	27.9	32.5	47.6	39.0	64.2	50.9	3.4	2.6	3.6	6.9	12.6	18.9	310.6
1953	23.5	17.5	20.1	24.5	11.6	3.0	2.6	3.9	2.3	5.9	12.5	19.1	147.2
1954	17.9	14.3	15.2	6.7	4.2	1.7	1.0	1.0	1.4	2.3	3.5	6.2	75.4
1955	6.5	12.1	14.4	5.2	5.6	12.6	1.9	1.3	1.2	3.0	5.9	7.0	76.9
1956	6.0	11.2	6.5	2.9	1.6	2.8	1.4	1.9	1.0	2.0	11.0	6.6	59.1
1957	5.6	7.3	4.2	11.9	162.4	131.5	20.6	7.6	9.1	15.9	22.4	29.3	427.8
1958	56.7	43.1	40.6	59.6	252.5	94.3	20.9	3.3	5.0	12.4	18.9	20.1	641.4
1959	17.2	17.2	25.9	61.9	54.6	15.3	1.8	1.3	1.3	9.2	11.4	17.3	235.6
1960	16.5	23.2	47.8	37.1	19.4	16.2	2.6	1.0	1.0	4.3	5.6	12.6	187.3
1961	14.6	13.1	13.9	15.9	42.9	179.1	8.1	5.1	11.8	75.8	84.3	78.8	543.4
1962	76.3	83.4	77.4	34.7	13.9	46.7	16.7	21.1	5.5	21.0	20.6	19.0	436.3
1963	17.5	34.1	45.6	6.2	3.2	3.0	2.0	1.6	7.1	12.3	12.6	13.3	160.7
1964	15.4	14.5	11.9	11.7	3.7	3.0	2.7	.9	.6	1.5	2.9	4.6	73.4
1965	5.5	6.7	7.3	3.5	2.6	262.9	61.6	52.7	23.9	71.4	58.4	57.8	616.7
1966	47.2	57.2	36.3	16.9	4.2	6.7	4.7	3.0	9.1	8.6	11.2	14.1	221.2
1967	14.5	12.7	6.1	2.5	5.1	90.8	86.2	3.0	2.4	6.4	10.4	16.2	258.3
1968	23.6	18.6	20.7	13.5	6.7	6.3	1.9	66.1	11.4	8.4	12.0	14.8	204.0
1969	16.0	14.6	15.2	6.6	127.4	208.2	44.9	2.9	2.3	10.4	46.6	61.4	558.9
1970	96.3	66.9	38.0	122.3	103.6	220.1	35.7	3.4	11.8	26.2	34.5	38.0	796.8
1971	86.6	58.1	55.5	51.8	198.8	54.1	4.8	1.5	18.2	21.4	25.0	26.1	561.9
1972	24.4	37.2	27.4	6.0	6.4	11.6	2.0	2.5	6.5	6.0	9.6	19.8	163.4
1973	81.0	53.2	54.5	94.7	528.1	217.8	20.9	7.4	88.3	86.1	57.6	40.0	1249.6
1974	76.6	60.7	62.6	69.2	9.3	9.6	1.7	1.7	11.9	8.2	7.9	19.3	338.9
1975	28.9	31.3	15.1	31.1	14.5	81.6	4.8	4.8	7.9	8.4	11.8	26.6	266.8
1976	35.5	25.9	30.9	8.8	5.7	3.0	1.4	1.1	2.8	4.6	3.8	7.4	130.9
1977	9.9	12.8	25.0	20.6	10.4	6.0	2.4	3.3	2.8	5.9	5.1	6.4	112.0
1978	7.9	10.1	11.6	4.3	3.6	13.6	1.9	1.0	.8	5.4	5.0	6.3	71.7
1979	9.5	29.5	14.9	17.6	44.2	260.8	19.7	42.6	19.3	16.9	32.1	50.5	557.6
1980	69.5	97.1	89.2	129.6	610.1	254.0	8.4	2.2	10.4	0.0	0.0	0.0	1270.5
AVERAGE	29.2	31.5	33.3	31.9	75.9	82.4	16.8	8.9	8.3	15.7	19.3	23.1	376.3

INITIAL VALUES AND CONSTANTS

PERKINGS COUNTY CANAL DIVERSION SCHEDULE

1.000	1.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	.500	1.000	1.000


N.
R 43 W
R 42 W
R 41 W
R 40 W
R 39 W
R 38 W
R 37 W
R 36 W
R 35 W
R 34 W
R 33 W
R 32 W
R 31 W
T13N
T12N
T11N
OGALLALA
Roscoe
Paxton
Brule
Big Springs
Julesburg
Ovid
SOUTH PLATTE RIVER
UNION PACIFIC RAILROAD
SOUTH PLATTE RIVER SUPPLY CANAL
SUTHERLAND CANAL
SUTHERLAND OUTLET CANAL
SUTHERLAND DAM & RESERVOIR
LAKE MALONEY
ROSCOE CANAL
ROSCOE LOW DAM & RESERVOIR
HAPPY HOLLOW DAM & RESERVOIR
SOUTH DIVIDE CANAL SECOND SECTION
RIVERVIEW NO. 4 DAM & RESERVOIR
RIVERVIEW EAST DAM & RESERVOIR
RIVERVIEW NO. 2 DAM & RESERVOIR
RIVERVIEW WEST DAM & RESERVOIR
WESTERN CANAL
SOUTH DIVIDE CANAL FIRST SECTION
OVID DIVERSION DAM
SOUTH DIVIDE CANAL
DEUEL CO.
KEITH CO.
SEDGWICK CO.
PERKINS CO.
LINCOLN CO.
EXPLANATION
EXISTING DAM & RESERVOIR
PROPOSED DAM & RESERVOIR
PROPOSED CANAL
EXISTING CANAL
PUMPING PLANT
PIPE DISCHARGE LINE
CHECK & DROP
CHECK
SCALE OF MILES
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
TECHNICAL ASSISTANCE TO STATE - NEBRASKA
TWIN PLATTE NATURAL RESOURCES DISTRICT
SOUTH DIVIDE CANAL PROJECT
GENERAL MAP
NEBRASKA - KANSAS PROJECTS
GRAND ISLAND, NEBRASKA
AUGUST 1982