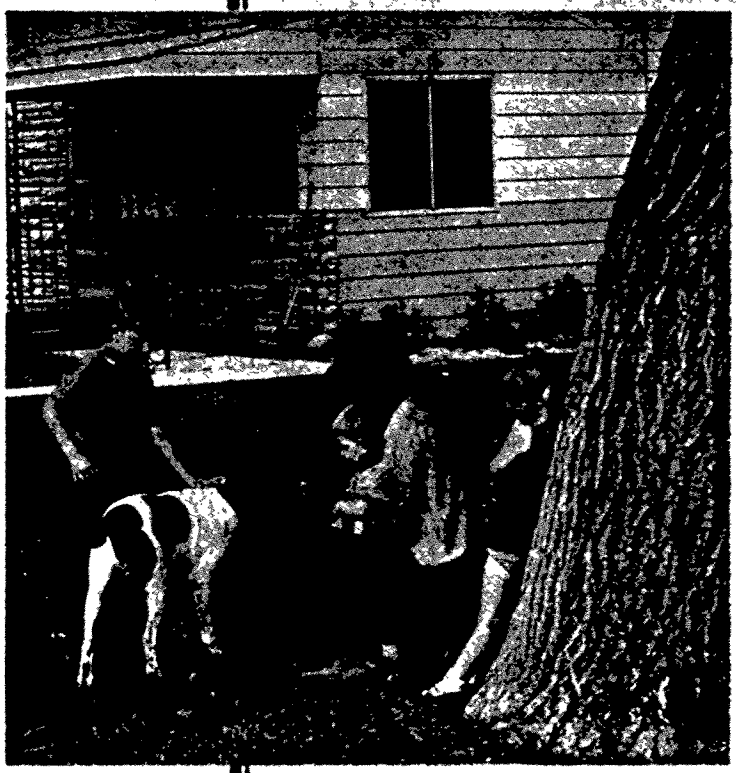
JENSEN UNIT

CENTRAL UTAH PROJECT

DEFINITE PLAN REPORT

DECEMBER 1975



DEPARTMENT OF THE INTERIOR
THOMAS S. KLEPPE, SECRETARY

Bureau of Reclamation
Gilbert G. Stamm, Commissioner

JENSEN UNIT

CENTRAL UTAH PROJECT
DEFINITE PLAN REPORT

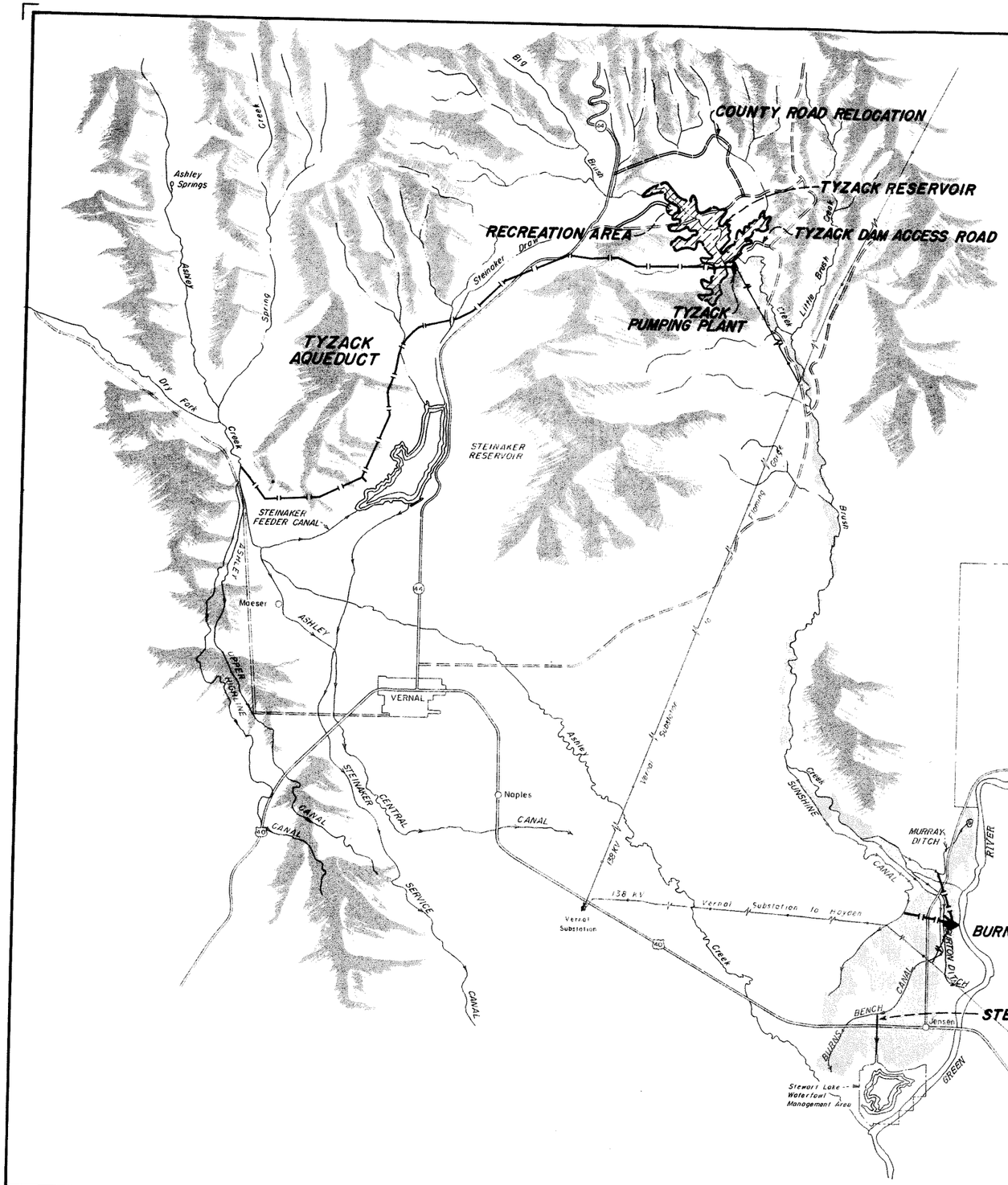
DECEMBER 1975

BUREAU OF RECLAMATION

GILBERT G. STAMM, COMMISSIONER

Upper Colorado Region

David L. Crandall, Regional Director


COUNTY ROAD RELOCATION
TYZACK RESERVOIR
RECREATION AREA
TYZACK DAM ACCESS ROAD
TYZACK PUMPING PLANT
TYZACK AQUEDUCT
STEINAKER RESERVOIR
STEINAKER FEEDER CANAL
Ashley Springs
Big Brush Creek
Ashley Spring
Dry Fork Creek
Steinaker Draw
Spring Creek
Little Brush Creek
Ashley Creek
Moeser
ASHLEY
VERNAL
Naples
STEINAKER CENTRAL CANAL
SERVICE CANAL
ASHLEY HIGHLINE PIPELINE
ASHLEY CANAL
SUNNYSIDE CANAL
138 KV
Vernal Substation
Vernal Substation to Hayden
Sunshine Creek
Fleming Coulee
DINOSAUR NATIONAL MONUMENT
MURRAY DITCH
SUNSHINE CANAL
GREEN RIVER
BURNS PUMPING PLANT
BURTON DITCH
BENCH CANAL
STEWART LAKE LATERAL
Jensen
BURNS
Stewart Lake Waterfowl Management Area
GREEN
40
191
121
SALT LAKE CITY
PROVO
CENTRAL UTAH PROJECT JENSEN UNIT
FILLMORE
UTAH
COLORADO RIVER
LOCATION MAP
N.
EXPLANATION
PROPOSED PROJECT FEATURES
RESERVOIR
PUMPING PLANT
PIPELINE
TRANSMISSION LINE
LATERAL
SUPPLEMENTAL SERVICE LAND
FULL SERVICE LAND
1 0 1 2 3
SCALE OF MILES
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT
JENSEN UNIT—UTAH
GENERAL MAP
SEPTEMBER-1975
450 – 418 – 71

SUMMARY SHEETS

Jensen Unit

LOCATION

Uintah County, northeastern Utah, in Uinta Basin of Upper Colorado River Basin.

AUTHORIZATION

Initial Phase of the Central Utah Project, including Jensen Unit, authorized as a participating project of the Colorado River Storage Project by act of April 11, 1956 (70 Stat. 105).

PLAN OF DEVELOPMENT

The Jensen Unit will provide municipal and industrial water to augment existing supplies throughout the project area and water for irrigation in the vicinity of Jensen. It also will benefit fish and wildlife, recreation, and flood control.

The main project feature will be Tyzack Reservoir to be constructed on Big Brush Creek. Project water will be pumped from the reservoir to Ashley Creek by the Tyzack Pumping Plant and Aqueduct and exchanged with Ashley Spring for municipal and industrial use. Tyzack Reservoir operation will be coordinated with operation of Steinaker Reservoir of the Vernal Unit to avoid winter operation of the Tyzack Aqueduct. Treatment and distribution of the municipal and industrial water will be the responsibility of the water users.

Storage water to be used for irrigation below Tyzack Reservoir will be released from the reservoir to Big Brush Creek and conveyed in the Brush Creek channel to points of diversion. The project Burns Pumping Plant will pump water from Green River for the irrigation of lands near Jensen and for municipal and industrial purposes by exchange with water from Big Brush Creek. The irrigation water, whether supplied from the reservoir or the pumping plant, will be distributed by existing canals. Only minor extensions of existing irrigation distribution facilities will be required and these will be provided by the water users. Project drainage will be provided as necessary. Power for operation of the project pumping plants will be obtained from the Colorado River Storage Project system.

Specific recreational facilities will be provided at Tyzack Reservoir. Measures for fish and wildlife will include a fishery pool in Tyzack Reservoir and rehabilitation of public lands as big game range to compensate for range lands that will be inundated by the reservoir. Also improvements will be made in the methods of water deliveries to the Stewart Lake Waterfowl Management Area, permitting improved operation of the area.

IRRIGATION SERVICE AREA (acres)

Full service land	440
Supplemental service land	3,640
Total	4,080

WATER SUPPLY (average annual acre-feet)

Project increases in supply	
Municipal and industrial use	18,000
Irrigation	4,600
Total	22,600
Depletion of Colorado River	15,000
Increases in salinity concentration at Imperial Dam (mg/l)	
From stream depletion	1.5
From increase in salt load	.1

COSTS

Construction costs (January 1975 prices, except as noted)	
Tyzack Dam and Reservoir	$18,455,000
Tyzack Pumping Plant and discharge line (aqueduct)	1/ 9,420,000
Burns Pumping Plant and discharge lines	3,290,000
Drains	774,000
Tyzack Pumping Plant switchyard	2/ 121,000
Burns Pumping Plant switchyard	65,000
Facilities to connect with Colorado River Storage Project power system	121,000
Transmission line to Tyzack Pumping Plant	97,000
Transmission line to Burns Pumping Plant	93,000
Recreational facilities	757,000
Fish and wildlife development	43,000
Permanent operating facilities	27,000
Total	33,263,000
Annual operation, maintenance, and replacement costs (1972-74 prices)	177,000

1/ Entire cost at July 1975 prices except $6,000 for acquisition of land and land rights which was estimated at January 1975 prices.

2/ At July 1975 prices.

COST ALLOCATIONS ($1,000)

	Construction costs	Reimbursable interest during construction (5.116 percent)	Annual operation, maintenance, and replacement costs
Reimbursable costs			
Municipal and industrial water	$25,668	$2,338	$120
Irrigation	4,933		6
Recreation			48
Subtotal	30,601	2,338	174
Nonreimbursable costs			
Fish and wildlife			
Enhancement	596		1
Mitigation	20		
Recreation	757		
Flood control	609		2
Highway improvement	680		
Subtotal	2,662		3
Total	33,263	2,338	177

REPAYMENT OF REIMBURSABLE COSTS (50-year repayment period)

Municipal and industrial water			
Prepayment[1/]	58		
Water users	16,903	1,543	120
Ad valorem tax revenue	8,707	795	
Subtotal	25,668	2,338	120
Irrigation			
Prepayment[1/]	11		
Water users	750		6
Apportioned revenues from Colorado River Storage Project	4,172		
Subtotal	4,933		6
Recreation (State of Utah)			48
Total	30,601	2,338	174

1/ Includes payments made for investigation from Colorado River Development Fund and funds contributed by State of Utah.

MUNICIPAL AND INDUSTRIAL WATER CONSTRUCTION COSTS AND REPAYMENT[1/]

Item	Initial use Block 1 (6,000 acre-feet)	Deferred costs or subsequent construction[2/] Block 2 (6,000 acre-feet)	Block 3 (6,000 acre-feet)	Total (18,000 acre-feet)
Tyzack Reservoir	$4,565,000	$4,566,000	$4,566,000	$13,697,000
Tyzack Pumping Plant and related facilities	10,546,000			10,546,000
Burns Pumping Plant and related facilities		2,363,000	1,323,000	3,686,000
Permanent operating facilities		19,000		19,000
Total	15,111,000	6,948,000	5,889,000	27,948,000
Annual payment (50 years)	842,600	387,400	328,400	1,558,400

1/ Costs shown include $2,338,000 in reimbursable interest during construction but exclude $58,000 in prepayments.

2/ "Subsequent construction" refers only to Burns Pumping Plant and related facilities.

BENEFIT-COST ANALYSIS
(100-year period of analysis at 3.25 percent interest)

	Direct	Indirect and public	Total
Average annual benefits			
Municipal and industrial water	$2,055,000		$2,055,000
Irrigation	166,000	$17,000	183,000
Fish and wildlife	24,000		24,000
Recreation	88,000		88,000
Flood control	24,000		24,000
Total	2,357,000	17,000	2,374,000

	Direct effects	Indirect effects	Total
Negative externalities			
Concentrating effects of stream depletion	$282,000	$63,000	$345,000
Increase in salt load	18,800	4,200	23,000

Average annual equivalent costs	1,371,000
Benefit-cost ratios	
Without externalities	
Ratio of total benefits to costs	1.73:1
Ratio of direct benefits to costs	1.72:1
With negative externalities from increased salt load	
Ratio of total benefits to costs	1.71:1
Ratio of direct benefits to costs	1.70:1

PROJECT FEATURES

Tyzack Reservoir	
Capacity (acre-feet)	
Active	24,000
Inactive and dead	2,000
Total	26,000
Surcharge	7,600
Normal water surface area (acres)	520
Tyzack Dam	
Height above streambed (feet)	145
Crest length (feet)	1,640
Volume of dam (cubic yards)	2,030,000
Tyzack Pumping Plant	
Maximum operating head (feet)	587
Design diversion capacity (second-feet)	46
Tyzack Discharge Line (aqueduct)	
Capacity (second-feet)	46
Length (miles)	11.8
Burns Pumping Plant	
Maximum static head at average flow of river (feet)	52 to 195
Design diversion capacity (second-feet)	97.4

CONTENTS

		Page
Chapter I	General discussions	1
	Location	1
	Population	2
	Natural setting	2
	Climate	2
	Stream systems	3
	Vegetation	3
	Fish and wildlife	3
	Economic development and natural resources	4
	Water resource developments	7
	Storage developments	7
	Irrigation	8
	Municipal and industrial use	8
	Water conservancy districts	9
Chapter II	Problems and needs	10
	Anticipated population growth	10
	Estimated new municipal and industrial water requirements	11
	Existing municipal and industrial water supplies	13
	Irrigation requirement	14
	Requirement for recreation opportunities	14
	Need for flood control	14
	Support for the project	14
Chapter III	Plan of development	16
	Project purposes	16
	Project plan	16
	Project administration	18
Chapter IV	Designs and estimates	20
	Rights-of-way	20
	Road relocation and access	20
	Project features	21
	Tyzack Dam and Reservoir	21
	Dam and reservoir design	21
	Geology	22
	Pumping plants	22
	Tyzack Pumping Plant and Discharge Line	22
	Burns Pumping Plant and Discharge Lines	24
	Drains	24
	Connection facilities, switchyards, and transmission lines	24
	Permanent operating facilities	24
	Recreation facilities	25
	Fish and wildlife facilities	27

CONTENTS (Continued)

		Page
Chapter IV	Designs and estimates (continued)	
	Sources of construction materials	27
	Estimated costs	28
	Construction costs	28
	Annual operation, maintenance, and replacement costs	28
	Development program	30
Chapter V	Water supply	34
	Water requirements	34
	Water resources	34
	Available streamflows	34
	Return flow	36
	Ground water	36
	Quality of water	36
	Water rights	36
	Existing rights	36
	Project rights	37
	Water utilization	38
	Water supply operation studies	38
	Project water supply	41
	Water supply shortages	41
	Effects of project on Colorado River System	42
	Stream depletions	42
	Return flows and salt loads	42
	Downstream salinity effects	42
	Externalities	43
Chapter VI	Irrigation	44
	Project lands	44
	Land classification	44
	Selection of project area	45
	Land characteristics	47
	Drainage	47
	Agricultural economy	48
	Types of farms	48
	Excess lands	48
	Development period	49
	Payments for irrigation water	49
	Irrigation benefits	50
Chapter VII	Municipal and industrial water	52
	Anticipated use	52
	Municipal and industrial water benefits	53
	Water charges	54
Chapter VIII	Other project effects	55
	Fish and wildlife	55
	Recreation	57
	Flood control	58
	Mineral development	59
	Public lands	59
	Environmental Protection Agency	60

CONTENTS (Continued)

		Page
Chapter IX	Environmental analyses	61
	Environmental impacts	61
	Construction activities	61
	Air, noise, and water pollution	61
	Borrow activity	61
	Economic and social impacts	62
	Effects on archaeological and historic sites	62
	Tyzack Reservoir development	62
	Seismicity	62
	Water quality	62
	Flora	63
	Fauna	63
	Sediment	64
	Flood control	65
	Recreation	65
	Tyzack Pumping Plant and Aqueduct	66
	Burns Pumping Plant and Discharge Line	66
	Transmission lines	66
	Streamflows	66
	Irrigation	67
	Municipal and industrial water development	67
	Cumulative impacts	67
	Economic and social conditions	67
	Fish and wildlife	68
	Unavoidable adverse effects	68
	Short-term uses versus long-term uses	69
	Irretrievable and irreversible commitment of resources	69
Chapter X	Economic and financial analyses	71
	Economic justification	71
	Average annual benefits	71
	Externalities	71
	Average annual equivalent costs	71
	Comparison of project effects	72
	Financial analysis	73
	Cost allocations	73
	Repayment	73
	Municipal and industrial water costs	75
	Irrigation costs	77
	Recreation costs	77
	Summary	77
Chapter XI	Plan formulation	80
	Modifications in plan since project authorization	80
	Plan summary	80
	Project costs	81
	Benefits	81
	Alternatives	81

CONTENTS (Continued)

		Page
Chapter XI	Plan formulation (continued)	
	Alternatives (continued)	
	Nondevelopment	81
	Partial development	82
	Irrigation only	82
	Municipal and industrial development only	82
	Irrigation with partial municipal and industrial water development	82
	Alternative sources of water	83
	Stage development	83
	Alternatives comparable to proposed plan	83
	Green River alternative	83
	Ground water	84
	Ratliff Dam and Reservoir	84
	Buckskin Hills Canal	84a
	Alternative features and operation of the proposed plan	84a
	Alternate Tyzack Dam sites	84a
	Alternates to Tyzack Aqueduct	84a
	Alternative operations	84a
	Summary	84b
	Reports of Cooperating Agencies	
	National Park Service letter dated June 28, 1974	85
	Fish and Wildlife Service	
	Fish and Wildlife Service letter dated November 18, 1974	87
	Fish and Wildlife Service letter dated March 5, 1974	88
	Memorandum dated January 30, 1969 (revised April 15, 1970)	90
	Description of the area	91
	Plan of development	92
	Fish	93
	Without the project	93
	With the project	94
	Wildlife	95
	Without the project	95
	With the project	96
	Discussion	97
	Conclusions	100
	Letter of January 9, 1969, from Director, Utah State Division of Fish and Game, to Regional Director, Bureau of Sport Fisheries and Wildlife	103
	Corps of Engineers	
	Letter dated February 27, 1974	104
	Letter dated January 21, 1970	105
	Report of December 22, 1967	107

CONTENTS (Continued)

Reports of Cooperating Agencies (Continued)

	Page
Environmental Protection Agency letter dated July 9, 1974. . . .	110
Bureau of Land Management	
Introduction	111
Location and description of the Jensen Unit Project.	111
Effect of the Jensen Project on BLM-administered lands, resources, and programs	112
Lands.	112
Recreation	113
Watershed.	114
Minerals	114
Wildlife	115
Livestock grazing.	115
Timber	115
Agriculture.	116
Roads.	116
Cadastral surveys and corner monumentation	116
Input of BLM lands and programs on proposed project--financial summary	116
Reimbursable.	116
Replaceable items chargeable to project	116
Improvements chargeable to project.	116
Irreplaceable resources	117
Conclusions and recommendations.	117
Bureau of Mines	
Summary.	118
Introduction	119
Location and accessibility	119
Physical features.	121
Land status.	121
Project plan	121
Geology.	125
Mineral resources.	126
Oil and gas	126
Oil shale	127
Bituminous sandstone.	127
Phospahte rock.	128
Coal.	130
Metallic minerals	130
Conclusions.	131

FOREWORD

This report presents the results of definite plan studies of the Jensen Unit of the Initial Phase of the Central Utah Project. Construction of the Initial Phase as a participating project with the Colorado River Storage Project was authorized by the Act of April 11, 1956 (70 Stat. 105). By the same act authorization was given to 4 units of the Colorado River Storage Project and 10 other participating projects, all of which will develop water of the Upper Colorado River Basin and which will be linked financially through the Upper Colorado River Basin Fund.

The Initial Phase is a segment of the Central Utah Project that can be constructed and operated independently. For programing and other considerations the Initial Phase has been divided into four units. Three of these, the Jensen, Vernal, and Upalco Units, are developments in the Uinta Basin of the Upper Colorado River Basin. The fourth or Bonneville Unit involves a diversion of water from the Uinta Basin to the Bonneville Basin and associated developments in both basins. The Jensen Unit is the last of the four units to come under definite plan study. Construction of the Vernal Unit has been essentially completed, the Bonneville Unit is under construction, and definite plan investigations for the Upalco Unit have been completed.

The Bureau of Reclamation sponsored the investigations leading to this report. Other interested Federal agencies were consulted in the studies, including the National Park Service, the Fish and Wildlife Service, the Corps of Engineers, the Environmental Protection Agency, the Bureau of Land Management, and the Bureau of Mines.

Authority to make this report is provided by the Federal reclamation laws (Act of June 17, 1902, 32 Stat. 388, and acts amendatory thereof or supplementary thereto, particularly the Colorado River Storage Project act previously mentioned).

CHAPTER I

GENERAL DISCUSSIONS

Location

The Jensen Unit area is near the northeastern corner of Utah in Uintah County. It includes Ashley Valley, a relatively flat basin about 5 miles wide along Ashley Creek, and the area extending east of the valley to the Green River. Vernal, near the center of Ashley Valley, is the major community of the project area. It is the county seat and the largest trading center within a 100-mile radius. Smaller communities include Naples and Maeser in Ashley Valley, and Jensen to the east.

The main street of Vernal, shopping center of Jensen Unit area.

The project area is well served by primary and secondary highways and roads. U.S. Highway 40 extends through the project area and connects Vernal with Denver to the east and with Salt Lake City to the west. State Highways 44 and 149 branch to the north from Highway 40 at Vernal and Jensen, respectively. The area has no railroads but is served by airlines, trucks, and buses.

Several tourist attractions and points of interest are in the general vicinity of the project. The Uinta Mountains, noted for their

clear lakes and streams and scenic beauty, are just north of the area. Flaming Gorge Reservoir is on the Green River about 40 miles north of Vernal over State Highway 44. Constructed as a feature of the Colorado River Storage Project, the reservoir is now the center of a recreation area of National significance. The Dinosaur National Monument is about 6 miles north of Jensen over State Highway 149. This monument has the world's most remarkable fossil deposits and offers visitors the opportunity to watch workmen use jackhammers, chisels, and picks to expose the fossil bones. Steinaker Reservoir of the Vernal Unit of the Central Utah Project is located 3 1/2 miles north of the city of Vernal. The boating and fishing that it offers are popular attractions to local residents and tourists. The Stewart Lake Waterfowl Management Area, described on page 4, is situated along the Green River just south of Jensen.

Population

Population in the Jensen Unit area has shown a recently accelerating growth pattern as reflected in the table below. The project area includes Vernal and the surrounding area which represents the major portion of the population of Uintah County.

Population Trends[1/]

					Average annual increase (percent)		
	1950	1960	1970	1973	1950-60	1960-70	1970-73
Vernal City	2,845	3,655	3,908	5,080	2.8	1.0	10.0
Uintah County	10,300	11,582	12,684	15,200	1.2	1.0	6.6
Jensen Unit Area	NA[2/]	8,809	9,845	14,300	NA	1.2	15.0

1/ Figures shown for 1950, 1960, and 1970 are taken from U.S. Census data whereas 1973 figures were estimated by the Bureau of Reclamation based on available data.

2/ NA denotes data not available.

In contrast to the rather nominal growth during the 1950's and 1960's, dramatic population increases have occurred since the 1970 census. For example, during this 3-year period, population in the project area increased about 45 percent. The population increases are attributed primarily to accelerated development of local natural resources. It does not reflect effects of oil shale development, which is just beginning.

Natural Setting

Climate

The climate in the Jensen Unit area is arid to semiarid. The frost-free period--or consecutive period with temperatures above 32° F.--is about 119 days as an average, but damaging frosts have occurred in each

month of the year. The growing season is about 180 days, extending from April 14 through October 10. The annual precipitation average is only about 7.8 inches, of which about 4.6 inches occur during the growing season. Prevailing winds are from the west.

Stream systems

The major stream in the area is the Green River which borders the project area on the east and is the largest tributary of the Colorado River. Brush Creek and Ashley Creek head in small glacial lakes on the south slopes of the Uinta Mountains and flow southward through the project area, entering the Green River near the town of Jensen. In its upper reaches Brush Creek is formed by two forks, Big Brush Creek from the west and Little Brush Creek from the east. Dry Fork Creek and Spring Creek entering from the west and east, respectively, are the main tributaries of Ashley Creek. A phenomenon of Ashley and Brush Creeks (and their tributaries) is the disappearance of their waters at sinks or caves in their upper reaches and the reappearance of the water at downstream springs. On Little Brush Creek a pipeline has been constructed to convey the summer flow of the stream around the sink area.

Streamflows in the project area normally run high in the spring when the mountain snow cover is melting but gradually diminish to base flow by summer. Except for some winter and high spring runoff, the natural flows are fully appropriated.

Vegetation

Dominant vegetative species vary throughout the area but all are common to the semiarid regions of the western United States. Prominent species include wheat grasses, June grass, sedges, shadscale, grease wood, four-wing salt brush, galleta grass, sagebrush, and rabbitbrush. Utah juniper grows on the rough, broken escarpment lands and willow, alder, bow elder, and cottonwood trees grow along the Green River and its tributaries. Irrigated land in the area is planted primarily to alfalfa hay, pasture, and small grains.

Fish and wildlife

Populations of brown, native cutthroat, and rainbow trout are found in the upper reaches of Big and Little Brush Creeks and Ashley Creek. Nongame species including sculpin, speckled dace, and suckers inhabit the lower portion of Brush Creek and Ashley Creek below the Steinaker Feeder Canal. A few channel catfish, a game species, are found in lower Brush Creek.

Cultivated lands in the vicinity of Vernal and Jensen and the lands bordering Brush and Ashley Creeks support a good pheasant population,

some California quail, and mourning dove. Other permanent residents common to the area include hawks, owls, larks, ravens, robins, and starlings. Because of their migratory nature, some birds that are common east of the Rocky Mountains are occasional migrants into the project area. Such birds include the northern waterthrush, pigeon hawk, Baird's sandpiper, Forster's tern, and the lark bunting.

Waterfowl traveling the Central Flyway stop to rest and nest in the area. They are found in the Stewart Lake Waterfowl Management Area, portions of the Green River bottom lands, and the small creeks and farm lands in the Brush Creek and Ashley Creek drainages. Waterfowl are fairly common during the spring, summer, and fall months. The principal species that nest in the area are mallard, gadwall, pintail, cinnamon teal, shoveler, red head, and ruddy duck. Goose hunting is good in the area of Brush and Ashley Creeks.

The Stewart Lake Waterfowl Management Area is a 595-acre area of marsh land at the junction of Ashley Creek and Green River. It is owned and managed by the Utah Division of Wildlife Resources. Most of the water supply for the area consists of water originating from local springs and seeps and of high spring runoff and irrigation return flows diverted from Ashley Creek. Some water also is pumped to the area from the Green River through an electrically operated pumping plant constructed in connection with the Vernal Unit of the Central Utah Project. Power for the existing pumping plant for the waterfowl management area is obtained from the Moon Lake Electric Association, an REA cooperative.

Brush Creek and Ashley Creek provide habitat for beaver and muskrat and these animals are found in the entire reaches of the streams. Mink are very scarce. Mule deer winter in the foothills adjacent to and above Big Brush Creek. The higher reaches of Brush Creek and Ashley Creek provide good summer range for large numbers of deer and a few elk. Coyotes, mice, shrews, gophers, skunks, and cottontail rabbits are also common in the area.

Economic Development and Natural Resources

Mineral development, tourism, and agriculture are the main sources of income in the Jensen Unit area. Mineral extraction is the chief industry affecting the economy of the area. Vernal is the headquarters of many of the businesses which directly or indirectly serve the oil drilling industry from Altamont, Utah, to Rangely, Colo. Stauffer Chemical Company's phosphate plant and mine north of Vernal make up another important mineral industry contributing to the area's economy. Current economic values of tourism and recreation are not available for the project area. However, statewide data show that recreation and tourism are becoming increasingly important as sources of income. Recreationists and tourists are attracted to the area not only by the nearby Flaming

Gorge Reservoir and Dinosaur National Monument, but also by the streams, lakes, and scenic beauty of the Uinta Mountains. Agriculture ranks third in its contribution of income to the local economy, and production of beef cattle and sheep is the major agricultural enterprise.

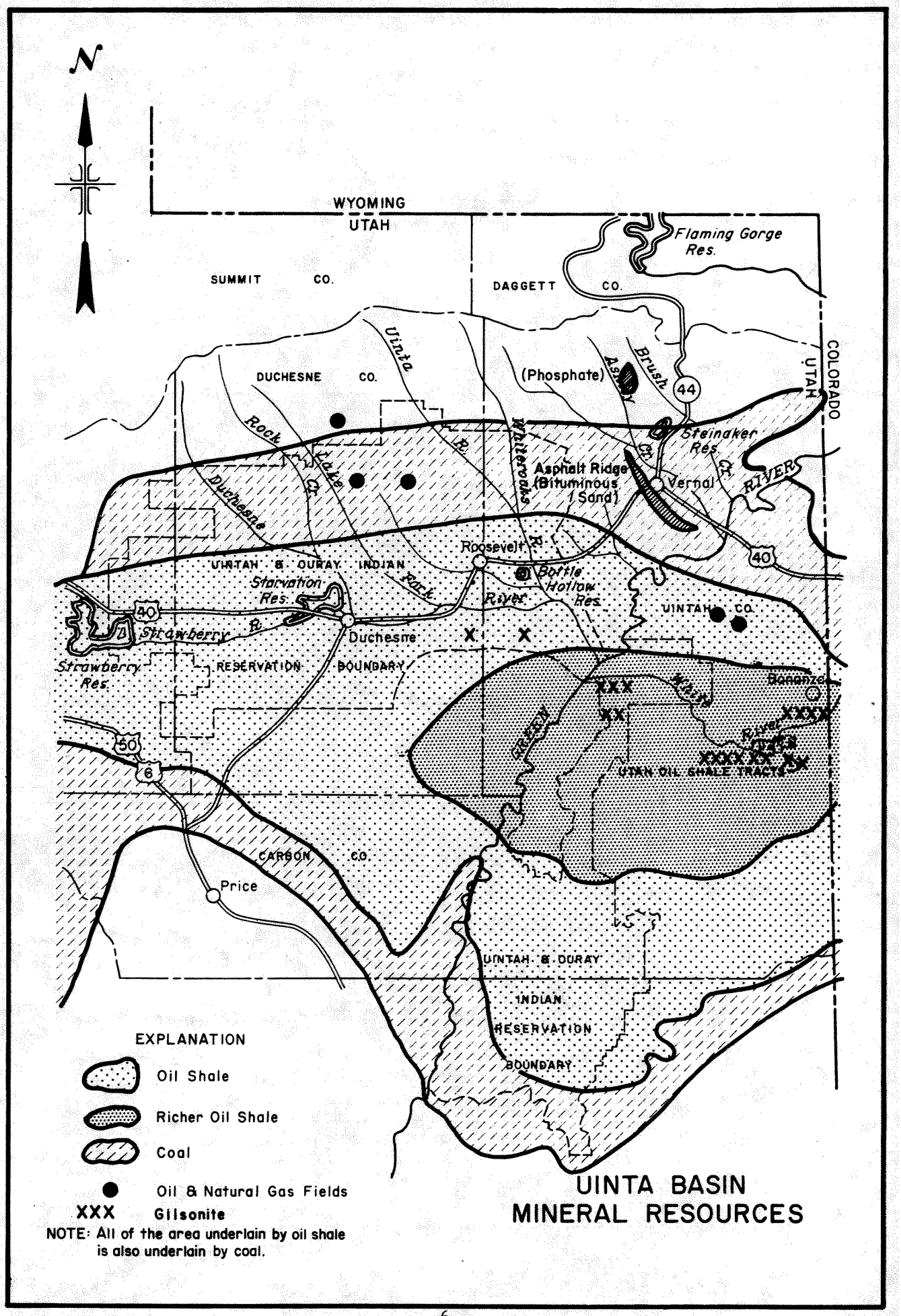
Mineral resources in the Uinta Basin are varied and widespread as shown by the map on the following page. A portion of the known oil reserves of Utah is contained in the Greater Red Wash field located in central Uintah County. Large new deposits have been discovered in the Bluebell, Altamont, and Cedar Rim areas of central Duchesne County which has become the State's most active area. Crude oil being produced in the Uinta Basin is transported by pipeline for processing near Salt Lake City. Large scale in-basin refining of the resource does not appear likely in the near future.

Roughly 2,500 square miles in northeastern Utah is underlain by oil shale beds 15 feet thick and containing an average of at least 15 gallons of crude oil per ton of shale. Gross oil in place in this area is estimated at about 320 billion barrels, or about nine times the estimated United States' reserve of crude oil in 1970. These deposits are part of the more extensive reserves underlying northeastern Utah and adjacent parts of Colorado and Wyoming which contain an estimated 1,800 billion barrels. These deposits are unique in the Nation and the largest known in the world. They are presently attracting much interest for development. Oil shale deposits in Utah having the greatest potential for development are centered about 40 miles south of Vernal and cover several hundred square miles. The potential yield is estimated to be about 80 billion barrels of crude oil for the deposits designated as "rich" (25 gallons per ton or more and with 10 feet or less of overburden).

An oil shale leasing program for prototype development, administered by the United States Department of the Interior, was initiated in January 1974 and made available for private development two leases in each of the three oil shale states. The two 5,120-acre tracts of public land, containing an estimated 510 million barrels of oil, represent a very small portion of the total Utah deposits. They were leased in May-June 1974 to three oil companies. The three companies--Phillips Petroleum, Sun Oil, and Sohio Petroleum--later formed a consortium known as the White River Shale Project, under which they plan to jointly develop a production plant of 100,000 barrel-a-day capacity. Development is still in the planning stage. Currently the preparation of an environmental impact statement is underway.

In addition to the leases referred to above, the Oil Shale Corporation (TOSCO) has leased 15,000 acres of oil shale land from the State of Utah. The company has indicated intent to develop a 100,000 barrel-a-day plant concurrently with the White River Shale Project.

Utah's reserve oil in oil-impregnated sandstone (bituminous sand) represents more than 90 percent of the total measured supply in the United


N
WYOMING
UTAH
SUMMIT CO.
DAGGETT CO.
Flaming Gorge Res.
DUCHESNE CO.
Uinta
(Phosphate)
Ashley
Brush
44
UTAH
COLORADO
Rock
Lake
Ck.
Duchesne
R.
Uintah
Asphalt Ridge (Bituminous Sand)
Steinaker Res.
Ck.
Vernal
RIVER
Roosevelt
R.
UINTAH & OURAY INDIAN
Starvation Res.
Fork
Bottle Hollow Res.
River
40
UINTAH CO.
Strawberry R.
Duchesne
Strawberry Res.
RESERVATION
BOUNDARY
Bonanza
XXX
XX
Evacuation Creek
XXXX
XXXX XX XX
UTAH OIL SHALE TRACTS
50
6
CARBON CO.
Price
UINTAH & OURAY
INDIAN
RESERVATION
BOUNDARY
EXPLANATION
Oil Shale
Richer Oil Shale
Coal
Oil & Natural Gas Fields
XXX Gilsonite
NOTE: All of the area underlain by oil shale is also underlain by coal.
UINTA BASIN
MINERAL RESOURCES

States. This resource is being open-pit mined from extensive deposits in the area 5-10 miles southwest of Vernal.

More than 3 billion tons of the richest reserves of phosphate in the western hemisphere are located in Uintah County. An estimated 700-million-ton deposit is found near Big Brush Creek north of Vernal.

The only supply of gilsonite in the United States is mined at several points near the project area. Gilsonite, a solid hydrocarbon, is used as a source of road oil, liquid fuels, paving binder, battery lining, oil well mud and cement additives, protective coatings, and asphalt tile. The gilsonite is slurried and conveyed through a 72-mile pipeline to a processing plant near Grand Junction, Colo.

Coal resources of the Uinta Basin are extensive but largely undeveloped. Much of the deposit is deeply embedded and the economic value unknown. Locally, the coal bearing rocks are broken by faults or concealed by younger deposits. At most places where coal is exposed, the thickness ranges from about 2 to 7 feet. Coal in the general range of 2 to 4 feet is abundant. The coal is of high volatile bituminous rank and is moderately high in heat value. In the past it was mined on a modest scale for local use. Although most of the mineral resource development and potential is outside the immediate project area, many of the services required by these industries are provided from the Vernal City area and many of the workers reside there.

Agricultural development centers around production of beef cattle and sheep. During the spring through fall seasons, the livestock are grazed on private pasture, Ashley National Forest land, and public domain administered by the Bureau of Land Management. Breeding stock and animals not ready for market are fed through the winter on crops produced on irrigated crop land.

Water Resource Developments

Storage developments

Several storage developments have been constructed in the Jensen Unit area to store surplus winter and spring flows for local use later in the year when streamflows are low. These developments, however, are inadequate to meet all of the needs. The Steinaker Reservoir is the largest of these developments. It was constructed by the Bureau of Reclamation as a part of the Vernal Unit, the first segment of the Central Utah Project, and was put in operation in 1962. The reservoir provides water for irrigation and municipal use in Ashley Valley and also benefits recreation and fish and wildlife. The reservoir is located at an offstream site on Steinaker Draw about 3.5 miles north of Vernal. It has a capacity of 38,000 acre-feet and receives water diverted from Ashley Creek through the 2.8-mile-long Steinaker Feeder Canal.

Two small reservoirs, the East Park and Oaks Park, have been constructed in the upper Brush Creek drainage area. The East Park Reservoir with a capacity of 2,650 acre-feet is on Little Brush Creek. It was completed in 1917 by a former mutual irrigation company and is presently operated by the Sunshine Irrigation Company. About 1,300 acre-feet of the reservoir capacity has been purchased by the Utah State Division of Wildlife Resources and is maintained as a fishery pool. Water from the remaining capacity is diverted by the Sunshine Canal for irrigation along Brush Creek. The Oaks Park Reservoir with a capacity of 5,750 acre-feet is on Big Brush Creek. It was built in 1939 by the Ashley Valley Reservoir Company and is operated by that company. Although the Oaks Park Reservoir is located on Big Brush Creek, its storage supply is used on lands along Ashley Creek. Water from the reservoir is diverted to Ashley Creek through the Oaks Park Canal.

Irrigation

Approximately 32,200 acres of land are presently irrigated in the project area. The major portion of this acreage (about 28,000 acres) is served by water conveyed from Ashley Creek by Highline, Upper Ashley, and Ashley Central Canals. About 15,000 acres receive supplemental water from the Vernal Unit directly through the Steinaker Service Canal or by exchange with other canals. The remaining 4,200 acres are served primarily by gravity diversions from Brush Creek, although a small quantity of water is pumped from Green River. Most of the diversions from Brush Creek are made by four major canals or ditches; namely, the Burns Bench and Sunshine Canals and the Burton and Murray Ditches, all owned and operated by mutual irrigation companies. Numerous smaller diversions are made from Brush Creek by individuals or small groups of private interests. The water from Green River is pumped to Burns Bench Canal by the Burns Bench Pumping Plant. This plant is powered by natural gas.

Municipal and industrial use

Most of the communities in the unit area, including Vernal, Maeser, Naples, and Jensen, are now provided with piped and chlorinated water supplies through the Ashley Valley municipal system. This system was originally constructed in about 1910 by the city of Vernal to obtain water from Ashley Spring. In 1962 additional water from the spring was made available to the system through exchange storage provided in Steinaker Reservoir of the Vernal Unit, and the system was enlarged and extended with the use of Vernal Unit funds.

A culinary water system serving the residents of Jensen and westward along Highway 40 was constructed in 1972 by the community of Jensen with financial assistance from the Farmers Home Administration and the Four Corners Regional Commission. The new system, which serves 122 subscribers, obtains its water from Vernal City and connects with four lines of the Ashley Valley municipal system. It extends east and north to the boundaries of the Dinosaur National Monument and east to the Green River.

Water Conservancy Districts

The Uintah Water Conservancy District will be the contracting and administrative agency for the Jensen Unit and will contract with the United States for administration of reclamation and joint use facilities and for repayment of reimbursable project costs. The district in turn is expected to contract with local water users for sale of water. The Uintah Water Conservancy District which includes all of Uintah County (except for a small western portion called Moon Lake Exclusion) was formed November 27, 1956, by court order and is the contracting agency for the Vernal Unit.

The Central Utah Water Conservancy District with headquarters at Orem, Utah, was established as a legal agency on March 2, 1964, by order of the Fourth Judicial Court of Utah as the sponsoring agency for the Central Utah Project. This district covers all or part of 12 counties in central Utah including Uintah County.

Under Utah law each conservancy district has power to levy taxes against all property within its boundaries and to collect additional assessments from the water users as required to cover operation, maintenance, and administrative costs and to meet repayment obligations to the United States as specified in the repayment contracts. Although the two districts are independent entities, they operate cooperatively. Representatives of the Uintah Water Conservancy District are also members of the Board of Directors of the larger district. By agreement, the combined rate of taxation levied by both districts in Uintah County will not exceed the rate levied by the Central Utah Water Conservancy District in the other counties.

CHAPTER II

PROBLEMS AND NEEDS

The irrigated area served by Brush Creek has long been plagued with an erratic and undependable water supply. Without storage regulation the irrigator has had to utilize the natural flows as they occurred with alternating high and low flows which seldom coincide with the ideal demand pattern. The high flows often alter the stream channel, damage irrigation diversion and conveyance structures, and deposit silt and debris upon the fields. With frequent water shortages, the irrigator has been unable to implement crop rotation and other practices necessary for optimum production from the land. As a result there has been little or no expansion of agriculture in this part of the project area in recent years and a steady reduction in farm population has occurred.

As discussed in Chapter I, major improvements have been made in municipal water service in the project area in recent years. Most residences are now served by the Ashley Valley Municipal System with excellent quality water from Ashley Spring. In contrast a few years ago many homes were served from wells, irrigation ditches, and by tank truck which presented a constant health hazard to many people. Ashley Spring, however, is also used for irrigation and the supply allocated for municipal use is barely adequate for this purpose even in normal water years. In below normal years and as the population increases as it is expected to do, additional water will be required. The increased municipal demand can be met either by the development of a new supply for exchange with Ashley Spring or by the conversion of water presently used for irrigation.

Anticipated Population Growth

Population growth in the Jensen Unit area between 1940 and 1970 approximated the State average of about 2 percent a year. As shown in Chapter I, there has been a significant population increase since 1970 as a result of accelerated development of natural resources, primarily petroleum. The area now stands on the threshold of a population boom of large proportions associated with the developing oil shale industry. There is a major need for water resource development, particularly for municipal use, to accommodate orderly development of the oil shale deposits and other natural resources which will benefit the local economy and help satisfy National energy requirements. Future municipal and industrial water requirements are based on these developments.

The problem of projecting population growth associated with oil shale development is difficult and speculative. Recognizing this, the Bureau of Reclamation made population estimates for three levels of

development; namely, a prototype development, a moderate commercial development, and an accelerated commercial development. The total estimated population increase from the oil shale industry including support workers was first ascertained. This population was then distributed among the various areas of the Uinta Basin on the basis of 60 percent to a "new city" assumed to be built near the work site 40 miles southeast of Vernal, 30 percent to Ashley Valley (Jensen Unit area), and 10 percent to other established communities in Duchesne and Uintah Counties. Population projections allocated to Ashley Valley on this basis for the three levels of oil shale development are shown below.

Estimated population of Ashley Valley
(1980 - 2000)

Year	Prototype Development	Moderate commercial development	Accelerated commercial development
1980	32,600	33,300	35,100
1985	34,000	35,600	42,400
1990	30,000	39,000	46,900
1995	32,200	47,100	49,100
2000	34,500	54,200	56,100

Estimated New Municipal and Industrial Water Requirements

New municipal water requirements for the projected increases in population are based on a per capita use of 225 gallons a day (0.25 acre-foot a year). This rate is considered to be conservative in view of the present rate of about 0.45 acre-foot per capita a year but is comparable to the projected rate for the Wasatch Front area of central Utah. The present per capita municipal usage is expected to decline as multiple dwellings increase and use of water for individual lots and gardens and stock watering diminishes. Annual requirements for new municipal water would range from 4,600 acre-feet in 1980 for prototype development to 10,500 acre-feet in 2000 for accelerated commercial development.

New water requirements for the industrial component are based on a moderate expansion of development of phosphate, gilsonite, petroleum, natural gas, and tar sand deposits located in or near the Jensen Unit area. These new industrial water requirements range from 1,300 acre-feet in 1980 to 5,700 acre-feet in 2000. Increased water requirements for both municipal and industrial use will reach 16,200 acre-feet by the year 2000. New water requirements for both municipal and industrial water are summarized in the table on the following page.

If plans for a "new city" fail to materialize or if the new city attracts less than 60 percent of the estimated oil shale workers, the

Estimated new municipal and industrial water requirements
(Unit--acre-feet annually

Year	Level of oil shale development	Projected population of project area	Population base (1973)	Population increase	Requirements for increased water supplies		
					Municipal[1/]	Industrial[2/]	Total
1980	Prototype	32,600	14,300	18,300	4,600	0	4,600
	Moderate commercial	33,300		19,000	4,800	1,300	6,100
	Accelerated commercial	35,100		20,800	5,200	1,300	6,500
1985	Prototype	34,000		19,700	4,900	100	5,000
	Moderate commercial	35,600		21,300	5,300	2,700	8,000
	Accelerated commercial	42,400		28,100	7,000	4,900	11,900
1990	Prototype	30,000		15,700	3,900	100	4,000
	Moderate commercial	39,000		24,700	6,200	2,900	9,000
	Accelerated commercail	46,900		32,600	8,200	5,100	13,300
1995	Prototype	32,200		17,900	4,500	100	4,600
	Moderate commercial	47,100		32,800	8,200	3,500	11,700
	Accelerated commercial	46,900		32,600	8,700	5,100	14,400
2000	Prototype	34,500		20,200	5,100	200	5,300
	Moderate commercial	54,200		39,900	10,000	3,500	13,500
	Accelerated commercail	56,100	14,300	41,800	10,500	5,700	16,200

1/ Estimated at 0.25 acre-foot per capita.

2/ Based on a moderate expansion of development of natural resources in the immediate project area for which water would be used in the processing of the resource. Water for processing oil shale is not included.

population of Ashley Valley and the demand for municipal water would be substantially greater than shown in the table. Likewise an accelerated expansion of other resources in the project area could create a greater demand for industrial water than shown. The need for additional water in the Jensen Unit area is substantiated by a resolution of the Vernal City Council dated October 23, 1974, expressing a willingness to subscribe for 18,000 acre-feet of municipal and industrial water annually.

Existing Municipal and Industrial Water Supplies

An average supply of 5,400 acre-feet and a firm supply (deliverable in a dry year) of 4,500 acre-feet is presently available for municipal, industrial, and stock water use in the Jensen Unit service area. Most of this water is delivered through the Ashley Valley Municipal System. Sources of the water include wells, springs, Ashley Creek direct flows, and storage water from Ashley Creek reservoirs and from the Vernal Unit of the Central Utah Project. The surface water supplies are exchanged for water diverted from Ashley Spring into the municipal system. Present diversions at the spring are only a fraction of the total exchangeable spring water. It would be possible to meet the municipal and industrial demands for several years by making maximum exchange with the spring.

Existing municipal, industrial, and stock water supplies available to the Jensen Unit service area under average and dry year conditions are summarized below.

Existing supplies
(Unit--acre-feet)

Source	Average year	Dry year firm supply
Ashley Creek	2,345	1,274
Ashley reservoirs	655	218
Steinaker Reservoir	1,600	1,600
Stockwater rights	300	300
Wells (1½ c.f.s.)		
Pump 7 months	456	
Pump 12 months		1,095
Total	5,356	4,487
Rounded	5,400	4,500

As previously stated, the firm supply of 4,500 acre-feet available in a dry year is insufficient to meet the present needs. Average or above average water years since 1972, however, have provided sufficient water to meet the municipal and industrial requirement. Obviously, shortages are certain to occur as soon as the requirement increases or the present supply diminishes in a below normal year.

Irrigation Requirement

An increased and more dependable irrigation water supply is needed to improve and stabilize the agricultural sector of the local economy. The natural flows of Brush Creek exceed the requirement of the presently irrigated lands during the spring snowmelt but in most years shortages occur during the last half of the irrigation season. Studies show that the shortages average 22 percent annually but range up to about 50 percent in some years.

In addition to the presently irrigated land, there are about 6,000 acres of land classified as arable in the project area which could become agriculturally productive if a dependable water supply were available. Most of this land, however, would require pumping or expensive gravity systems and storage facilities to serve. Precipitation in the area is insufficient during the growing season for successful dry farming operations.

Requirement for Recreation Opportunities

The State of Utah has determined that a high priority need exists in the Jensen Unit area for additional outdoor recreational opportunities including, hunting, fishing, camping, picnicking, and water-oriented activities. A need also exists for protection and enhancement of fish and wildlife habitat against encroachment from man-made developments. Improvement in the delivery of the water supply is needed for optimum operation and development of the Stewart Lake Waterfowl Management Area. The present system does not have the flexibility in supply or location needed to permit the planned expansion of the area.

Need for Flood Control

Flood damages occur to some extent nearly every year along Brush Creek. The Corps of Engineers has estimated that flood damage on Brush Creek occurs whenever the flows exceed 200 second-feet. Flows above this magnitude result in damage to canal headings, farm buildings, fences, irrigation ditches, and county roads and bridges, and silt deposition on fields and crops. A review of the historic flow record (1939-72) shows that the flow of Brush Creek exceeded 200 second-feet during 26 years of the 34-year period of record.

Support for the Project

The Jensen Unit is actively supported by agencies of the State of Utah, including the Division of Water Resources, the Division of Wildlife

Resources, and the Department of Natural Resources, the Central Utah Water Conservancy District, Uintah Water Conservancy District, Vernal City, and local irrigation companies. Water users have expressed a desire for additional water supplies and a willingness to repay the reimbursable construction costs. The Jensen Unit is recognized as a practical means of water resource development in the project area.

CHAPTER III

PLAN OF DEVELOPMENT

Project Purposes

The Jensen Unit of the Central Utah Project will serve several purposes--municipal and industrial use, irrigation, recreation, fish and wildlife conservation, and flood control. Hydroelectric power production in connection with the project was not found to be justified.

Construction of the Jensen Unit facilities will develop about 22,600 acre-feet of water annually, with 18,000 acre-feet of this amount for municipal and industrial use and 4,600 acre-feet for irrigation. The municipal and industrial water will be made available under a coordinated operation with the Vernal Unit to meet existing and projected requirements in the project area resulting primarily from energy exploration and development. Approximately 3,000 acre-feet of the irrigation water will be used for supplemental service of about 3,640 acres of presently irrigated land and 1,600 acre-feet for full service of about 440 acres of nonirrigated land. All of the land served will be in the vicinity of Jensen.

Project Plan

Water for the Jensen Unit will be obtained by regulation of flows of Big Brush Creek and by pumping from the Green River. The project supply along with direct stream flows presently obtained from Big and Little Brush Creeks will be used directly for irrigation and for municipal and industrial use by exchange.

Project storage will be provided in Tyzack Reservoir which will be constructed on Big Brush Creek about 10 miles northeast of Vernal. Storage water will be lifted by the Tyzack Pumping Plant and conveyed westward 11.8 miles in the Tyzack Aqueduct to Ashley Creek for irrigation use by local water users in exchange for Ashley Spring water which will be diverted into the municipal water system. Delivery of project water to Ashley Creek above all major irrigation diversions will facilitate this exchange. Water diverted to Ashley Creek will be replaced to irrigators now served from Brush Creek by water pumped from the Green River by the Burns Pumping Plant to be constructed near the mouth of Brush Creek. With construction of the new project pumping plant, a small privately owned plant on the river will be abandoned. Both the Tyzack and Burns Pumping Plants will be operated with power obtained from the Colorado River Storage Project. Although present supplies of storage project power have been fully subscribed, supplies from expired contracts will be available when needed for Jensen Unit use. Connection with the storage project system will be through a tap on the Vernal-Flaming Gorge line No. 1 near Brush Creek and

a tap on the Vernal-Rangley line near its crossing with Utah Highway 149. Switchyards will be constructed at the pumping plants and transmission lines constructed from the point of connection to the switchyards.

Aerial view looking upstream at Tyzack Dam and Reservoir site.

The irrigation water will be distributed by the four existing canals diverting from Brush Creek discussed in Chapter I. The only new distribution facilities required will be minor extensions of existing laterals to serve the small acreages of project full service lands interspersed with the presently irrigated lands. These extensions will be constructed by the water users. Drainage will be provided as necessary to safeguard sustained productivity of the project lands.

A coordinated operation of Tyzack and Steinaker Reservoirs will facilitate the municipal and industrial water exchange and avoid winter operation of the Tyzack Pumping Plant and Aqueduct. This operation will not increase shortages to the Vernal Unit nor significantly affect water levels at Steinaker Reservoir. Places for use of the municipal and industrial water will depend largely on concentrations of population increases but are expected to be primarily in the vicinity of Vernal. The water will be distributed by enlargements and extensions of the Ashley Valley municipal system or by construction of other facilities as required. The distribution

facilities, as well as treatment of the water as necessary to meet the municipal standards, will be the responsibility of the water users.

Several measures are planned for recreation and fish and wildlife purposes. Specific facilities will be provided for recreation at Tyzack Reservoir, including facilities for boat launching, camping and picnicking, sanitation, and administration. These facilities are described in detail in Chapter IV. A permanent minimum fishing pool of 1,900 acre-feet will be provided in Tyzack Reservoir. As compensation for losses of big game habitat resulting from inundation of the reservoir area, public range land near the reservoir will be rehabilitated and improved for big game habitat. The public range land is now under the administration of the Bureau of Land Management.

Approximately 670 acre-feet of water will be provided by the project to the Stewart Lake Waterfowl Management Area as replacement for water presently obtained by diversions from Ashley Creek and from the Green River through the existing pumping plant. Studies have shown that management area water can be delivered more economically by the Jensen Unit than by the existing facilities and at a higher point which will permit development of an additional 100 acres of marsh habitat. This development presumes retirement and salvage of the existing pump. About 440 acre-feet of the replacement water will be project return flow delivered directly to the management area by the project drains and 230 acre-feet will be pumped from the Green River by the Burns Pumping Plant and delivered via the existing Burns Bench Canal and the potential Stewart Lake Lateral (see Frontispiece Map).

Flood damage along Brush Creek will be reduced by the regulation of flows in Tyzack Reservoir. Storage space for control of flood flows will be made available in the reservoir on a forecast basis.

Project Administration

The Uintah Water Conservancy District will contract with the United States for operation of project irrigation and joint use facilities and for repayment of project costs. The local water users will continue to operate and maintain the existing canals and municipal systems in the project area.

The Bureau of Reclamation will be responsible for runoff forecasting for flood control and for administration of flood control operations. Its administration will be in accordance with regulations prescribed by the Secretary of the Army as provided by Section 7 of the Flood Control Act of 1944.

The Bureau of Reclamation will develop recreational facilities under authority of Section 8 of the Colorado River Storage Project Act in accordance with the recreation plan proposed jointly by the National Park Service and the Bureau of Reclamation.

The Utah Division of Parks and Recreation has indicated its willingness to assume responsibility for operation of the recreation facilities at Tyzack Reservoir, and for assumption of all expenses associated with operation and maintenance of the facilities. The Utah Division of Wildlife Resources will continue to operate the Stewart Lake Waterfowl Management Area. The public range lands that will be rehabilitated for deer winter range will continue to be administered by the Bureau of Land Management in cooperation with the Utah Division of Wildlife Resources.

CHAPTER IV

DESIGNS AND ESTIMATES

Rights-of-way

A total of 2,549 acres of land will be required for construction of Jensen Unit features. Most of this acreage, about 2,010 acres, is public land which has been withdrawn for construction of the Tyzack Reservoir and Pumping Plant. The remaining 539 acres is privately owned land, 480 acres of which would be required for the reservoir, 32 acres for Tyzack Pumping Plant and Aqueduct, and 27 acres for Burns Pumping Plant and discharge lines and road relocations. Construction and operation of the transmission lines to the pumping plants will require an easement on about 11 acres of private land. The only improved land to be acquired as right-of-way is a farmstead in the reservoir basin that includes a ranch house and a few sheds and corrals.

Road Relocation and Access

An existing road crossing the Tyzack Reservoir Basin will be inundated by the reservoir and will be replaced by a road 3.3 miles long located on the north side of the reservoir on land administered by the Bureau of Land Management. The road will be replaced to current standards required for the anticipated use.

The Tyzack Dam site can presently be reached from Vernal by 13 miles of existing roads, including a portion of Utah Highway 44, the graded county road through the reservoir basin, and unimproved farm roads. Minor improvements of the county and farm roads will be necessary for construction access to the dam site. Existing roads will provide adequate construction access for other project features. To provide permanent access for operation and maintenance, short reaches of new road will be constructed from existing roads to the Tyzack Dam and Pumping Plant and the Burns Pumping Plant. These gravel-surfaced roads will be about 18 feet wide and will extend 0.8 mile and 300 feet, respectively, from existing county roads to the structures. An access road will be constructed to connect the recreation area with Utah Highway 44. The new road will be 22 feet wide and 2 miles long, including improvement of about 0.5 mile of existing county road.

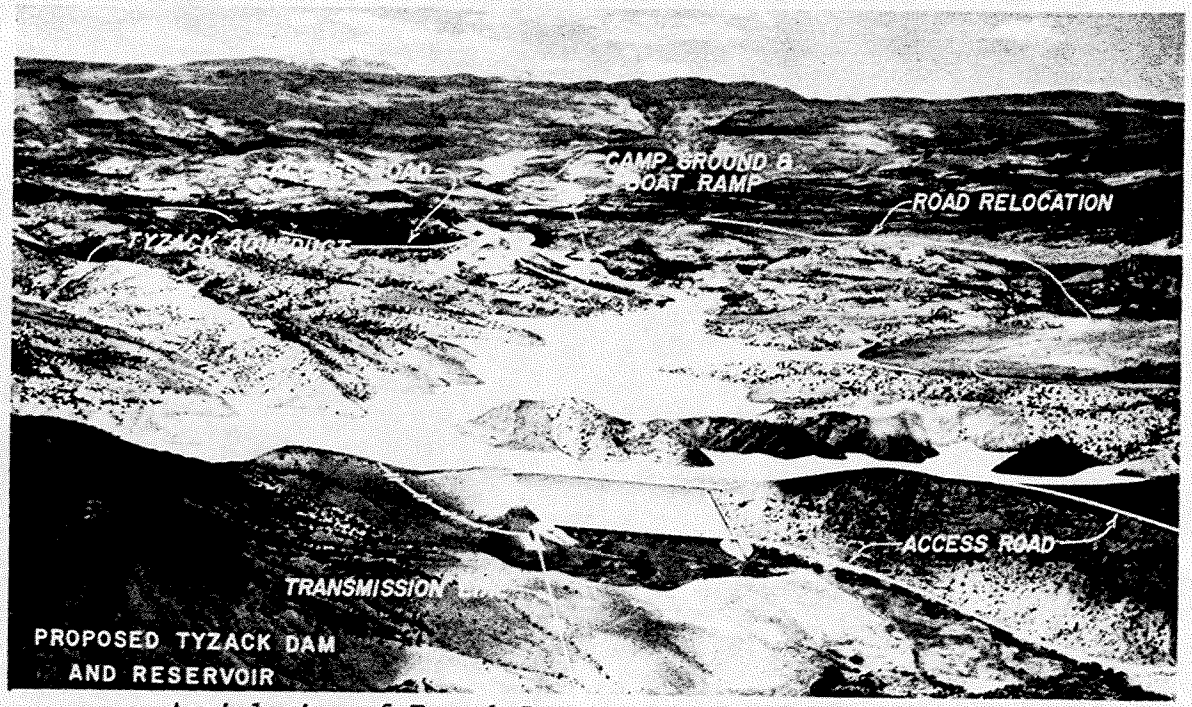
Project Features

Tyzack Dam and Reservoir

Dam and Reservoir Design

Tyzack Reservoir on Big Brush Creek will have a capacity of 26,000 acre-feet, including an active capacity of 24,000 acre-feet and an inactive and dead capacity of 2,000 acre-feet, of which 1,900 acre-feet will be provided as a fishery pool. A surcharge capacity of 7,600 acre-feet will be available for routing the spillway design flood. Sediment deposits are expected to amount to only about 580 acre-feet in 100 years or about 2 percent of the total reservoir capacity. Therefore, no storage was provided specifically for sediment. The reservoir will have a surface area of 521 acres at normal water surface elevation 5,608.2 feet.

Tyzack Reservoir will be formed by a dam on Big Brush Creek about 3.5 miles downstream from State Highway 44. The dam will be a rolled, earthfill structure protected on the upstream face with a 3-foot layer of riprap. It will rise about 145 feet above streambed and at the crest elevation of 5,628 feet it will be 1,640 feet long and 30 feet wide. The dam will contain a total of about 2,030,000 cubic yards of embankment material.



Aerial view of Tyzack Reservoir site with artist's concept of dam and reservoir.

The outlet from Tyzack Reservoir, located in the right abutment of the dam, will have a capacity of 550 second-feet at maximum water surface

elevation of 5,621.5 feet and a capacity of 320 second-feet with the water surface at elevation 5,528.5 feet at the top of the inactive storage pool. A pipeline leading to the pumping plant will be connected at the discharge end of the outlet works. The reservoir spillway will be a 25-foot open chute situated on the left abutment of the dam. It will have an ogee crest at elevation 5,608.2 feet and a capacity of 4,550 second-feet at maximum water surface elevation. Details of Tyzack Dam and Reservoir are shown on the Tyzack Dam Feasibility Design Drawing on the following page.

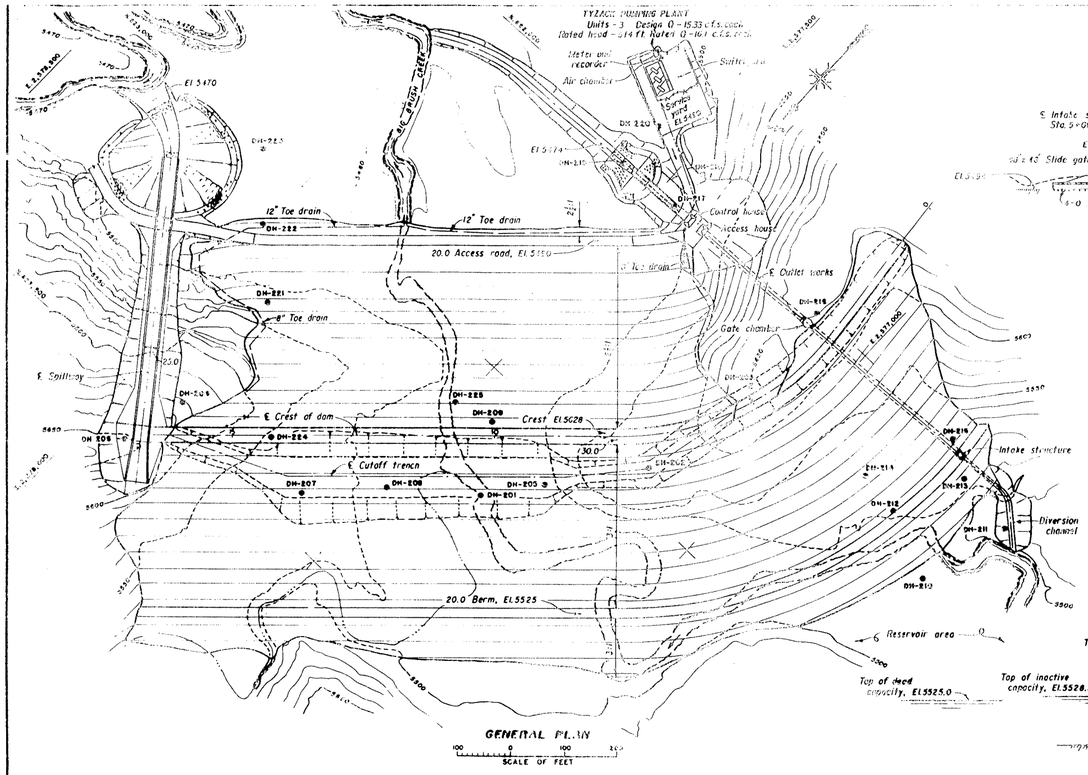
Geology

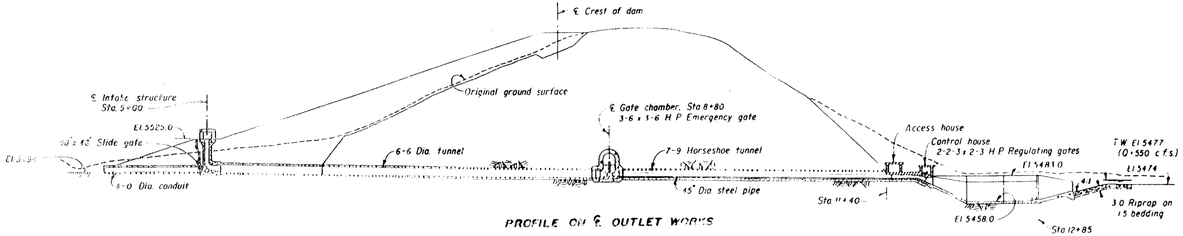
Tyzack Reservoir will occupy an erosional valley cut in the south-dipping Jurassic formations. Navajo, Carmel, Entrada, Curtis, and Morrison formations all underlie the alluvium which covers the valley floor. These formations are predominantly shale with impervious sandstones which indicate good water holding capability. Geologic conditions are favorable for construction of the dam, and the reservoir basin is expected to be watertight. The same formations and geologic conditions occur at Steinaker Reservoir about 10 miles west where that reservoir is adequately retaining water. Generally the reservoir rim is not steep and is stable. Some small slides and beaching can be expected in the softer rocks on the east side of the reservoir but these will present no problem.

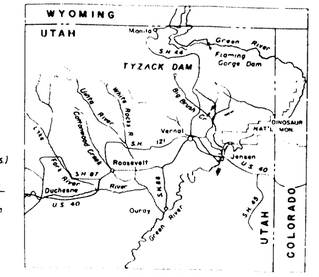
Pumping plants

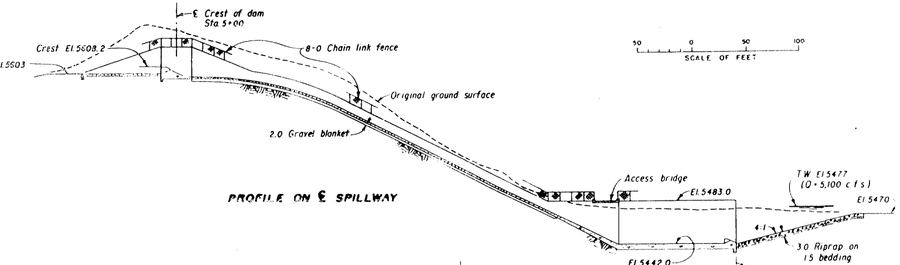
Tyzack Pumping Plant and Discharge Line

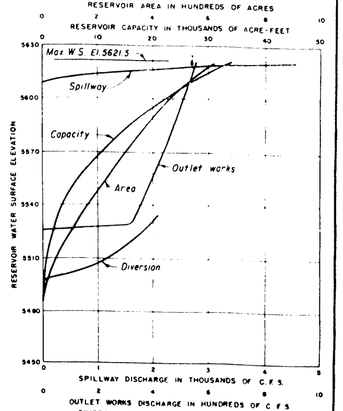
Tyzack Pumping Plant, located near the downstream end of the outlet works of Tyzack Dam, will deliver water from Tyzack Reservoir through the discharge line to Ashley Creek. The plant will have a rated capacity of 48.3 second-feet, which will allow 2.3 second-feet for wear and provide a design capacity of 46 second-feet at 514 feet rated head. It will consist of two 1,500-horsepower and two 750-horsepower electric-driven pumps designed for outdoor operation. The average annual amount of water to be pumped will be 18,000 acre-feet. Power requirements of the plant are expected to average about 11,650,000 kilowatt-hours annually and the peak power demand from year to year will range from 2,470 to 2,890 kilowatts. The aqueduct will be a pressurized pipe extending 11.8 miles from the pumping plant to Ashley Creek. Conditions along the aqueduct alinement are favorable for construction, and no geologic difficulties are anticipated. Although shown as the Tyzack Pumping Plant Discharge Line on the Project Cost Estimate and the Control Schedule, this pipeline is shown on maps and referred to frequently throughout the report as the Tyzack Aqueduct.

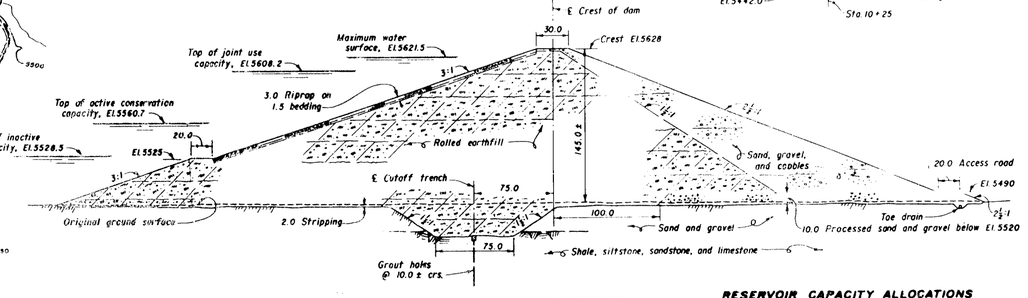


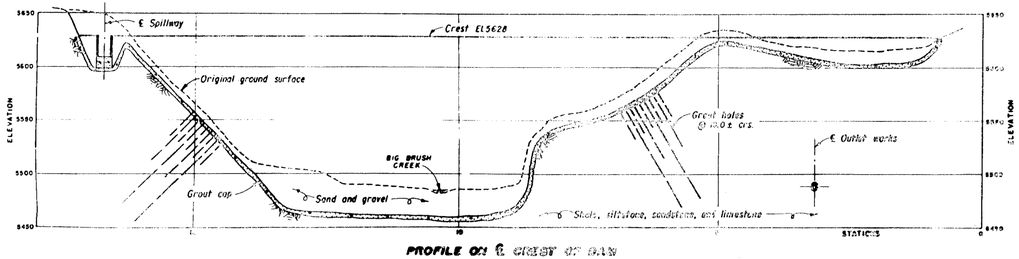












RESERVOIR CAPACITY ALLOCATIONS

PURPOSE	ELEVATIONS	CAPACITY ACRE - FEET
Joint use	5560.7 to 5608.2	18,000
Active conservation	5528.5 to 5560.7	6,000
Inactive	5525.0 to 5528.5	370
Dead	Streambed to 5525.0	1,630
Total reservoir capacity		26,000

A surcharge of 7,600 a.f. (Max. W.S. El 5621.5) in combination with a spillway discharge of 4,550 c.f.s. and a river outlet discharge of 550 c.f.s. is provided to protect against the inflow design flood which has a peak of 18,500 c.f.s. and a 2-day volume of 12,300 a.f.

10-1-74 D-HOB	ENLARGED TYZACK PUMPING PLANT
2-3-71 D. HOB	ADDED TYZACK PUMPING PLANT

THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT
JENSEN UNIT - UTAH

TYZACK DAM
AXIS "C"

FEASIBILITY DESIGN DRAWING

DESIGNED W.R.R. SUBMITTED
DRAWN W.R.R. RECOMMENDED
CHECKED APPROVED
DIRECTOR OF DESIGN AND CONSTRUCTION

DENVER, COLORADO, APRIL 6, 1973

450-D-7

Burns Pumping Plant and Discharge Lines

The Burns Pumping Plant will be located on the west bank of the Green River, about 2.5 miles upstream from the town of Jensen. The plant will pump water through four separate discharge lines extending to four existing canals and will contain 14 pumping units for flexibility in meeting the demand patterns of the various canals. The plant will have a total rated capacity of 115.8 second-feet, which will allow 18.4 second-feet for wear and provide a design capacity of 97.4 second-feet. The design horsepower of the plant will total 2,245. The average annual amount of water pumped will be 9,700 acre-feet. Power requirements of the pumping plant are expected to average about 1,483,000 kilowatt-hours annually and the peak power demand from year to year will range from 580 to 1,320 kilowatts. The maximum static heads from the river to the canals at average flow of the river will range from 52 to 195 feet. The discharge lines from the pumping plant will be precast concrete pressurized pipes, varying in length from 1,350 to 4,950 feet for a total of 2 miles, and in capacity from 12 to 39 second-feet. The discharge lines to Burns Bench Canal, Sunshine Canal, and Burton Ditch will extend westward from the plant in parallel lines while the Murray Ditch discharge line will extend northward.

Drains

Drainage facilities will be constructed for about 700 acres of project land. The construction will consist of 6.1 miles of drains including 1.4 miles of open outlet drains and 4.7 miles of closed lateral drains. All drains will have a design depth of about 10 feet.

Connection facilities, switchyards, and transmission lines

In order that power may be supplied to the Jensen Unit pumping plants from the Colorado River Storage Project system, taps will be made on the Vernal-Flaming Gorge 138-kilovolt line No. 1 and on the Vernal-Hayden line. Transmission lines of 138-kilovolt capacity will be built from the point of connection to switchyards that will be constructed at Tyzack and Burns Pumping Plants. The capacity of Tyzack Switchyard will be 5,000 kilovolt-ampers and of the Burns Switchyard 2,500 kilovolt-ampers. The line to the Tyzack Pumping Plant will be a maximum of 2.3 miles long and the line to the Burns Pumping Plant a maximum of 1.1 miles long.

Permanent operating facilities

The Uinta Basin Field Division Office at Duchesne, Utah, will serve as the main Government construction office for the Jensen Unit. It is anticipated that the field office at Vernal, established for construction and operation of the Vernal Unit, will be used for construction of Jensen

Unit. Following the construction period the field office facilities will be used as operation and maintenance headquarters for both the Jensen and Vernal Units. Housing facilities in the Vernal area, about 10 miles from Tyzack Dam site, are expected to adequately meet the requirements for Government employees during construction of the unit.

Recreation Facilities

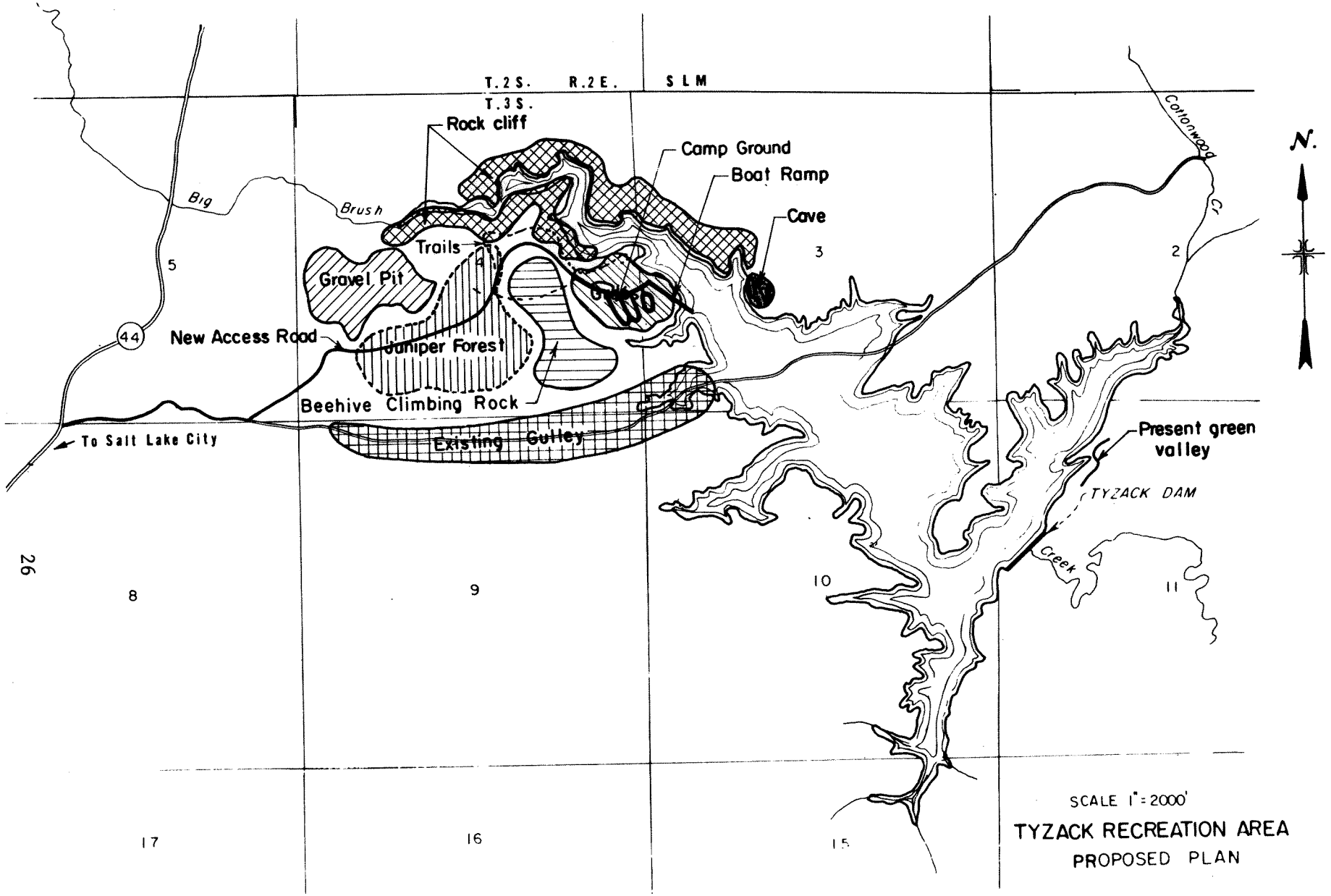
The recreation development will be located on a grassy plateau along the west side of the reservoir near the upper (northwest) end, as shown on the following map. Facilities to be constructed by the United States as part of the Jensen Unit will consist of those necessary for boating, picnicking, camping, hiking, and administration with a total capacity of 412 people at one time. The recreation plan prepared cooperatively by the National Park Service and Bureau of Reclamation now includes the following items.

Item	Quantity
Access road (miles)	2
Recreation complex	
Boat ramp	1
Picnic shelters	47
Group picnic shelters	2
Restrooms	2
Trailer sanitary station	1
Fish cleaning station	1
Double parking stalls	32
Single parking stalls	65
Boat trailer parking stalls	38
Utilities	
Water, electricity, sewer, and solid waste disposal systems	

In order to provide access to the recreation area, a 2-mile-long road will be built from a point on Utah Highway 44 about 10 miles north of Vernal. The first portion of about half a mile is an existing unimproved road that will be upgraded and paved. The remaining 1 1/2-mile portion, to be built on a new alignment, will also be paved.

The boat ramp will be of concrete 470 feet long. Picnic shelters will be of rough timber construction. Each will include a table attached to the shelter structure. Restrooms will be built of masonry and wood. Roadways and parking areas within the recreation complex will be paved except for the boat trailer parking which will be gravelled.

Facilities for water, electricity, sewer, and garbage pickup within the recreation complex will be provided as part of the project. The


T.2S. R.2E. SLM
T.3S.
Rock cliff
Camp Ground
Boat Ramp
Cave
Trails
Gravel Pit
New Access Road
Juniper Forest
Beehive Climbing Rock
Existing Gulley
To Salt Lake City
Big
Brush
Cottonwood
Cr
Present green valley
TYZACK DAM
Creek
N.
SCALE 1"=2000'
TYZACK RECREATION AREA
PROPOSED PLAN

restrooms, trailer sanitary station, and fish cleaning station will be constructed with sewage holding tanks. The tanks will be pumped out periodically by sanitary tank trucks for disposal in other approved sanitation systems.

Fish and Wildlife Facilities

Tyzack Reservoir and appurtenant facilities will cause a loss of about 500 acres of deer winter range. This loss will be mitigated by the rehabilitation and improvement of 500 acres of range land in a nearby area. Juniper-pinion cover on these lands will be partially removed and reseeded to grasses and browse plants.

The Stewart Lake Lateral, which will deliver water from the Burns Bench Canal to the Stewart Lake Waterfowl Management Area, will be three-fourths of a mile long. The unlined conveyance facility will have a capacity of 5 second-feet.

Sources of Construction Materials

Embankment materials of suitable quality and sufficient quantity for the Tyzack Dam are available within 1 mile of the site. Much of the embankment material can be obtained from within the reservoir basin. However, some material will be obtained from areas adjacent to the reservoir and from bench areas near the dam.

Excellent quality riprap material is available at the limestone quarry used for Steinaker Dam. The quarry is located along Little Brush Creek about 15 miles from Tyzack Dam and Pumping Plant sites and 37 miles from Burns Bench Pumping Plant site.

Backfill materials for pipelines will be obtained from trench excavation.

Concrete aggregate deposits approved by the Bureau of Reclamation are located along the Green River near Jensen, Utah, about 28 miles from Tyzack Dam and Pumping Plants sites and about 1 to 4 miles from Burns Bench Pumping Plant site.

Steel mills and pipe plants are located near Orem, Utah, about 170 miles from the dam site. Conrete pipe is manufactured at Pleasant Grove, Utah, 5 miles north of Orem. Lumber and native timber are available from lumber yards or sawmills in Vernal, Utah.

Estimated Costs

Construction costs

The construction cost of the Jensen Unit is estimated at $33,263,000, including $32,463,000 for reclamation and joint use facilities to be financed under the Upper Colorado River Basin Fund (Section 5 of the Colorado River Storage Project Act) and $800,000 to be expended specifically for recreation and fish and wildlife (Section 8 of the Colorado River Storage Project Act). The costs of facilities required for distribution of municipal and industrial water are not included in the estimate as those works would be provided by the local water users. The total amount expended for investigations as of June 30, 1975, is $1,601,677 of which $69,000 was expended prior to authorization.

Costs of reclamation and joint use facilities were estimated by the Bureau of Reclamation on the basis of January and July 1975 prices. The estimates were made from feasibility designs providing for a useful life of at least 100 years and include costs for rights-of-way and relocation of existing facilities. Costs of fish and wildlife facilities were estimated by the Fish and Wildlife Service except for the big game range rehabilitation, which was estimated by the Bureau of Land Management. Recreation facilities costs were estimated jointly by the Bureau of Reclamation and the National Park Service. Estimated costs of the individual features are shown on the following page.

Annual operation, maintenance, and replacement costs

Project operation, maintenance and replacement costs were estimated at $177,000 annually on the basis of 1972-74 prices. Annual costs for the reclamation and joint use facilities were estimated by the Bureau of Reclamation. These include costs for personnel, equipment, supplies, and replacements, as well as costs of energy for pumping. The estimates for the energy costs were based on the assumption that the energy would be purchased from the Colorado River Storage Project at rates of $1.32 per kilowatt per month and 4 mills per kilowatt-hour. Annual costs for specific recreation facilities were estimated jointly by the Bureau of Reclamation and the National Park Service. The $48,000 a year for specific recreation facilities consists of $28,000 for annual operation and maintenance (the average equivalent value for 100 years at 3 1/4 percent--corresponding to 56,000 recreation days a year) and $20,000 for annual replacement cost (based on a 20-year life of facilities at 3 1/4 percent). The operation and maintenance cost of specific fish and wildlife facilities were estimated by the Fish and Wildlife Service at $300 and considered to be negligible. The annual costs are summarized on page 30.

7-1720 (5-72)
Bureau of Reclamation
Formerly Basic Estimate DC-1 Summary

PROJECT COST ESTIMATE

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

OFFICE PREPARED BY:

PROJECT CENTRAL UTAH - JENSEN UNIT
Date of Estimate September 2, 1975
Prices as of January & July 1975

PROPERTY CLASS	IDENTIFIED PROPERTY	PLANT ACCOUNT	DESCRIPTION	CCE SHEET NUMBERS	LABOR AND MATERIALS BY CONTRACTOR Cost	LABOR AND MATERIALS BY GOVERNMENT Cost	FIELD COST Plant Account	TOTAL FIELD COST Identified Property	OTHER COSTS Identified Property	TOTAL COST Identified Property	TOTAL COST Property Class	Previous Estimate Prices as of TOTAL COST Identified Property
1			2	3	4	5	6	7	8	9	10	11
			JENSEN UNIT - CENTRAL UTAH PROJECT - TOTAL									
			PROJECT COST								33,263,000	
			UPPER COLORADO RIVER BASIN FUND COSTS									
			(Section 5 of Colorado River Storage Project Act)									
01			RESERVOIRS AND DAMS									
	01		TYZACK DAM AND RESERVOIR	7-12				12,946,000	5,509,000	18,455,000	18,455,000	
03			PUMPING AND PUMPING GENERATING PLANTS								12,710,000	
	01		TYZACK PUMPING PLANT AND DISCHARGE LINE	13-15				6,336,000	3,084,000	9,420,000		
	02		BURNS PUMPING PLANT AND DISCHARGE LINES	16-23				2,209,000	1,081,000	3,290,000		
07			DRAINS								774,000	
	01		JENSEN AREA DRAINS	24				517,000	257,000	774,000		
13			TRANSMISSION LINES, SWITCHYARDS AND SUBSTATIONS								497.000	
	01		TYZACK PUMPING PLANT SWITCHYARD	25				80,000	41,000	121.000		
	02		BURNS PUMPING PLANT SWITCHYARD	25				43,000	22,000	65,000		
	03		FACILITIES TO CONNECT TO CRSP SYSTEM	25				90.000	31,000	121.000		
	04		TRANSMISSION LINE TO TYZACK PUMPING PLANT	26				67,000	30,000	97,000		
	05		TRANSMISSION LINE TO BURNS PUMPING PLANT	26				64,000	29,000	93,000		
15			GENERAL PROPERTY								27,000	
	01		PERMANENT OPERATING FACILITIES	27				27,000		27,000		
15			SERVICE FACILITIES									
	01		JENSEN UNIT CONSTRUCTION CAMP	28								
			SUBTOTAL - UCR BASIN FUND COSTS					22,379,000	10,084,000	32,463,000		
15			RECREATION AND FISH AND WILDLIFE COSTS								800,000	
			(Section 8 of Colorado River Storage Project Act)									
	02		TYZACK RESERVOIR RECREATION FACILITIES	3				570,000	187,000	757,000		
	03		BIG GAME RANGE REHABILITATION	3				15,000	5,000	20,000		
	04		STEWART LAKE LATERAL	3				17,000	6,000	23,000		
			SUBTOTAL - RECREATION, FISH AND WILDLIFE COSTS					602,000	198,000	800,000		
			TOTAL CONSTRUCTION COST					22,981,000	10,282,000	33,263,000	33,263,000	

Reclamation and joint use facilities	$128,000
Specific recreation facilities	48,000
Flood forecasting and administration of flood control operations	1,000
Total	$177,000

A reserve fund eventually reaching about $40,000 will be established by the Uintah Water Conservancy District. The fund will be used for emergency, special, or unforeseen operation and maintenance costs of reclamation and joint use facilities. This fund, maintained separately from the regular operation and maintenance funds by the district, will be built up in $10,000 increments beginning with the first year in which water is made available.

Development Program

The start of construction will depend on appropriations from Congress and on the meeting of other conditions discussed on page 19. Tyzack Reservoir will be the first feature constructed, and project irrigation water will be available about 4 years after construction is begun. Completion of the Tyzack Pumping Plant, Aqueduct, and related facilities--scheduled about one year later--will provide 6,000 acre-feet of municipal and industrial water. The Burns Pumping Plant and related facilities will be added some years later in accordance with the growth of need for municipal and industrial water. The Burns Pumping Plant will provide water for irrigation, which will make available by exchange a corresponding quantity of water for municipal and industrial use. Construction of the drains is scheduled to be concurrent with the Tyzack Pumping Plant and Aqueduct. Recreation facilities associated with Tyzack Reservoir are scheduled for construction during the period of reservoir filling. Building of the Stewart Lake Lateral is scheduled to follow the beginning of construction on Tyzack Dam by about 6 years.

For planning purposes, it is assumed that preconstruction activities could be completed and project construction started in fiscal year 1976. On this basis, project water for irrigation would be available in fiscal year 1979 and the first block of municipal and industrial water in fiscal year 1980. Blocks 2 and 3 are scheduled to be available approximately in 1984 and 1989, respectively.

The planned construction program is shown on the Control Schedules on the following three pages. The total project program is divided into work to be accomplished with funds from the Upper Colorado River Basin Fund (Section 5 of the Colorado River Storage Project Act) and work to be accomplished specifically for recreation and fish and wildlife (Section 8 of the Colorado River Storage Project Act).

LEGEND: Types of Activity — Preconstruction and Other Work; Construction

LINE NO.	PROGRAM ITEM	QUANTITY	ESTIMATED TOTAL	TOTAL TO JUNE 30, 1975	FISCAL YEARS 1976 (J A S O N D J F M A M J)	TRANS. QTR. JULY 1976 - SEPT 1976	1977 (O N D J F M A M J J A S)	1978 (O N D J F M A M J J A S)	1979 (O N D J F M A M J J A S)	1980 (O N D J F M A M J J A S)	1981 (O N D J F M A M J J A S)	1982 (O N D J F M A M J J A S)	1983 (O N D J F M A M J J A S)	1984 (O N D J F M A M J J A S)	BALANCE TO COMPLETE	LINE NO.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1	PROGRAM GOALS															1
2	Irrigation Service Land-Full	440 Ac							440 Ac							2
3	Irrigation Service Land-Supplemental	3640 Ac							3640 Ac							3
4	Municipal and Industrial	18,000 AF								6,000 AF				6,000 AF	6,000 AF	4
5	Recreation Capacity	412 PAOT							412 PAOT							5
6	Water Fowl Area	100 Ac							100 Ac							6
7	Big Game Range	500 Ac							500 Ac							7
8																8
9	CONSTRUCTION PROGRAM															9
10	Tyzack Dam and Reservoir	26,000 AF	1/ 18,455,000	1,001,203	300,000	1,735,000	6,537,000	6,147,000	2,734,797	Initial Storage						10
11	Tyzack Pumping Plant and Discharge Line-46.0 cfs	4,500 hp. 11.8 mi.	9,699,000	292,606			86,000	3,406,000	3,917,000	1,997,394	Initial Water	Service		Initial Water Service		11
12	Burns Pumping Plant and Discharge Line-97.4 cfs	2,245 hp. 2.0 mi.	3,508,000	238,204								216,000	1,045,000	719,000	1,289,796	12
13	Drains	6.1 mi.	774,000	47,135			64,000	317,000	345,865							13
14	Permanent Operating Facilities		27,000											27,000		14
15	Recreational Facilities	Camping Boating	757,000	22,529	5,000	5,000	15,000	300,000	409,471							15
16	Fish and Wildlife Facilities		43,000					20,000				23,000				16
17	Service facilities, depreciation, and Salvage				50,000	75,000	20,000	-50,000	-60,000	-35,000						17
18																18
19	TOTAL CONSTRUCTION & PROJECT COST		33,263,000	1,601,677	355,000	1,815,000	6,722,000	10,140,000	7,347,133	1,962,394		239,000	1,045,000	746,000	1,289,796	19
20																20
21	Consolidated expenditures and credits		-20,000 2/	-42,178	-50						20,944				1,284	21
22																22
23	TOTAL EXPENDITURES		33,243,000	1,559,499	354,950	1,815,000	6,722,000	10,140,000	7,347,133	1,962,394	20,944	239,000	1,045,000	746,000	1,291,080	23
24																24
25	TOTAL OBLIGATIONS		33,243,000	1,559,499	354,950	1,815,000	6,722,000	10,140,000	7,347,133	1,962,394	20,944	239,000	1,045,000	746,000	1,291,080	25

NOTES: Estimated costs based on January & July 1975 prices.

1/ Includes $680,000 for incremental cost of constructing county road to current standards over costs of replacing road in kind.

2/ Includes -$65,000 from nonreimbursable Colorado River Development Fund and -$4,000 from Reclamation Fund expended prior to project authorization and $49,000 in nonappropriation costs, property transfers, and miscellaneous costs.

RECOMMENDED: _____ (Operating Office Head) _____ (Date)

RECOMMENDED: _____ (Regional Director) _____ (Date)

RECOMMENDED: _____ (Chief, Div. of P C & F) _____ (Date)

APPROVED: _____ (Commissioner) _____ (Date)

REVISED: _____ (Date)

SHEET 1 OF 3 SHEETS

PF-2 (6-75)

UNITED STATES
DEPARTMENT OF THE INTERIOR
Bureau of Reclamation

CONTROL SCHEDULE

CENTRAL UTAH PROJECT
JENSEN UNIT

Utah Activities (OFFICE) — Dec. 3, 1975 (DATE) — UC (REGION)

☐ GENERAL INVESTIGATIONS ☐ LOAN PROGRAM
☐ CONSTRUCTION ☐ OTHER

LEGEND: Types of Activity — Preconstruction and Other Work; Construction

LINE NO.	PROGRAM ITEM	QUANTITY	ESTIMATED TOTAL	TOTAL TO JUNE 30,1975	FISCAL YEARS 1976 (J A S O N D J F M A M J)	TRANS. QTR. JULY 1976 SEPT 1976	1977 (O N D J F M A M J J A S)	1978 (O N D J F M A M J J A S)	1979 (O N D J F M A M J J A S)	1980 (O N D J F M A M J J A S)	1981 (O N D J F M A M J J A S)	1982 (O N D J F M A M J J A S)	1983 (O N D J F M A M J J A S)	1984 (O N D J F M A M J J A S)	BALANCE TO COMPLETE	LINE NO.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1	PROGRAM GOALS															1
2	Irrigation Service Land-Full	440 AC							440 Ac.							2
3	Irrigation Service Land-Supplental	3640 Ac.							3640 Ac.							3
4	Municipal and Industrial	18,000 A.F.								6,000 A.F.				6,000 A.F.	6,000 A.F.	4
5	Power Development	None														5
6																6
7	CONSTRUCTION PROGRAM															7
8	01.01 Tyzack Dam and Reservoir	26,000AF	1/18,455,000	1,001,203	300,000	1,735,000	6,537,000	6,147,000	2,734,797	Initial Storage						8
9	03.01 Tyzack Pumping Plant & Discharge Line (Aqueduct)	4500 hp 46 cfs 11.8 mi	9,420,000	292,606			86,000	3,400,000	3,800,000	1,841,394	Initial Water Service	210,000	900,000	652,000	1,289,796	9
10	03.02 Burns Pumping Plant and Discharge Line - 97.4 cfs	2245 hp 2.0 mi	3,290,000	238,204			64,000	317,000	345,865							10
11	07.01 Drains	6.1 mi	774,000	47,135				4,000	22,000	95,000						11
12	13.01 Tyzack Pumping Plant Switchyard	138 Kv 5,000 Kva	121,000									4,000	50,000	11,000		12
13	13.02 Burns Pumping Plant Switchyard	138 Kv 2,500 Kva	65,000						25,000	36,000			25,000	35,000		13
14	13.03 Facilities to Connect with Colorado River Storage Project System	138 KV	121,000					2,000	70,000	25,000						14
15	13.04 Transmission Line to Tyzack Pumping Plant	2.3 mi. 138 Kv	97,000									2,000	70,000	21,000		15
16	13.05 Transmission Line to Burns Pumping Plant	1.1 138 Kv	93,000											27,000		16
17	15.01 Permanent Operating Facilities		27,000													17
18	G.L. 115.01 Service Facilities, Depreciation and Salvage				50,000	75,000	20,000	-50,000	-60,000	-35,000						18
19																19
20	TOTAL CONSTRUCTION & PROJECT COST		32,463,000	1,579,148	350,000	1,810,000	6,707,000	9,820,000	6,937,662	1,962,394		216,000	1,045,000	746,000	1,289,796	19
21											20,944				1,284	20
22	Consolidated Expenditures and Credits		-20,000 2/	-42,178	-50											21
23																22
24	Total Expenditures		32,443,000	1,536,970	349,950	1,810,000	6,707,000	9,820,000	6,937,662	1,962,394	20,944	216,000	1,045,000	746,000	1,291,080	23
25	TOTAL OBLIGATIONS		32,443,000	1,536,970	349,950	1,810,000	6,707,000	9,820,000	6,937,662	1,962,394	20,944	216,000	1,045,000	746,000	1,291,080	24
																25

NOTES: Estimated costs based on January & July 1975 prices.
1/ Includes $680,000 for incremental cost of constructing county road to current standards over costs of replacing road in kind.
2/ Includes-$65,000 from nonreimbursable Colorado River Development Fund and-$4,000 from Reclamation Fund expended prior to project authorization and-$49,000 in nonappropriation costs, property transfers, and miscellaneous costs.

RECOMMENDED: _____ (Operating Office Head) _____ (Date)
RECOMMENDED: _____ (Regional Director) _____ (Date)
RECOMMENDED: _____ (Chief, Div. of P C & F) _____ (Date)
APPROVED: _____ (Commissioner) _____ (Date)
REVISED: _____ (Date)

SHEET 2 OF 3 SHEETS

PF-2 (8-75)
UNITED STATES
DEPARTMENT OF THE INTERIOR
Bureau of Reclamation

CONTROL SCHEDULE

CENTRAL UTAH PROJECT-JENSEN UNIT
UPPER COLORADO RIVER BASIN FUND
(Section 5 of Colorado River Storage Project Act)

Utah Activities (OFFICE) Dec. 3, 1975 (DATE) UC (REGION)

☐ GENERAL INVESTIGATIONS ☐ LOAN PROGRAM
☒ CONSTRUCTION ☐ OTHER

LEGEND: Types of Activity

Preconstruction and Other Work | Construction

LINE NO.	PROGRAM ITEM	QUANTITY	ESTIMATED TOTAL	TOTAL TO JUNE 30, 1975	FISCAL YEARS 1976 (J A S O N D J F M A M J)	TRANS. QTR. JULY 1976 - SEPT 1976	1977 (J A S O N D J F M A M J J A S)	1978 (O N D J F M A M J J A S O N D J F M A M J J A S)	1979 (O N D J F M A M J J A S O N D J F M A M J J A S)	1980 (O N D J F M A M J J A S O N D J F M A M J J A S)	1981 (O N D J F M A M J J A S O N D J F M A M J J A S)	1982 (O N D J F M A M J J A S)	1983 (O N D J F M A M J J A S)	1984 (O N D J F M A M J J A S)	BALANCE TO COMPLETE	LINE NO.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1	PROGRAM GOALS															1
2	Recreation Capacity	PAOT	412 PAOT						412 PAOT							2
3	Water Fowl Area	Ac	100 Ac						100 Ac							3
4	Big Game Range	Ac	500 Ac						500 Ac							4
5																5
6	CONSTRUCTION PROGRAM															6
7	RECREATIONAL FACILITIES															7
8	15.02 Fyzack Reservoir	Camping Boating	757,000	22,529	5,000	5,000	15,000	300,000	409,471							8
9																9
10	FISH AND WILDLIFE FACILITIES															10
11	15.03 Big Game Range Rehabilitation	500 Ac	20,000					20,000								11
12	15.04 Stewart Lake Lateral	0.8 mi.	23,000									23,000				12
13																13
14	TOTAL CONSTRUCTION & PROJECT COST		800,000	22,529	5,000	5,000	15,000	320,000	409,471			23,000				14
15																15
16	TOTAL EXPENDITURES		800,000	22,529	5,000	5,000	15,000	320,000	409,471			23,000				16
17																17
18	TOTAL OBLIGATIONS		800,000	22,529	5,000	5,000	15,000	320,000	409,471			23,000				18
19																19
20																20
21																21
22																22
23																23
24																24
25																25

NOTES: Estimated costs based on January 1975 prices.

RECOMMENDED: _____ (Operating Office Head) _____ (Date)

RECOMMENDED: _____ (Regional Director) _____ (Date)

RECOMMENDED: _____ (Chief, Div. of P C & F) _____ (Date)

APPROVED: _____ (Commissioner) _____ (Date)

REVISED: _____ (Date) SHEET 3 OF 3 SHEETS

PF-2 (6-75)

UNITED STATES
DEPARTMENT OF THE INTERIOR
Bureau of Reclamation

CONTROL SCHEDULE

CENTRAL UTAH PROJECT-JENSEN UNIT
RECREATION, FISH, AND WILDLIFE FACILITIES
(Section 8 of Colorado River Storage Project Act)

~~Utah Activities~~ OFFICE | Dec. 3, 1975 DATE | UC REGION

☐ GENERAL INVESTIGATIONS ☐ LOAN PROGRAM
☒ CONSTRUCTION ☐ OTHER

CHAPTER V

WATER SUPPLY

Water Requirements

The requirement for project water at points of diversion is estimated at about 22,600 acre-feet annually, including 18,000 acre-feet for municipal and industrial use and 4,600 acre-feet for irrigation.

The requirement for municipal and industrial water is based on anticipated population growth and industrial development as discussed in Chapters II and VII.

The irrigation diversion requirement for project lands has been estimated at 3.70 acre-feet an acre which includes allowance for 15 percent conveyance loss in the conveyance facilities. Estimated diversion requirements, existing supplies, and diversion requirements from the project are shown in the tabulation below.

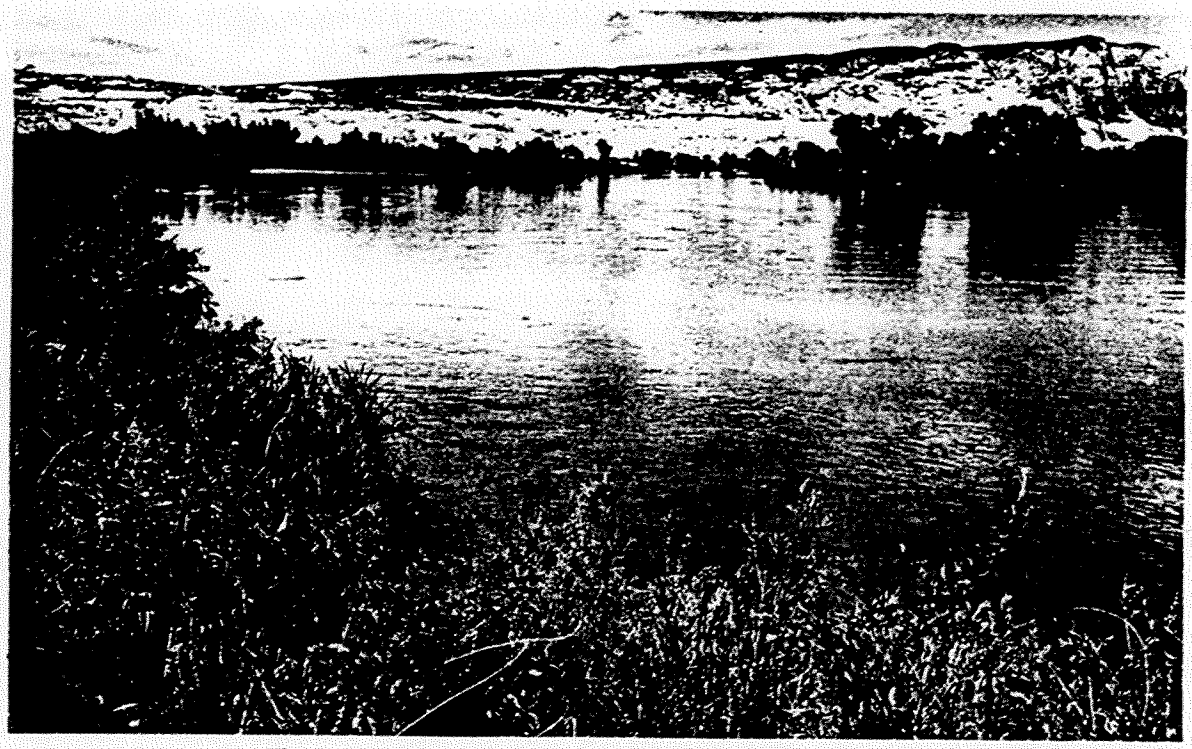
		Total diversion requirement		Existing supplies		Additional diversion requirement	
	Acreage	Per acre	Total	Per acre	Total	Per acre	Total
Nonirrigated lands	444	3.70	1,600	0	0	3.70	1,600
Presently irrigated lands	3,638	3.70	13,500	2.89	10,500	0.81	3,000
Total	4,082		15,100		10,500		4,600

Water Resources

Available streamflows

Streamflows available for project development include flows of Big and Little Brush Creeks and the Green River. Estimates of the flows of these streams available for project use were based on recorded flows at gaging stations near points of potential project diversion, including Big Brush Creek near Vernal, Little Brush Creek near its mouth, and Green River near Jensen. Periods for which records are available are shown below.

Big Brush Creek near Vernal	1939-present
Little Brush Creek near mouth	1964-69
Green River near Jensen	1946-present



The Green River at the approximate site of the project Burns Pumping Plant.

Recorded flows of Big and Little Brush Creeks were extended by correlation with flows of other streams over the 1930-72 period which was used as a basis for the project studies. Flows of Big Brush Creek were correlated with the recorded flow of Ashley Creek near Vernal and also were modified to reflect the operation of the upstream Oaks Park Reservoir and Canal for the years of the study period prior to the construction of these facilities in 1939. The recorded flow of Little Brush Creek was correlated with the extended and modified flows of Big Brush Creek near Vernal. Since the recorded flows of Green River are far in excess of the project demands, it was not considered necessary to extend these flows over the entire study period nor to modify the flows to reflect operation of Flaming Gorge Reservoir and other recent upstream developments.

Significant annual streamflows used in the project studies are shown below.

	(Unit--acre-feet)		
	1930-72		
	Big Brush Creek near Vernal	Little Brush Creek near mouth	1947-72 Green River near Jensen
Maximum	41,200	6,800	4,522,000
Minimum	12,200	2,200	1,055,000
Average annual	24,900	4,200	3,067,000

Return flow

Most of the return flow from project irrigation will enter the Green River below the irrigated lands and will not be usable by the project. Some return flow, however, will be discharged through project drains to the Stewart Lake Waterfowl Management Area and will aid in meeting the management area's water requirements. Some return flow from irrigated lands also will accrue in Brush Creek and has been assumed to offset stream channel losses. The return flow from municipal and industrial use is expected to accrue to lower Ashley and Brush Creeks and the Green River. Since the return flow pattern is speculative at this time, none of this water was considered redivertible for Jensen Unit purposes.

Ground water

Limited quantities of ground water are available from two sources--shallow unconfined gravel aquifers overlying Mancos shale and deep bedrock aquifers. The water from these sources, however, is not usable by the Jensen Unit. The water in the shallow zones contains excessive concentrations of salts and is not suitable for municipal and industrial purposes. In areas where appreciable amounts are available, withdrawals in sufficient quantities for irrigation could result in a depletion to surface streams. Development of water from deep bedrock aquifers for municipal and industrial use or irrigation is not economically feasible at the present time. A small amount of water has been developed from this source in connection with oil well drilling and is being used for irrigation.

Quality of water

The water of Big and Little Brush Creeks and of Green River is of good quality for irrigation. The Big Brush Creek water is also expected to be of good quality for industrial use. Water from Ashley Springs which will be made available to the project by exchange for municipal use is of excellent quality and will require only minimal treatment.

Water Rights

Existing rights

The water of Green River is fully covered by established water rights and applications for use, including applications for the Central Utah Project and other participating projects of the Colorado River Storage Project. Flows of Brush Creek and its tributaries have been over appropriated and except for the high runoff little or no water is available for applications with a late priority.

In order that water rights in the Uinta Basin may be fully defined, an adjudication proceeding was ordered March 20, 1956, by the Fourth

Judicial District Court in and for Uintah County in Civil Action No. 3070. The adjudication is in process but is not expected to be completed for several years.

Project rights

Several water right applications have been filed with the Utah State Engineer by the Bureau of Reclamation for appropriation of water for the Jensen Unit area.

Application No. 17558 was filed on April 23, 1946, to appropriate 30 second-feet of water from Big Brush Creek for the irrigation of 3,500 acres of presently irrigated land and 1,500 acres of nonirrigated land. This application also proposed to store 10,000 acre-feet at the Tyzack Reservoir site to supplement the direct flow rights. It provided for storage of water during high runoff years to be used during low runoff years. The application was approved by the State Engineer on March 17, 1961, and is still valid.

Since the storage right under Application No. 17558 would be inadequate for the Jensen Unit as presently planned, the Bureau of Reclamation on February 21, 1969, filed Segregation Application No. 30414-a to segregate 40,000 acre-feet from the 4,000,000 acre-feet appropriated by Application No. 30414 for storage in Flaming Gorge Reservoir. At the same time Change Application No. a-5769 was filed to change the segregated 40,000 acre-feet to Big Brush Creek for storage in Tyzack Reservoir and use by the Jensen Unit. Segregation Application No. 30414-a was approved by the State Engineer on July 8, 1969, and Change Application No. a-5769 was approved July 9, 1969.

Water to be pumped from the Green River to Jensen Unit lands is covered by two water rights. Application No. 30415 covers the appropriation of 50 second-feet and Application No. 30416 as amended by Change Application No. a-5767 is for 100 second-feet. Both applications were submitted to the Utah State Engineer on August 7, 1958, and approved on March 17, 1961. Application No. 30416 was originally filed to pump water from Green River for lands in the vicinity of Ouray. When it was found not to be needed in that area and that additional capacity was needed in the Burns Pumping Plant, Change Application No. a-5767 was filed to change it to the Jensen Unit. Change Application No. a-5767 was filed February 18, 1969, and approved by the State Engineer on May 5, 1969.

The Utah Division of Wildlife Resources has the right to pump 5 second-feet from the Green River for waterfowl propagation at the Stewart Lake Waterfowl Management Area. This right was obtained under Application No. 28853 which was approved on February 24, 1958. Water under this right will be delivered by project features as explained in Chapter III.

Water Utilization

Water supply operation studies

The adequacy of available water supplies in meeting requirements of the project area was demonstrated by two water supply studies made to show conditions over the 1930-72 period. These are summarized on the following two pages. The first study shows available supplies under preproject conditions. The second study shows supplies available under project conditions with operation of Tyzack Reservoir, Tyzack Pumping Plant and Aqueduct, and the Burns Pumping Plant. This study also shows coordinated operation with Steinaker Reservoir of the Vernal Unit in delivery of the municipal and industrial water to Ashley Creek.

In the operation studies the Jensen Unit lands were divided into two areas--the Upper Brush Creek and the Lower Brush Creek. The Upper Brush Creek area includes land between Tyzack Reservoir and the potential discharge line of the Burns Pumping Plant and cannot be served by the pumping plant. It includes 664 acres of presently irrigated land and 141 acres of nonirrigated land that will be served by the project.1/ The Lower Brush Creek area includes land downstream from the discharge line of the pumping plant and is serviceable from the plant. It includes 2,974 acres of presently irrigated land and 303 acres of nonirrigated land that will be served by the project.1/ In addition, the lower area includes 333 acres of class 6W land which will continue to receive the water supplies to which they are entitled under prior rights but which will not receive project water.

The preproject study covered the distribution of direct streamflows of Big and Little Brush Creeks to presently irrigated lands. Although some water for irrigation is presently obtained from Green River, the amount is so small that it was not included in the study.

In the project operation study, direct streamflows of Big and Little Brush Creeks were used first to meet the irrigation demands of the upper Brush Creek area. Flows of Big Brush Creek remaining after these diversions were considered storable in Tyzack Reservoir. Water from Tyzack Reservoir was released to Tyzack Pumping Plant and Aqueduct for delivery to Ashley Creek. For most months, water was pumped directly to meet Jensen Unit municipal and industrial demands on Ashley Spring by exchange except that up to 2,400 acre-feet of extra water was pumped in late summer and fall for storage in Steinaker Reservoir to allow winter shutdown of Tyzack Pumping Plant and Aqueduct. Also in late winter an average of 1,000 acre-feet of water was borrowed from storage in Steinaker Reservoir and replaced in early spring by pumping from Tyzack Reservoir in excess

1/ Project acreages delineated for the water supply areas differ slightly from those in other sections of the report as the figures have not been rounded as have those in other sections.

Summary
Preproject study
(One unit = 1,000 acre-feet)

Year	Present modified flow of: Big Brush Creek near Vernal (1)	Present modified flow of: Little Brush Creek at mouth (2)	Upper Brush Creek area (664 acres): Demand (3)	Demand met from: Little Brush Creek (4)	Demand met from: Big Brush Creek (5)	Remaining demand (6)	Remaining flow: Little Brush Creek (2-4) (7)	Remaining flow: Big Brush Creek near Vernal (1-5) (8)	Lower Brush Creek area (3,307 acres): Demand (9)	Demand met from: Little Brush Creek (10)	Demand met from: Big Brush Creek (11)	Remaining demand (12)	Remaining flow: Little Brush Creek (7-10) (13)	Remaining flow: Big Brush Creek (8-11) (14)	Year
1930	31.4	6.5	2.5	2.5		0	4.0	31.4	12.2	2.0	8.4	1.8	2.0	23.0	1930
1931	16.1	3.6	2.5	1.5	1.0		2.1	15.1	12.2	.4	4.5	7.3	1.7	10.6	1931
1932	28.5	5.2	2.5	2.4	.1		2.8	28.4	12.2	1.4	9.1	1.7	1.4	19.3	1932
1933	18.8	3.9	2.5	2.0	.5		1.9	18.3	12.2	.5	7.9	3.8	1.4	10.4	1933
1934	12.2	3.0	2.5	1.4	1.1		1.6	11.1	12.2	.4	4.1	7.7	1.2	7.0	1934
1935	26.6	4.1	2.5	2.0	.5		2.1	26.1	12.2	.7	8.6	2.9	1.4	17.5	1935
1936	15.0	3.4	2.5	1.8	.7		1.6	14.3	12.2	.5	6.2	5.5	1.1	8.1	1936
1937	29.6	5.4	2.5	2.5			2.9	29.6	12.2	1.7	9.0	1.5	1.2	20.6	1937
1938	30.9	5.3	2.5	2.5			2.8	30.9	12.2	1.5	9.4	1.3	1.3	21.5	1938
1939	27.1	5.0	2.5	2.0	.5		3.0	26.6	12.2	1.1	5.1	6.0	1.9	21.5	1939
1940	17.5	3.1	2.5	1.7	.8		1.4	16.7	12.2	.3	5.1	6.8	1.1	11.6	1940
1941	31.9	5.0	2.5	2.4	.1		2.6	31.8	12.2	1.6	8.4	2.2	1.0	23.4	1941
1942	40.9	6.6	2.5	2.5			4.1	40.9	12.2	2.1	9.2	.9	2.0	31.7	1942
1943	20.0	4.1	2.5	2.0	.5		2.1	19.5	12.2	.7	7.6	3.9	1.4	11.9	1943
1944	37.2	5.6	2.5	2.5			3.1	37.2	12.2	1.9	9.9	.4	1.2	27.3	1944
1945	22.5	4.3	2.5	2.2	.3		2.1	22.2	12.2	.7	8.4	3.1	1.4	13.8	1945
1946	14.7	3.7	2.5	1.9	.6		1.8	14.1	12.2	.4	6.3	5.5	1.4	7.8	1946
1947	41.2	6.8	2.5	2.5			4.3	41.2	12.2	2.7	9.5		1.6	31.7	1947
1948	25.1	5.1	2.5	2.5			2.6	25.1	12.2	1.2	9.1	1.9	1.4	16.0	1948
1949	34.0	6.0	2.5	2.5			3.5	34.0	12.2	2.2	9.2	.8	1.3	24.8	1949
1950	36.3	6.1	2.5	2.5			3.6	36.3	12.2	2.1	8.7	1.4	1.5	27.6	1950
1951	19.7	3.9	2.5	2.1	.4		1.8	19.3	12.2	.4	8.5	3.3	1.4	10.8	1951
1952	35.4	5.3	2.5	2.5			2.8	35.4	12.2	1.8	8.7	1.7	1.0	26.7	1952
1953	19.7	3.9	2.5	2.1	.4		1.8	19.3	12.2	.4	8.8	3.0	1.4	10.5	1953
1954	16.4	3.5	2.5	1.8	.7		1.7	15.7	12.2	.5	6.1	5.6	1.2	9.6	1954
1955	14.4	2.9	2.5	1.7	.8		1.2	13.6	12.2	.2	7.7	4.3	1.0	5.9	1955
1956	16.4	3.1	2.5	1.8	.7		1.3	15.7	12.2	.1	7.0	5.1	1.2	8.7	1956
1957	27.9	4.6	2.5	2.1	.4		2.5	27.5	12.2	1.5	10.2	.5	1.0	17.3	1957
1958	23.9	4.0	2.5	2.3	.2		1.7	23.7	12.2	.5	8.0	3.7	1.2	15.7	1958
1959	15.9	3.1	2.5	1.9	.6		1.2	15.3	12.2	.2	8.1	3.9	1.0	7.2	1959
1960	12.6	2.4	2.5	1.6	.9		.8	11.7	12.2	.1	7.1	5.0	.7	4.6	1960
1961	13.3	2.4	2.5	1.6	.9		.8	12.4	12.2		6.8	5.4	.8	5.6	1961
1962	36.3	4.7	2.5	2.2	.3		2.5	36.0	12.2	1.5	7.5	3.2	1.0	28.5	1962
1963	12.5	2.2	2.5	1.4	1.1		.8	11.4	12.2		5.9	6.3	.8	5.5	1963
1964	19.3	3.0	2.5	1.9	.6		1.1	18.7	12.2	.4	8.1	3.7	.7	10.6	1964
1965	32.4	4.2	2.5	2.1	.4		2.1	32.0	12.2	1.1	11.0	.1	1.0	21.0	1965
1966	23.9	4.2	2.5	2.0	.5		2.2	23.4	12.2	.7	6.2	5.3	1.5	17.2	1966
1967	30.9	2.6	2.5	1.1	1.4		1.5	29.5	12.2	.2	9.7	2.3	1.3	19.8	1967
1968	32.6	2.7	2.5	2.1	.4		.6	32.2	12.2	.4	10.3	1.5	.2	21.9	1968
1969	27.6	3.9	2.5	2.2	.3		1.7	27.3	12.2	.8	8.6	2.8	.9	18.7	1969
1970	32.0	4.1	2.5	2.3	.2		1.8	31.8	12.2	.6	9.3	2.3	1.2	22.5	1970
1971	29.1	5.0	2.5	2.3	.2		2.7	28.9	12.2	1.4	8.9	1.9	1.3	20.0	1971
1972	21.5	4.5	2.5	2.2	.3	0	2.3	21.2	12.2	.7	8.1	3.4	1.6	13.1	1972
Total	1,071.2	182.0	107.5	89.1	18.4	0	92.9	1,052.8	524.6	39.6	344.3	140.7	53.3	708.5	Total
Average	24.9	4.2	2.5	2.1	.4	0	2.1	24.5	12.2	.9	8.0	3.3	1.2	16.5	Average

Annual summary
Jensen Unit operation study

YEAR	Upper Brush Creek area irrigation: Present modified flow: Big Brush Creek near Vernal	Upper Brush Creek area irrigation: Present modified flow: Little Brush Creek at mouth	Upper Brush Creek area irrigation: Area above Little Brush Creek (133 acres): Demand	Upper Brush Creek area irrigation: Area above Little Brush Creek (133 acres): Demand met from Big Brush Creek	Upper Brush Creek area irrigation: Area below Little Brush Creek (672 acres): Demand	Upper Brush Creek area irrigation: Area below Little Brush Creek (672 acres): Demand met from Little Brush Creek	Upper Brush Creek area irrigation: Area below Little Brush Creek (672 acres): Demand met from Big Brush Creek	Municipal and industrial water supply operations: Storable flow of Big Brush Creek	Municipal and industrial water supply operations: Spills from Steinaker Reservoir (before Jensen Unit)	Municipal and industrial water supply operations: Municipal and industrial demand	Municipal and industrial water supply operations: Steinaker Reservoir end-of-year content (before Jensen Unit)	Municipal and industrial water supply operations: Water pumped to Steinaker Reservoir	Municipal and industrial water supply operations: Municipal and industrial demand met from: Steinaker Reservoir spills	Municipal and industrial water supply operations: Municipal and industrial demand met from: Steinaker Reservoir credits	Municipal and industrial water supply operations: Municipal and industrial demand met from: Direct pumping from Tyzack Reservoir	Municipal and industrial water supply operations: Shortage	Municipal and industrial water supply operations: Effect of Jensen Unit on Steinaker Reservoir at end of year	Municipal and industrial water supply operations: Steinaker Reservoir end-of-year content (with Jensen Unit)	Municipal and industrial water supply operations: Tyzack Reservoir: Evaporation	Municipal and industrial water supply operations: Tyzack Reservoir: End-of-year content	Municipal and industrial water supply operations: Tyzack Reservoir: Maximum content	Municipal and industrial water supply operations: Tyzack Reservoir: Minimum content	Municipal and industrial water supply operations: Tyzack Reservoir: Spills	Lower Brush Creek area irrigation: Remaining flow of Little Brush Creek	Lower Brush Creek area irrigation: Total supply available (21+22)	Lower Brush Creek area irrigation: Nonproject class 6W lands (333 acres): Demand	Lower Brush Creek area irrigation: Nonproject class 6W lands (333 acres): Demand met from: Little Brush Creek and reservoir spills	Lower Brush Creek area irrigation: Nonproject class 6W lands (333 acres): Demand met from: Pumping from Green River	Lower Brush Creek area irrigation: Nonproject class 6W lands (333 acres): Shortage	Lower Brush Creek area irrigation: Project lands (3,277 acres): Demand	Lower Brush Creek area irrigation: Project lands (3,277 acres): Demand met from: Little Brush Creek and reservoir spills	Lower Brush Creek area irrigation: Project lands (3,277 acres): Demand met from: Pumping from Green River	Water supplied to Stewart Lake Waterfowl Management Area by pumping from Green River	Remaining flow of Brush Creek (23-25-29)	YEAR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(20a)	(20b)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	
1929																				22.6															1929
1930	31.4	6.5	0.5	0.5	2.5	2.5		30.9	28.4	18.0	21.2	0.8	9.3	0.6	8.1	0	0.8	22.0	1.7	21.7	24.0	20.8	21.2	4.0	25.2	1.2	1.0		0.2	12.1	6.3	5.8	0.2	17.9	1930
1931	16.1	3.6	.5	.5	2.5	1.4	1.1	14.5	2.5	18.0	1.7	2.4	1.7	2.8	13.5		.8	2.5	1.6	16.5	24.0	13.7	2.2	2.2	4.4	1.2	.3	0.3	.6	12.1	1.2	10.9	.2	2.9	1931
1932	28.5	5.2	.5	.5	2.5	2.5		28.0		18.0	19.5	3.3		3.3	14.7		.8	20.3	1.6	21.7	24.0	19.7	3.2	2.7	5.9	1.2	1.0		.2	12.1	3.3	8.8	.2	1.6	1932
1933	18.8	3.9	.5	.5	2.5	1.9	.6	17.7		18.0	8.5	3.3		3.3	14.7		.8	9.3	1.6	19.4	24.0	16.4	.4	2.0	2.4	1.2	.5	.4	.3	12.1	.3	11.8	.2	1.6	1933
1934	12.2	3.0	.5	.5	2.5	1.4	1.1	10.6		18.0	-.1	3.3		3.3	14.7		.8	.7	1.2	10.8	18.5	8.2		1.6	1.6	1.2	.2	.3	.7	12.1	.2	11.9	.2	1.2	1934
1935	26.6	4.1	.5	.5	2.5	2.0	.5	25.6		18.0	6.6	3.3		3.3	14.7		.8	7.4	1.3	17.1	20.7	14.2		2.1	2.1	1.2	.7	.2	.3	12.1		12.1	.2	1.4	1935
1936	15.0	3.4	.5	.5	2.5	1.8	.7	13.8		18.0	.1	3.3		3.3	14.7		.8	.9	1.2	11.7	16.7	9.6		1.6	1.6	1.2	.2	.5	.5	12.1	.3	11.8	.2	1.1	1936
1937	29.6	5.4	.5	.5	2.5	2.5		29.1		18.0	20.2	3.3		3.3	14.7		.8	21.0	1.4	21.4	23.6	19.1		2.9	2.9	1.2	.8	.2	.2	12.1	.8	11.3	.2	1.3	1937
1938	30.9	5.3	.5	.5	2.5	2.5		30.4	17.0	18.0	22.3	3.3	4.0	3.3	10.7		.8	23.1	1.6	21.9	24.0	21.9	14.3	2.8	17.1	1.2	1.1		.1	12.1	5.6	6.5	.2	10.4	1938
1939	27.1	5.0	.5	.5	2.5	1.9	.6	26.0	17.7	18.0	9.7	1.1	6.7	1.1	10.2		.8	10.5	1.7	17.9	24.0	15.4	17.0	3.1	20.1	1.2	.4	.3	.5	12.1	2.8	9.3	.2	16.9	1939
1940	17.5	3.1	.5	.5	2.5	1.6	.9	16.1		18.0	1.7	3.3		3.3	14.7		.8	2.5	1.5	14.5	21.5	11.7		1.5	1.5	1.2	.1	.5	.6	12.1	.3	11.8	.2	1.1	1940
1941	31.9	5.0	.5	.5	2.5	2.5		31.4	11.0	18.0	22.3	3.3	2.1	3.3	12.6		.8	23.1	1.6	21.6	24.0	21.6	6.8	2.5	9.3	1.2	.9	.1	.2	12.1	3.6	8.5	.2	4.8	1941
1942	40.9	6.6	.5	.5	2.5	2.5		40.4	34.5	18.0	17.7	1.1	8.8	1.1	8.1		.8	18.5	1.7	22.0	24.0	19.8	29.1	4.1	33.2	1.2	1.1		.1	12.1	6.2	5.9	.2	25.9	1942
1943	20.0	4.1	.5	.5	2.5	1.9	.6	18.9	8.7	18.0	15.2	3.3	3.9	3.3	10.8		.8	16.0	1.6	19.6	24.0	17.0	5.6	2.2	7.8	1.2	.8		.4	12.1	4.3	7.8	.2	2.7	1943
1944	37.2	5.6	.5	.5	2.5	2.5		36.7	17.1	18.0	23.2	3.3	2.1	3.3	12.6		.8	24.0	1.6	22.3	24.0	20.3	16.5	3.1	19.6	1.2	1.1		.1	12.1	6.2	5.9	.2	12.3	1944
1945	22.5	4.3	.5	.5	2.5	2.1	.4	21.6	10.4	18.0	19.9	3.3	4.0	3.3	10.7		.8	20.7	1.6	20.3	24.0	18.1	8.0	2.2	10.2	1.2	.8	.1	.3	12.1	5.2	6.9	.2	4.2	1945
1946	14.7	3.7	.5	.5	2.5	1.8	.7	13.5		18.0	1.4	3.3		3.3	14.7		.8	2.2	1.5	14.3	20.5	11.8		1.9	1.9	1.2	.1	.6	.5	12.1	.3	11.8	.2	1.5	1946
1947	41.2	6.8	.5	.5	2.5	2.5		40.7	15.6	18.0	23.2	3.3	2.7	3.3	12.0		.8	24.0	1.6	22.8	24.0	20.6	15.3	4.3	19.6	1.2	1.2			12.1	8.2	3.9	.2	10.2	1947
1948	25.1	5.1	.5	.5	2.5	2.5		24.6	13.3	18.0	13.3	3.3	4.0	3.3	10.7		.8	14.1	1.6	21.5	24.0	19.0	10.3	2.6	12.9	1.2	1.0		.2	12.1	5.4	6.7	.2	6.5	1948
1949	36.0	6.0	.5	.5	2.5	2.5		33.5	11.9	18.0	18.4	3.3	2.1	3.3	12.6		.8	19.2	1.6	22.1	24.0	20.8	15.4	3.5	18.9	1.2	1.1		.1	12.1	5.8	6.3	.2	12.0	1949
1950	36.3	6.1	.5	.5	2.5	2.5		35.8	20.0	18.0	21.1	3.3	4.0	3.3	10.7		.8	21.9	1.7	21.8	24.0	19.7	20.4	3.6	24.0	1.2	1.1		.1	12.1	5.6	6.5	.2	17.3	1950
1951	15.7	3.9	.5	.5	2.5	2.0	.5	18.7	3.7	18.0	16.5	3.3	2.1	3.3	12.6		.8	17.3	1.6	19.8	24.0	17.2	3.2	1.9	5.1	1.2	.7	.2	.3	12.1	2.9	9.2	.2	1.5	1951
1952	35.4	5.3	.5	.5	2.5	2.5		34.9	22.4	18.0	24.7	3.3	4.0	3.3	10.7		.8	25.5	1.6	21.3	24.0	18.9	17.8	2.8	20.6	1.2	1.0		.2	12.1	5.5	6.6	.2	14.1	1952
1953	19.7	3.9	.5	.5	2.5	2.0	.5	18.7	3.4	18.0	14.1	3.3	3.3	3.3	11.4		.8	14.9	1.6	20.1	24.0	17.5	3.6	1.9	5.5	1.2	.6	.3	.3	12.1	3.0	9.1	.2	1.9	1953
1954	16.4	3.5	.5	.5	2.5	1.7	.8	15.1		18.0	3.7	3.3		3.3	14.7		.8	4.5	1.5	15.7	21.5	13.0		1.8	1.8	1.2	.3	.4	.5	12.1	.3	11.8	.2	1.2	1954
1955	14.4	2.9	.5	.5	2.5	1.7	.8	13.1		18.0	-.1	3.3		3.3	14.7		.8	.7	1.2	9.6	14.9	6.7		1.2	1.2	1.2	.2	.6	.4	12.1		12.1	.2	1.0	1955
1956	16.4	3.1	.5	.5	2.5	1.8	.7	15.2		18.0	0	3.3		3.3	14.7		.8	.8	1.0	5.8	11.0	2.9		1.3	1.3	1.2	.1	.6	.5	12.1	.6	12.1	.2	1.2	1956
1957	27.9	4.6	.5	.5	2.5	2.2	.3	27.1		18.0	9.1	3.3		3.3	14.7		.8	9.9	1.0	13.9	15.7	11.4		2.4	2.4	1.2	.8	.3	.1	12.1	.6	11.5	.2	1.0	1957
1958	23.9	4.0	.5	.5	2.5	2.2	.3	23.1	2.2	18.0	15.0	3.3	2.1	3.3	12.6		.8	15.8	1.7	19.4	23.9	16.4		1.8	1.8	1.2	.5	.4	.3	12.1	.1	12.0	.2	1.2	1958
1959	15.9	3.1	.5	.5	2.5	1.9	.6	14.8		18.0	-.1	3.3		3.3	14.7		.8	.7	1.4	14.8	19.4	11.9		1.2	1.2	1.2	.2	.6	.4	12.1		12.1	.2	1.0	1959
1960	12.6	2.4	.5	.5	2.5	1.6	.9	11.2		18.0	0	3.3		3.3	14.7		.8	.8	1.2	6.8	13.6	3.9		.8	.8	1.2	.1	.6	.5	12.1		12.1	.2	.7	1960
1961	13.3	2.4	.5	.5	2.5	1.6	.9	11.9		18.0	0	3.3		3.3	14.7		.8	.8	.7	0	5.8	0		.8	.8	1.2		.7	.5	12.1		12.1	.2	.8	1961
1962	36.3	4.7	.5	.5	2.5	2.2	.3	35.5	21.0	18.0	20.3	3.3	4.0	4.5	9.5		.8	21.1	1.1	20.2	24.0	17.6	1.4	2.5	3.9	1.2	.8		.4	12.1	2.1	10.9	.2	1.0	1962
1963	12.5	2.2	.5	.5	2.5	1.3	1.1	10.9		18.0	3.5	3.3		3.3	14.7		.8	4.3	1.3	11.8	19.5	8.8		.9	.9	1.2		.6	.6	12.1	.1	12.0	.2	.8	1963
1964	19.3	3.9	.5	.5	2.5	1.9	.6	18.2		18.0	2.2	3.3		3.3	14.7		.8	1.0	1.0	11.0	15.2	8.1		1.1	1.1	1.2	.4	.5	.3	12.1		12.1	.2	.7	1964
1965	32.4	4.2	.5	.5	2.5	2.1	.4	31.5		18.0	30.2	3.3		3.3	14.7		.8	31.0	1.3	22.1	24.0	21.3	1.1	2.1	3.2	1.2	.7	.5		12.1	1.6	10.5	.2	.9	1965
1966	23.9	4.2	.5	.5	2.5	1.9	.6	22.8	16.7	18.0	8.0	1.1	5.7	1.1	11.2		.8	8.8	1.7	18.5	24.0	15.8	12.4	2.3	14.7	1.2	.4	.3	.5	12.1	2.7	9.4	.2	11.6	1966
1967	30.9	2.6	.5	.5	2.5	1.0	1.5	28.9	8.4	18.0	25.2	3.2	2.5	3.3	12.2		.7	25.9	1.6	21.7	24.0	19.5	8.7	1.6	10.3	1.2	.6	.4	.2	12.1	3.2	8.9	.2	6.5	1967
1968	32.6	2.7	.5	.5	2.5	2.2	.3	31.8	10.8	18.0	21.9	3.4	2.1	3.3	12.6		.8	22.7	1.6	21.9	24.0	20.0	14.0	.5	14.5	1.2	.5	.5	.2	12.1	3.0	9.1	.2	11.0	1968
1969	27.6	3.3	.5	.5	2.5	2.1	.4	26.7	14.2	18.0	17.7	3.3	4.0	3.3	10.7		.8	18.5	1.6	20.7	24.0	18.1	12.3	1.8	14.1	1.2	.7	.3	.2	12.1	5.3	6.8	.2	8.1	1969
1970	32.0	4.1	.5	.5	2.5	2.2	.3	31.2	15.6	18.0	20.0	3.3	2.1	3.2	12.6		.8	20.8	1.6	21.3	24.0	18.8	13.1	1.9	15.0	1.2	.7	.3	.2	12.1	3.1	9.0	.2	11.2	1970
1971	29.1	2.0	.5	.5	2.5	2.1	.2	28.4	10.3	18.0	18.0	3.3	2.1	3.3	12.6		.8	18.8	1.6	21.8	24.0	19.6	10.4	2.7	11.1	1.2	.8	.1	.3	12.1	3.3	8.8	.2	8.8	1971
1972	21.5	4.5	.5	.5	2.5	2.1	.4	20.6	11.1	18.0	14.9	3.3	4.0	3.3	10.7	0	.8	15.7	1.6	20.0	24.0	20.0	6.8	2.4	9.2	1.2	.8	.1	.3	12.1	5.2	6.9	.2	3.2	1972
Total	1,071.2	182.0	21.5	21.5	107.5	87.8	19.6	1,030.1	347.9	774.0	551.9	131.9	93.4	133.3	547.3	0	34.3	586.2	63.0				290.5	94.2	384.7	51.6	26.4	11.9	13.3	520.3	114.1	406.2	8.6	244.2	Total
Avg.	24.9	4.2	.5	.5	2.5	2.0	.5	23.9	8.1	18.0	12.8	3.1	2.2	3.1	12.7	0	.8	13.6	1.5				6.7	2.2	8.9	1.2	.6	.3	.3	12.1	2.7	9.4	.2	5.7	Avg.

of the amount needed for direct exchange with Ashley Spring. Whenever possible, spills from Steinaker Reservoir were utilized to reduce pumping from Tyzack Reservoir. Increased evaporation losses at Steinaker Reservoir due to the coordinated operation were negligible. Irrigation demands in the lower Brush Creek area were met from direct flows of Little Brush Creek, spills from Tyzack Reservoir, and pumping from the Green River by the Burns Pumping Plant. Also water was provided from the Green River by the Burns Pumping Plant for the Stewart Lake Waterfowl Management Area. Although not shown in the operation studies, return flows from project irrigation would accrue to the management area.

In project operation Tyzack Reservoir would be filled in the winter and early spring. Irrigation releases generally would be made from April through October. Pumping to Ashley Creek for municipal and industrial use would generally take place from March through November to avoid winter operation of the Tyzack Pumping Plant and Aqueduct. Water would be pumped from the Green River to the Stewart Lake Waterfowl Management Area during the non-peak irrigation season when capacity is available in the Burns Pumping Plant and Burns Bench Canal.

Natural flows of Green River would fully meet the requirements of Burns Pumping Plant since the historical flows of the river near Jensen are far in excess of the project diversion requirements. Projected future uses under rights senior to the project rights would not encroach on the project water supply.

Project water supply

The project water supply will average about 22,600 acre-feet annually, including 4,600 acre-feet for irrigation and 18,000 acre-feet for municipal and industrial use. Approximately 670 acre-feet of water will be provided by the project to the Stewart Lake Waterfowl Management Area as replacement for water presently obtained by diversion from Ashley Creek or from Green River through the existing pumping plant operated by the Utah Division of Wildlife Resources. Approximately 230 acre-feet of the replacement water will be pumped from the Green River through the project Burns Pumping Plant and 440 acre-feet will be return flow delivered through project drains.

Water supply shortages

Irrigation shortages on presently irrigated lands without the project would have averaged 22 percent annually over the study period and would have occurred in 42 of the 43 years. The greatest shortages would have been 50 percent in 1931, 52 percent in 1934, and 46 percent in 1940. With the project in operation over the study period, the project water supplies would have met all of the project demands. No shortages would have occurred for irrigation nor for municipal and industrial use.

Effects of Project on Colorado River System

Stream depletions

The Jensen Unit will deplete the flow of the Colorado River by an estimated average of 15,000 acre-feet annually. the depletion will result from the various project water uses as shown below.

Use	Annual depletion (acre-feet)
Municipal	4,000
Industrial	6,400
Irrigation	2,800
Reservoir evaporation	1,500
Total	14,700
(Rounded)	15,000

Return flows and salt loads

The average water supply diverted each year for all project uses will be about 22,600 acre-feet. Of this total, approximately 8,000 acre-feet is expected to return to local stream channels and ultimately to the Green River and Colorado River.

The salt load of the Colorado River will be increased by an estimated 880 tons annually as a result of project operation. This is based on an estimated average increase of 2 tons per acre in addition to natural contributions from the 440 acres of full service land. The increased salt load from the supplemental service land is estimated to be negligible since the lands have already been leached by irrigation over a number of years.

The estimated quantity of dissolved solids that will be added to the river by return flows from municipal and industrial water uses is so small that it may be considered negligible. The only present industrial use of any significance in the project area is Stauffer Chemical, which is operating on the basis of zero discharge. In view of existing legal restraints, it is logical to assume that future industrial users of project water will operate on a similar basis, especially those with significant pollutants. Specific sources of salt pickup from municipal water uses are negligible at present and are expected to remain so in the foreseeable future.

Downstream salinity effects

The estimated increase in salt load resulting from operation of the Jensen Unit will increase the salinity concentration of the Colorado

River at Imperial Dam by about 0.1 mg/l or 0.01 percent. The salt-concentrating effects resulting from streamflow depletions will increase the salinity concentration of the river at Imperial Dam by an estimated 1.5 mg/l or 0.17 percent. The changes in concentration will only slightly affect the total concentration of the river at Imperial Dam, which was 879 mg/l in 1972.

The estimated effects of the Jensen Unit on the salinity of the Colorado River are based on the Bureau of Reclamation's Quality of Water, Colorado River, Progress Report No. 7 (January 1975). This report shows modifications of the stream conditions made to December 1972. The conditions were further modified to reflect the impacts of all developments constructed since 1972 or currently under construction. The salinity increases from the Jensen Unit were then computed as if the project were the next development constructed.

Externalities

Negative externalities will be realized from the project's effects in increasing the salinity of the Colorado River in the Lower Colorado River Basin. These are estimated as shown below.

	Direct effects	Indirect effects	Total effects
Increase in salt load	$18,800	$4,200	$23,000
Concentrating effects of stream depletion	282,000	63,000	345,000

The negative externalities are based on rates of $230,000 for each mg/l of salinity increase at Imperial Dam, including $188,000 in direct effects and $42,000 in indirect effects. These rates were computed by the Bureau of Reclamation, taking into account reduced productivity and increased agricultural production costs that downstream water users might experience as a result of salinity increases as well as increased costs that might be necessary for treatment of municipal and industrial water. They also take into account the reduced life of water pipes and other facilities that would result from mineral concentrations.

CHAPTER VI

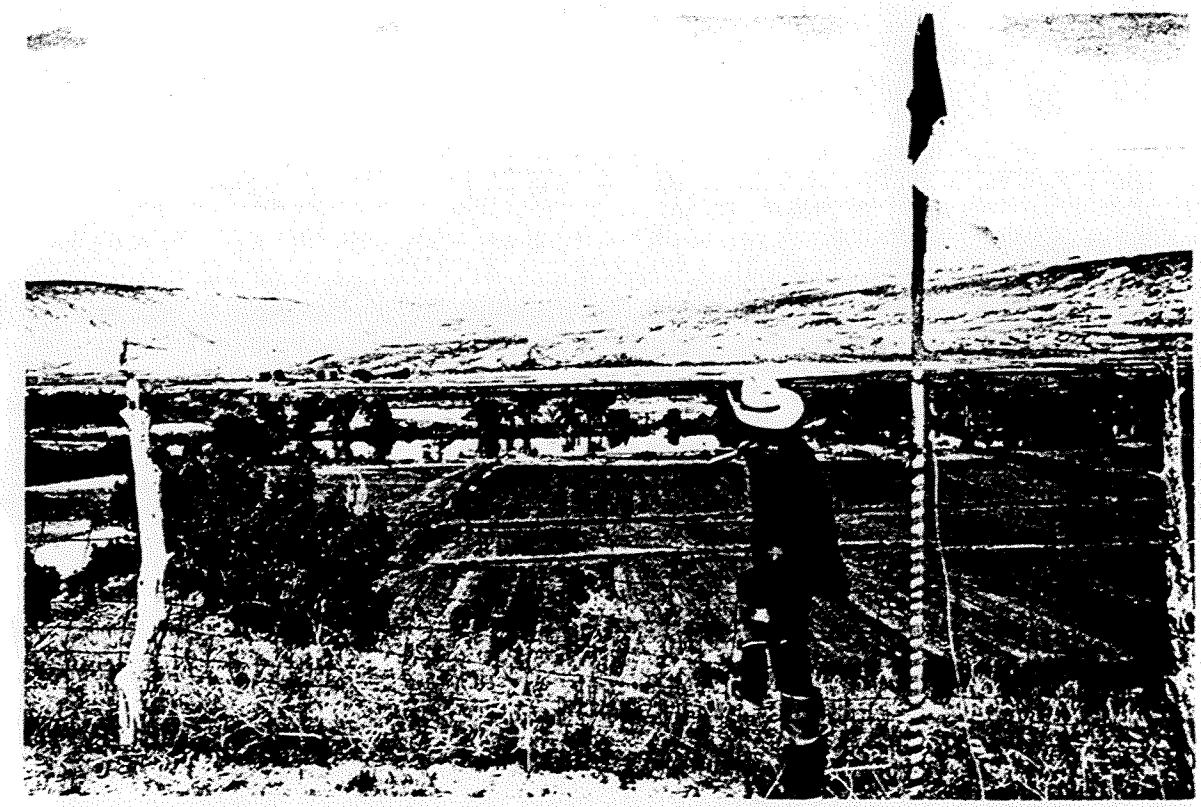
IRRIGATION

Lands which will be irrigated by the Jensen Unit lie in scattered tracts along Brush Creek and in a large block west of Green River in the vicinity of Jensen, Utah. They are at an average elevation of about 4,800 feet and range in elevation from 4,730 to 5,460 feet.

Project Lands

Land classification

Lands in the Jensen Unit area have been classified as to their relative suitability for irrigation in a detailed survey made by the Bureau of Reclamation. The original classification was made in 1946. Minor refinements were completed in 1957, and the classification was revised and updated in 1964-65. Certification as to the adequacy of soil survey and land classification as required by the 1954 Appropriation Act was accomplished by the Assistant Secretary of the Interior in his letter of April 8, 1971, to the President of the United States Senate.



Project lands along Green River at approximate site of discharge lines from Burns Pumping Plant.

A total of 15,720 acres of land was covered in the land classification survey. Of this acreage 4,320 acres were designated as class 1, 2, and 3 land, or arable and suitable for project irrigation. The remaining 11,400 acres were designated as nonarable with 330 acres of irrigated land designated as class 6W and 11,070 acres of nonirrigated land designated as class 6. Results of the land classification are summarized below.

Land classification summary
(Unit--acres)

	Irrigated land	Nonirrigated land	Total
Arable land			
Class 1	70		70
Class 2	3,350	280	3,630
Class 3	420	200	620
Subtotal	3,840	480	4,320
Nonarable land			
Class 6W	330		330
Class 6		11,070	11,070
Subtotal	330	11,070	11,400
Total	4,170	11,550	15,720

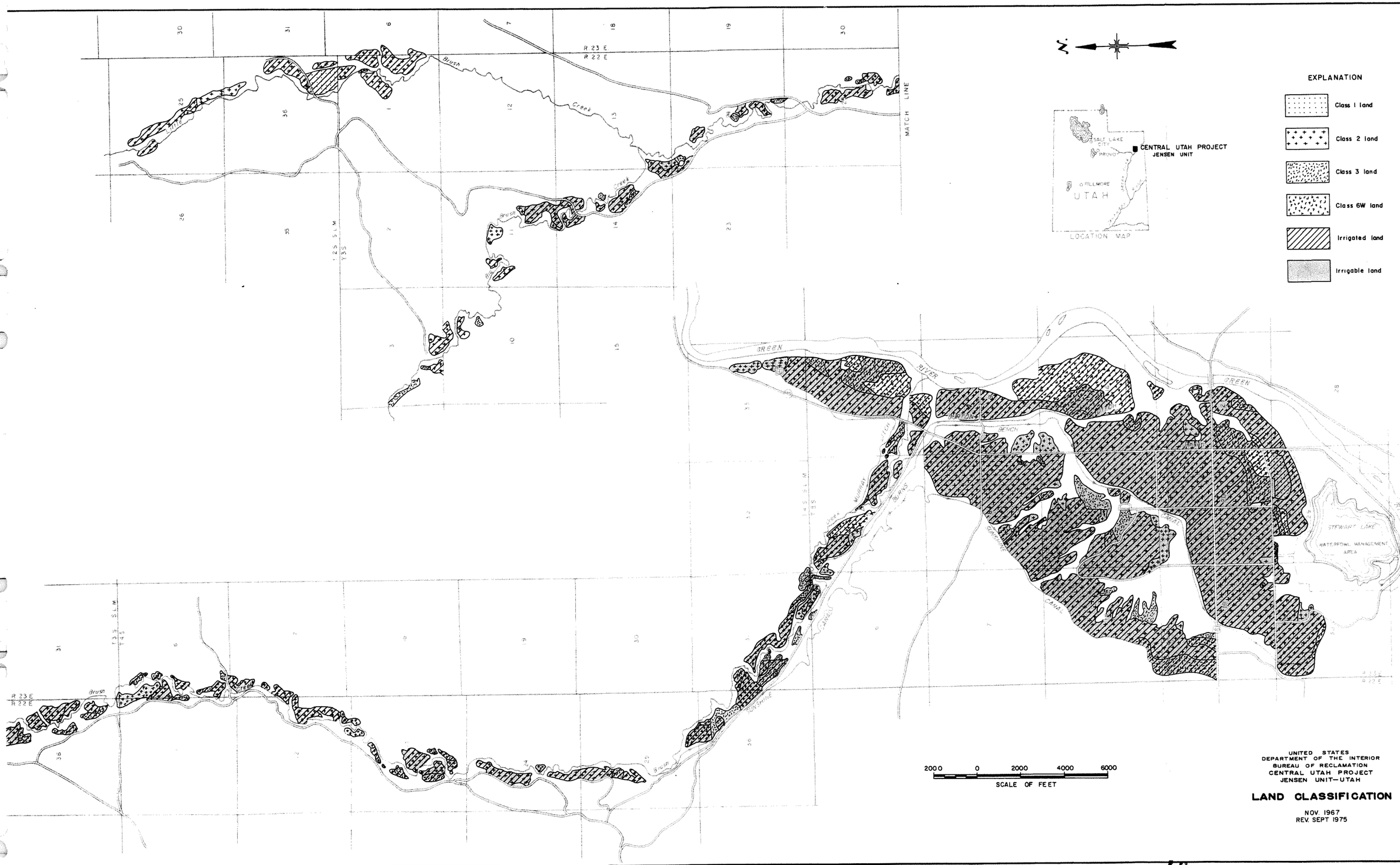
Selection of project area

Of the 4,320 acres of land found to be arable, 4,080 acres have been selected for project service. The 240 acres not served will be either inundated by Tyzack Reservoir or situated in isolated areas that cannot be economically served. Of the land selected for project service, 440 acres will be full service land and the remaining 3,640 acres will receive supplemental service. The full service lands are all in small tracts interspersed among the supplemental service lands and will be incorporated in existing farm units. The 330 acres of nonarable class 6W land in the project area will not be furnished project water but will continue to receive their proportionate share of natural streamflow.

The project acreage is summarized below by land class and shown on the map on the following page.

Project service area
(Unit--acres)

	Supplemental service land	Full service land	Total
Class 1	40		40
Class 2	3,180	250	3,430
Class 3	420	190	610
Total	3,640	440	4,080



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT
JENSEN UNIT—UTAH

LAND CLASSIFICATION

NOV 1967
REV. SEPT 1975

450-418-8

Land characteristics

Characteristics of the project lands vary largely with their locations on benches or terraces west of the Green River and in the long, narrow valley along Brush Creek.

The lands west of Green River are on two benches--the Burns Bench adjacent to the river and the higher Sunshine Bench. Soils of the bench lands were derived from alluvial material of recent geologic origin which has been modified and reworked by the river. The soils have no distinct profile patterns or horizons. Areas of deep, fine-textured soils are often in close proximity to areas of coarse-textured soils or shallow soils over gravel and cobble. The bench lands are generally smooth with long, gentle slopes that are highly conducive to irrigation.

The valley lands adjacent to Brush Creek are characterized by narrow tracts of arable land which are gently rolling and have moderate slopes. Many of these lands are on small alluvial fans deposited at right angles to the major stream course. The soils are derived from recent alluvial material. They are yellowish brown in color, deep, and medium textured except for an occasional clay profile. The fields are usually small and irregular, resulting in short to moderately long irrigation runs. The larger blocks of these lands are located near the mouth of Brush Creek.

Lands selected for project service are generally well leached of soluble salt and are highly productive. Their suitability for irrigation is evidenced by the nearly 90 years of sustained irrigation farming that has been undertaken on the presently irrigated lands.

Drainage

Project drainage will be required on about 700 acres of project land, almost all of which will be supplemental service land. The land requiring drains has been identified as either drainage deficient at the present time or as likely to develop deficiencies with project development. The remaining project lands have natural characteristics which would provide for adequate drainage. There is expected to be no need for individual farm drainage on project lands.

The drainage-deficient or potentially deficient lands occupy low topographic positions on the southern portion of Burns Bench in the general vicinity of Jensen. These lands are subject to the encroachment of surface and subsurface water from lands higher on the bench, have a relatively flat ground surface and barrier surface slopes, and have no well developed outlet channels for surface runoff and subsurface drainout. They do, however, have good permeability rates so that artificial drainage with the project would be feasible.

Agricultural Economy

Types of farms

Production of beef cattle is the primary agricultural enterprise with production of sheep next in importance. Either beef cattle or sheep or a combination of both is found on most of the farms. Irrigated lands are devoted almost exclusively to crops for winter livestock feeds. Alfalfa hay and pasture are produced on about 80 percent of the irrigated land. Corn silage and small grains also are important crops. No cash crops are grown.

Typical herd of cattle in Jensen Unit area.

No significant change will be made with project development in the types of farming enterprises. Substantial increases in feed crop production will be realized with the increased water supplies and the additional feeds will permit an expansion and stabilization of the livestock industry.

Excess lands

In the Jensen Unit area, two ownerships contain more than 160 acres of irrigable land, and one ownership contains more than 320 acres of irrigable land. Reclamation law limits delivery of project water to 160 acres in single ownership or 320 acres owned jointly by a man and wife. The larger ownership contains approximately 1,000 acres of irrigable land; however, there are indications that this farm will soon be divided into smaller parcels. The 440 acres of full service land will be included in the existing farm units but will not create excess holdings.

Development period

Project irrigators will be allowed a development period of 3 years after the first delivery of project water and before the assessment of construction charges. The same period will be allowed for full and supplemental service land since only small acreages of full service land will be included in the project and these will all be incorporated in existing units.

Payments for irrigation water

An average amount of $4.50 annually for each acre-foot of project water measured at canal heads is recommended for payment by the irrigation water users toward project operation, maintenance, replacement, and construction costs. At this rate the irrigators' annual payments would total $21,000 for the 4,600 acre-feet of irrigation water that will be provided each year. One rate of payment is recommended for lands in all classes in the project area.

The recommended irrigation water charge is the amount determined as payable by the project water users after their payments for farm operating expenses, interest on investment, return to labor and management, and a 15 percent contingency. The payments were estimated from detailed farm budget analyses of agricultural conditions anticipated with and without project development on representative beef and beef-sheep farms. The studies were made for conditions anticipated near the end of the development period when the water users would be required to start making payments on construction costs. The studies were made of farm units composed entirely of class 2 land since only nominal acreages of land in other classes are in the project service area. Prices used represent current agricultural prices normalized for short-term fluctuations. Selected data in the determination of recommended charges for the irrigators are summarized on the following table.

Selected data in determination of recommended annual payments by irrigators (per farm)

	Without project	With project	Increase due to project
Irrigable area (acres)	160	160	0
Water supply (acre-feet)	456	1/592	136
Gross farm income	$30,598	$33,002	$2,404
Farm expenses	20,653	21,706	1,053
Net farm income	9,944	11,295	1,351
Return to equity	1,728	1,802	74
Return to labor and management	8,217	8,774	557
Payment capacity		720	720
Recommended water charge 2/		612	612
Recommend water charge per acre-foot			4.50
Total recommended water charge ($4.50/acre-foot x 4,600 acre-feet of project irrigation supply) rounded			$21,000

1/ Water for full irrigation service, based on supply of 3.70 acre-feet per acre.

2/ Reflects contingency allowance of approximately 15 percent, amount rounded.

Irrigation benefits

The value of irrigation benefits from the Jensen Unit is estimated at an average of $183,000 annually, including $166,000 in direct benefits and $17,000 in indirect and public benefits. The direct benefits represent increased net farm income to the water users resulting from project development. The indirect benefits include increased profits of enterprises off the farm from the handling and processing of farm production. Public benefits representing the economic growth are estimated at 5 percent of direct benefits.

The benefits were estimated from detailed farm budget analyses similar to those prepared for estimating payment capacity. The budget for the benefit analyses were based on agricultural conditions anticipated about 15-20 years following the development period to reflect increases in farm production anticipated in the area in line with increases continuously being realized throughout the Nation as a result of improvements in farm machinery, techniques, and management. The benefits were estimated on the same price base as the payment capacity as discussed above.

The estimates of benefits were made for project conditions over a 100-year period of analysis. Adjustments were made in the estimate for

accrual of only partial benefits during the development period. Adjustments also were made for losses in agricultural production on lands that will be inundated by the Tyzack Reservoir in excess of land acquisition costs.

Data used in the determination of irrigation benefits are shown on the table below.

Summary of farm budget data for determination of average annual irrigation benefits

Item	Project increase
Gross farm income	$248,000
Farm expenses	-76,000
Net farm income	172,000
Total water supply (acre-feet)	4,600
Project water supply (acre-feet)	4,600
Project irrigation benefits	
Direct benefits with full irrigation development	172,000
Indirect benefits	20,000
Public benefits	9,000
Total benefits	200,000
Project benefits adjusted for development and rounding	
Direct benefits	166,000
Indirect benefits	19,000
Public benefits	8,000
Total benefits	194,000
Loss of indirect benefits (reservoir inundation)	-10,500
Total benefits (rounded)	183,000
Total benefits per acre-foot	40.00

CHAPTER VII

MUNICIPAL AND INDUSTRIAL WATER

Anticipated Use

Anticipated requirements for municipal and industrial water use are discussed in Chapter II, and the planned project operation to meet these requirements is discussed in Chapter V. Projected requirements were based on population growth associated with an accelerated commercial level of oil shale development in Uintah County and accelerated development of other natural resources within the project area. Although the oil shale development is expected to occur outside the Jensen Unit area, significant numbers of people employed by the industry are expected to reside in the project area, thus increasing the demand for municipal water. In addition, an industrial water requirement has been projected for increased development of other natural resources such as phosphate, tar sands, gilsonite, and petroleum expected to develop in or near the project area. The anticipated requirements for new municipal and industrial water are summarized below.

Estimated new municipal and industrial water requirement and supply
(Unit--acre-feet)

Year	Estimated population increases	Requirement for additional water supplies	Available from Jensen Unit
1980	20,800	6,500	6,000
1985	28,100	11,900	12,000
1990	32,600	13,300	18,000
1995	34,800	14,400	18,000
2000	41,800	16,200	18,000

After the project is completed, a municipal and industrial water supply of 18,000 acre-feet will be provided each year. It is anticipated that separate blocks of water, each of 6,000 acre-feet, will be made available for use by about 1980, 1985, and 1990. Although it has been assumed that the requirement for municipal and industrial water will develop in areas serviceable by the Ashley Valley municipal water system, there is flexibility in the project plan for use elsewhere in the project area if the need develops. For example, water could be made available on Brush Creek below Tyzack Reservoir or above the reservoir by exchange. Exchange possibilities also exist on Ashley Creek in addition to the exchange with Ashley Spring. The exact distribution of the water supply will therefore be determined on the basis of when and where the need actually develops.

The estimated monthly distribution of the municipal and industrial demand is shown below. The demand is a combination of an 8,000-acre-foot per year industrial component with a uniform monthly distribution pattern and a 10,000-acre-foot municipal component that varies monthly in accordance with the present pattern of use in Vernal City.

Estimated monthly demand for municipal and industrial water

Month	Percent	Acre-feet
January	6.7	1,200
February	5.6	1,000
March	6.7	1,200
April	7.8	1,400
May	10.5	1,900
June	11.7	2,100
July	11.1	2,000
August	10.0	1,800
September	9.4	1,700
October	8.3	1,500
November	6.1	1,100
December	6.1	1,100
Total	100.0	18,000

Municipal and Industrial Water Benefits

Benefits from the project municipal and industrial water supply are estimated at an average of $2,055,000 annually for the 18,000 acre-feet of water planned for this purpose. These benefits were measured by the average annual equivalent costs of obtaining the quantity of water provided by the project from the most likely alternative single-purpose means of development. This alternative was considered to be a diversion of water from Ashley Spring and replacement of this supply from the Green River. The replacement water from Green River would be pumped to Ashley Valley through a series of three pumping plants, each with a rated capacity of 46 second-feet, and through a pipeline about 16 miles long.

Construction costs of the single-purpose alternative were based on 1975 prices, a 3-year construction period, and private financing with 6 percent municipal bonds, amortized over 20 years. Annual operation, maintenance, and replacement costs were estimated using 1972-74 prices. Power pumping costs were based on the Colorado River Storage Project rate for preferential customers of 3 mills a kilowatt-hour for energy and $1.32 a kilowatt-month for capacity.

As shown in the following table the annual municipal and industrial benefit is computed as $114.00 per acre-foot.

Computation of municipal and industrial water benefits

Item	Estimated cost
Investment	
Construction cost	$23,217,000
Interest during construction	2,031,000
Total investment	25,248,000
Annual costs	
Investment (50 years at 7 percent)	1,829,000
Annual operation, maintenance, and replacement costs	226,000
Total annual costs	2,055,000
Annual benefit per acre-foot (18,000 acre-feet)	114.17
Rounded	114.00
Total municipal and industrial water benefits	2,055,000

Water Charges

Repayment will be required for all project costs allocated to municipal and industrial water, as shown in Chapter X, including construction costs, interest during construction, interest on the unpaid balance, and annual operation, maintenance, and replacement costs. The water users would be required to start making payments for water as soon as the water is put to use. Costs of reservoir storage not immediately used would be deferred under provisions of the Water Supply Act of July 3, 1958 (72 Stat. 319). In addition to costs of project works, additional costs would be incurred by the water users for facilities provided by them for diversion, distribution, and treatment of water supplies.

CHAPTER VIII

OTHER PROJECT EFFECTS

In addition to providing irrigation and municipal and industrial water as previously discussed, the Jensen Unit will improve fish and wildlife resources, increase recreational opportunities, and provide flood control. Hydroelectric power production in connection with the project was not found to be feasible.

Possible effects of the Jensen Unit in their fields of interest have been appraised by the Federal agencies concerned, including the Fish and Wildlife Service, National Park Service, Corps of Engineers, Bureau of Mines, Environmental Protection Agency, and the Bureau of Land Management. Reports or letters from these agencies are attached to this report, and their conclusions are briefly summarized in this chapter.

Fish and Wildlife

The Fish and Wildlife Service reports that the project as presently planned with several specific measures for fish and wildlife will be generally beneficial to fish and wildlife resources although some adverse effects will occur.

Fishing opportunities will be increased with construction of Tyzack Reservoir but some opportunities for stream fishing will be lost. The dead and inactive capacity of 2,000 acre-feet in Tyzack Reservoir will provide an adequate minimum pool for fish. The reservoir is expected to provide about 9,500 man-days of fishing annually. A loss of 1,700 man-days of stream fishing is anticipated with project development on Big Brush Creek. No feasible means for mitigation of this loss has been found. No estimates have yet been made of the effects on fish and wildlife of the project diversions to Ashley Creek and Steinaker Reservoir but they are expected to be somewhat beneficial.

The operation for the Stewart Lake Waterfowl Management Area will be improved with delivery of water from the project to replace the present supply. Replacement water from the project will be provided more economically than from present sources and will be delivered at a higher point in the area, which will permit the development of an additional 100 acres of marsh land.

A range rehabilitation program to be undertaken as a part of project development will mitigate the loss of deer winter range and other wildlife habitat that will result from inundation of the reservoir basin and construction of access roads around the reservoir. Approximately 500

acres of public land about 2 miles north of the reservoir will be rehabilitated. No acquisition of land will be required. The juniper-pinon cover on the lands will be partially removed and the lands will be reseeded to grasses and browse plants.

View of developed section of Stewart Lake Waterfowl Management Area.

Some habitat for upland game will be lost with the construction of Tyzack Reservoir but the losses will be compensated for by improvements in habitat on the new agricultural land that will be irrigated by the project. Hunting opportunities for pheasants will be slightly increased but hunting opportunities for other upland game will be virtually unchanged. Small increases will also be realized in the hunting opportunities for waterfowl and fur animals, particularly in the Stewart Lake area.

Specific costs for project fish and wildlife development amount to $43,000 and include costs of rehabilitating land for big game range and costs of constructing the Stewart Lake Lateral to the Stewart Lake Waterfowl Management Area. Other costs for fish and wildlife development in project joint-use facilities are included in the Bureau of Reclamation cost estimates and are allocated for fish and wildlife as discussed in Chapter X. The specific fish and wildlife costs are summarized on the following page.

Specific costs for fish and wildlife

	Capital cost
Big game range rehabilitation	$20,000
Stewart Lake Lateral	23,000
Total	43,000

The only annual costs associated with the fish and wildlife development will be the operation, maintenance, and replacement cost of the Stewart Lake Lateral, estimated as $300 a year.

Benefits to fish and wildlife from project development are estimated at an average of $24,000 annually, most of which will be attributable to increased fishing. The U.S. Fish and Wildlife Service has estimated an increase of 9,500 man-days of fishing annually resulting from project development. The value of a fisherman day, estimated by Fish and Wildlife Service and updated to the criteria published in the Federal Register Vol. 38, No. 174, September 10, 1973, is $2.25. At this rate increased fishing benefits are estimated to be $21,400 annually.

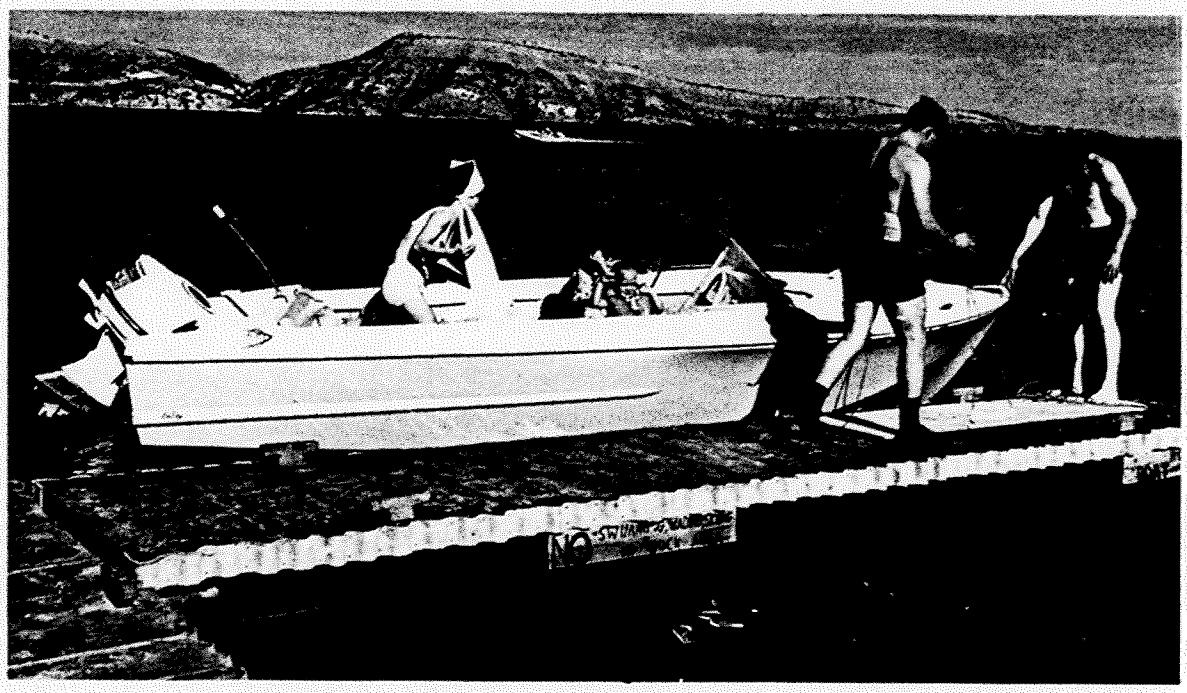
Sources and amounts of the total benefits are summarized in the following tabulation.

Fish and wildlife benefits	
Reservoir fishery	$21,400
Increase in pheasant hunting	300
Improvements in Stewart Lake Waterfowl Management Area	
Savings of operational costs	1,100
New marsh land development	900
Total	23,700
Rounded	24,000

Recreation

As discussed in Chapter IV, the recreational development at Tyzack Reservoir will include an access road, recreation facilities, and utilities. According to the National Park Service, the recreation potential of the development is moderate. The use will be limited to the warmer months of May to September and most of the users will be from within a 100-mile travel zone.

The recreational complex will be located on a sloping 10-acre sagebrush-covered site along the northwest portion of the reservoir. The site is situated at the base of a large dome rock formation and opposite rock formations similar to those found in southern Utah's parks. The surrounding terrain is rolling hills covered with sagebrush and old stands of juniper forest. The boater will experience the opportunity to view rock formations similar to those found at Lake Powell.



Water recreation on Steinaker Reservoir of Vernal Unit, indicative of recreational opportunities that will be available at Tyzack Reservoir of Jensen Unit.

Use of the recreational development has been estimated by the National Park Service in a letter of June 28, 1974, which is attached to this report. The Park Service estimated the annual recreational use to be about 40,000 recreation days initially, with an increase to about 50,000 recreation days by the year 2000, and to a peak of 70,000 recreation days by the year 2020. Increases to about 2020 are expected to be uniform. After 2020 and for the remaining life of the development, use is expected to remain at about 70,000 recreation days annually.

Benefits from the recreational development are estimated at an average of $88,000 annually. These benefits have been based on a value of $1.60 for each of 55,000 recreation days. The 55,000 recreation days represent the annual equivalent of the anticipated recreational use over a 100-year period after project construction.

Flood Control

Studies of the Corps of Engineers indicate that the Tyzack Reservoir will provide average benefits of $24,000 annually on the basis of January 1974 prices through control of snowmelt and rainstorm floods on Big Brush Creek. The benefits are based on control of floods not exceeding the 100-year event and will depend on evacuation of the reservoir on the basis of snowmelt forecasts and on use of surcharge storage capacity to reduce damaging flood flows below the reservoir.

Mineral Development

The Bureau of Mines concluded that future mining activity and oil and gas development in the area of the Tyzack Dam and Reservoir site and auxiliary facilities will not be affected adversely by the project construction. The Park City formation, containing large reserves of phosphate rock, outcrops northwest of the Tyzack Reservoir site where the Stauffer Chemical Company is mining. This formation is undoubtedly also present beneath the Tyzack Reservoir site. Because of the huge reserves of phosphate rock that are more readily accessible upstream from the reservoir, it appears unlikely that underground mining of the rock in the vicinity of the reservoir would be considered in the foreseeable future. No significant amounts of other mineral deposits are known to exist in the areas proposed for construction.

Public Lands

The Bureau of Land Management has conducted a survey to determine the potential impact of the Jensen Unit on public lands, resources, and programs. It states that 4,800 acres within the Tyzack Reservoir drainage are administered by the Bureau of Land Management and, since these lands will have a direct influence on Tyzack Reservoir, intensive watershed management should be continued with attention to land pollution sources and programs for treatment. The Bureau of Land Management states that Tyzack Reservoir will be within its Red Mountain Recreation Area which is planned for development as demand warrants and funds become available. It concurs in the recommendation of the National Park Service that recreational facilities at the reservoir be administered by the Utah Division of Parks and Recreation and recommends that the State and Federal recreational activities be closely coordinated to be of the greatest service to the users and to offer maximum protection of the resources.

The Bureau of Land Management estimates that it will incur reimbursable costs of about $13,000 in connection with the Jensen Unit, including $12,000 for determination of the validity of mining claims and $1,000 for cadastral surveys and corner remonumentation. These costs have been included with rights-of-way costs in the project cost estimates.

The Bureau of Land Management anticipates the loss of about 60 animal unit months of livestock forage from inundation of Tyzack Reservoir Basin. It states, however, that this is not a serious loss as 3,200 acres located immediately to the east have been reseeded to provide needed additional livestock forage. It is likely that improvement projects in the immediate vicinity will offset the loss, eliminating need for grazing reductions.

Environmental Protection Agency

After reviewing the revised project plan of the Jensen Unit, the Environmental Protection Agency expressed some concern about maintaining the quality of water in Tyzack Reservoir. The future aspects of this concern are discussed in detail in Chapter IX, Environmental Analysis.

CHAPTER IX

ENVIRONMENTAL ANALYSES

This chapter describes the environmental impacts of the Jensen Unit. It represents a summary of the data contained in the Final Environmental Statement (FES 75-103) which was filed with the Council on Environmental Quality on December 16, 1975. Filing of the final statement, plus a 30-day waiting period, is a necessary prerequisite to execution of a repayment contract between the United States and the Uintah Water Conservancy District.

Environmental Impacts

Construction activities

Air, Noise, and Water Pollution

Project construction involving the operation of machinery and vehicles, with associated noise, dust, and emissions, will have a temporary adverse effect on human and animal inhabitants of the Jensen Unit area. Controls imposed on contractors by State and Federal regulations, however, will minimize the disturbance and pollution. Silt will be added to Brush Creek, causing increased turbidity, particularly during periods of low streamflows. This will result in increased deposition in the channel substrate which will adversely affect the habitat for aquatic organisms. Settling ponds will be constructed to alleviate the turbidity as effectively as practical. Duration of direct impacts resulting from construction activities of Tyzack Dam and Reservoir will be about 4 1/2 years.

Borrow Activity

Most of the borrow areas will be inundated by the Tyzack Reservoir and therefore hidden from view much of the time. About 32 acres of borrow area will be below minimum water surface and 53 acres will be between minimum and normal water surface of the reservoir. Areas which will be exposed during the reservoir drawdown will be graded to even slopes before the reservoir is filled so that pools will not be left by the receding water and erosion will be minimized. About 33 acres of potential borrow area is located in juniper woodland in two locations outside the reservoir basin. Use of these areas will have a temporary adverse esthetic impact upon the area. With adequate restoration measures, a period of 4 to 6 years will be required for revegetation.

The removal of 60,000 cubic yards of riprap material from the Steinaker quarry will result in the redisturbance of the area which has had

several years to stabilize. The quarry will approximately double in size and the esthetic quality of the location will be degraded, particularly during the period when material is being removed and transported.

Economic and Social Impacts

The local economy will receive a substantial stimulation during the construction period. An average construction force of about 95 will be required during the construction period which will consist primarily of local people. The increased payroll will contribute to higher retail sales for local merchants and higher demands for goods and services. Demand for construction material will stimulate the local as well as the National economy. Construction and operation of the project will attract some people from outside the local area who will have customs and interests different from those of the current resident population.

Effects on Archaeological and Historic Sites

Studies made to date by the University of Utah indicate that except for four small chipping sites, there are no archaeological phenomena at the Tyzack Reservoir site or in the area of proposed construction. Three of the chipping sites are located north of the reservoir above the normal water surface and the fourth is near the Tyzack Aqueduct alinement. The 1974 National Register of Historic Places indicates that no Nationally designated properties having historical significance would be affected by the proposed action. The Bureau of Reclamation will apply appropriate protective and evaluation measures if a potentially valuable resource is located during construction activities.

Tyzack Reservoir development

Seismicity

The potential hazard of seismic activity in the project area is rated in a minimum zone 1 risk classification on the Seismic Risk Map of the Western United States. Zone 1 includes those areas where earthquake occurrence is least probable and where very minor damage would be expected. Only one earthquake has been recorded in the project area, and this occurred at Vernal in February 1956 with a Richter magnitude of 3.7. Tyzack Dam has been designed to withstand potential seismic stress.

Water Quality

The question of potential contamination of Tyzack Reservoir was raised by the Environmental Protection Agency and others in their comments on the draft environmental statement. Concern was expressed about contaminants from Stauffer Chemical Company's phosphate operation that could enter the reservoir by (1) runoff through the overburden, (2) by failure

or overtopping of the tailings pond dams, or (3) by any other effluent from the tailings ponds. From additional studies conducted it was concluded that the phosphate operation did not present a significant pollution hazard for the following reasons. First, analyses of water samples from Brush Creek show the water to be alkaline with high calcium content. Bioassays of this water show low nutrient concentrations and that no single nutrient was limiting to algal production. Under this condition, it is expected that phosphate material carried into the stream will be insoluble and will not become available for assimilation by plants and animals. Second, the Bureau of Reclamation as well as an engineering consulting firm have made runoff studies and have concluded that the tailings ponds have adequate capacity and the dams are not likely to fail except under catastrophic conditions. Third, the Stauffer Chemical Company is presently operating under an Environmental Protection Agency special permit leading to a "no discharge" system for wastewater treatment by the end of 1975.

Flora

An estimated 521 acres of land will be committed permanently to a reservoir basin. Vegetative communities that will be lost or altered by the Tyzack Reservoir are shown below.

Composition of the vegetation of the Tyzack Reservoir site

Plant community	Percentage	Acres
Grass-sagebrush	42	219
Dense sagebrush-rabbitbrush	20	102
Sparse juniper	13	68
Streamside forest (including stream)	8	41
Juniper woodland	5	25
Mountain brush	Trace	2
Cultivated	12	64
Total	100	521

The plant growth found along the approximately 3 miles of Brush Creek between Tyzack Dam and Little Brush Creek, although reduced, will not be destroyed because of expected spills and seepage past the dam which will be sufficient to sustain a riparian community. Below the confluence of Little Brush Creek sufficient flows will be in the stream to largely maintain existing stream and bank communities.

Fauna

Tyzack Reservoir will inundate vegetative communities harboring upland game species including pheasants, chukars, quails, doves, and cottontail rabbits. It is anticipated that loss of this upland game habitat will be compensated by the habitat created through development and irrigation of 440 acres of full service land.

The reservoir will inundate an area which presently provides habitat for deer and grazing for livestock. Estimated loss of cattle grazing is 60 AUM's. Also inundated will be one 2-acre farmstead site. The loss of grazing lands for livestock will not be significant since about 3,200 acres immediately east of the reservoir have been reseeded by the Bureau of Land Management for livestock forage.

Improvements will be made in the Stewart Lake Waterfowl Management Area. Management area water, delivered by the project at a higher point than at present, will permit development of an additional 100 acres of marsh habitat which is expected to increase the productivity of the area and provide additional hunting opportunities.

Inundation will eliminate approximately 2 1/2 miles of Brush Creek classified by the Utah Division of Wildlife Resources as Class III (fair productivity, artificial stocking, good accessibility, significant in quantity of fishing available--representing the bulk of Utah stream fishing). The Fish and Wildlife Service, with the aid of the Utah Division of Wildlife Resources, has determined that that section of stream within the reservoir site currently provides about 1,600 man-days of fishing each year which will be lost through inundation. About 3 miles of stream, from Tyzack Dam to Little Brush Creek, will be affected under project operation, resulting in a loss of an additional 100 man-days of stream fishing. The reservoir, with a 1,900-acre-foot minimum pool for fishery maintenance, will provide an estimated 9,500 man-days of fishing annually. The estimated use is based on the average water surface area available and assumes adequate public access and regular fish stocking from the State hatcheries.

When the reservoir begins filling and terrestrial habitats are inundated, the animals occupying them will be forced to move to higher ground. Upland game, small mammals, amphibians, and reptiles will be exposed to greater predation and competition, and their numbers will be reduced to the carrying capacity of the surrounding land.

To mitigate the loss of deer winter range in the Tyzack Reservoir basin, about 500 acres of public rangelands near the reservoir will be rehabilitated as deer habitat. The juniper-pinion cover on the lands to be rehabilitated will be partly removed, and the land will be reseeded to grasses and browse plants, including crested wheat, Russion wild rye, alfalfa (nomad), fourwing saltbush, rabbit brush, and bitter brush.

Supplemental water supplies to 3,640 acres presently irrigated and a full supply to 440 acres of unirrigated land will be beneficial to pheasant populations by creating additional farmland habitat.

Sediment

Sediment deposition in Tyzack Reservoir will occur at a relatively slow rate which will not significantly affect the minimum fishery pool.

Sediments that are retained in the reservoir will result in reduced sedimentation and turbidity downstream from the reservoir and less sediment being transported to Green River.

Flood Control

The planned operation of Tyzack Reservoir will reduce the reservoir inflow to a nondamaging flow below the reservoir. This will result in increased production and economic gain to the local ranchers.

Recreation

The recreational capability of the Jensen Unit area will be increased through the development of Tyzack Reservoir and attendant recreational facilities. Estimated annual use of the recreational complex is 40,000 recreation days initially, 50,000 recreation days by year 2000, and a peak of 70,000 recreation days by year 2020.

Some increase in noise will occur with increased recreational activity and automobile traffic estimated at an average of 50 additional vehicles a day. Hills in the area, however, will serve to suppress the transmission of noises from one area to another. Increased sustained disturbances borne out of the recreational development may result in displacement of some resident wildlife species. Increased use of the area by the general public will also increase potential for wildfires.

The recreational facilities constructed within an undisturbed juniper-sagebrush woodland will result in loss of 2 to 3 acres of wildlife habitat. This loss, along with about 10 acres of wildlife habitat necessary for construction of access road, will exert an unquantified but likely minor adverse impact upon bird and mammal populations by eliminating cover, nesting, and feeding areas. While the total loss of 12 to 13 acres of habitat would not be significant individually, such loss will be cumulatively important. The physical disturbance of the old, stable, and relatively unique juniper vegetative community will result in ecological instability characterized by soil erosion, plant succession, and changes in use of the area by wildlife. The esthetic character of the location will be altered in a negative manner by the disturbance.

The esthetic experience of recreational uses will be lessened during periods of reservoir drawdown by exposed mud flats that will be visible from the campground and the reservoir surface. The roads and facility construction will result in abrupt and unattractive changes in soil and flora color along with some sheet erosion and rock falls. There will be excavation scars within the development area, particularly around the boat ramp.

Tyzack Pumping Plant and Aqueduct

Tyzack Pumping Plant, located at the downstream end of the outlet works of the dam, will be designed to blend in with the dam and thus its visual impact will be lessened. Installation of the buried aqueduct will require the removal of about 30 acres of vegetation. The right-of-way will be devoid of vegetation during construction and until reseeding and invasion of native vegetation occur--a process which will take at least 3 to 4 years. A small area, about a half acre in size and located on steep, rocky terrain, will resist revegetative efforts, and a permanent scar, visible from the reservoir, will result. Overall, however, construction of the aqueduct is expected to improve slightly the habitat for birds and mammals as a result of the revegetation. Duration of direct impacts resulting from construction activities of Tyzack Pumping Plant and Aqueduct will be about 3 years.

Burns Pumping Plant and Discharge Lines

Burns Pumping Plant and Discharge Lines will require about 12 acres of land and will cause no permanent damage to the environment except the minor visual alteration. Vegetative cover will include about 6 acres of irrigated crop lands, 4 acres of river bottom and irrigated pasture land, 1 acre of hillside grazing land, and 1 acre of farmstead. Following construction, the excavated material will be replaced and full use of the land restored. Silt accumulating in the intake will require occassional disposal. Duration of direct impacts resulting from construction activities of Burns Pumping Plant and Discharge Lines will be about 2 years.

Transmission Lines

Direct impacts associated with the 3.4 miles of 138-kV transmission lines will be minor. An estimated 5 acres of land will be disturbed by construction. Some deer and upland game habitat will be crossed but since no fences are planned, animal movement will not be restricted. Clearing along the alinement will not be necessary because the vegetation is sparse. Thus wildlife habitat will not be significantly reduced. Visual impact of the new lines will be relatively minor because of their location and short length.

Streamflows

Under project operation, the flow of Brush Creek below the reservoir will be greatly reduced. This will have an adverse effect on fish and wildlife and stream and bank vegetative communities but a positive effect with respect to control of flood flows as previously discussed. Reservoir releases to maintain minimum flows for stream fishery could not be justified.

The annual flow of the Colorado River will be reduced by an average of 15,000 acre-feet. The salt-concentrating effects resulting from streamflow depletions will increase the salinity concentration of the river at Imperial Dam by approximately 1.5 mg/l. An additional increase of 0.1 mg/l in salinity concentration will occur from salt loading as a result of the project. The change in concentration will only slightly affect the total concentration at Imperial Dam, which was 879 mg/l in 1972.

Irrigation

The use of project water for irrigation will help to stabilize the farm economy and result in improved crop and livestock production, which will lead to economic benefits to farmers and ranchers. Economic improvement will be manifested by attainment of a higher living standard, as well as overall expansion and stabilization of the local economy.

Irrigation supplies will create more habitat for pheasants and other upland game which is critical for their winter survival. Project drains will also produce upland bird and waterfowl habitat. As the new lands are changed from their natural condition to irrigated lands, negative impacts on big game will be insignificant since the new lands are interspersed with presently irrigated lands.

No significant increase in insecticide and herbicide will be expected since the Jensen Unit will bring only 440 new acres into production.

Municipal and industrial water development

The municipal and industrial water will support industrial developments which are underway and expected to continue in the Jensen Unit area, particularly in the petroleum field. The development of secondary businesses will accompany the industrial growth. The project will facilitate the recent and projected growth attributable to natural resource development rather than being responsible for such growth. The new residents will require water, power, telephone, and sewer service, and educational and recreational facilities, all of which will exert pressure on the existing facilities. The project municipal and industrial water supply will give Vernal City planners a degree of flexibility in developing the area in an orderly fashion. The Jensen Unit is not expected to have a significant effect on housing in the project area.

Cumulative impacts

Economic and Social Conditions

The Jensen Unit will have important economic and social impacts on the local area. The development of water for irrigation, municipal, and

industrial purposes will not only satisfy present demands but also projected demands that are based on current trends. Population growth can be expected to continue without the project, but without an additional water supply continued growth would ultimately require reevaluation of water use priorities.

Fish and Wildlife

The project will cumulatively influence the quantity and quality of fish and wildlife habitat and populations. Development of the Jensen Unit will contribute to the general trend throughout the United States of a gradual reduction in the amount and the carrying capacity of habitat. Water development activities have resulted in the loss of over 2,000 miles of stream habitat since the State was settled.

Reservoir inundation and reduced flows of Brush Creek below the Tyzack Dam will eliminate or reduce about 5 miles of stream ecosystems including existing populations of flowing water fish and other similarly adapted organisms. About one-half of the stream habitat that will be lost to the Jensen Unit is good quality.

In contrast to the general trend of decreasing marsh land through drainage, the proposed improvement in the water supply for Stewart Lake Waterfowl Management Area will allow the development of an additional marsh habitat within the area. This action will increase waterfowl productivity as well as create additional habitat for other species of marsh birds and animals.

Unavoidable Adverse Effects

Several adverse effects that will result from the project cannot be mitigated. These are listed below.

1. Approximately 520 acres of farm and range lands and 2 1/2 miles of the Brush Creek fishery classified by the State as a Class III (significantly important) fishery will be inundated by Tyzack Reservoir.

2. The flow of the Colorado River will be reduced by an average of 15,000 acre-feet annually. The salt-concentrating effects of the depletions will increase the salinity concentration of the river at Imperial Dam by an estimated 1.5 mg/l. The increase in salt load from the project is estimated at 0.1 mg/l.

3. Construction of the Jensen Unit will further alter the natural landscape which has already been gradually changed by past development.

4. Tyzack Aqueduct will leave construction scars that cannot be completely restored.

5. New transmission lines, although short, will cause unavoidable minor impacts.

6. Project water will support the continuing industrial and residential growth in the Jensen Unit area. The growth will increase the potential for air, water, and noise pollution.

Short-Term Uses versus Long-Term Uses

Impacts on the environment from construction will largely be of a short-term adverse nature, as construction scars can largely be obliterated through smoothing and revegetation measures.

Construction activities connected with the project will have a significant short-term economic impact on the area. It is anticipated that about 25 percent of the total construction cost will be reflected in local payrolls. As a result, area economic activity will be increased during construction and operation of the project.

Through development of irrigation and municipal and industrial water and control of floods, the Jensen Unit will provide many long-term positive effects on the economy and general well-being of the project area. The fishing and other recreational developments will also be long-term effects, primarily of a beneficial nature.

Higher returns from increased agricultural production made possible by the project irrigation supply will be reflected in improvements in homes and farms, in local businesses, and in general living standards.

Resources development which will be facilitated by project municipal and industrial water supply will provide long-term stability in the tax base of this semi-isolated area.

The Jensen Unit will have a long-term effect on fishing in the project area. The filling of Tyzack Reservoir will permanently eliminate about 2 1/2 miles of stream fishing on Big Brush Creek and substitute a flat water fishery.

As a result of Tyzack Reservoir operation, flood damages to fields, canal headings, farm buildings, fences, irrigation ditches, and county roads and bridges will be reduced, and the reductions will have both short and long-term effects.

Irretrievable and Irreversible Commitment of Resources

An estimated 520 acres of land including 2 1/2 miles of Brush Creek will be irretrievably committed to the storage of water for project uses.

Some native vegetation and associated habitat for resident and migratory fauna will be eliminated. These losses will be minor in terms of State-wide impact but will be irretrievable in terms of loss of natural conditions.

The Jensen Unit will involve the commitment of about 2 percent of Utah's share of Colorado River water to project purposes.

Local borrow material required for the dam and embankment will be committed to irretrievable use. Cement, steel construction materials, and operating equipment will be shipped in from other areas and for all practical purposes committed irretrievably to project features.

CHAPTER X

ECONOMIC AND FINANCIAL ANALYSES

Economic Justification

The economic justification of the Jensen Unit has been measured by a comparison of estimated benefits and costs over a 100-year period beginning with first delivery of project water. An interest rate of 3.25 percent, which was in effect at the time the project was authorized, was used in the analysis. The project is well justified economically.

Average annual benefits

A total value of $2,374,000 has been estimated for benefits from the various project purposes. The benefits are discussed in preceding chapters and the estimated values are summarized below.

Average annual benefits

Purpose	Direct benefits	Indirect and public benefits	Total benefits
Municipal and industrial use	$2,055,000		$2,055,000
Irrigation	166,000	$17,000	183,000
Fish and wildlife	24,000		24,000
Recreation	88,000		88,000
Flood control	24,000		24,000
Total	2,357,000	17,000	2,374,000

Externalities

Negative externalities associated with the project's effects on salinity of the Colorado River in the lower basin are discussed in Chapter V and summarized in the following tabulation.

Negative externalities

	Direct effects	Indirect effects	Total effects
Concentrating effects of stream depletion	$282,000	$63,000	$345,000
Increase in salt load	18,800	4,200	23,000

Average annual equivalent costs

The average annual equivalent costs computed for comparison with the benefits amount to $1,371,000. These costs include the project investment

amortized at 3.25 percent interest over the 100-year period of analysis, the annual operation, maintenance, and replacement costs, and assigned costs of the river regulatory features of the Colorado River Storage Project. The project investment includes construction costs and interest during construction computed at a rate of 3.25 percent simple interest over the construction period. Certain cost items were excluded from the project investment for the benefit-cost analysis since they would have no bearing on the desirability of undertaking project construction. These were the costs of investigations made prior to authorization and the costs for construction of relocated roads to current standards in excess of the costs for replacement in kind. The assigned cost of river regulatory facilities is based on $2.00 for each acre-foot of annual stream depletion attributable to the Jensen Unit. Derivation of the average annual equivalent costs is shown below.

Project costs	
Construction costs	$33,263,000
Interest during construction	1,888,000
Subtotal	35,151,000
Less costs of investigations prior to authorization	-69,000
Less incremental costs of highway improvement to current standards	
Construction costs	-680,000
Interest during construction	-48,000
Total investment for benefit-cost analysis	34,354,000
Average annual equivalent costs	
Investment	1,164,000
Annual operation, maintenance, and replacement costs	177,000
Assigned costs of Colorado River Storage Project	30,000
Total	1,371,000

Comparison of project effects

The benefits and costs of the project have been compared both with and without consideration of the negative externalities that would be realized from the project's effects on the salinity of the Lower Colorado River. The negative externalities from the salt-concentrating effects of the project stream depletions have not been included in the comparisons since it is considered that the right to divert and deplete stream flows in the Upper Colorado River Basin provided by the Colorado River Basin Compact of 1922 are accompanied by a corresponding right to concentrate the salt load of the stream without penalty. The comparisons of benefits and costs are shown on the following page.

Without externalities	
Ratio of total benefits to costs	1.73:1
Ratio of direct benefits to costs	1.72:1
With negative externalities	
Ratio of total benefits to costs	1.71:1
Ratio of direct benefits to costs	1.70:1

Financial Analysis

Cost allocations

Project costs, including construction costs, interest during construction, and annual operation, maintenance, and replacement costs, have been allocated to the various project purposes. Costs of specific facilities for recreation and fish and wildlife were allocated to these purposes. Costs that will be incurred in construction of the relocated roads to current standards in excess of the costs for replacement in kind were allocated to highway improvement. All other costs were allocated by the separable costs-remaining benefits method. Interest for the cost allocations was computed at the rate of 3.25 percent. Reimbursable interest during construction, as shown in the following table, was computed at 5.116 percent interest, which is the rate to be used for Colorado River Storage Project's participating projects on which construction will start during FY 1976. The specific recreation and fish and wildlife costs will be financed under the provisions of Section 8 of the project authorizing act and all other costs will be financed under Section 5 of the act. The allocations made to the various project purposes are shown in the table on the following page.

The allocation of construction costs made to irrigation amounts to $1,209 for each acre of land served and $1,072 for each acre-foot of the project irrigation water supply.

Repayment

Reimbursable costs of the Jensen Unit include costs allocated to irrigation and to municipal and industrial water use and specific annual operation, maintenance, and replacement costs of recreation. These costs will be repaid as discussed in the following sections. All other project costs will be nonreimbursable. Annual off-site costs for flood forecasting will be funded directly by the Bureau of Reclamation on a nonreimbursable basis since the Bureau will be responsible for that work. Operation, maintenance, and replacement costs allocated to fish and wildlife and at-site flood control will be paid by the Uintah Water Conservancy District with appropriate adjustments in the district's repayment obligation.

Allocation of project costs
(Unit: $1,000)

	Basin Fund costs						Section 8 costs			
								Fish and wildlife		
	Municipal and industrial water	Irrigation	Flood control	Fish and wildlife	High way improvement	Subtotal	Recreation	Enhancement	Mitigation	Total project costs
Costs to be allocated						$38,158	$2,174	$23	$20	$40,375
Construction costs						32,463	757	23	20	33,263
Interest during construction (3.25 percent)						1,888				1,888
Operation, maintenance, and replacement costs										
Present worth (100 years)						3,807	1,417			5,224
Annual value						(129)	(48)			(177)
Benefits										
Present worth	$60,649	$5,401	$708	$649						
Annual value	(2,055)	(183)	(24)	(22)						
Alternative single purpose	30,816	14,907								
Construction cost	23,217	13,574								
Interest during construction (3.25 percent)	929	890								
Operation, maintenance, and replacement costs										
Present worth	6,670	443								
Annual value	(226)	(15)								
Justifiable expenditure	30,816	5,401	708	649	$728	38,302				
Separable costs	23,835	3,934	30		728	28,527				
Construction costs	19,462	3,629			680	23,771				
Interest during construction (3.25 percent)	1,068	187			48	1,303				
Operation, maintenance, and replacement costs										
Present worth	3,305	118	30			3,453				
Annual value	(112)	(4)	(1)			(117)				
Remaining justifiable expenditure	6,981	1,467	678	649		9,775				
Percent	71.4	15.0	7.0	6.6						
Remaing joint costs	6,876	1,445	675	635		9,631				
Construction costs	6,206	1,304	609	573		8,692				
Interest during construction (3.25 percent)	417	88	41	39		585				
Operation, maintenance, and replacement costs										
Present worth	253	53	25	23		354				
Total allocation	30,711	5,379	705	635	728	38,158	2,174	23	20	40,375
Construction costs	25,668	4,933	609	573	680	32,463	757	23	20	33,263
Interest during construction (3.25 percent)	1,485	275	41	39	48	1,888				1,888
Operation, maintenance, and replacement costs										
Present worth	3,558	171	55	23		3,807	1,417			5,224
Annual value	(120)	(6)	(2)	(1)		(129)	(48)			(177)
Reimbursable costs										
Construction costs	25,668	4,933				30,601				
Interest during construction (5.116 percent)	2,338					2,338				
Total	28,006	4,933				32,939				
Less funds prior to authorization	-58	-11				-69				
Reimbursable investment	27,948	4,922				32,870				
Annual operation, maintenance, and replacement costs	120	6				126	48			174

The Uintah Water Conservancy District will contract with the United States for the repayment of reimbursable investment costs. The area within the Uintah Water Conservancy District is also a part of the larger Central Utah Water Conservancy District, although the two districts are separate legal entities. Repayment policy of the Central Utah Water Conservancy District is that it will, with ad valorem tax revenue, pay 34 percent of the reimbursable investment costs allocated to municipal and industrial use. The remaining 66 percent of the investment cost, plus the annual operation, maintenance, and replacement costs, will be paid by the Uintah Water Conservancy District.

Municipal and Industrial Water Costs

The Uintah Water Conservancy District has agreed to contract for 18,000 acre-feet of municipal and industrial water. Repayment will be pursuant to provisions of the Water Supply Act of July 3, 1958 (72 Stat. 319). This act provides that storage may be and was included in the Tyzack Reservoir for future municipal and industrial demand. Repayment of a proportionate share of costs of water supply facilities to provide storage for future demand may be deferred interest free for up to 10 years. If water associated with the deferred costs should be used prior to the end of the interest-free period, costs associated with this water would become due at the time the water is first used and repayment would begin. At the end of the 10-year period, all allocated municipal and industrial water costs which have not been repaid will become due and interest bearing.

In this repayment analysis, three equal blocks of 6,000 acre-feet of municipal and industrial water have been established. It is assumed for this analysis that the first block will be delivered in 1980 and the second and third blocks in about 1985 and 1990, respectively. The table on the following page shows how the costs associated with each block were determined under provisions of the 1958 Water Supply Act. Each block will have a repayment period of 50 years. A total of $27,948,000 will be required over the repayment period, including construction cost and reimbursable interest during construction, less $58,000 prepayment from the Colorado River Development Fund and contributed funds, plus interest at 5.116 percent.

The cost of the first 6,000 acre-feet of water over the repayment period will be approximately $843,000 annually, exclusive of annual operation, maintenance, and replacement charges of approximately $40,000. The cost of subsequent blocks of municipal and industrial water will be about $387,000 annually for Block 2 and about $328,000 for Block 3, with an additional operation, maintenance, and replacement charge of about $40,000 annually for each block. The cost per acre-foot will vary with each block of municipal and industrial water and will depend on actual sales of water. When all three blocks of water are developed and sold, the average cost per acre-foot over the repayment period will be about $78.60, exclusive of annual charges for operation, maintenance, and replacement.

Determination of municipal and industrial water repayment under provisions of the 1958 Water Supply Act

Item	Capacity (acre-feet)	Cost
Total project cost		
Construction		$33,263,000
Reimbursable interest during construction		2,338,000
Total		35,601,000
Tyzack Reservoir capacity	26,000	
Allocated to irrigation	8,000	
Allocated to municipal and industrial water	18,000	
Initial use	(6,000)	
Future use	(12,000)	
Maximum deferral pursuant to Water Supply Act (30 percent x $35,601,000)		10,680,000

Allocated by blocks and amount of deferred costs including interest during construction[1/]

Item	Initial use Block 1 (6,000 acre-feet)	Deferred costs or subsequent construction[2/] Block 2 (6,000 acre-feet)	Block 3 (6,000 acre-feet)	Total (18,000 acre-feet)
Tyzack Reservoir	$4,565,000	$4,566,000	$4,566,000	$13,697,000
Tyzack Pumping Plant and related facilities	10,546,000			10,546,000
Burns Pumping Plant and related facilities		2,363,000	1,323,000	3,686,000
Permanent operating facilities		19,000		19,000
Total	15,111,000	6,948,000	5,889,000	27,948,000
Annual payment (50 years)	842,600	387,400	328,400	1,558,400

1/ Costs shown include $2,338,000 in reimbursable interest during construction but exclude $58,000 in prepayments.

2/ "Subsequent construction" refers only to Burns Pumping Plant and related facilities.

Irrigation Costs

Operation, maintenance, and replacement costs allocated to irrigation will be paid each year by the irrigators. The current estimate of project operation, maintenance, and replacement costs allocated to irrigation is $6,000 annually. This figure will change each year to reflect actual expenditures. Of the allocated irrigation construction costs, $11,000 for investigations has already been paid from the Colorado River Development Fund and funds contributed by the State of Utah, $750,000 will be paid by the irrigators, and $4,172,000 will be paid with revenues from the Colorado River Storage Project accruing in the Upper Colorado River Basin Fund and apportioned to the State of Utah for use in repayment of irrigation costs of participating projects. Anticipated payments by the irrigators amount to about 15 percent of the total irrigation allocation. Payments from the Upper Colorado River Basin Fund account for the remaining 85 percent.

The irrigators' payments toward their costs are based on total recommended annual payments of $21,000 as discussed in Chapter VI. With $6,000 allowed for operation, maintenance, and replacement costs, an annual amount of $15,000 or $750,000 over a 50-year period will be available for payment of irrigation construction costs. Irrigation repayment is computed assuming the irrigators will start their payments toward amortization of construction costs immediately following completion of a 3-year development period.

Costs to be repaid with revenues from the Colorado River Storage Project in the Upper Colorado River Basin Fund, amounting to $4,172,000, are those in excess of the irrigators' recommended payments and the prepayment from the Colorado River Development Fund and contributed funds. Tentative schedules indicate that revenues will be available in the fund in about the year 2010, as needed to complete project repayment within a 50-year period following the development period. In the computation of credits available to the Jensen Unit, allowances were made for prior commitments for the Vernal and Bonneville Units of the Central Utah Project and for the Emery County Project.

Recreation Costs

Operation, maintenance, and replacement costs of specific recreational facilities, estimated at $48,000 annually, will be paid by the Utah Division of Parks and Recreation, which will be the administering agency for the facilities.

Summary

Estimates of reimbursable costs are summarized in the following table. A detailed presentation of the payout schedule assumed for

municipal and industrial water and irrigation is shown in the table on the following page. Actual payout schedules will depend on contract negotiations in progress.

Repayment of reimbursable costs

	Construction costs	Reimbursable interest during construction (5.116 percent)	Annual operation, maintenance, and replacement costs
Municipal and industrial water			
Prepayment[1/]	$58,000		
Water users	16,108,000	$2,338,000	$120,000
Ad valorem tax revenues	9,502,000		
Subtotal	25,668,000	2,338,000	120,000
Irrigation			
Prepayment[1/]	11,000		6,000
Irrigators	750,000		
Apportioned revenues of Colorado River Storage Project	4,172,000		
Subtotal	4,933,000		6,000
Recreation			
Utah Division of Parks and Recreation			48,000
Total	30,601,000	2,338,000	174,000

1/ Payments made for investigations from Colorado River Development Fund and funds contributed by the State of Utah.

Summary repayment schedule--Jensen Unit

Year	Municipal and industrial water use: Source of revenues: Ad valorem taxes	Source of revenues: Water users	Total	Revenues applied to: Interest	Revenues applied to: Principal	Unpaid balance	Plant in service at end of year	Allowable unpaid balance at end of year	Irrigation: Source of revenues: Water users	Apportioned revenues of Colorado River Storage Project	Total	Payment to principal	Unpaid balance	Plant in service at end of year	Allowable unpaid balance at end of year	Recapitulation of project repayment: Total revenues	Revenues applied to: Interest	Revenues applied to: Principal	Unpaid balance	Plant in service at end of year	Allowable unpaid balance at end of year	Year
						1/$24,243,000	1/$24,243,000	1/$24,243,000					2/$4,922,000	2/$4,922,000	2/$4,922,000				3/$29,165,000	3/$29,165,000	3/$29,165,000	
1980	$287,000	$556,000	$843,000	$773,079	$69,921	24,173,079			0	0	0	0	4,922,000			$843,000	$773,079	$69,921	29,095,079			1980
1981	287,000	556,000	843,000	769,502	73,498	24,099,581			0		0	0	4,922,000			843,000	769,502	73,498	29,021,581			1981
1982	287,000	556,000	843,000	765,741	77,259	24,022,322			0		0	0	4,922,000			843,000	765,741	77,259	28,944,322			1982
1983	287,000	556,000	843,000	761,789	81,211	23,941,111	24,243,000	24,243,000	$15,000		$15,000	$15,000	4,907,000			858,000	761,789	96,211	28,848,111	29,165,000	29,165,000	1983
1984	287,000	556,000	843,000	757,634	85,366	26,237,745	26,625,000	26,625,000	15,000		15,000	15,000	4,892,000			858,000	757,634	100,366	31,129,745	31,547,000	31,547,000	1984
1985	419,000	812,000	1,231,000	1,108,726	122,274	26,115,471			15,000		15,000	15,000	4,877,000			1,246,000	1,108,726	137,274	30,992,471			1985
1986	419,000	812,000	1,231,000	1,102,471	128,529	25,986,942			15,000		15,000	15,000	4,862,000			1,246,000	1,102,471	143,529	30,848,942			1986
1987	419,000	812,000	1,231,000	1,095,895	135,105	25,851,837			15,000		15,000	15,000	4,847,000			1,246,000	1,095,895	150,105	30,698,837			1987
1988	419,000	812,000	1,231,000	1,088,983	142,017	25,709,820	26,625,000	26,625,000	15,000		15,000	15,000	4,832,000			1,246,000	1,088,983	157,017	30,541,820	31,547,000	31,547,000	1988
1989	419,000	812,000	1,231,000	1,081,718	149,282	26,883,538	27,948,000	27,948,000	15,000		15,000	15,000	4,817,000			1,246,000	1,081,718	164,282	31,700,538	32,870,000	32,870,000	1989
1990	531,000	1,028,000	1,559,000	1,375,362	183,638	26,699,900			15,000		15,000	15,000	4,802,000			1,574,000	1,375,362	198,638	31,501,900			1990
1991	531,000	1,028,000	1,559,000	1,365,967	193,033	26,506,867			15,000		15,000	15,000	4,787,000				1,365,967	208,033	31,293,867			1991
1992	531,000	1,028,000	1,559,000	1,356,091	202,909	26,303,958			15,000		15,000	15,000	4,772,000				1,356,091	217,909	31,075,958			1992
1993	531,000	1,028,000	1,559,000	1,345,710	213,290	26,090,668			15,000		15,000	15,000	4,757,000				1,345,710	228,290	30,847,668			1993
1994	531,000	1,028,000	1,559,000	1,334,799	224,201	25,866,467			15,000		15,000	15,000	4,742,000				1,334,799	239,201	30,608,467			1994
1995	531,000	1,028,000	1,559,000	1,323,328	235,672	25,630,795			15,000		15,000	15,000	4,727,000				1,323,328	250,672	30,357,795			1995
1996	531,000	1,028,000	1,559,000	1,311,271	247,729	25,383,066			15,000		15,000	15,000	4,712,000				1,311,271	262,729	30,095,066			1996
1997	531,000	1,028,000	1,559,000	1,298,598	260,402	25,122,664			15,000		15,000	15,000	4,697,000				1,298,598	275,402	29,819,664			1997
1998	531,000	1,028,000	1,559,000	1,285,275	273,725	24,848,939			15,000		15,000	15,000	4,682,000				1,285,275	288,725	29,530,939			1998
1999	531,000	1,028,000	1,559,000	1,271,272	287,728	24,561,211			15,000		15,000	15,000	4,667,000				1,271,272	302,728	29,228,211			1999
2000	531,000	1,028,000	1,559,000	1,256,552	302,448	24,258,763			15,000		15,000	15,000	4,652,000				1,256,552	317,448	28,910,763			2000
2001	531,000	1,028,000	1,559,000	1,241,078	317,922	23,940,841			15,000		15,000	15,000	4,637,000				1,241,078	332,922	28,577,841			2001
2002	531,000	1,028,000	1,559,000	1,224,813	334,187	23,606,654			15,000		15,000	15,000	4,622,000				1,224,813	349,187	28,228,654			2002
2003	531,000	1,028,000	1,559,000	1,207,716	351,284	23,255,370			15,000		15,000	15,000	4,607,000				1,207,716	366,284	27,862,370			2003
2004	531,000	1,028,000	1,559,000	1,189,745	369,255	22,886,115			15,000		15,000	15,000	4,592,000				1,189,745	384,255	27,478,115			2004
2005	531,000	1,028,000	1,559,000	1,170,854	388,146	22,497,969			15,000		15,000	15,000	4,577,000				1,170,854	403,146	27,074,969			2005
2006	531,000	1,028,000	1,559,000	1,150,996	408,004	22,089,965			15,000		15,000	15,000	4,562,000				1,150,996	423,004	26,651,965			2006
2007	531,000	1,028,000	1,559,000	1,130,123	428,877	21,661,088			15,000		15,000	15,000	4,547,000				1,130,123	443,877	26,208,088			2007
2008	531,000	1,028,000	1,559,000	1,108,181	450,819	21,210,269			15,000		15,000	15,000	4,532,000				1,108,181	465,819	25,742,269			2008
2009	531,000	1,028,000	1,559,000	1,085,117	473,883	20,736,386			15,000		15,000	15,000	4,517,000				1,085,117	488,883	25,253,386			2009
2010	531,000	1,028,000	1,559,000	1,060,874	498,126	20,238,260			15,000		15,000	15,000	4,502,000				1,060,874	513,126	24,740,260			2010
2011	531,000	1,028,000	1,559,000	1,035,389	523,611	19,714,649			15,000		15,000	15,000	4,487,000				1,035,389	538,611	24,201,649			2011
2012	531,000	1,028,000	1,559,000	1,008,601	550,399	19,164,250			15,000		15,000	15,000	4,472,000				1,008,601	565,399	23,636,250			2012
2013	531,000	1,028,000	1,559,000	980,443	578,557	18,585,693			15,000		15,000	15,000	4,457,000				980,443	593,557	23,042,693			2013
2014	531,000	1,028,000	1,559,000	950,844	608,156	17,977,537			15,000		15,000	15,000	4,442,000				950,844	623,156	22,419,537			2014
2015	531,000	1,028,000	1,559,000	919,731	639,269	17,338,268			15,000		15,000	15,000	4,427,000				919,731	654,269	21,765,268			2015
2016	531,000	1,028,000	1,559,000	887,026	671,974	16,666,294			15,000		15,000	15,000	4,412,000				887,026	686,974	21,078,294			2016
2017	531,000	1,028,000	1,559,000	852,648	706,352	15,959,942			15,000		15,000	15,000	4,397,000				852,648	723,152	20,356,942			2017
2018	531,000	1,028,000	1,559,000	816,511	742,489	15,217,453			15,000		15,000	15,000	4,382,000				816,511	757,489	19,599,453			2018
2019	531,000	1,028,000	1,559,000	778,525	780,475	14,436,978			15,000		15,000	15,000	4,367,000				778,525	795,475	18,803,978			2019
2020	531,000	1,028,000	1,559,000	738,596	820,404	13,616,574			15,000		15,000	15,000	4,352,000				738,596	835,404	17,968,574			2020
2021	531,000	1,028,000	1,559,000	696,624	862,376	12,754,198			15,000		15,000	15,000	4,337,000				696,624	877,376	17,091,198			2021
2022	531,000	1,028,000	1,559,000	652,505	906,495	11,847,703			15,000		15,000	15,000	4,322,000				652,505	921,495	16,169,703			2022
2023	531,000	1,028,000	1,559,000	606,128	952,872	10,894,831			15,000		15,000	15,000	4,307,000				606,128	967,872	15,201,831			2023
2024	531,000	1,028,000	1,559,000	557,380	1,001,620	9,893,211			15,000		15,000	15,000	4,292,000				557,380	1,016,620	14,185,211			2024
2025	531,000	1,028,000	1,559,000	506,137	1,052,863	8,840,348			15,000		15,000	15,000	4,277,000				506,137	1,067,863	13,117,348			2025
2026	531,000	1,028,000	1,559,000	452,272	1,106,728	7,733,620			15,000		15,000	15,000	4,262,000				452,272	1,121,728	11,995,620			2026
2027	531,000	1,028,000	1,559,000	395,652	1,163,348	6,570,272	27,948,000		15,000		15,000	15,000	4,247,000				395,652	1,178,348	10,817,272		32,870,000	2027
2028	531,000	1,028,000	1,559,000	336,135	1,222,865	5,347,407	12,837,000		15,000		15,000	15,000	4,232,000		1,574,000		336,135	1,237,865	9,579,407		17,759,000	2028
2029	501,873	972,578	1,474,451	273,573	1,200,878	4,146,529			15,000		15,000	15,000	4,217,000		1,489,451		273,573	1,215,878	8,363,529			2029
2030	244,000	472,000	716,000	212,136	503,864	3,642,665			15,000		15,000	15,000	4,202,000		731,000		212,136	518,864	7,844,665			2030
2031	244,000	472,000	716,000	186,359	529,641	3,113,024			15,000	0	15,000	15,000	4,187,000	4,922,000	731,000		186,359	544,641	7,300,024			2031
2032	244,000	472,000	716,000	159,262	556,738	2,556,286	12,837,000	15,000	$4,172,000	4,187,000	4,187,000	0	0	4,903,000			159,262	4,743,738	2,556,286		17,759,000	2032
2033	244,000	472,000	716,000	130,780	585,220	1,971,066	5,889,000	0	0	0	0			716,000			130,780	585,220	1,971,066		12,837,000	2033
2034	201,835	390,385	592,220	100,840	491,380	1,479,686								592,220			100,840	491,380	1,479,686		5,889,000	2034
2035	112,000	216,000	328,000	75,701	252,299	1,227,387								328,000			75,701	252,299	1,227,387			2035
2036	112,000	216,000	328,000	62,793	265,207	962,180								328,000			62,793	265,207	962,180			2036
2037	112,000	216,000	328,000	49,225	278,775	683,405								328,000			49,225	278,775	683,405			2037
2038	112,000	216,000	328,000	34,963	293,037	390,368	5,889,000							328,000			34,963	293,037	390,368		5,889,000	2038
2039	139,515	270,824	410,339	19,971	390,368	0	0	0	0	0	0	0		410,339			19,971	390,368	0		0	2039
	26,506,223	51,317,787	77,824,010	49,876,010	27,948,000	0	27,948,000		750,000	4,172,000	4,922,000	4,922,000	0	4,922,000		82,746,010	49,876,010	32,870,000		32,870,000		

1/ Excludes $58,000 for investigations paid from Colorado River Development Fund and contributed by the State of Utah.
2/ Excludes $11,000 for investigations paid from Colorado River Development Fund and contributed by the State of Utah.
3/ Excludes $69,000 for investigations paid from Colorado River Development Fund and contributed by the State of Utah.

CHAPTER XI

PLAN FORMULATION

Modifications in Plan Since Project Authorization

Authorization of the Initial Phase of the Central Utah Project, including the Jensen Unit, was based on a feasibility report of February 1951 for the entire Initial Phase and on testimony presented at congressional hearings. Changes in plan have been made since authorization to better serve the needs of the area and to improve the project economic justification within the project authorization and within the intent of Congress for service of the Initial Phase area.

Plan summary

The original plan for the Jensen area was essentially a single-purpose irrigation development but included nominal recreational facilities. Irrigation service was provided for 4,460 acres of land, including 1,240 acres of full service land and 3,220 acres of supplemental service land. The service area was essentially the same as in the present plan except that the supplemental service land has been increased and the full service land decreased. Facilities for irrigation included an 8,000-acre-foot Tyzack Reservoir on Brush Creek, laterals to serve the full service lands, and drains to maintain agricultural production.

During advance planning and definite plan studies, the project plan was modified significantly to be more receptive to the problems and needs of the area as discussed in Chapter II. This action was in accordance with directives provided in the authorizing legislation for the formulation of comprehensive multiple-purpose developments under the Colorado River Storage Project and Participating Projects.

To accommodate the growing needs for water, the total capacity of Tyzack Reservoir has been increased from 8,000 to 26,000 acre-feet. The Tyzack Pumping Plant and Aqueduct were added to deliver project water to Steinaker Reservoir of the Vernal Unit for municipal and industrial use. The Burns Pumping Plant and discharge lines were then added to the plan to serve irrigation requirements in the Jensen area. Specific facilities were included in the modified plan for fish and wildlife enhancement and for increased recreation development. The larger reservoir provides regulation for flood flows with accompanying flood control benefits.

In the plan detailed in the Jensen Unit Draft Environmental Statement, the Tyzack Aqueduct terminated at Steinaker Reservoir. At the public hearing on the draft statement held May 28, 1975, and in subsequent

written comments, the local water users proposed and requested that the Tyzack Aqueduct be extended beyond Steinaker Reservoir to Ashley Creek. This proposal, which has been implemented in the plan, will facilitate municipal and industrial water use by exchange with Ashley Spring as previously described.

Project costs

The estimated cost of the original single-purpose irrigation plan based on 1953 prices was $1,787,000, of which all but $50,000 was allocated to irrigation. Annual operation, maintenance, and replacement costs for the original plan were estimated at $4,850, based on 1939-44 prices.

Benefits

Average annual benefits were estimated at $32,300 on the basis of prices prevailing at the time of authorization. The tabulation below lists the benefits from various sources.

Irrigation	
Direct benefits	$22,200
Indirect benefits	7,500
Subtotal	29,700
Recreation	2,600
Total	32,300

At the time of authorization, the ratio of benefits to costs was estimated to be near unity, with the benefits and costs compared over a 100-year period of analysis at an interest rate of 2.5 percent.

Alternatives

During the course of feasibility and advance planning investigations, consideration has been given to numerous alternatives. These alternatives can be grouped in five categories as follows: (1) nondevelopment, (2) partial development, (3) stage development, (4) alternatives comparable to proposed plan, and (5) alternative features and operation of the proposed plan.

Nondevelopment

Under this alternative, none of the features of the proposed plan or any of the alternatives would be constructed and the existing and projected water requirements would be largely unsatisfied. Growth and development of the area resources would be limited and the outmigration of people from farms, resulting from an unstable agricultural economy, would probably continue. Without additional water supplies, landowners in the

Jensen area would be deprived of optimum production from their lands. Growth that should result from development of energy resources would be curtailed because of a lack of municipal water. Irrigation water would probably be converted to municipal and industrial use at the expense of the agricultural sector. Undoubtedly this alternative would be unacceptable and could not become a lasting reality.

Partial development

Options under the alternative of partial development include (1) irrigation only, (2) municipal and industrial development only, (3) irrigation with partial municipal and industrial development, and (4) alternative sources of water.

Irrigation Only

This alternative would supply 4,600 acre-feet of water to the 3,640 acres of supplemental service land and 440 acres of full service land. The irrigation demand would be met either by pumping from the Green River or by the construction of a 10,000-acre-foot-capacity Tyzack Dam and Reservoir. Costs of the pumping plant alternative would include $3,818,000 for construction costs and $21,000 for annual operation, maintenance, and replacement costs. The benefits of the pumping plant alternative would be $158,000 annually from irrigation only. The reservoir construction costs would be $11,824,000. Annual operation, maintenance, and replacement costs would amount to $40,000. Tyzack Reservoir alternative would also provide 23,000 man days of recreation use and 4,500 man days of fish and wildlife use. Flood control benefits would amount to $9,200 annually. The total direct benefits of the reservoir alternative would be $231,000 annually.

Municipal and Industrial Development Only

This alternative would provide a municipal and industrial water supply to the project area by exchange by pumping from the Green River near the proposed Burns Pumping Plant site. The plan would include three pumping plants and a 16.3-mile-long Green River Aqueduct. The pumping plants and aqueduct would deliver 18,000 acre-feet of Green River water annually to irrigators along Ashley Creek for exchange with Ashley Spring as in the proposed plan. Construction costs of this single purpose alternative would be $23,447,000. Annual operation, maintenance, and replacement costs would be $226,000. The direct municipal and industrial benefits would be $1,922,000 annually.

Irrigation with Partial Municipal and Industrial Water Development

Several plans were studied involving storage site and diversion from Upper Brush Creek and North Fork of Ashley Creek which would develop

much smaller amounts of municipal and industrial water than the proposed plan. Some of these plans would develop the same water source. The storage sites include Trout Creek and Soldier Park Reservoirs on the North Fork of Ashley Creek which would develop 3,200 acre-feet of water and 4,000 acre-feet of water, respectively. Oaks Park Reservoir Enlargement on Upper Brush Creek would have a firm yield of 2,500 acre-feet. A Brush Creek diversion plan involving a diversion dam, pumping plant, an 8 1/2-mile pipeline, and a small offstream reservoir would yield 7,200 acre-feet of municipal and industrial water. Also a diversion plan involving Red Cloud Aqueduct would divert Big Brush Creek flows to Ashley Creek. Burns Pumping Plant would be built with each of these alternative plans to develop the irrigation supply. The maximum supply that would be developed by these plans would be 6,800 acre-feet of water annually for municipal and industrial use and 4,600 acre-feet of water annually for irrigation. Thus these plans would develop less municipal and industrial water than the proposed plan. Construction costs for these alternatives range from $10,380,000 to $26,315,000. Annual operation, maintenance, and replacement costs range from $65,000 to $192,000. The total annual benefits of these plans range from $527,000 to $1,058,000.

Alternative Sources of Water

Alternative sources of water considered include (1) water produced from oil wells, (2) weather modification, (3) water salvage measures, and (4) importation of water from an adjoining drainage. None of these alternative sources appears to be competitive to development of the existing supply at this time. All could be considered as augmentation possibilities in the future.

Stage development

The alternative of stage development, which would develop water for irrigation initially and the municipal and industrial water supply later, was given serious consideration a few years ago. At that time the irrigation need as well established whereas the municipal and industrial requirement was nebulous. The recent expansion in resource development and the upsurge in population have created a present need and firmed up the projected requirement for municipal and industrial water, all of which makes the stage development alternative less attractive.

Alternatives comparable to proposed plan

Green River Alternative

The Green River Alternative would develop 18,000 acre-feet of water for municipal and industrial use and 4,600 acre-feet for irrigation by direct pumping from Green River to the project lands and to Ashley Valley.

This alternative includes $27,264,000 for construction costs and $247,000 for operation, maintenance, and replacement costs. The irrigation benefits would be $158,000 annually and the municipal and industrial benefits would be $1,922,000 annually. Tyzack Reservoir would not be built under this alternative and recreation, fish and wildlife, and flood control purposes would not be served.

Ground Water

Ground water development was considered as an alternative source of municipal and industrial water. Ground water in the project area is available from the shallow alluvium system and the deep bedrock strata. The poor quality of the ground water available from the shallow alluvium system limits its possible use to irrigation. Water from the deep system is of better quality but would require treatment for municipal use. It is estimated that the average yield for each well would be 1 second-foot. On this basis it would require about 46 wells to provide the same capacity (46 second-feet) and as much water (18,000 acre-feet) for municipal and industrial purposes as the proposed plan. It would be necessary to develop additional wells or pump from the Green River to develop the irrigation supply. If large numbers of wells were drilled in those areas where water of suitable quality is available, the existing municipal supplies would be completely depleted. Development of the shallow alluvial aquifer would deplete surface streams thereby requiring replacement water to protect existing rights. The average development cost for each well would be about $168,000 and the total estimated cost for this alternative would be $25,690,000. The direct annual benefits of this alternative are $2,080,000, resulting in net benefits of $467,000 annually or about one-half of the net benefits of the recommended plan. Because of the decrease in economics, the uncertain water supply, and strong opposition by local irrigators to future well development, this alternative was not recommended.

Ratliff Dam and Reservoir

The Ratliff Dam and Reservoir site is located about 2 miles upstream from the Tyzack site. It would develop a comparable amount of water but at a higher cost than the proposed Tyzack Reservoir. Two means of conveyance of water to Ashley Creek were studied. One would utilize the Ratliff Pumping Plant and the 10.3-mile-long Ratliff Aqueduct. The other would be a gravity system consisting of a 3.1-mile-long tunnel and a 7-mile-long aqueduct. The estimated construction cost for this alternative would be $34,867,000. Annual operation, maintenance, and replacement costs would be about $150,000. Environmental impacts of the Ratliff Reservoir plan with either means of conveyance would be similar to those of the proposed plan except that Utah State Highway 44 would require extensive relocation and 4.5 miles of Class III fishery on Brush Creek below the reservoir would be dewatered.

In addition, a possibility exists that this alternative could conflict with future mining operations. Ratliff Reservoir could inundate phosphate resources that are minable by strip mining methods.

Buckskin Hills Canal

The Buckskin Hills Canal plan would involve the same municipal and industrial supply as the proposed plan. Water would be delivered to Ashley Valley from Tyzack Reservoir by the 27.2-mile-long 46-second-foot Buckskin Hills Canal, instead of the Tyzack Pumping Plant and Tyzack Aqueduct. This plan would give the same flexibility for exchange with Ashley Spring as the proposed plan but would be more costly. The Burns Pumping Plant capacity and location would remain the same as in the proposed plan. Construction costs would be about $34,060,000 and annual operation, maintenance, and replacement costs would be about $165,000.

Alternative features and operation of the proposed plan

Alternate Tyzack Dam Sites

Three alternative dam sites within about 1,000 feet of the proposed site were studied. Initially the uppermost axis was favored. On the basis of additional geological studies, however, the lowermost was determined to be superior to the other two. Environmental effects were similar at all three.

Alternates to Tyzack Aqueduct

Alinement changes for Tyzack Aqueduct and discharge line to reduce the environmental impact were considered. A short tunnel through a ridge for the aqueduct in lieu of an open cut was considered to reduce the visual impact and disturbance to the natural vegetation but the cost would be prohibitive.

Alternative Operations

Construction of the proposed plan would not preclude future modified operation of the project. Features of the project have been designed to accommodate considerable flexibility in operation. Three possible modified operations were developed that demonstrate this flexibility--maximum irrigation, maximum municipal and industrial use, and maximum fish and wildlife conservation plans. Departure from the proposed plan, however, would undoubtedly be accompanied by a loss in efficiency of operation and an increase in costs.

Summary

The results of a benefit-cost analysis of all likely alternatives indicate the proposed plan has the best benefit-cost ratio, the greatest net annual benefit, and least cost per acre-foot for municipal and industrial water. Also, the selected plan provides high-quality municipal water that does not require a treatment plant for culinary use.

REPORTS OF COOPERATING AGENCIES

United States Department of the Interior
NATIONAL PARK SERVICE
ROCKY MOUNTAIN REGIONAL OFFICE
655 Parfet Street
P.O. BOX 25287
Denver, Colorado 80225

IN REPLY REFER TO:

L7423 (RMR)CF

JUN [illegible] 1974

Memorandum

To: Regional Director, Upper Colorado Region, Bureau of Reclamation, Salt Lake City, Utah

From: Regional Director, Rocky Mountain Region

Subject: Tyzak Reservoir - revised projected recreation use and benefits

The estimated recreation use and benefits at Tyzak Reservoir are:

Present

40,000 annual recreation days
x$1.60 recreation day benefits
$64,000 = annual recreation benefits

$20,000 = annual operation and maintenance costs
$17,700 = annual replacement cost for $590,000 in recreation facilities

Future - year 2000 (estimated increase of 25% visitation)

50,000 annual recreation days
x$1.60 recreation day benefits
$80,000 = annual recreation benefits

$25,000 = annual operation and maintenance costs
$17,700 = annual replacement cost for $590,000 in recreation facilities

Future - year 2020 (estimated increase of 75% of present)

70,000 annual recreation days
x$1.60 recreation day benefits
$112,000 = annual recreation benefits

Save Energy and You Serve America!

$35,000 = annual operation and maintenance costs
$17,700 = annual replacement cost for $590,000 in recreation facilities

The necessity for this revision is to update current estimated recreation use figures and reflect the current visitor day benefits. These figures are based on seasonal use primarily by the local population in the area of influence of Tyzak Reservoir. The population projection figures are from the "OBERS Projections - Regional Economic Activity in the USA" by the Water Resources Council, Washington, D.C.

The $1.60 single unit value per visitor day has been updated from the figures given in the "Supplement No. 1 to Senate Document No. 97" by using the more recent figures from "Guidelines for Implementing Principles and Standards for Multiobjective Planning of Water Resources" dated December, 1972. The estimated recreation use figures will remain valid if the recreation facilities are developed and managed in a high quality manner.

Material which we have previously submitted to you may be used in your "Definate Plan Report for Tyzak Reservoir" as you see fit.

If we can be of further assistance, please contact us.

Glenn T. Bean
Deputy Regional Director
for Lynn H. Thompson

United States Department of the Interior
FISH AND WILDLIFE SERVICE

AREA OFFICE COLORADO—UTAH
2215 FEDERAL BUILDING
125 SOUTH STATE STREET
SALT LAKE CITY, UTAH 84138

In Reply Refer To
ES

November 18, 1974

Memorandum

To: Regional Director
Upper Colorado Region
Bureau of Reclamation
Salt Lake City, Utah

From: Area Manager
U. S. Fish and Wildlife Service
Salt Lake City, Utah

Subject: Jensen Unit - Central Utah Project
Fish and Wildlife Analysis

This memorandum responds to your September 20, 1974 correspondence relating current planning for the Jensen Unit. The noted plan modifications would not significantly alter our evaluation of project impact on fish and wildlife resources. Please consider the information in our report of January 30, 1969 as revised April 15, 1970 and qualified by our memorandum of March 5, 1974 as a current evaluation with this one exception; with the inclusion of full service irrigation to 440 acres of land the benefits to upland game hunting would be realized. These project evaluations have been prepared in cooperation with the Utah Division of Wildlife Resources and have their concurrence.

United States Department of the Interior
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
AREA OFFICE COLORADO—UTAH
2215 FEDERAL BUILDING
125 SOUTH STATE STREET
SALT LAKE CITY, UTAH 84138

In Reply Refer To

ES/8120:51506

March 5, 1974

Memorandum

To: Regional Director, Upper Colorado Region, Bureau of Reclamation, Salt Lake City, Utah

From: Area Manager, Bureau of Sport Fisheries and Wildlife, Salt Lake City, Utah

Subject: Jensen Unit, Central Utah Project, Utah - Bureau of Sport Fisheries and Wildlife Analysis

This memorandum is in response to your communication dated January 22, 1974 requesting a fish and wildlife cost benefit analysis.

We find that the project modifications listed therein do not significantly alter the project impacts on fish and wildlife resources. Therefore, we suggest that the evaluations provided in our report of January 30, 1969, and revisions dated April 15, 1970 are still applicable with these exceptions; 1. Stream fishing losses (400 man-days) attributed to the planned diversion of Brush Creek waters to the Stauffer chemical Company phosphate plant would not now occur. 2. Increased upland game hunting (100 man-days) credited to the new lands that were to be irrigated will not be realized.

These findings have been reviewed by the Utah Division of Wildlife Resources and they are in agreement with our determinations.

We assume that estimated costs for fish and wildlife measures will be updated to reflect current prices of implementation. The Utah

State Division of Wildlife Resources has informed us that expenditures required for big game range rehabilitation have increased twofold since 1969 mainly due to the doubling of seed costs for reseeding rehabilitated areas. Therefore, it is suggested that the cost estimate for the big game range rehabilitation feature be increased to $9,000.

Opportunities for the enhancement of resource values at Stewart Lake Waterfowl Management Area will be evaluated when the weather permits an onsite examination. We will advise you of any significant results of this examination.

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Bureau of Sport Fisheries and Wildlife
Post Office Box 1306
Albuquerque, New Mexico 87103

January 30, 1969
Revised April 15, 1970

Memorandum

To: Regional Director, Bureau of Reclamation, Region 4,
Salt Lake City, Utah 84111

From: Regional Director

Subject: Jensen Unit, Central Utah Project, Utah--Bureau of Sport Fisheries and Wildlife report

This memorandum is the Bureau of Sport Fisheries and Wildlife detailed report on the relationship of the Jensen Unit of the Central Utah Project to the associated fish and wildlife resources. The Jensen Unit is one of the four independent units of the Central Utah Project's initial phase which is a participating project of the Colorado River Storage Project authorized by the Act of April 11, 1956 (70 Stat. 105).

This report has been prepared in accordance with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). It is intended to accompany the Bureau of Reclamation definite plan report for the Jensen Unit. Evaluations of project effects on the fish and wildlife resources are based upon data made available by the Bureau of Reclamation in September 1967, and a memorandum dated February 13, 1970, concerning expected population increases in the area.

Close coordination has been maintained with the Utah State Division of Fish and Game during report preparation and concurrence in the report is shown by the enclosed letter dated January 9, 1969, from Director John E. Phelps. A subsequent letter dated March 23, 1970, concurred in the revised fishery benefit which was the occasion for the revisions on the above date.

Fish and wildlife aspects of this Unit were initially presented in "A Preliminary Evaluation Report on Fish and Wildlife Resources in Relation to the Proposed Water Development Plan for the Jensen Project, Brush Creek, Green River Subbasin, Colorado River basin, Utah," dated June 21, 1946, and revised on May 12, 1948. Brief mention of the Unit also was made in "A Preliminary Report on Fish and Wildlife Resources in Relation to the Colorado River Storage Project."

BUREAU OF SPORT FISHERIES AND WILDLIFE

The Jensen Unit is the last of the four independent units of the Central Utah Project (Initial Phase) to undergo definite plan formulation. This unit, shown on Plate 1, is located in the eastern part of the Uinta Basin in Uintah County, Utah. It will control remaining undeveloped waters of Brush Creek and also use flows of the Green River near Jensen, Utah. Purposes of the project include water supplies for municipal and industrial uses and for irrigation, recreation, fish and wildlife conservation, and flood control.

DESCRIPTION OF THE AREA

Brush Creek is the easternmost important tributary to the Green River in the Uinta Basin of Utah. Big and Little Brush Creeks originate in the Uinta Mountains at elevations of 10,500 feet. They flow southeasterly and join to form Brush Creek which flows to the junction with the Green River at an elevation of 4,800 feet. The confluence of Big Brush Creek and Little Brush Creek is about 13 miles upstream from the Green River. These creeks drain an area of 255 square miles of which nearly one-half are within the Ashley National Forest.

Native vegetation of the Brush Creek drainage is typical of the various altitudes. The alpine meadows and peaks of the Uinta Mountains above timberline give way to spruces, aspens, and firs in the higher parts of the timbered mountains. Ponderosa pine and lodgepole pines appear at lower elevations. These give way on the lower hillsides to juniper, pinyon, sagebrush, and bitterbrush. Willows, cottonwoods, tamarisk, and grasses are predominant along the lower creek beds.

Flows of Big Brush Creek and Little Brush Creek have been extensively developed for irrigation. Irrigation water storage works on the headwaters of these streams include the 6,847 acre-foot Oak Park Reservoir on Big Brush Creek and the 2,600 acre-foot East Park Reservoir on Little Brush Creek. The narrow bottoms of the lower part of Brush Creek are irrigated and the stream also is diverted onto bottomlands along the west side of the Green River in the vicinity of Jensen. This area extends for about 7 miles from the boundary of the Dinosaur National Monument on the north to the mouth of Ashley Creek on the south. Irrigated lands are cultivated primarily for small grains, alfalfa, and other forage crops.

The livestock industry has for many decades been a most important part of the area's economy. More recently, however, a phosphate-producing operation of the Stauffer Chemical Company has developed along Big Brush Creek just upstream from Utah State Highway No. 44 which connects Vernal with the Flaming Gorge area.

The 1960 population of Vernal was 3,655 persons while that of Jensen was less than 100 persons. Since then Uintah County has experienced considerable growth as a result of the expanding industrial and tourist economy.

Adjacent to the Green River bottomlands that receive Brush Creek water for irrigation is an important wildlife area developed by the Utah State Division of Fish and Game. It is the 595-acre Stewart Lake Waterfowl Management Area that is located between the Green River and the terminal reach of Ashley Creek.

The Brush Creek drainage is east and north of the Ashley Creek drainage, in which the constructed Vernal Unit of the Central Utah Project is located. The most prominent feature of the Vernal Unit is Steinaker Dam and Reservoir which supplies irrigation water to the Ashley Valley and municipal water to the city of Vernal. The Ashley Creek area was described in previous Bureau of Sport Fisheries and Wildlife reports on the Vernal Unit and the last such report was issued in May 1957 for the Vernal Unit Definite Plan Report.

PLAN OF DEVELOPMENT

The Jensen Unit will develop about 22,700 acre-feet of water for irrigation and municipal and industrial purposes. Supplemental irrigation water will be provided to about 3,640 acres of irrigated land and a full service supply to 440 acres of new land in the Jensen area. About 18,000 acre-feet of municipal and industrial water will be developed to supply the phosphate plant on Big Brush Creek and for delivery to the Vernal Area. Projected needs for municipal and industrial water are based on year 2020 estimates prepared by the Bureau of Reclamation.

Tyzack Dam and Reservoir will be constructed on Big Brush Creek about 3 miles downstream from the intersection of the creek and Utah State Highway No. 44. Spring runoff and surplus flows of Big Brush Creek will be stored for subsequent irrigation and municipal and industrial uses. Pertinent data on Tyzack Reservoir appear in Table 1.

Table 1
Tyzack Reservoir data

Pool level	Elevation (feet)	Capacity (acre-feet)	Area (acres)
Normal	5,633	26,000	422
Minimum	5,542	2,000	105
Streambed	5,495	-	-

The 35 second-foot capacity Tyzack Pumping Plant will lift 10,800 acre-feet of water from Tyzack Reservoir a maximum of 460 feet over the divide to Ashley Valley. Tyzack Aqueduct, a pipeline, will carry this water 7.2 miles to Steinaker Reservoir for municipal and industrial use in the Vernal area.

Water supplies for the Stauffer Chemical Company Plant will be pumped by a company installation at a point about 4 miles upstream from Tyzack Dam. This demand on project water will consume about 7,000 acre-feet annually.

When water stored in Tyzack Reservoir is available it will be used to irrigate lands in the Jensen area, as well as for diversion to Steinaker Reservoir. When there is insufficient water in storage, supplies will be supplemented by Green River waters from the Burns Pumping Plant to be constructed on the Green River near the mouth of Brush Creek. This 97 second-foot capacity installation will supply 10,200 acre-feet of water for irrigation in the Jensen area. About 4,700 acre-feet will be an increase over present supplies while 5,500 acre-feet will be exchanged for Big Brush Creek flows that can be used for municipal and industrial purposes. Discharge lines from the Burns Pumping Plant will connect to four existing irrigation canals in the Jensen area.

Project plans provide for progressive construction as needs for the various features develop. Tyzack Reservoir will be a part of the initial development. Construction of the Tyzack Pumping Plant and Aqueduct will follow the buildup of demand for municipal and industrial water in Ashley Valley. Such features will be followed in turn by the construction of the Burns Pumping Plant and other necessary works to replace irrigation waters diverted to Ashley Valley.

The period of analysis for fish and wildlife in this report is 100 years, the expected life of the project.

FISH

Without the Project

Fish habitat in about 19 miles of Big Brush and Brush Creeks downstream from the site of the Stauffer Chemical Company Plant diversion will be affected by the project. This stream fishery is sustained primarily by providing catchable-sized rainbow trout. From about 2 miles above Utah State Highway No. 44 to its junction with Little Brush Creek, Big Brush Creek has been a very popular and fairly productive stream fishery to local anglers. However, since completion of Flaming Gorge Reservoir, most of the fishing pressure has been drawn to that new, highly productive reservoir. Brush Creek provides little fishing opportunity, has marginal game-fish habitat, flows mainly through private

lands, and is inhabited primarily by nongame fish species. No particular change is expected without the project except that Big Brush Creek near State Highway No. 44 would likely be restored to its former popularity as demand for stream fishing increases in the future.

Steinaker Reservoir of the Vernal Unit also is involved. This 820-acre fishery has been quite productive, but also has been affected by the popularity of Flaming Gorge Reservoir. Its future will be described in a forthcoming final report on the Vernal Unit.

With the Project

Under the proposed plan of operation, Big Brush Creek between the Stauffer Chemical Company Plant diversion and Tyzack Reservoir will be dewatered one or more months in 11 years out of 35. Also, its flow will drop to less than 5 second-feet virtually every year. This stream section will not support continuously a trout population and the effectiveness of a put-and-take fishery program will be limited. The fishery potential and amount of fishing will be greatly reduced.

Approximately 2.5 miles of Big Brush Creek will be inundated by Tyzack Reservoir and the stream fishing lost. Below Tyzack Dam, Big Brush Creek downstream to Little Brush Creek will be dewatered or nearly so during the winter months. Stream fishing on this segment of Big Brush Creek virtually will be lost. Downstream from Little Brush Creek there will be little change in this poor fishery.

The size of Tyzack Reservoir and the planned operation will contribute to the development of a good coldwater fishery in this impoundment. Since the primary demand on this storage will be for municipal and industrial purposes, fluctuation will not be drastic. Operation studies indicate that drawdown during the recreation season would never completely reach the minimum pool and that in only 4 years out of 33 would storage be less than 10,000 acre-feet. During the major portion of the recreation season from June through November, the average amount of water in storage will be about 20,600 acre-feet with an average surface area of 379 acres. However, fishing pressure at Tyzack Reservoir is not expected to be particularly heavy since it would be competing for fishermen with 12 existing or planned fishing waters along the south slope of the Uinta Mountains in addition to the highly attractive Flaming Gorge Reservoir.

Through the coordinated efforts of the Utah State Division of Fish and Game, the Bureau of Reclamation, and our Bureau, 1,900 acre-feet of the 2,000 acre-feet inactive storage capacity in Tyzack Reservoir were added specifically for fish conservation. The reservoir would provide about 9,500 man-days of fishing annually which would be 8,500 man-days more than would occur without a minimum pool.

Changes in the operation of Steinaker Reservoir, due to the introduction of water from Big Brush Creek through the Tyzack Aqueduct, have not been estimated. It is probable that the resultant effects on the fishery would be somewhat beneficial but not of measurable significance. For these reasons, Steinaker Reservoir is not evaluated in this report.

Estimates of projected fishing without and with the project appear in Table 2.

Table 2
Estimated man-days of fishing annually

Fishing water	Size	Without project	With project	Gain or loss
	(miles)			
Big Brush Creek				
Stauffer Chemical Co. Plant diversion to Tyzack Reservoir	1.5	600	200	-400
In Tyzack Reservoir site	2.5	1,600	0	-1,600
Tyzack Dam to Little Brush Creek	2.0	100	0	-100
Brush Creek	13.0	-	-	0
Total		2,300	200	-2,100
	(acres)			
Tyzack Reservoir	379	0	9,500	9,500

WILDLIFE

Without the Project

The project area of influence on wildlife includes 19 miles of the valleys of Big Brush Creek and Brush Creek from the Stauffer Chemical Company Plant diversion site downstream to the Green River, including about 500 acres in the Tyzack Reservoir site, and about 10 square miles of Green River bottomlands in the vicinity of Jensen. Vegetative types include juniper-pinyon and sagebrush sidehills, irrigated farmlands, and cottonwood-willow groves along the streams and drains.

Deer are abundant in segments of this drainage during various seasons of the year. All of the area is within a management unit specified by the Utah State Division of Fish and Game as Deer Herd Unit No. 26. Many mule deer that summer in the mountains of the Ashley National Forest winter in the area of Tyzack Reservoir. Some deer inhabit the river bottoms and agricultural areas year around. The Utah State Division of Fish and Game reports that about 12,000 hunter-days would be expended in the pursuit of deer in Herd Unit No. 26. Approximately 2,400 man-days of this hunting would be associated with the area of project influence without the project.

Upland-game birds found in the Brush Creek area drainage consist of pheasants, chukar partridges, mourning doves, and California quails. Pheasants, quails, and mourning doves are quite common through the irrigated farmlands while chukar partridges occur in foothill areas adjacent to the farmland areas. About 2,300 man-days of hunting would be spent annually in the pursuit of upland-game birds. Cottontails are fairly abundant along stream bottoms, on the irrigated farmlands, and lower foothills of the drainage and would provide about 200 man-days of hunting without the project.

The Uinta Basin is an important stopover area for waterfowl that follow the Green River as they migrate through eastern Utah. The portion of the Green River bottomlands, the Stewart Lake Waterfowl Management Area, and the small creeks and farmlands in the Brush Creek drainage comprise a part of that area. Waterfowl are fairly common during the spring, summer, and fall months. Hunting on these lands and waters would amount to about 400 man-days annually without the project. Virtually all of this hunting is for ducks. Only rarely is a goose killed in the area.

Uintah County supports one of the largest beaver populations in Utah. They are quite common along streams in the project area. About 100 pelts are taken annually by trappers in the project area. Other fur animals such as minks, martens, skunks, and muskrats are present and there is some incidental trapping for them.

With the Project

Impounded waters of Tyzack Reservoir together with road construction around the reservoir will eliminate about 500 acres of valuable deer winter range. This loss of wintering habitat will result in a reduction of deer with an associated reduction in man-days of hunting. With the project there will be about 2,350 man-days of deer hunting annually.

About 500 acres of upland-game habitat will be lost in the Tyzack Reservoir Basin and in areas developed as access roads for the project.

This habitat supports pheasants, chukars, quails, mourning doves, and cottontails. However, these losses will be compensated for by the upland-game habitat that will be improved in the 440 acres of new agricultural land to be irrigated by the project. Pheasants especially will increase on such lands. With the project there will be 2,400 man-days annually of hunting for upland-game birds and essentially no change in hunting for cottontails.

Waterfowl habitat in the project area would remain relatively unchanged. Tyzack Reservoir will provide a resting area for migrant waterfowl but a lack of food will preclude any significant amount of use.

Some of the increased irrigation return flows resulting from the increased water supply will flow to the Stewart Lake Waterfowl Management Area. These flows could reach 1 to 2 second-feet in volume. This amount of water would be of value to the management of the area although it would not result in any definable increase in man-days of hunting. Man-days of waterfowl hunting with the project would remain at 400 annually.

Impoundment of water in the Tyzack Reservoir will eliminate about 3 miles of streamside beaver habitat. The annual take of beaver pelts in this reach will be reduced insignificantly. Effects on other fur animals will be insignificant.

Projected effects of the project on hunting are summarized in Table 3.

Table 3
Annual man-days of hunting, Jensen Unit

Kind of game	Without project	With project	Gain or loss
Mule deer	2,400	2,350	-50
Upland game			
Pheasant	1,400	1,500	100
Chukar	500	500	0
Mourning dove	200	200	0
California quail	200	200	0
Cottontail	200	200	0
Waterfowl (ducks)	400	400	0
Fur animals (pelts)	100	100	0

DISCUSSION

Planning for the Jensen Unit has incorporated several project modifications that will be beneficial to fish and wildlife resources. Without additional inactive storage for fish conservation, Tyzack Reservoir would not provide satisfactory habitat for a good fishery management program. Therefore, as previously mentioned, 1,900 acre-feet of water were added to the inactive storage pool to provide an adequate minimum pool for fish. Fishing associated with provision of the minimum pool was based on the assumption that the projected increases in local population used in project planning will occur. If these population increases are not realized, a much smaller amount of fishing will be done at Tyzack Reservoir.

To mitigate the loss of deer winter range in the Tyzack Reservoir Basin, it is proposed that $4,000 be provided to help assist the State in a range rehabilitation project about 2 miles north of Tyzack Reservoir in sections 27 and 28, T. 2 S., R. 22 E., S.L.B.&M. Juniper-pinyon

cover on these lands would be partly removed and they would be reseeded to grasses and browse plants. This would mitigate fully the loss of deer winter range occasioned by the project. It is proposed that the $4,000 be programed and spent for this purpose under authority of Section 8 of the authorizing Act for the Colorado River Storage Project.

The Utah State Stewart Lake Waterfowl Management Area presently receives most of its water supply from Ashley Creek. When flows in this creek are limited, water is pumped to the management area from the Green River. This pumping operation was established as a feature of the Vernal Unit, Central Utah Project, to improve the area water supply and to prevent waterfowl habitat reduction from a decreased water supply as a result of the increased consumptive use of Ashley Creek flows. Expected larger diversions of Ashley Creek water in the future will require greater reliance upon the flows provided by pumping.

The Jensen Unit offers an opportunity to improve greatly the method of operation for the Stewart Lake Area. Under the Jensen Unit an annual water need of 2,100 acre-feet as part of the supply to the Stewart Lake Waterfowl Management area can be met by three sources. Existing springs and seeps will supply more than one-half of the requirement. Project drains as planned can deliver return irrigation flows and drain waters to the point of most desirable water delivery for the area, as shown on Plate II. In addition, water pumped from the Green River at the Burns Pumping Plant and carried by the Burns Bench Canal could be delivered at the same point. This would require construction of a lateral to the desired point of delivery or to the project drain terminating at this point of delivery. Water demands for the area are shown in Table 4.

Table 4
Average Monthly Water Demand, Stewart Lake
Waterfowl Management Area

Month	Acre-feet	Second-feet
January	62	1.0
February	67	1.1
March	78	1.3
April	181	3.0
May	264	4.4
June	275	4.6
July	371	6.2
August	341	5.7
September	225	3.7
October	124	2.1
November	62	1.0
December	62	1.0
Total	2,112	

Costs involved in effecting this improved water supply include $17,000 for construction and $300 annually for maintenance of the Stewart Lake Lateral, and water carriage charges through existing canals to the Stewart Lake Lateral heading. Additional annual operation and maintenance costs allocable to fish and wildlife for joint use of the Burns Pumping Plant will be determined by the Bureau of Reclamation. It is assumed that capital costs would be project costs to be funded under Section 8 of the Colorado River Storage Project Act and that the Utah State Division of Fish and Game would fund operation, maintenance, and replacement costs.

Benefits to the project from this proposal would be realized in two ways. Costs for delivery of the required water supply to the Stewart Lake Area from the Burns Pumping Plant would be less than supplying water by the existing pumping system which was constructed as part of the Vernal Unit. A preliminary estimate by the Bureau of Reclamation showed that a savings of $1,100 annually would be realized by providing the Stewart Lake Area with water from the Burns Pumping Plant instead of by the present method of operation.

Providing a gravity-fed water supply to the northwest boundary of the management area also would make it possible to develop 100 acres of emergent marsh where none now exists. It also would improve the overall water management program for the area. The value of 100 acres of marsh was computed by comparing expenditures of the State of Utah to develop comparable waterfowl marshes. Such alternative costs are estimated at about $900 annually, which may be considered as another benefit from the planned water supply. The Utah State Division of Fish and Game has ample water rights to Green River flows to supply the potential 100-acre marsh, but watering the area from the existing pump is not feasible.

In view of the above, it is recommended that:

1. The sum of $4,000 be provided to assist in the rehabilitation of 500 acres of big-game range located approximately 2 miles north of Tyzack Reservoir as mitigation for the loss of range in the Reservoir site, such funds to be expended under authority of Section 8 of the authorizing Act for the Colorado River Storage Project.

2. Provision be made for delivery to the Utah State Stewart Lake Waterfowl Management Area, through project canals and drains, an annual water supply of approximately 670 acre-feet, such measure to include specific costs of $17,000 for additional canal construction under authority of Section 8 of the authorizing Act.

CONCLUSIONS

The Jensen Unit will result in the loss of 2,100 man-days of stream fishing for which there is no feasible means of mitigation. Tyzack Reservoir will provide a productive reservoir fishery that will result in about 9,500 man-days of fishing for a benefit of $14,300 annually. The benefit is based on the assumption that the reservoir area will be developed under authority of Section 8 of the Colorado River Storage Project Act and administered for public use in keeping with Department of the Interior policies.

The project also will inundate some good deer winter range. This loss can be essentially mitigated by a contribution to the improvement of a nearby area, as proposed in Recommendation No. 1.

Pheasant hunting benefits incidental to the irrigation of new lands will amount to $300 annually. In addition, provision for a water supply to the Stewart Lake Waterfowl Management Area, as outlined in Recommendation No. 2, will result in benefits of $900 and operational savings of $1,100 annually.

Total fish and wildlife benefits with adoption of the above recommendations are thus $16,600 annually. Costs associated with the realization of these benefits are listed in Table 4.

Table 4. Cost Associated with the Fish and Wildlife Purpose

Item	Capital cost	Annual O&M costs
Adding 1,900 acre-feet to Tyzack Reservoir	1/	1/
Deer range improvement	$4,000	--
Water supply to Stewart Lake	17,000	2/$300

1/ Separable cost to be determined by the Bureau of Reclamation.
2/ Utah State Division of Fish and Game cost. Additional annual costs allocable to fish and wildlife for joint use of the Burns Pumping Plant will be determined by the Bureau of Reclamation.

The cooperation received from your Bureau during preparation of our report is appreciated.

/s/ William T. Krummes
William T. Krummes

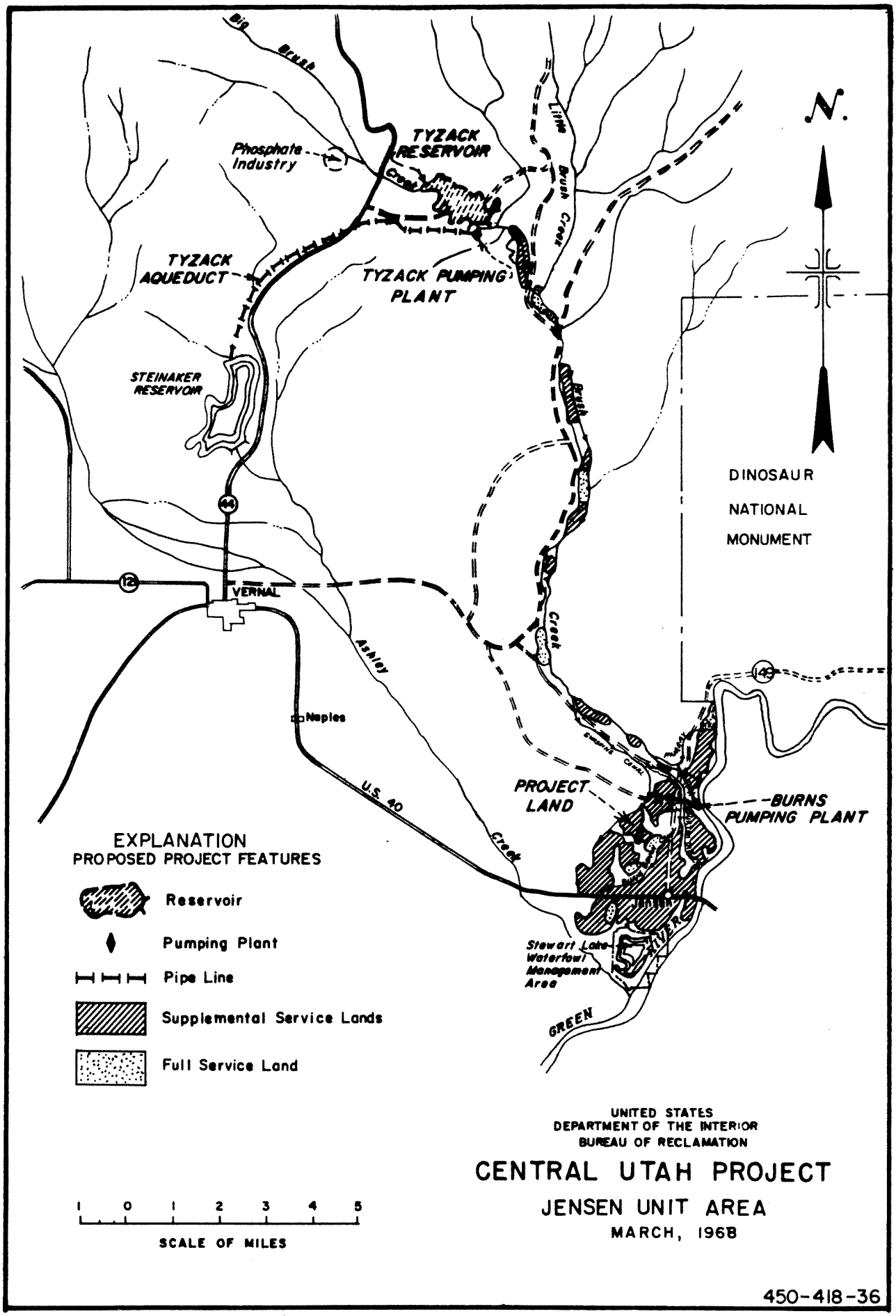
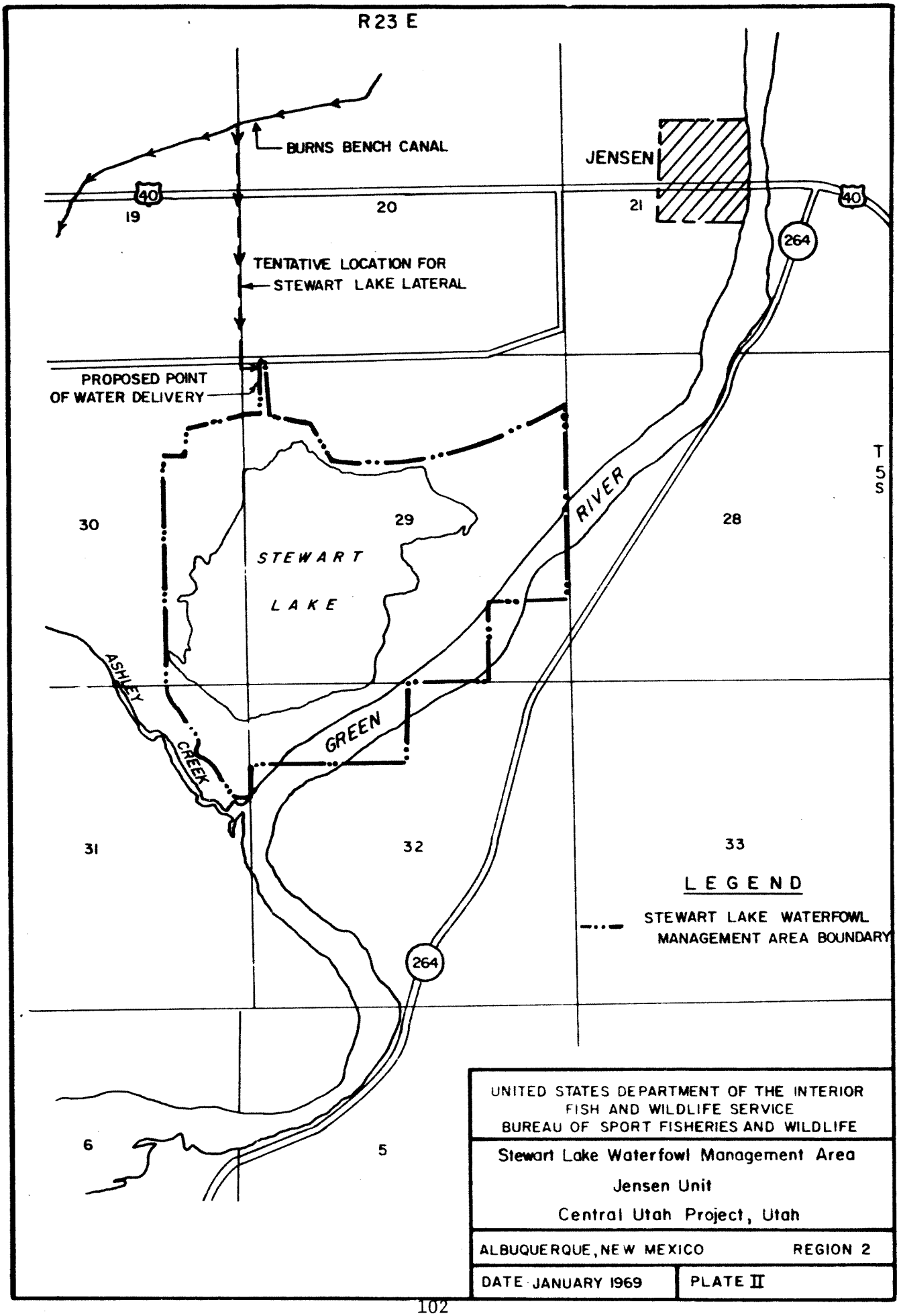

Big Brush
Phosphate Industry
TYZACK RESERVOIR
Little Brush Creek
TYZACK AQUEDUCT
TYZACK PUMPING PLANT
STEINAKER RESERVOIR
N.
DINOSAUR NATIONAL MONUMENT
44
12
VERNAL
Ashley Creek
Naples
U.S. 40
PROJECT LAND
BURNS PUMPING PLANT
Stewart Lake Waterfowl Management Area
GREEN RIVER
EXPLANATION
PROPOSED PROJECT FEATURES
Reservoir
Pumping Plant
Pipe Line
Supplemental Service Lands
Full Service Land
0 1 2 3 4 5
SCALE OF MILES
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT
JENSEN UNIT AREA
MARCH, 1968
450-418-36

PLATE I


R23 E
BURNS BENCH CANAL
JENSEN
40
19
20
21
40
264
TENTATIVE LOCATION FOR
STEWART LAKE LATERAL
PROPOSED POINT
OF WATER DELIVERY
T
5
S
30
29
28
STEWART
LAKE
RIVER
ASHLEY
CREEK
GREEN
31
32
33
LEGEND
STEWART LAKE WATERFOWL
MANAGEMENT AREA BOUNDARY
264
6
5
UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
Stewart Lake Waterfowl Management Area
Jensen Unit
Central Utah Project, Utah
ALBUQUERQUE, NEW MEXICO
REGION 2
DATE JANUARY 1969
PLATE II

DEPT. OF NATURAL RESOURCES

DIVISION OF FISH & GAME

State of Utah
Governor
Calvin L. Rampton

Director
John E. Phelps

Board of Fish & Game
1596 West North Temple
Salt Lake City, Utah 84116

January 9, 1969

Mr. William T. Krummes
Regional Director
Bureau of Sport Fisheries & Wildlife
P. O. Box 1306
Albuquerque, New Mexico 87103

Attention Mr. Robert F. Stephens

Gentlemen:

It has come to our attention that we have not responded to your request for comments on the Jensen Unit Report which you sent us for review.

We have no further comment on your report, and fully concur in the findings as contained in the draft of November 6, 1968.

Very truly yours,

/s/ Bud
John E. Phelps
Director

AIR MAIL

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
650 CAPITOL MALL
SACRAMENTO, CALIFORNIA 95814

REPLY TO
ATTENTION OF
SPKED-P

27 February 1974

Regional Director
Upper Colorado Regional Office
Bureau of Reclamation
P.O. Box 11568
Salt Lake City, Utah 84111

Dear Sir:

Flood control benefits have been reevaluated for the potential Tyzack Reservoir, Jensen Unit, Central Utah Project as requested by your letter of 22 January 1974, your reference 720 564.

The reservoir routing studies furnished with your recent letter were compared with operation studies and related data submitted for appraisal in 1969. From the comparison it appears the revised operations will control the 100-year inflow peak of 4,000 c.f.s. to a non-damaging flow of 200 c.f.s. below the damsite. The active reservoir capacity presently proposed at 24,000 acre-feet is also comparable with that previously analyzed.

Revised estimates of flood control benefits have been prepared by updating previously furnished benefits for January 1974 price levels and current projections of economic development for a 100-year economic life of the project and a discount rate of 3-1/4 percent. Average annual flood control benefits creditable to the project on these bases are estimated to be $24,000.

The estimated flood damage reduction benefits are based on snowmelt runoff reduction. Development of flood control operating criteria by our office, in accordance with Section 7 of the Flood Control Act of 1944, will be required to provide for realization of these benefits.

Sincerely yours,

Christ F. Potamos

CHRIST F. POTAMOS
Lieutenant Colonel, CE
Acting District Engineer

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT CORPS OF ENGINEERS
650 CAPITOL MALL
SACRAMENTO, CALIFORNIA 95814

SPKED-P

21 January 1970

Regional Director, Region 4
Bureau of Reclamation
P.O. Box 11568
Salt Lake City, Utah 84111

Dear Sir:

Reference is made to your letter of 6 October 1969 furnishing operation studies and related data for the proposed Tyzack Reservoir, Jensen Unit, Central Utah Project. You requested verification of the flood control operation studies and final data on flood control benefits creditable to the proposed project.

The reservoir routings furnished indicate that the 100-year flood event on Brush Creek, with a peak reservoir inflow of 4,000 c.f.s., will be controlled to a nondamaging flow of 200 c.f.s. below the damsite and that total storage used would be 19,000 acre-feet. A review of your operation studies indicates that all data used are quite satisfactory for flood control benefit evaluation for Tyzack Reservoir, based on the assumption that the reservoir will be operated for flood control on the basis of Federal-State cooperative runoff forecasts.

The preliminary analysis of flood control benefits creditable to Tyzack Reservoir furnished by our Los Angeles District in December 1967 has been reviewed. Revised estimates of flood control benefits have been prepared on the basis of current price levels and current projections of economic development for an estimated 100-year economic life of the project. Future benefits were discounted at 3-1/4 percent interest, the rate which was informally indicated would be used in your definite project studies. Preproject flood damage estimates were based on flow frequency data developed in connection with the December 1967 evaluations and project flood damage estimates were based on your operation studies, which show the 100-year flood event would be controlled to nondamaging flows. On these bases the average annual primary flood control benefits creditable to Tyzack Reservoir are estimated to be $19,800.

SPKED-P 21 January 1970
Regional Director, Region 4

The flood damage reduction benefits indicated above are based upon Tyzack Reservoir being operated for flood control in accordance with operating criteria to be established in accordance with Section 7 of the Flood Control Act of 1944. Such operating criteria will be prepared by this District as mutually scheduled with your office.

Sincerely yours,

/s/ George B. Fink
GEORGE B. FINK
Colonel, CE
District Engineer

22 December 1967

LOS ANGELES DISTRICT, CORPS OF ENGINEERS

PRELIMINARY ANALYSIS OF BENEFITS FROM FLOOD CONTROL

JENSEN UNIT - CENTRAL UTAH PROJECT, BRUSH CREEK, UTAH

1. The Los Angeles District received a request from Region 4, U.S. Bureau of Reclamation, by letter dated 1 September 1967, for a preliminary estimate of the flood-control benefits to be obtained from the construction of the Jensen Unit of the Central Utah Project. The Jensen Unit is a multiple-purpose project on Brush Creek, a tributary of the Green River. The mouth of Brush Creek is located near the town of Jensen, Utah, about 13 miles southwest of Vernal, Utah.

2. An engineer from the Los Angeles District, Corps of Engineers, inspected the area in September 1967 and discussed the flood-control aspects of the project with personnel in the Provo, Utah Office of the Bureau of Reclamation. The following paragraphs summarize our findings relative to the existing conditions in the project area and the estimated flood-control benefits to be expected if the project is constructed.

3. Preliminary plan formulation studies by the USBR indicate that a combination of pumping from the Green River and storage on Brush Creek would be the most economical development. A supplemental water supply would be provided for about 4,000 acres of presently irrigated land and a full supply for about 500 acres of new land. At the present time, about 750 acres are being irrigated along Brush Creek. These irrigated acres constitute the area subject to flood damage from Brush Creek. About 3,250 acres to be irrigated under the proposed project are located along the Green River, upstream and downstream from the mouth of Brush Creek, but not subject to flood damage from Brush Creek. This area is served by four canals with headings on Brush Creek. These canal headings, which are owned and operated by local irrigation districts, have been upgraded in recent years and are not subject to damage from floodflows on Brush Creek.

4. The Tyzack Reservoir, proposed for construction about 15 miles upstream from the mouth of Brush Creek, would provide irrigation water for the project lands, municipal and industrial water for the Vernal area, and recreation in the Tyzack Reservoir. Inviolate storage for flood control is not proposed in the Tyzack Reservoir. Flood-control benefits on Brush Creek downstream from Tyzack Dam would depend upon evacuation of the reservoir on the basis of snowmelt forecasts and on surcharge storage, depending upon the spillway design features. The design features and operational plan of the outlet works are not yet available. For the purpose of this study, control of floods not exceeding the 100-year event is assumed.

5. The overflow area along the valley of Brush Creek comprises 750 acres of irrigated land and about 1,200 acres of undeveloped land. There are 12 homesteads in the valley; the irrigated farmsteads vary in size from 40 to 160 acres. Alfalfa is the principal crop. Small grains, mostly oats and barley, are grown on about 20 percent of the irrigated area. The estimated value of property in the Brush Creek overflow area is summarized as follows:

Estimated Value of Property in Brush Creek Overflow Area

Land	$320,000
Buildings and equipment	280,000
Irrigation structures	500,000
Roads and bridges	700,000
Total	1,800,000

6. Brush Creek below the Tyzack damsite meanders across a valley about one-half mile wide, flanked by sparsely vegetated hills. The stream gradient has an average slope of about 40 feet per mile between the Tyzack damsite and the mouth. The stream channel, which averages about 20 feet in width and is about 5 feet deep, has a capacity of about 450 cubic feet per second. Bank erosion begins, however, when flows exceed about 200 c.f.s.

7. Flood damages along Brush Creek, other than bank erosion, include damage to canal headings, farm buildings, fences, irrigation ditches, and county roads and bridges, and silt damage to fields and crops. Seven privately owned canal headings are located in the upper 7-mile reach of Brush Creek. These headings are constructed of logs, brush, and earth and are damaged to some degree almost every year. Silt damage and damage to ditches, fences, and roads will occur when discharges exceed the capacity of the channel. Erosion damage to the abutments of four county bridges occurs to some degree about once every 2 years.

8. A discharge-frequency curve was drawn, utilizing the 27 years of record available for Big Brush Creek near Vernal, Utah (1939-1965), with a drainage area of 82 square miles. The flood of record at this site was 543 c.f.s. on 12 July 1962. The flood of record on Ashley Creek, which is adjacent to Brush Creek on the west and has a drainage area of 101 square miles, was 3,500 c.f.s. on 11 June 1965 near Vernal, Utah. The period of record for this gaging station is 55 years (1911-1965). The Brush Creek discharge-frequency curve was adjusted to conform to the longer record on Ashley Creek and also to recognize the occurrence of thunderstorm floods in the Brush Creek basin.

The following table summarizes the frequencies, discharges, and damages for all floods (snowmelt and thunderstorm) in the Brush Creek overflow area:

Frequency Percent	Peak Discharge Cubic feet per second	Damages
1.0	4,000	$327,000
2.0	1,500	123,000
5.0	600	47,000
10.0	450	35,000
20.0	370	25,000
50.0	270	12,000
75.0	200	0

9. The average annual damages from both snowmelt and thunderstorm floods on Brush Creek under present conditions amount to $16,000. Damage from snowmelt floods would be prevented by operation of the proposed Tyzack Reservoir on the basis of snowmelt forecasts. This operation would be accomplished by releases from the reservoir not exceeding the channel nondamaging capacity (200 c.f.s.) to provide storage for anticipated snowmelt runoff. The volumes of thunderstorm floods are relatively small compared to the active reservoir storage capacity and it is estimated that these flood volumes originating above the damsite would be absorbed by the reservoir and/or by surcharge storage. This feature can be reviewed later when the outlet and spillway details are available.

10. Little Brush Creek, with a drainage area of 28 square miles, would be the largest uncontrolled tributary with the proposed project in operation. Most uncontrolled damage would be from channel erosion and damage to canal headings in the upper reaches. The average annual damages from tributary flow downstream from the Tyzack Dam not prevented by the proposed project are estimated to be $4,000. The average annual damages prevented (benefits), under present conditions, would be $16,000 minus $4,000, or $12,000.

11. It is estimated that some increase in value would take place in the overflow area with or without the proposed project. This increase would be due to upgrading of existing facilities and more intensified agriculture. The total value of property subject to damage is estimated to increase by 75 percent during the 100-year study period. The growth factor, after discounting at 3-1/4 percent, is 1.2. The average annual benefits, under average future conditions, would be 1.2 times $12,000, or $14,400.

12. A revised flood control benefit analysis will be made after operational procedures are established, to provide storage for snowmelt floods on the basis of snowmelt forecasts. If flood-control storage is allocated and operational procedures are established in accordance with section 7 of the Flood Control Act of 1944, a final analysis of flood-control benefits will be made.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VIII
1860 LINCOLN STREET
DENVER, COLORADO 80203

JUL 9 1974

Mr. David L. Crandall
Regional Director
U.S. Bureau of Reclamation
Upper Colorado Regional Office
P.O. Box 11568
Salt Lake City, Utah 84111

Dear Mr. Crandall:

The Environmental Protection Agency has briefly reviewed the summary sheets and the ecological study for the Jensen Unit of the Central Utah Project.

The most significant aspect of the project appears to be the potential impact of the Stauffer Chemical Company's phosphate plant operation on water quality in the proposed Tyzack Reservoir. The major problems associated with the operation are (1) potential for storm runoff to erode overburden from mining activities and carry it to the reservoir, (2) potential failure of tailings stabilization dam and (3) the quality of effluent from the tailings pond and its effects on the reservoir.

The definite plan report should consider these problems in detail rather than, e.g. stating that the company will comply with Federal-State water quality standards.

We would appreciate reviewing the definite plan report and environmental statement for the Jensen Unit concurrently, and recommend that if at all possible, review of these documents be so scheduled.

Sincerely yours,

for John A. Green
Regional Administrator

PROJECT

Jensen Unit
Central Utah Project
Bureau of Reclamation

IMPACT REPORT

JENSEN UNIT

Bureau of Land Management
Utah State Office and
Vernal District Office

July 1974

BUREAU OF LAND MANAGEMENT

I. INTRODUCTION

The Bureau of Land Management (BLM) administers more than 23 million acres of Utah's public land under the principles of mutiple use. Authority for this multiple use management was conferred by the Classification and Multiple Use Act of 1964. This act specifies that BLM shall manage the lands for:

A. Fish and wildlife development and utilization
B. Outdoor recreation
C. Mineral production
D. Watershed protection
E. Wilderness preservation
F. Domestic livestock grazing
G. Industrial development
H. Occupancy
I. Timber production
J. Preservation of public values that would be lost if the land passed from public ownership.

In carrying out these responsibilities BLM studies programs of other agencies which propose to alter existing uses and resources on the public lands. Thus, when the Bureau of Reclamation announced its intent to formulate development plans on the Jensen Unit, BLM initiated a study to determine the potential impact this project could have on lands, resources, and programs administered by BLM. This is a report of the study.

II. LOCATION AND DESCRIPTION OF THE JENSEN UNIT PROJECT

The Jensen Unit area is located in the northeastern corner of Utah within Uintah County. The project area is adjacent to the city of Vernal, the major population and trading center within Uintah Basin. The Vernal district BLM office has administrative responsibility over public domain in the area.

The Jensen Unit is within an area of intermingled private, Bureau of Land Management, and Bureau of Reclamation withdrawn and acquired lands. It is within the inventoried Red Mountain recreation area which has eight inventoried features.

Major features of the project include Tyzack Dam reservoir, pumping plant and aqueduct.

Purpose of the project would be to furnish water for irrigation, municipal and industrial purposes, and provide fishery and recreation benefits along with providing flood control.

The Tyzack Dam will be located on Big Brush Creek, three miles below Highway 44. It will create a reservoir having a normal water elevation of 5,608 feet with a capacity of 26,000 acre feet, of which 24,000 acre feet will be active. The reservoir will provide storage on Big Brush Creek to provide municipal and industrial water as well as supplemental irrigation water on lower Brush Creek and the Jensen area. The Tyzack pumping plant will lift the municipal and industrial water from the Tyzack Reservoir over the divide into 7.4 miles of discharge line and aqueduct leading to Steinaker Reservoir. This water will be available for anticipated municipal and industrial development in the Vernal area.

The Big Brush Creek bottom to be covered by Tyzack Reservoir is vegetated with willows, squawbush, big sage, and bullberry with an understory of native grass and forbs. The steep, thinly mantled slopes are vegetated with mountain mahogany, shadscale, sagebrush, and native grasses. Some private land in the creek bottom is under cultivation. Grazing carrying capacity of BLM lands to be inundated is estimated at 15 acres per AUM. This stretch of the creek is very scenic. Steep sandstone canyon slopes give a feeling of remoteness and seclusion. Presently trout fishing on Big Brush Creek is only fair. The creek bottom area receives use by deer, rabbits and upland birds. The area in general receives heavy use by deer in winter months.

Watersheds immediately upstream from the proposed reservoir are primarily BLM-administered. They are rated as moderate silt producers. BLM has constructed 17 erosion control dams in the major side drainage areas of the proposed reservoir. These dams have greatly reduced silt movement downstream. Most of the reservoir siltation will come from lands upstream from the immediate project area which is generally private and national forest.

The proposed Tyzack Reservoir site is underlain with phosphate-bearing rock. The area is also potentially valuable for oil and gas production. BLM works closely with mineral interests in this area to insure maximum protection of surface resources and protection of aesthetic values.

Effect of the Jensen project on BLM-administered lands, resources and programs.

A. Lands

The Bureau of Land Management administers about 4,800 acres within the Tyzack Reservoir drainage. Approximately 2,200 acres within the immediate vicinity of the proposed reservoir have been withdrawn for reclamation purposes. The Tyzack aqueduct will be located on public domain lands for about three miles.

Public domain lands in the vicinity of the project have been classified for retention and multiple use management under the Classification and Multiple Use Act of 1964. The lands were segregated from appropriation under the agricultural land laws (43 U.S.C., Part 7 & 9, 25 U.S.C. Section 334) and from public sale under Section 2455 of the Revised Statutes (43 U.S.C., Chapter 2).

B. Recreation

The Tyzack project will enhance recreation resources of the area by creating a fresh water reservoir which is readily available for boating and fishing. Adjoining land lends itself well to development of recreation sites which complement the fishing and boating activities (campground-picnic area-developed overlook). Added opportunity for recreation resulting from the project will significantly complement the overall recreation resource in the area.

Recreation facilities to complement water based recreation on the reservoir could be built in several areas. Facilities on these sites would include camping and picnicking facilities and a boat ramp on at least one location. No detailed plans have been made to date for these developments.

The project, located on a major access route to the heavily used Flaming Gorge Reservoir, has excellent recreational potential. Average cars over Highway 44 in 1973 was 980 per day. Traffic shows a significant yearly increase in recent years. Tyzack Reservoir may logically be compared to Steinaker Reservoir. Steinaker, located 10 miles southwest of the proposed Tyzack Reservoir, provides excellent trout fishing but has no culinary water or overnight camping facilities. Steinaker had 44,860 visitors in 1973. The Utah Parks and Recreation Division anticipates visitor use will double quickly if overnight camping facilities are provided. No doubt Tyzack Reservoir will provide excellent fishing, swimming, and boating opportunities.

The proposed reservoir is encompassed by BLM's Red Mountain Recreation Area. Within this area eight sites have been inventoried as having potential for recreation development. These do not include sites that could be developed around the proposed reservoir. BLM plans call for development of inventoried sites as demand warrants and funds become available.

No archeological sites have been identified in the project area but it is likely sites exist along Brush Creek. A comprehensive inventory should be made before project construction.

The BLM has conferred with National Park Service officials who are responsible for evaluating the area's recreation potential. The NPS has advised that the Utah Parks and Recreation Division is interested in

administering recreation at the Tyzack project. The development would be managed in conjunction with their on-going program at Steinaker Reservoir. BLM has no objection to this proposal and supports this state agency's program. A close working relationship is urged between state, BLM, and other government agencies in planning, development and administration of the recreation facilities.

C. Watershed

Tyzack Reservoir will control Big Brush Creek thus reducing downstream sediment movement. The stream from the dam to Green River will generally be free of silt.

Very little sedimentation is expected from adjacent BLM-administered lands due to intensive watershed management. In past years 17 erosion control dams were built to the east of the proposed Tyzack Reservoir to slow silt movement into Brush Creek.

D. Minerals

The area of the Tyzack project is underlain with the Park City formation of which the lower member is valuable for production of phosphate. Presently phosphate is being open pit mined four miles above the Tyzack Reservoir location by Stauffer Chemical Company. Phosphate deposits under the proposed Tyzack Reservoir are 800-1,000 feet below the ground surface.

It is possible that construction of the Tyzack Reservoir development will conflict to some degree with future phosphate mining in the immediate reservoir vicinity. Phosphate could conceivably be removed from underneath the reservoir by pillar mining, but an underground operation could create surface disturbances adverse to a reservoir project. Considerable study should be done before phosphate in the immediate vicinity is leased. The vicinity has a large reserve of phosphate, much of which is available for open pit mining. Known reserves of phosphates in the United States contain an adequate 100 year supply with the ocean floor offering a significant potential supply.

The area is considered prospectively valuable for oil and gas, although no production has taken place. If significant reserves are found in the area the project would not limit development of this resource.

Mining claims blanket the vicinity of the proposed project necessitating mining claim validity determinations. The area has not been closely examined by mineral specialists but from acquaintance with the area and other similar projects it is estimated that 200 mining claims will be involved in the total project area. The work will logically be accomplished by BLM Mineral examiners with reimbursement funds from the Bureau of Reclamation.

E. Wildlife

Although the reservoir is within an important deer winter range, impact on wintering deer herd will not be serious. Some deer winter forage will be inundated but in most winters there will be adequate forage on nearby ranges for the deer herd. Improvements of habitat on adjoining lands is suggested to mitigate any loss to deer winter range. No major deer migration routes will be blocked by any of the project features.

Some chukar partridge, mourning dove, and cottontail rabbit habitat would be lost. This loss of habitat would cause a reduction in numbers in the vicinity of the reservoir. Though real, this reduction, when compared to the areas as a whole, would not be serious.

Presently a few duck nest and feed along the stretch of Big Brush Creek to be inundated by the Tyzack Reservoir. The reservoir would destroy this nesting habitat, but would create a valuable waterfowl resting area for duck and geese traveling the Pacific Flyway. The reservoir would provide only a small amount of nesting and feeding habitat but the overall effect of the project on waterfowl would be favorable.

Big Brush Creek presently is rated as only a "fair" trout fishing stream. No doubt excellent trout fishing would be provided in the Tyzack Reservoir.

Irrigation water to be provided for farmlands near Jensen would provide additional habitat for pheasant, mourning dove, and cottontail rabbit.

F. Livestock Grazing

The Tyzack Reservoir would inundate about 60 AUMs of livestock forage (enough for 60 cattle for one month). This is not considered a serious loss as 3,200 acres, located immediately to the east, have recently been reseeded to provide needed additional livestock forage. It is likely that improvement projects in the immediate vicinity will offset this loss eliminating need for grazing reductions.

The Tyzack Reservoir will partly inundate a one-mile section of BLM-constructed fence. This fence presently controls livestock movement. After project completion the fence will no longer be needed as the reservoir shoreline will be a natural barrier to livestock movement. BLM will salvage the fence before project completion and there will be no claim for reimbursement of improvement value.

G. Timber

No commercially valuable timber would be lost. Only a few small, poorly formed juniper trees will be inundated.

H. Agriculture

Bureau of Reclamation officials indicate the project will provide supplemental irrigation water for private land only and there will be no demand created for BLM-administered lands which could be cultivated if transferred to private ownership.

I. Roads

The Tyzack Reservoir will inundate a section of the county road leading from Highway 44 to BLM Brush Creek resource conservation area. This road is essential for administration of BLM lands east of Big Brush Creek. A new road will be located north of the reservoir. It will offer similar access to that now existing and will not have an adverse effect on public access or BLM programs.

J. Cadastral Surveys and Corner Monumentation

The Tyzack Reservoir will adversely affect four section or quarter corners. Control of official surveys in the area can be maintained by monumenting three witness corners as witness points a safe distance from the reservoir. This is particularly important in this area because the corners affected are at the edge of a large area east and south which is original survey with rock corners. Total cost of the survey work is estimated at $1000. One year lead time should be allowed to accomplish this work.

III. INPUT OF BLM LANDS AND PROGRAMS ON PROPOSED PROJECT-FINANCIAL SUMMARY

A. Reimbursable

1. Mining claim examination -
   200 claims @ $60/claim = $12,000

2. Cadastral survey and corner remonumentation -
   4 @ $250 each = $1000

B. Replaceable Items Chargeable to Project

1. County road leading to Brush Creek area (BR indicates a similar road will be constructed out of the reservoir area.)

C. Improvements Chargeable to Project

None. A fence affected by the project will be salvaged and not replaced.

D. Irreplaceable Resources (opportunity costs)

1. Loss of forage production -
60 AUMs @ $5/AUM = $300
Opportunity cost @ 6% = $5,000

2. Loss of wildlife habitat -

Approximately 500 acres of winter deer habitat will be eliminated by the project. It is recommended that $10,000 be provided to rehabilitate this amount of acreage on federal lands north and east of the project area. Breakdown of anticipated cost were summarized in our letter of 4-16-73 to Mr. Palmer B. DeLong of your Provo office.

IV. CONCLUSIONS AND RECOMMENDATIONS

1. The Bureau of Land Management manages public domain lands in the vicinity of the project for multiple use purposes. Several important uses have been identified and management framework plans are being drawn up to insure wise use of the resources. Since the proposed project will have a significant impact on public lands in the immediate vicinity effort should be made to coordinate all planning and management activities among interested parties.

2. BLM recognizes the logic of state administration of recreation on the project in conjunction with the Steinaker project. Since recreation use will be an important feature of the project it is recommended that overall impact of a new recreation area be considered and state and federal activities be closely coordinated to be of greatest service to the users and to offer maximum protection of the resources.

3. The 4,800 acres of BLM-administered watershed immediately above the reservoir will have a direct influence on the Tyzack Reservoir. Intensive watershed management should be continued with attention to land pollution sources and programs for treatment. Other pollution sources, such as chemicals, should be carefully watched and preventive programs implemented to insure maximum protection to fish and wildlife.

4. Maintaining desirable aesthetics is an important consideration in construction work outside the reservoir pool area. Disturbance should be kept to a minimum and surroundings restored as nearly as possible to their natural appearance.

Mineral Resources at Tyzack Reservoir Site, Jensen Unit, Central Utah Project, Uintah County, Utah

Revised July 1974

United States
Department of the Interior
Bureau of Mines

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

Mineral Resources at Tyzack Reservoir Site, Jensen Unit, Central Utah Project, Uintah County, Utah

by

S. R. Wilson[1]/

SUMMARY

The dam and reservoir proposed at the Tyzack site on Brush Creek in Uintah County, Utah, would inundate an area approximately 2½ miles long and 8,500 feet in maximum width along the channel of the creek. Construction at the damsite would cover the Mancos Formation, and the reservoir would inundate outcrops of the Dakota, Morrison, Curtis, Entrada, Carmel, Navajo, and Chinle Formations.

Oil and gas are produced from nearby fields, but no exploratory wells have been drilled within the area of the proposed Tyzack Reservoir. No geologic structures favorable for oil and gas exploration are known within the reservoir area.

Large reserves of oil shale occur in the Green River Formation in the Uinta Basin. However, this formation is absent in areas of proposed construction, older rocks being present at the surface. Bituminous sandstone deposits are known in several areas in the Uinta Basin, but none within the reservoir boundary.

The Park City Formation, containing large reserves of phosphate rock, crops out northwest of the Tyzack site where San Francisco Chemical Co. is mining the phosphate by open pit method. The Park City Formation undoubtedly is present downdip beneath the Tyzack Reservoir site. However, because of the tremendous reserves of phosphate rock known at the surface, it appears unlikely that underground mining will be necessary for many years.

Coal deposits occur in the general area, principally in the Frontier Sandstone member of the Mancos Formation. No coal is known within the boundary of the planned Tyzack Reservoir.

No significant metallic mineral deposits are known to be present in the immediate vicinity of the Tyzack Dam and Reservoir site. Copper ores

---

1/ Liaison Officer-Utah, Bureau of Mines, U.S. Department of the Interior, Salt Lake City, Utah.

containing gold and silver have been produced from the Dyer mine in the Carbonate district, 13 miles northwest of the Tyzack Damsite.

Future mining activity and oil and gas development in the area of the Tyzack Dam and Reservoir site and auxiliary related facilities would not be affected adversely by the planned construction.

INTRODUCTION

The Tyzack Reservoir site, Uintah County, Utah, was examined in October 1967, to determine the mineral potential of the area, and the effect that proposed construction might have on exploration and exploitation of any mineral resources in the vicinity. The proposed construction is part of the Central Utah project.

Specific areas that would be covered by water impounded by the proposed dam include parts of secs. 2, 3, 4, 5, 9, 10, 11, and 15, T. 3 S., R. 22 E. The dam axis falls in the W½ of sec. 11. Legal land descriptions listed here and elsewhere in this report refer to the Salt Lake meridian, except as otherwise noted.

Total capacity of the Tyzack Reservoir would be 26,000 acre-feet of water, and the earth- and rock-fill dam would be approximately 150 feet high.

Tyzack Dam and Reservoir would store water for irrigation as well as for municipal and industrial purposes.

LOCATION AND ACCESSIBILITY

Tyzack Reservoir site lies on the south slope of the Uinta Mountains at an elevation of approximately 5,650 feet above sea level (fig. 1). The reservoir area is 12.5 miles by road northeast of Vernal, being accessible over 10.2 miles of State Highway 44, and 2.3 miles of dirt road that leads east from a point near the intersection of Brush Creek and State Highway 44. The dirt road is an access way to Brush Creek and also to a ranch along the creek. The damsite is 1½ road-miles to the southeast from the ranchhouse.

Normally all roads leading to the damsite area are accessible and traversable by car throughout the year. Snow may interfere with travel to a limited degree during the most severe winter months.

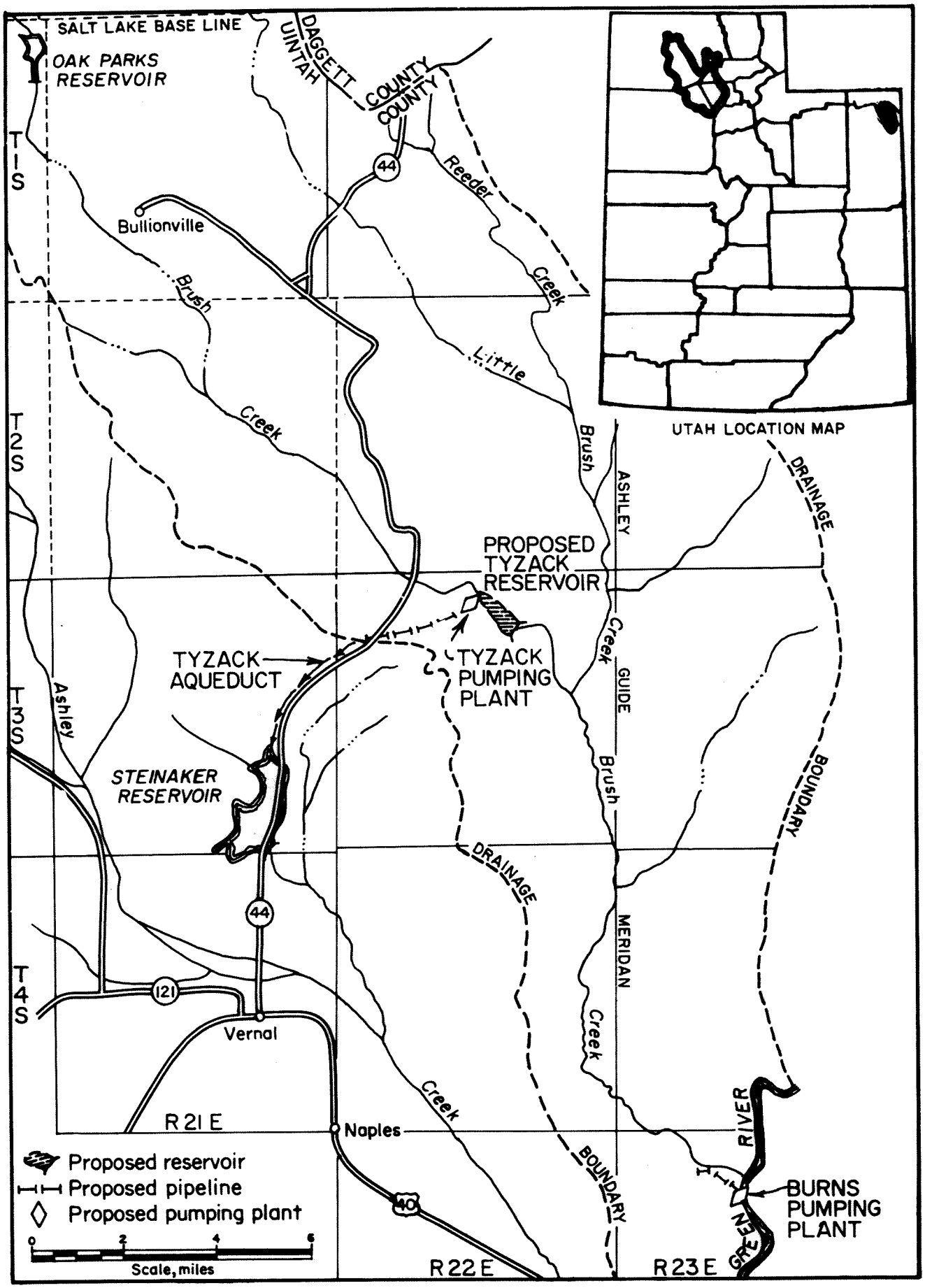


FIGURE 1.—Location map, Tyzack Dam and Reservoir site, Uintah County, Utah.

PHYSICAL FEATURES

Tyzack Dam would inundate land along the channel of Brush Creek for a distance of approximately 2½ miles. Width of the reservoir at the widest section adjacent to the dam would be approximately 8,500 feet (fig. 2).

Brush Creek is a gently flowing, meandering stream in the area of the reservoir site. The basin that would be inundated was formed primarily by stream erosion. Willows and other forms of brush growth are prominent along the stream channel. Elsewhere the growth is sparse, consisting chiefly of sagebrush.

Water impounded by Tyzack Dam would inundate buildings on one ranch now in operation. No important roads would require realignment at the damsite.

LAND STATUS

Tyzack Damsite, in the W½ of sec. 11, T. 3 S., R. 22 E., is approximately 3½ miles south of the Ashley National Forest boundary. The greater part of the adjacent section 10 is under Reclamation withdrawal.

Land upstream on Brush Creek that would be inundated by Tyzack Reservoir, in secs. 3, 4, and 5, T. 3 S., R. 22 E., is largely covered by a Federal phosphate withdrawal.

PROJECT PLAN

The dam planned at the Tyzack site would be an earth- and rock-fill structure, standing 150 feet high above the streambed of Brush Creek (figs. 3-5). At its crest, the dam would have an altitude of 5,652 feet and a length of 950 feet. Total capacity of the reservoir would be 26,000 acre-feet, and the normal water surface is planned at an altitude of 5,633 feet.

Tyzack Reservoir would be approximately 2½ miles long and have a maximum width of 8,500 feet. Other than Tyzack Dam, Reservoir, and Pumping Plant, the principal project structures would include Burns Pumping Plant and Tyzack Aqueduct.

Burns Pumping Plant on the Green River in sec. 9, T. 5 S., R. 23 E., would pump water for irrigation of Jensen unit lands if sufficient water were unavailable from storage behind Tyzack Dam. Tyzack Pumping Plant would serve to pump water from Tyzack Reservoir into the Tyzack Aqueduct at a greater elevation. Such water then would flow into Steinaker Reservoir to the southwest, serving municipal and industrial uses in the Vernal area. Approximately 7,200 acre-feet of water would be pumped from

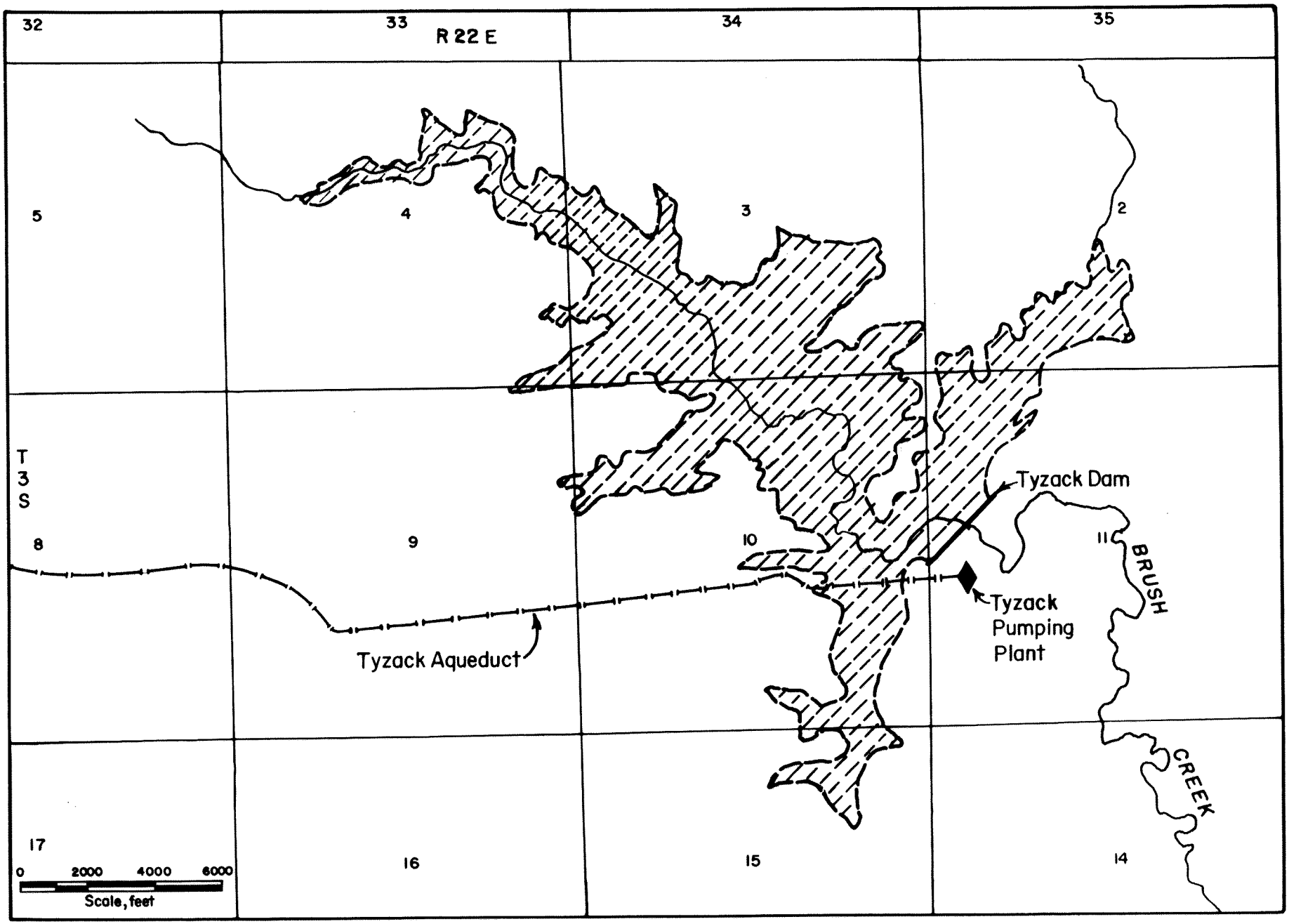


FIGURE 2. – Plan map illustrating outline of proposed reservoir.

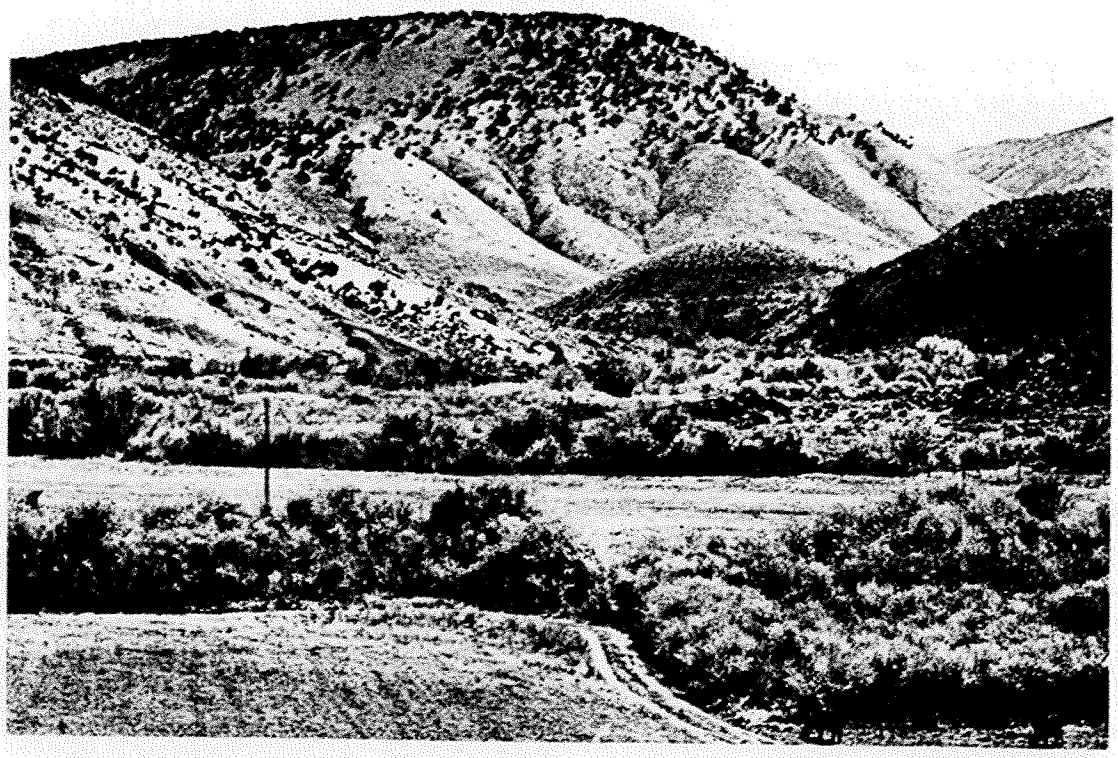


FIGURE 3. – Downstream view showing reservoir basin a short distance above proposed dam axis.

FIGURE 4. – Upstream view from a point 2,000 feet above dam axis.

FIGURE 5. – Cultivated land upstream from the damsite.

the reservoir annually by San Francisco Chemical Co., in a pumping plant about 4 miles above Tyzack Dam.

Realignment of State Highway 44 will not be necessary if the construction is completed as proposed.

Enough impervious material for construction of Tyzack Dam appears to be available within the planned reservoir area. Riprap may be quarried from the Frontier Sandstone near the damsite. Concrete aggregate is available from deposits near Jensen.

GEOLOGY

Tyzack Damsite lies on the south flank of the Uinta Mountains, which structurally form an anticlinal arch having an east-west trending axis. Erosion has removed the younger rocks from the mountain crests, but they are present along the south flank where dips range from 8° to 30° to the south in the area of the damsite.

Sedimentary rocks are exposed in and near the reservoir area and range in age from Pennsylvanian to Recent.2/ Igneous rocks are not known in the area. The Permian Park City Formation is found in significant outcrops north and northwest of the damsite. Younger rocks include the Moenkopi, Shinarump, and Chinle Formations (Triassic), the Navajo, Carmel, Entrada, Curtis, and Morrison Formations (Jurassic), and the Dakota, Mancos, and Mesaverde Formations (Cretaceous).

Holes drilled near the proposed Tyzack Dam axis indicate that the alluvial material consists principally of clay, silt, and fine sand, with gravels in the creek channel. Thickness of the alluvial material in the damsite area is approximately 23 feet.

Brush Creek, as it flows southeast within the area of the proposed Tyzack Dam and Reservoir, cuts through the Chinle, Navajo, Carmel, Entrada, Curtis, Morrison, Dakota, and Mancos Formations. Tyzack Dam would cover the Mancos Formation and the thin mantle of overburden lying on the Mancos. The Frontier Sandstone member of the Mancos Formation crops out prominently in the area. A short distance below the surface, drilling has indicated the presence of thin limestone, sandstone, and shale beds at the base of the Frontier Sandstone member, and at the top of the Mowry Shale member of the Mancos Formation. The Mowry Shale is less than 30 feet from the surface at the stream channel.

2/ Kinney, D.M., Geology of the Uintah River-Brush Creek Area, Duchesne and Uintah Counties, Utah. U.S. Geol. Survey Bull. 1007, 1955, 185 pp.

BUREAU OF MINES

MINERAL RESOURCES

No mineral resources of potential commercial significance, either metallic or nonmetallic, are known to occur within the Tyzack Reservoir site nor within areas that will accommodate related construction facilities.

Oil and Gas

No exploratory oil or gas wells have been drilled within the area of the proposed Tyzack Reservoir. Drilling has been done nearby at Neal Dome in secs. 28 and 30, T. 3 S., R. 21 E., 8 to 10 miles southwest of the Tyzack site.3/ Two wells were bottomed in the Weber Sandstone. Fresh water flowed from both wells at depths of 1,190 to 1,575 feet. Neither oil nor gas was encountered in the drilling.

Shallow wells were drilled on Asphalt Ridge, 3 to 4 miles southwest of Vernal, during 1911 to 1913. A deep hole was drilled in this area during 1947 by Carter Oil Co. Traces of oil and gas were noted in the shallow holes, and an oil sand was cored in the deep hole. However, no commercial oil or gas production has resulted from the drilling.

The westward plunging nose of Split Mountain anticline was drilled by Equity Oil Co. in 1949. The hole, Kendall No. 1, was drilled in the SW¼ sec. 33, T. 4 S., R. 22 E., 2 miles south of Tyzack Damsite. The hole intersected Weber Sandstone at 4,907 feet, bottomed at 4,992 feet, and was written off as "dry and abandoned."

The Ashley Creek gasfield, in sec. 23, T. 5 S., R. 22 E., 6 miles southeast of Vernal, was discovered in April 1925. A structural high point on the westward-plunging Section Ridge anticline was indicated by dips of the Mancos Shale at the surface. Commercial gas production was recorded from two wells in the field during the period 1929 to 1941, when the field was abandoned. Production totaled 536,336 cubic feet of gas. The gas was derived from a 10-foot interval of coarse-grained sandstone in the lower part of the Morrison Formation.

Discovery of oil at deep horizons in the Rangely field of northwestern Colorado in 1942 indicated that deeper drilling in the Ashley Creek gasfield might disclose oil-bearing horizons. Deep drilling was started in August 1948 by Equity Oil Co., and oil was disclosed in the Weber Sandstone at a depth of 4,136 feet. Production from the first well was 260 barrels of oil per day. Later other holes were drilled over a producing area of approximately 800 acres. Most of the production was derived from the Weber Formation, but some oil has been pumped from the younger Park City and Entrada Formations. In addition to the oil, 13,832,000 barrels (1,780 acre-feet) of water was produced at the Ashley

3/ Work cited in footnote 2.

Valley field in 1966. The water was fresh and in part was used for irrigation and livestock.4/

Known potential oil and gas structures in the Vernal area have been tested by drilling. Localities that may be favorable for further oil and gas exploration include those in which Tertiary rocks overlap rocks of Mesozoic and Paleozoic ages. Structures of the older formations may thus be obscured. However, no structures favorable for oil and gas are present within the proposed boundary of Tyzack Reservoir or in nearby areas that would be adversely influenced by the proposed construction.

Oil Shale

Oil shale deposits in the Uinta Basin are found principally in the Green River Formation (Eocene).5/ This formation is not present in the Tyzack Dam and Reservoir site, nor are oil shale deposits known in the immediate area.

The Green River Formation is present over a wide area south of Vernal, and large reserves of oil shale are indicated there.

Bituminous Sandstone

Several bituminous sandstone deposits occur in Uinta Basin, but none would conflict with the planned construction of the Tyzack Dam and Reservoir and related facilities.6/

The Asphalt Ridge bituminous sandstone deposits are 3 to 6 miles south and southwest of Vernal in parts of T. 4 S., R. 20 E.; T. 4 S., R. 21 E.; T. 5 S., R. 21 E.; and T. 5 S., R. 22 E. Asphalt Ridge is a topographic feature that stands out above the less resistant Mancos Shale in the surrounding valley. The ridge consists of sandstone and shale of the Cretaceous Mesaverde Formation which is overlain unconformably by the Oligocene Duchesne River Formation. The degree of bitumen saturation of sandstone beds in the two formations is related to the unconformities along the ridge.

It is estimated that a reserve of at least 250 million barrels of bitumen is present in the Asphalt Ridge deposits. This estimate is based on the bitumen in all beds along a strike length of 10 miles and within

4/ Johnson, C. E. Ashley Valley Oil Field, Uintah County, Utah. Intermountain Assoc. of Petrol. Geol., 13th Annual Field Conf., 1964, pp. 187-189.

5/ Cashion, W.B. Distribution and Quality of Oil Shale in the Green River Formation of the Uinta Basin. Intermountain Assoc. of Petrol. Geol., 13th Annual Field Conf., 1964, p. 209.

6/ Covington, R.E. Bituminous Sandstones in the Uinta Basin. Intermountain Assoc. of Petrol. Geol., 13th Annual Field Conf., 1964, p. 227.

1 mile downdip from the outcrop of the beds. Approximately 53 diamond drill holes, totaling 21,000 feet of drilling, have been completed in exploring the bituminous sandstone on Asphalt Ridge.

A second large area of bituminous sandstone is the Whiterocks area in secs. 17, 18, and 19, T. 2 N., R. 1 E., and secs. 24 and 25, T. 2 N., R. 1 W., Uinta Meridian. This area is 32 miles west of the Tyzack site and would not be affected.

The Whiterocks bituminous sandstone deposits are found in the Navajo Formation, which strikes northeast and dips to the southeast at an angle of approximately 62°. The deposits contain at least 65 million barrels of bitumen.

Phosphate Rock

In the area of the Tyzack Dam and Reservoir site, the basal member of the Park City Formation includes phosphate rock interbedded with phosphatic mudstone and argillaceous and phosphatic limestone, lying on the Pennsylvanian Weber Sandstone.7/ The phosphate-bearing section ranges in thickness from 20 to 30 feet.

Phosphate rock deposits along the south flank of the Uinta Mountains were investigated by the U.S. Geological Survey in 1914. As a result of this study, a large area was withdrawn from mineral entry under Phosphate Withdrawal No. 24, Utah No. 3 (fig. 6). Placer mining claims covering part of the withdrawn area were patented prior to the withdrawal, and therefore are valid. Humphreys Phosphate Co. originally owned the claims, but currently the claims are controlled by the San Francisco Chemical Co.

San Francisco Chemical Co. in 1961 began mining and milling operations on the phosphate deposits in secs. 30 and 31, T. 2 S., R. 22 E. The open pit mine is on the west side of Brush Creek gorge, a short distance to the northwest from the upstream end of the proposed Tyzack Reservoir (fig. 7).

The upper end of Tyzack Reservoir would be in the vicinity of outcrops of the phosphate-bearing Park City Formation. Beds in this area dip to the southeast at an average of 12°. Assuming this dip to be uniform, the Park City Formation is covered by at least 900 feet of younger rocks at the upper end of the Tyzack Reservoir site. Similarly, at the Tyzack Damsite, the Park City Formation is covered by more than 2,700 feet of younger sediments.

Large reserves of phosphate rock, minable by open pit methods, are present on property controlled by San Francisco Chemical Co. in the area near the proposed Tyzack Dam and Reservoir. Undoubtedly the phosphate

7/ Work cited in footnote 2.

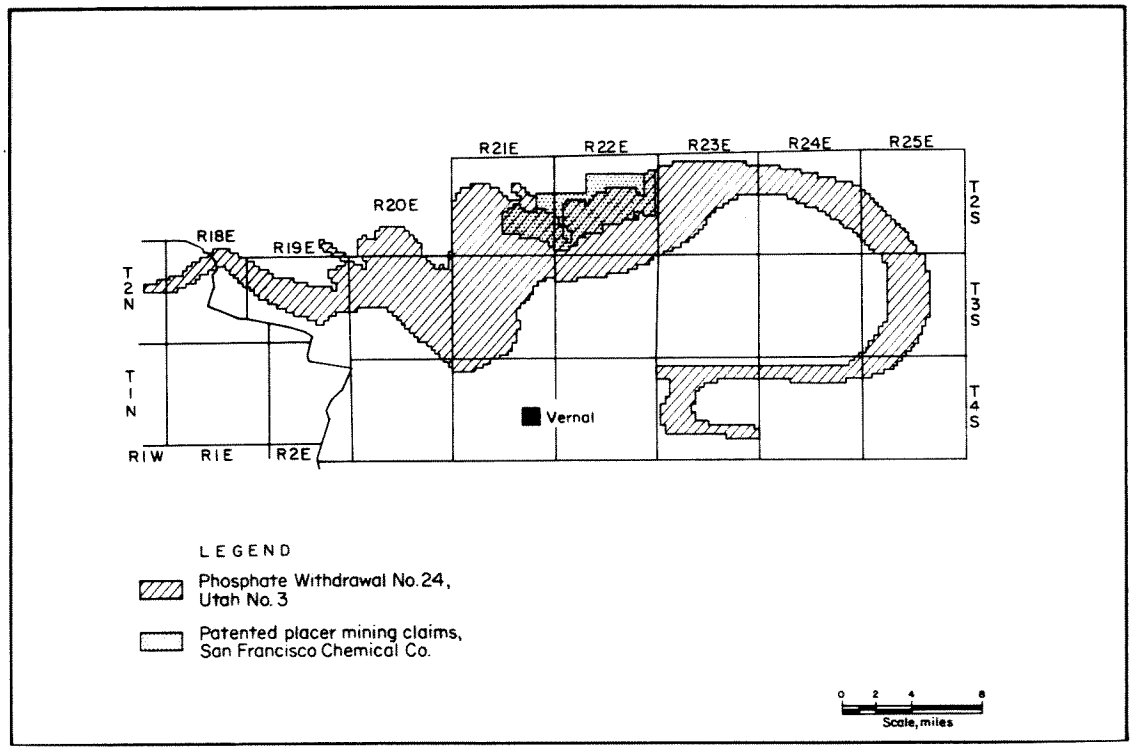


FIGURE 6. – Plan map showing Phosphate Withdrawal No. 24, Utah No. 3, with patented placer mining claims controlled by San Francisco Chemical Co.

FIGURE 7. – Open pit phosphate rock mine, San Francisco Chemical Co. Prominent cut at right center is the gorge of Brush Creek.

rock extends downdip to the southeast under cover of younger rocks. However, because of the large tonnages of phosphate rock at the surface, and current mining economics, it is unlikely that underground extraction of phosphate rock will be attempted in the Vernal area in the foreseeable future.

Coal

Coal occurs in the Vernal area in beds of variable thickness, principally in the upper part of the Frontier Sandstone member of the Mancos Formation. Minor coal occurrences are also known in shale of Mississippian age.

Minable coal in the Frontier member is not continuous over any great strike length. Commonly individual coalbeds are found as lenses in brown shale, usually averaging 3 to 4 feet thick. A few beds may be as much as 7 feet thick.

Brush Creek flows south approximately normal to the strike of the Frontier member of the Mancos Formation at the Tyzack Damsite. The dam, if constructed, would cover the Frontier member at this point. No coal is present in the Frontier member here, but a few prospect pits have been excavated in the shale. Several minor occurrences of coal are present in the Frontier member 1 to 4 miles northeast of the Tyzack Damsite. Two small mines 1½ to 2½ miles west of the damsite have been abandoned.

No known coalbeds will be covered by water behind the planned Tyzack Dam. The Frontier member dips to the southeast beyond influence of the Tyzack Dam, and below younger sediments.

Metallic Minerals

No metallic mineral occurrences are known within the areas of the proposed Tyzack Dam and Reservoir, and related structures.

The Dyer mine in the carbonate district in sec. 16, T. 1 S., R. 21 E., 13 miles northwest of the Tyzack Damsite, yielded high-grade copper oxide ore containing gold and silver, during intermittent intervals from 1891 to 1941.8/ Production from the district, during this period, almost all of which came from the Dyer mine, totaled 4,393 tons of ore containing an average of 29.65 percent copper. 0.207 ounce of gold, and 23.4 ounces of silver per ton.

Small quantities of lead ore in the minerals galena and cerussite are present in sec. 21, T. 1 S., R. 21 E., 1¼ miles south of the Dyer mine. During past years a few tons of the ore was probably shipped during intermittent intervals, but production records are incomplete.

8/ Work cited in footnote 2.

Copper and lead in the area are found principally in the lower part of the limestone unit of Mississippian age.

Hematite and other iron oxide minerals occur in small bodies a short distance northwest of the Dyer mine. Minor production of high-grade red hematite ore has been recorded from the Pope mine. This ore is found in the upper shale of the Uinta Mountain group (Precambrian). Iron oxides also occur in the limestone unit of Mississippian age.

CONCLUSIONS

No metallic or nonmetallic minerals, petroleum, or coal have been extracted from land that would be covered by water behind the proposed Tyzack Dam and related facilities.

Oil and gas are being produced from fields 16 miles south of the Tyzack site. No exploratory drilling for oil and gas has been conducted at the Tyzack site, and no geologic structures favorable for oil and gas are known within the immediate area.

Oil shale and bituminous sandstone deposits occur in nearby areas, but none are known to be present within the proposed Tyzack Reservoir boundaries.

Phosphate rock reserves in the area are large and are being exploited by San Francisco Chemical Co. in an open pit operation. The phosphate beds probably extend downdip beneath the area of the proposed Tyzack Reservoir. However, because of the huge reserves at the surface, it is believed unlikely that mining will be attempted underground for a long period.

Construction of the proposed facilities at the Tyzack site will not be detrimental to future exploration or exploitation of mineral commodities in the general area.

No difficulty is anticipated, if the need arises, in applying the Department of Interior's Mineral Rights policy as contained in Departmental Manual (751.14E) at Tyzack Reservoir site.