UNITED STATES
DEPARTMENT OF THE INTERIOR
Fred A. Seaton, Secretary

BUREAU OF RECLAMATION
W. A. Dexheimer, Commissioner
E. O. Larson, Regional Director

# VERNAL UNIT
# CENTRAL UTAH PROJECT

## DEFINITE PLAN REPORT

## APPENDIX B
## WATER SUPPLY

May 1957

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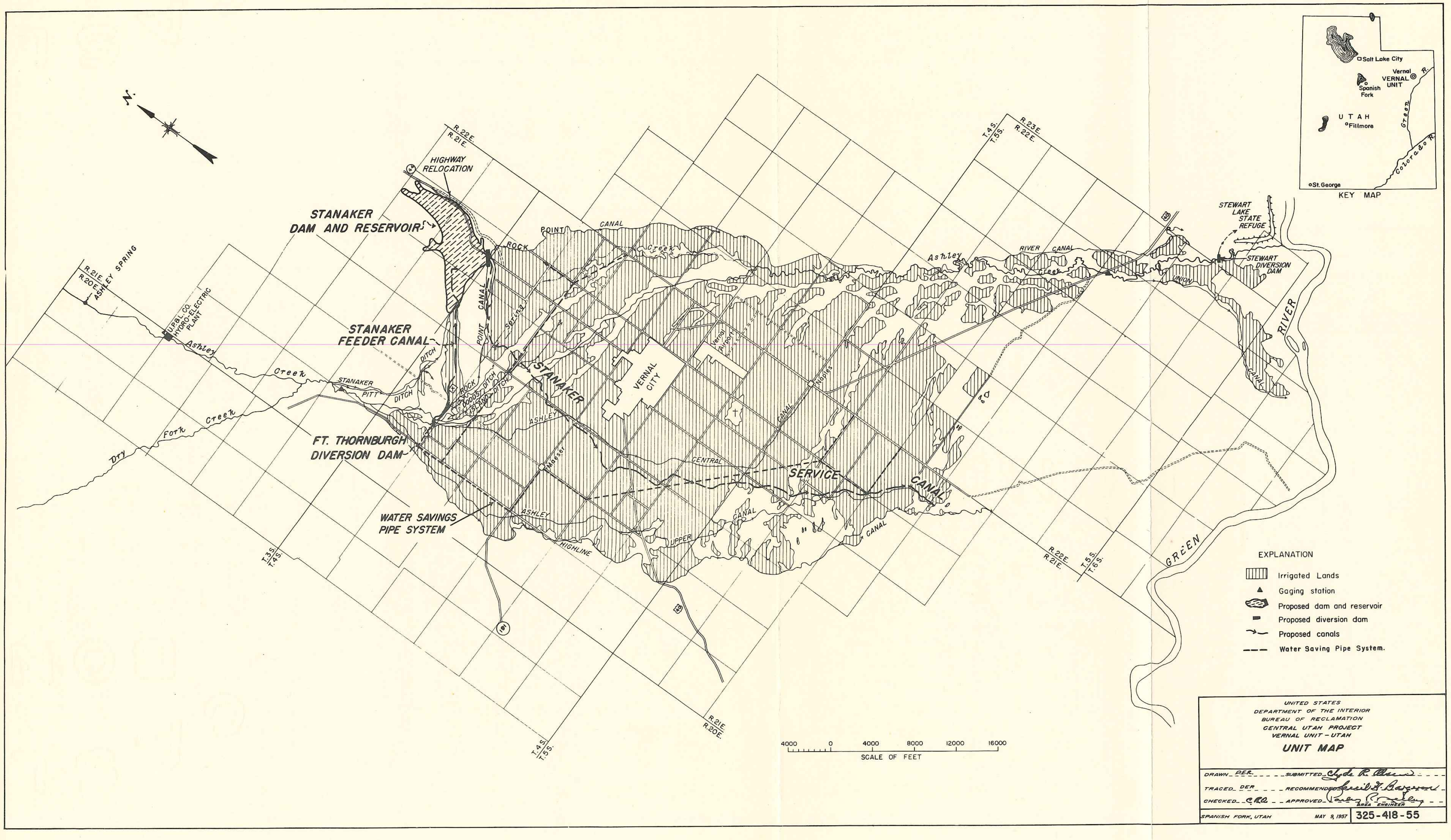

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DEPARTMENT OF THE INTERIOR
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Appendixes to the Vernal Unit Definite Plan Report have been issued in four volumes with the data grouped as shown below.

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PROJECT LANDS
LAND DRAINAGE

APPENDIX B
WATER SUPPLY

APPENDIX C
DESIGNS AND ESTIMATES

APPENDIX D
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# SUMMARY SHEETS

## Vernal Unit--Central Utah Project

LOCATION: Northeast Utah in Ashley Valley of the Uinta Basin, approximately centered by Vernal, Utah.

AUTHORIZED: Initial phase of the Central Utah project, including the Vernal unit, authorized as a participating project with the Colorado River Storage project by the Act of April 11 1956 (70 Stat. 105).

### PLAN

Through storage regulation and water exchanges, the Vernal unit will provide supplemental irrigation water for 14,781 acres of land and 1,500 acre-feet of water annually to supplement the municipal supplies of Vernal, Naples, and Maeser. The unit will also provide benefits to fish and wildlife and recreation. Excess flows of Ashley Creek will be diverted at the Ft. Thornburgh Diversion Dam into the Stanaker Feeder Canal and conveyed to the Stanaker Reservoir. Water stored in the reservoir will be released into the Stanaker Service Canal and delivered to existing irrigation canals and ditches. The water will in part replace Ashley Creek water, including releases from upstream reservoirs. Some of the replaced water will be used on lands above the Stanaker Service Canal and some will be diverted from Ashley Spring on Ashley Creek into the municipal pipeline. Land drains will be provided as needed and some sections of existing canals will be lined to prevent seepage. A pipe system will be constructed for stock-watering purposes during the nonirrigation season to save for unit storage and use water now lost through open canals. Recreational and fishing attractions will be provided at Stanaker Reservoir. Small tracts of land distributed among the unit area will be acquired and developed for upland game, and a pump and pipeline will be installed to deliver water from Green River to the Stewart Lake State Refuge. Repayment of reimbursable construction costs will be completed in 50 years, following a 3-year development period. Irrigation costs that are beyond the repayment ability of the irrigators will be paid from the Upper Colorado River Basin Fund.

SUMMARY SHEETS (Continued)

## CONSTRUCTION COSTS

1/$6,874,000

| | |
|---|---|
| Stanaker Dam and Reservoir . . . . | $3,870,000 |
| Ft. Thornburgh Diversion Dam . . . | 200,000 |
| Stanaker Service Canal . . . . . . . | 1,060,000 |
| Stanaker Feeder Canal . . . . . . . | 570,000 |
| Water Savings pipe system . . . . | 340,000 |
| Stanaker Canal laterals. . . . . . | 40,000 |
| Vernal area drainage system . . . | 675,000 |
| Recreation . . . . . . . . . . . . . | 92,000 |
| Fish and wildlife . . . . . . . . . | 27,000 |

1/ Estimated at January 1957 prices.

## BENEFITS, ALLOCATIONS, AND REPAYMENT

| Unit purpose | Benefits (annual) | Allocations (tentative) Construction costs | Annual O.M.& R. costs |
|---|---|---|---|
| Irrigation . . . . . . | $253,500 | 1/$6,154,000 | $12,700 |
| Municipal water . . . | 23,800 | 2/619,000 | 1,800 |
| Recreation . . . . . . | 14,200 | 3/92,000 | 7,100 |
| Fish and wildlife . . | 13,600 | 3/27,000 | 1,200 |
| Total. . . . . . . | 305,100 | 2/6,892,000 | 22,800 |

1/ $1,500,000 will be repaid by Vernal unit irrigators through the Upper Colorado River Basin Fund and the remaining $4,654,000 will be paid from other revenues in the basin fund apportioned to Utah.

2/ Includes $18,000 in interest during construction.

3/ Nonreimbursable

Average annual water costs per acre-foot

| | Construction repayment | O.M.& R. costs |
|---|---|---|
| Irrigation water . . . . . . . . . | $1.65 | $0.70 |
| Municipal water . . . . . . . . . | 1/ | 1.20 |

1/ Municipal water payment will increase from $12.00 per acre-foot during first 10 years to $22.13 during last 10 years of 50-year repayment period.

## BENEFIT-COST RATIO

1.44 to 1

## REPAYMENT ORGANIZATION

The Uintah Water Conservancy District has been organized in accordance with Utah State law and will contract with the United States for the repayment of irrigation and municipal water costs.

## SUMMARY SHEETS (Continued)

### IRRIGATION

| Irrigable area furnished supplemental water | Acres |
|---|---|
| Class 1 | 3,286 |
| Class 2 | 5,357 |
| Class 3 | 5,801 |
| Unclassified (town site) | 337 |
| Total | 14,781 |

| | |
|---|---|
| Elevation of farm lands (avg. feet msl) | 5,300 |
| Frost-free period (avg. days annually) | 119 |
| Effective precipitation (avg. inches annually) | 3 |
| Diversion requirement (avg. ac.-ft. annually) | 51,700 |
| Increase in water supply (avg. ac.-ft. annually) | 18,000 |
| Increased depletion of Colorado River from unit operation (avg. ac.-ft. annually) | 11,800 |

### UNIT WORKS

Stanaker Dam

Located on offstream Stanaker Draw, 3.5 miles north of Vernal.

| | |
|---|---|
| Type | rolled earth-fill |
| Height above ground | 140 ft. |
| Height above foundation | 145 ft. |
| Volume of embankment | 1,820,000 cu. yds. |
| Spillway capacity | (emergency only) |
| Outlet capacity (at res. elev. 5,472) | 300 sec.-ft. |

Stanaker Reservoir

| | |
|---|---|
| Elevation at normal water surface (37,560 ac.-ft.) | 5,516.2 ft. |
| Active storage capacity | 33,200 ac.-ft. |
| Inactive storage capacity | 4,360 ac.-ft. |
| Total storage capacity | 37,560 ac.-ft. |
| Reservoir surcharge capacity above normal water surface elevation | 2,170 ac.-ft. |

Stanaker Feeder Canal

| | |
|---|---|
| Length | 3.1 miles |
| Capacity | 400 sec.-ft. |

Stanaker Service Canal

| | |
|---|---|
| Length | 11.8 miles |
| Capacity at head | 300 sec.-ft. |

Water Savings Pipe System

| | |
|---|---|
| Length | 17.3 miles |
| Capacity at head | 289 gal. per min. |

SUMMARY SHEETS (Continued)

## HYDROLOGY

Ashley Creek at "Sign of the Maine" gage

| | |
|---|---|
| Drainage area | 241 sq. mi. |
| Period of record | 1940-56 |
| Average runoff, 1940-56 | 92,800 ac.-ft. |
| Maximum annual runoff | 142,300 ac.-ft. |
| Minimum annual runoff | 52,400 ac.-ft. |
| Maximum daily discharge of record | 2,650 sec.-ft. |
| Minimum daily discharge of record | 14 sec.-ft. |

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# WATER SUPPLY

## CHAPTER I

### INTRODUCTION

The Vernal Unit of the Central Utah project, located in northeastern Utah, includes most of the irrigable lands in Ashley Valley. Settlement of the valley began in 1873 with the establishment of a ranch on Ashley Creek north of the present site of Maeser. In the following years other ranchers made their homes in the valley, constructed ditches, and began irrigating large tracts of land from Ashley Creek. By 1900 most of the irrigable lands in the valley had been placed under production. Since 1900 additional small areas have been developed primarily by extensions of the canal systems.

### Unit area

The unit area, consisting of some 56 square miles, covers the major part of Ashley Valley. Included in the area as shown in the frontispiece drawing are the communities of Vernal, Maeser, and Naples, Utah.

There are seven major canal companies serving the project area diverting from Ashley Creek. These are the Stanaker, Island, Dodds, Rock Point, Ashley Upper, Ashley Central, and Highline. The Colton Ditch is served from the Ashley Upper Canal and the Hardy Ditch is served from the Ashley Central Canal. In addition to the canals diverting primary water, the Union and River Canals divert from Ashley Creek in the lower part of the valley. There are several other minor water users having rights on some drainage areas in the unit area between the upper seven major canal and lower two major canal diversions.

A detailed land classification was made of the unit area in 1956 which is discussed in the Project Lands Appendix. A summary of this classification as applies to water supply giving the area under each of the major canals broken down as to areas above and below the proposed Stanaker Service Canal is given in Table 24.

### Present Development and Practices

The natural flows of Ashley Creek, supplemented by limited storage, are currently used for irrigation, municipal use, and power production. By means of several diversion dams, most of the flow of Ashley Creek is taken into the forementioned nine canals and conveyed to the irrigated lands. Four of the canals, Highline, Ashley Upper, Ashley Central, and the Union, divert from the right bank of the stream and serve lands lying south and west of Ashley Creek. The other canals, Stanaker, Rock Point, Dodds, Island, and River, divert from the left bank of the stream and serve the area north and east of the creek. Not including River and Union, these canals have a combined capacity of 808 cfs as shown in Table 1.

Table 1
Present capacities of canals[1/]

| Canal | Capacity (cfs) |
|---|---|
| Stanaker Ditch | 15 |
| Highline | 2/182 |
| Ashley Upper | 315 |
| Ashley Central | 197 |
| Rock Point | 67 |
| Island | 26 |
| Dodds | 6 |
| Total | 808 |

1/ Taken from highest flow measured into the canals for the period 1951-1955.

2/ Highline Canal has a water right of 182 c.f.s. However, the highest flow measured through the canal was 96 c.f.s.

The Stanaker Canal diverts from the creek above the "Sign of the Maine" gage, all others divert below the gage as shown on Drawing No. 325-418-56.

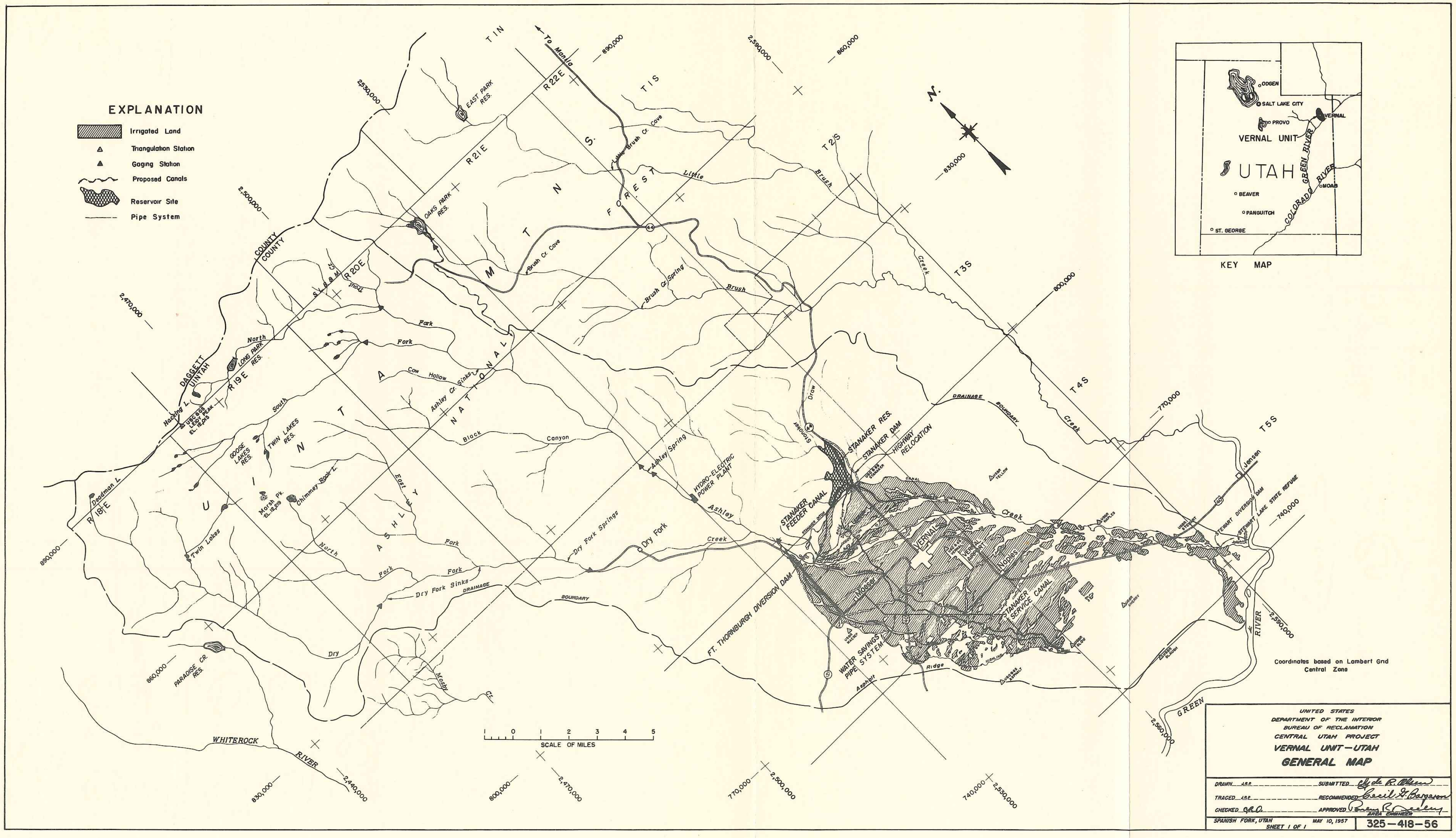
Municipal water for Vernal and the surrounding area is diverted from the Ashley Creek Springs above all irrigation diversions. Other small ditches diverting from the creek serve limited areas adjacent thereto.

A small hydroelectric plant 9 miles northwest of Vernal uses the flow of Ashley Creek to produce electrical energy for the Vernal area. The plant is situated above all diversions and does not interfere with the use of water for irrigation.

Supplemental water is provided from storage at Oaks Park Reservoir on Brush Creek, Long Park Reservoir, and a group of small glacial lakes on Ashley Creek with a combined capacity of 6,870 acre-feet. The storage water is released during the late summer months but when combined with the natural flow of Ashley Creek the total is insufficient to supply adequately the needs of presently irrigated lands.

## Unit Plan

The unit plan contemplates the construction of an off-stream reservoir in Stanaker Draw, a feeder canal leading from Ashley Creek to the Stanaker Reservoir, and a service canal from the reservoir to Vernal Unit land. Spring flows during the high runoff period that can not be beneficially used on existing irrigated land would be diverted to Stanaker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Irrigated Land
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Proposed Canals
Reservoir Site
Pipe System
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VERNAL UNIT
UTAH
OGDEN
SALT LAKE CITY
PROVO
VERNAL
BEAVER
PANGUITCH
ST. GEORGE
MOAB
GREEN RIVER
COLORADO RIVER
UINTA MTNS.
ASHLEY NATIONAL FOREST
DAGGETT
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COUNTY
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STANAKER DAM
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STANAKER SERVICE CANAL
HYDRO-ELECTRIC POWER PLANT
VERNAL
Naples
Maeser
Jensen
OAKS PARK RES.
EAST PARK RES.
LONG PARK RES.
TWIN LAKES RES.
GOOSE LAKES RES.
PARADISE CR. RES.
Dry Fork
Dry Fork Springs
Dry Fork Sinks
Ashley Spring
Ashley Creek
WHITEROCK RIVER
GREEN RIVER
SCALE OF MILES
Coordinates based on Lambert Grid Central Zone
UNITED STATES
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VERNAL UNIT—UTAH
GENERAL MAP
SPANISH FORK, UTAH
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Reservoir. Winter flows currently used for livestock watering purposes will also be diverted to the reservoir. In exchange a water savings pipe system will replace this present wasteful practice during the nonirrigation season.

Drainage facilities will be provided where necessary along with whatever rehabilitation of existing canals is required for Vernal unit operation.

Through storage regulation and water exchanges, the area's needs for increased municipal water and late season irrigation water would be supplied. The project would also provide protection of fish and wildlife, development of new recreational areas, and incidental control of floods.

Ft. Thornburgh Diversion Dam would be located on Ashley Creek at the head of the Stanaker Feeder Canal. Stanaker Feeder Canal will have a capacity of 400 c.f.s. Stanaker Reservoir, with a capacity of 37,560 acre-feet, will be formed by an earth fill dam at the mouth of Stanaker Draw about $3\frac{1}{2}$ miles north of Vernal. The reservoir will have 33,200 acre-feet of active capacity. A dead storage pool of 3,266 acre-feet would be utilized for fish and wildlife, and an additional 1,094 acre-feet of inactive storage above the sill of the outlet works would be reserved to provide head on the outlet works during low reservoir elevation.

WATER SUPPLY

# CHAPTER II

## WATER RESOURCES

The Ashley Creek drainage area above irrigation diversions at the head of Ashley Valley is 238 square miles. The watershed ranges from elevation 5,700 feet to 12,000 feet, and is characterized by glaciated mountain slopes, steep canyons, a relatively impervious bed rock, and comparatively shallow soil mantle which provides very little ground water storage. As a result the runoff is rapid, contributing to wide seasonal fluctuations in stream flow. Runoff reaches its high stage of 200 to 2,650 second-feet in May and June and falls off rapidly to a flow of 14 to 300 second-feet in late summer.

### Runoff Records

Streamflow records are available at nine gaging stations maintained by the Geological Survey. Four of these stations are significant in regard to Vernal unit water supply: Ashley Creek near Vernal, Ashley Creek at Sign of the Maine, Ashley Creek near Jensen, and Oaks Park Canal near Vernal. Table No. 2 is a summary of pertinent data for each of the nine stations which are shown on Drawing No. 325-418-56.

#### Ashley Creek at "Sign of the Maine"

The station is located 4-3/4 miles northwest of Vernal which is above all diversions to the unit area except for municipal water for Vernal area and irrigation water for Stanaker Canal. In addition to the natural stream flow the gage also reflects the releases from Oaks Park Reservoir. Elevation of the station is 5,750 and the drainage area covers 241 square miles. The gage was installed in June 1939 approximately 1 mile above the Ft. Thornburgh diversion dam and has been operated continuously to the present time. Since 1941 storage releases from Oaks Park Reservoir have been conveyed through the Oaks Park Canal and emptied into Ashley Creek above the "Sign of the Maine" gage. These releases are included in the recorded flows at the gage. Runoff at the "Sign at the Maine" gage for years of missing records during the period of study (1925-39) were estimated by correlation with runoff of "Ashley Creek near Vernal" after first deducting the Oaks Park Reservoir releases from the records of both stations. Table No. 3 gives the monthly summary of the recorded flow at the "Sign of the Maine" station for the period of 1940 through 1956. Table No. 4 gives the estimated and recorded flow less the Oaks Park Reservoir releases at the "Sign of the Maine" gage and is the water supply available for unit use.

Operation of upstream storage on Ashley Creek dates from 1919 and the operation of Oaks Park Reservoir began November 31, 1939. Because

Table 2
Stream gaging stations on Ashley Creek

| Gaging station | Location | Drainage area square miles | Available records | Average water year runoff for period of record (acre-feet) |
|---|---|---|---|---|
| Ashley Creek near Vernal, Utah (below springs) | 4.5 miles upstream from Dry Fork and 10 miles northwest of Vernal. | 101 | Oct. 1911 to date. Fragmentary records from 1911-18 at this and other locations | 75,760 |
| Ashley Creek at "Sign of the Maine" near Vernal, Utah | .75 mile down stream from Dry Fork and 4.75 miles from Vernal. | 241 | June 1939 to date | 92,800 |
| Ashley Creek above springs near Vernal, Utah | 5 miles upstream from Dry Fork and 10.5 miles northwest of Vernal. | 100 | June 1941 to Sept. 1945 | 49,530 |
| Ashley Creek below Trout Creek, near Vernal, Utah | 3 miles upstream from South Fork and 21 miles northwest of Vernal. | 27 | October 1943 to date | 17,440 |
| South Fork of Ashley Creek near Vernal, Utah. | 3.25 miles upstream from mouth and 21 miles northwest of Vernal | 20 | October 1943 to date | 13,630 |
| Oaks Park Canal near Vernal, Utah | 1,000 feet down stream from Oaks Park Dam | -- | July 1941 to date | 4,800 |
| Ashley Creek near Jensen, Utah | 3 miles upstream from mouth of U.S. Highway 40 bridge | 386 | October 1946 to date | |
| Dry Fork above Sinks near Dry Fork, Utah | 14 miles upstream from mouth | 48 | March 1939 to date | 27,670 |
| Dry Fork below springs near Dry Fork, Utah | 6 miles upstream from mouth | 102 | May 1941 to Sept. 1945 | 29,330 |

Table No. 3 1/

Runoff of Ashley Creek at "Sign of the Maine" near Vernal

Including Diversions of Oaks Park Canal from Brush Creek

Unit: 1000 a.f.

| Year | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1939 | | | | | | | | | | 3.2 | 2.0 | 5.8 | |
| 1940 | 5.4 | 3.4 | 2.4 | 1.8 | 1.4 | 1.5 | 4.3 | 21.2 | 6.1 | 3.7 | 1.7 | 2.4 | 55.3 |
| 41 | 4.5 | 3.3 | 2.4 | 2.0 | 1.6 | 1.6 | 1.7 | 45.2 | 40.3 | 11.9 | 6.7 | 7.1 | 128.3 |
| 42 | 11.3 | 6.9 | 4.4 | 2.9 | 2.1 | 2.2 | 6.1 | 29.9 | 41.0 | 10.5 | 5.9 | 4.6 | 127.8 |
| 43 | 3.3 | 2.4 | 2.1 | 1.8 | 1.5 | 1.6 | 9.3 | 24.7 | 16.7 | 8.7 | 5.6 | 3.2 | 80.9 |
| 44 | 2.4 | 2.0 | 1.8 | 1.5 | 1.2 | 1.4 | 1.8 | 33.7 | 65.4 | 18.6 | 8.3 | 4.2 | 142.3 |
| 1945 | 2.8 | 2.2 | 1.8 | 1.7 | 1.5 | 1.6 | 1.5 | 19.2 | 24.1 | 10.9 | 7.2 | 5.3 | 79.8 |
| 46 | 3.8 | 2.5 | 2.0 | 1.7 | 1.4 | 1.4 | 6.8 | 10.6 | 7.9 | 4.5 | 3.2 | 3.3 | 49.1 |
| 47 | 3.2 | 3.2 | 2.9 | 2.4 | 1.7 | 2.1 | 3.4 | 52.1 | 34.9 | 14.8 | 7.8 | 5.5 | 134.0 |
| 48 | 4.3 | 2.6 | 2.3 | 1.9 | 1.5 | 1.6 | 2.0 | 32.5 | 17.9 | 6.9 | 5.3 | 2.3 | 81.1 |
| 49 | 2.0 | 1.7 | 1.6 | 1.4 | 1.2 | 1.3 | 2.5 | 30.5 | 41.1 | 10.8 | 7.0 | 3.5 | 104.6 |
| 1950 | 3.6 | 2.8 | 2.2 | 2.0 | 1.7 | 2.0 | 4.5 | 36.0 | 37.7 | 13.7 | 7.8 | 4.3 | 118.3 |
| 51 | 3.2 | 2.2 | 2.0 | 1.8 | 1.4 | 1.5 | 1.3 | 21.7 | 22.4 | 7.5 | 6.5 | 4.3 | 75.8 |
| 52 | 3.6 | 2.3 | 1.9 | 1.8 | 1.5 | 1.6 | 4.1 | 46.6 | 38.2 | 11.5 | 13.0 | 6.1 | 132.2 |
| 53 | 4.4 | 2.9 | 2.3 | 2.2 | 1.8 | 2.0 | 2.1 | 8.8 | 22.6 | 8.4 | 5.3 | 2.3 | 65.1 |
| 54 | 1.8 | 2.0 | 2.0 | 1.8 | 1.4 | 1.4 | 3.2 | 23.3 | 8.7 | 6.8 | 3.7 | 2.5 | 58.6 |
| 1955 | 2.5 | 2.1 | 1.8 | 1.6 | 1.3 | 1.4 | 1.5 | 17.5 | 11.1 | 5.1 | 4.0 | 2.5 | 52.4 |
| 56 | 2.4 | 1.7 | 1.8 | 1.6 | 1.3 | 1.4 | 2.2 | 31.6 | 14.4 | 6.3 | 3.3 | 1.7 | 69.7 |
| 1940-1956 2/ | | | | | | | | | | | | | |
| Total | 64.5 | 46.2 | 37.7 | 31.9 | 25.5 | 27.6 | 58.3 | 485.1 | 450.5 | 160.6 | 102.3 | 65.1 | 1555.3 |
| Mean | 3.8 | 2.7 | 2.2 | 1.9 | 1.5 | 1.6 | 3.4 | 28.5 | 26.5 | 9.5 | 6.0 | 3.8 | 91.5 |
| 1941-1956 3/ | | | | | | | | | | | | | |
| Total | 59.1 | 42.8 | 35.3 | 30.1 | 24.1 | 26.1 | 54.0 | 463.9 | 444.4 | 156.9 | 100.6 | 62.7 | 1500.0 |
| Mean | 3.7 | 2.7 | 2.2 | 1.9 | 1.5 | 1.6 | 3.4 | 29.0 | 27.8 | 9.8 | 6.3 | 3.9 | 93.8 |

1/ USGS Records from July 1939 to present.

2/ For all full years of record. Oaks Park Canal diversions did not begin until 1941.

3/ Portion of record during which Oaks Park canal diversions were made.

Table No. 4

Natural Runoff of Ashley Creek at Sign of the Maine 1/

(Minus Oaks Park Canal Diversions)

| Year | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1925 | 2.4 | 2.3 | 2.2 | 2.1 | 2.0 | 2.1 | 3.2 | 17.0 | 17.1 | 7.6 | 5.1 | 5.8 | 68.9 |
| 26 | 7.0 | 4.9 | 3.4 | 2.6 | 2.0 | 2.2 | 8.8 | 27.7 | 11.3 | 6.2 | 4.8 | 2.8 | 83.7 |
| 27 | 2.7 | 2.3 | 2.2 | 1.9 | 1.8 | 1.9 | 2.4 | 36.2 | 27.3 | 12.5 | 7.2 | 17.9 | 116.3 |
| 28 | 7.4 | 5.9 | 3.6 | 3.0 | 2.6 | 2.5 | 3.9 | 49.1 | 19.2 | 6.8 | 4.5 | 2.6 | 111.1 |
| 29 | 3.0 | 2.9 | 2.3 | 2.5 | 2.0 | 2.1 | 2.4 | 38.3 | 56.0 | 13.0 | 7.4 | 7.2 | 139.1 |
| 1930 | 5.5 | 4.3 | 3.3 | 3.0 | 2.3 | 2.4 | 6.4 | 30.5 | 24.0 | 6.7 | 8.2 | 6.1 | 102.7 |
| 31 | 5.4 | 3.6 | 3.0 | 2.7 | 2.1 | 2.3 | 2.6 | 9.4 | 4.0 | 2.0 | 1.9 | 1.8 | 40.8 |
| 32 | 2.1 | 2.1 | 2.1 | 2.0 | 2.0 | 2.0 | 2.0 | 33.5 | 30.1 | 10.7 | 6.0 | 4.4 | 99.0 |
| 33 | 3.4 | 2.8 | 2.0 | 1.8 | 1.6 | 1.6 | 1.5 | 9.4 | 24.4 | 4.2 | 3.3 | 2.0 | 58.0 |
| 34 | 2.0 | 1.8 | 1.7 | 1.6 | 1.4 | 1.5 | 3.5 | 7.2 | 2.0 | 1.6 | 2.6 | 2.3 | 29.2 |
| 1935 | 2.2 | 2.2 | 2.1 | 1.9 | 1.7 | 1.9 | 1.8 | 13.3 | 47.6 | 7.2 | 3.8 | 2.1 | 87.8 |
| 36 | 2.0 | 1.9 | 1.7 | 1.5 | 1.4 | 1.4 | 2.2 | 12.6 | 6.5 | 3.8 | 4.8 | 3.9 | 43.7 |
| 37 | 3.2 | 2.7 | 1.9 | 1.7 | 1.3 | 1.4 | 2.3 | 45.2 | 24.8 | 11.6 | 6.1 | 3.7 | 105.9 |
| 38 | 2.9 | 2.3 | 1.9 | 1.7 | 1.4 | 1.6 | 2.3 | 26.8 | 42.5 | 12.0 | 5.8 | 4.9 | 106.1 |
| 39 | 7.0 | 5.1 | 3.5 | 2.7 | 2.1 | 2.4 | 7.9 | 22.5 | 7.8 | 3.2 | 2.0 | 5.8 | 72.0 |
| 1940 | 5.4 | 3.4 | 2.4 | 1.8 | 1.4 | 1.5 | 4.3 | 21.2 | 6.1 | 3.7 | 1.7 | 2.4 | 55.3 |
| 41 | 4.5 | 3.3 | 2.4 | 2.0 | 1.6 | 1.6 | 1.7 | 45.2 | 40.3 | 10.5 | 5.8 | 6.3 | 125.2 |
| 42 | 11.3 | 6.9 | 4.4 | 2.9 | 2.1 | 2.2 | 6.1 | 29.9 | 41.0 | 9.4 | 3.9 | 2.3 | 122.4 |
| 43 | 2.7 | 2.4 | 2.1 | 1.8 | 1.5 | 1.6 | 9.3 | 24.7 | 16.7 | 6.1 | 3.6 | 2.1 | 74.6 |
| 44 | 2.4 | 2.0 | 1.8 | 1.5 | 1.2 | 1.4 | 1.8 | 33.7 | 65.4 | 17.3 | 5.1 | 2.8 | 136.4 |
| 1945 | 2.7 | 2.2 | 1.8 | 1.7 | 1.5 | 1.6 | 1.5 | 19.2 | 24.1 | 9.4 | 5.7 | 3.8 | 75.2 |
| 46 | 3.2 | 2.4 | 2.0 | 1.7 | 1.4 | 1.4 | 6.8 | 10.5 | 6.0 | 2.7 | 3.0 | 3.1 | 44.2 |
| 47 | 3.2 | 3.2 | 2.9 | 2.4 | 1.7 | 2.1 | 3.4 | 52.0 | 34.8 | 13.6 | 6.6 | 4.4 | 130.3 |
| 48 | 3.0 | 2.6 | 2.3 | 1.9 | 1.5 | 1.6 | 2.0 | 32.5 | 17.7 | 4.9 | 2.9 | 1.5 | 74.4 |
| 49 | 4.8 | 1.7 | 1.6 | 1.4 | 1.2 | 1.3 | 2.5 | 30.5 | 40.9 | 9.5 | 4.5 | 2.5 | 99.4 |
| 1950 | 3.3 | 2.8 | 2.2 | 2.0 | 1.7 | 2.0 | 4.5 | 36.0 | 37.7 | 13.1 | 5.2 | 3.1 | 113.6 |
| 51 | 2.4 | 2.2 | 2.0 | 1.8 | 1.4 | 1.5 | 1.3 | 21.7 | 22.4 | 5.3 | 5.4 | 3.7 | 71.1 |
| 52 | 3.0 | 2.3 | 1.9 | 1.8 | 1.5 | 1.6 | 4.1 | 46.6 | 38.2 | 9.6 | 12.5 | 5.4 | 128.5 |
| 53 | 3.1 | 2.9 | 2.3 | 2.2 | 1.8 | 2.0 | 2.1 | 8.8 | 22.6 | 5.9 | 2.6 | 1.8 | 58.1 |
| 54 | 1.8 | 2.0 | 2.0 | 1.8 | 1.4 | 1.4 | 3.2 | 23.3 | 7.7 | 4.6 | 3.0 | 2.2 | 54.4 |
| 1955 | 2.5 | 2.1 | 1.8 | 1.6 | 1.2 | 1.4 | 1.5 | 17.5 | 11.0 | 3.3 | 3.9 | 1.2 | 49.0 |
| 56 | 2.4 | 1.7 | 1.8 | 1.6 | 1.3 | 1.4 | 2.2 | 31.6 | 14.4 | 4.0 | 1.8 | 1.1 | 65.3 |
| 1941-1956 2/ | | | | | | | | | | | | | |
| Total | 53.3 | 42.3 | 35.3 | 30.1 | 24.1 | 26.1 | 54.0 | 463.7 | 440.8 | 129.1 | 75.4 | 48.5 | 1422.7 |
| Mean | 3.3 | 2.6 | 2.2 | 1.9 | 1.5 | 1.6 | 3.4 | 29.0 | 27.6 | 8.1 | 4.7 | 3.0 | 88.9 |
| 1925-1956 3/ | | | | | | | | | | | | | |
| Total | 116.9 | 93.2 | 74.6 | 64.6 | 53.1 | 56.9 | 111.5 | 863.6 | 791.6 | 242.0 | 150.7 | 123.0 | 2741.7 |
| Mean | 3.7 | 2.9 | 2.3 | 2.0 | 1.7 | 1.8 | 3.5 | 27.0 | 24.7 | 7.6 | 4.7 | 3.8 | 85.7 |

1/ USGS records are available from June 1939 through 1956. Runoff for 1925 through May 1939 was estimated by correlation with Ashley Creek near Vernal minus diversions to Ashley Creek from Oaks Park Reservoir on Brush Creek.

2/ 1941-1956 is the period during which additional water was diverted to Ashley Creek from Oaks Park Reservoir on Brush Creek.

3/ 1925-1956 is the period of study.

the regulation of upstream storage at the glacial lakes and Long Park Reservoir is less than one percent of the Ashley Creek runoff, no adjustments were made for its effect. This is justified because the correction would not be within the accuracy of stream flow measurements.

### Ashley Creek near Vernal

The station is located $4\frac{1}{2}$ miles upstream from Dry Fork, a tributary to Ashley Creek, and $5\frac{1}{4}$ miles upstream from the station Ashley Creek at "Sign of the Maine." Discharge records are available from October 1911 through September 1956. This station has been operated almost continuously since its installation. However, it has been operated at three different locations, and the final location established in October 1914 is the only record of value in the present studies. The present location near the Utah Power and Light Company's hydroelectric plant is below the Ashley Creek Spring and above Dry Fork, the main tributary of Ashley Creek. The record, therefore, provides only data on the main fork of Ashley Creek and does not give information on the total available supply for storage in the Stanaker Reservoir. However, this station does serve for comparison with the later established station, at "Sign of the Maine," below Dry Fork, in developing a record of water available for unit use. This station is above all diversions for irrigation uses and is used as the basic long time record station. Elevation of the station is 6,250 feet and the drainage area covers 101 square miles. The natural flow at this gage is increased by water released from Oaks Park Reservoir through the Oaks Park Canal. Municipal water for the city of Vernal and surrounding area is diverted from a tributary spring about 1,000 feet above the station. Table No. 5 gives the monthly summary of the natural flow at "Ashley Creek near Vernal" station for a period of 1925 through 1956.

### Oaks Park Canal near Vernal

The station is located 1,000 feet downstream from Oaks Park Dam and 200 feet downstream from the point of diversion from Brush Creek. This record gives the transmountain diversion from Brush Creek drainage to the Ashley Creek drainage. Surplus Brush Creek water not required by downstream users in the Brush Creek drainage is stored in Oaks Park Reservoir, active capacity 5,740 acre-feet, and released as needed to Ashley Creek through the Oaks Park Canal. Discharge records at this station are available from April 1946 to September 1956. The divertible supply from Brush Creek is limited by the storable flow at the reservoir and the reservoir capacity. Table No. 6 gives the monthly summary of flows diverted through the Oaks Park Canal.

### Oaks Park Reservoir

Data on stream flow at the Oaks Park Reservoir are limited. Table No. 37 gives the summary of the storable flow of Brush Creek at Oaks Park

Table No. 5

Flow of Ashley Creek near Vernal minus Oaks Park Canal Diversion 1/

Unit: 1000 a.f.

| Year | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1925 | 2.4 | 2.1 | 2.0 | 1.9 | 1.7 | 1.8 | 3.4 | 14.2 | 11.8 | 6.8 | 5.0 | 5.4 | 58.5 |
| 26 | 6.7 | 4.6 | 3.2 | 2.4 | 1.8 | 1.9 | 8.4 | 20.9 | 9.0 | 6.0 | 4.8 | 3.0 | 72.7 |
| 27 | 2.7 | 2.1 | 2.0 | 1.7 | 1.5 | 1.6 | 2.5 | 26.1 | 16.9 | 9.1 | 6.4 | 13.7 | 86.3 |
| 28 | 7.0 | 5.4 | 3.4 | 2.8 | 2.3 | 2.1 | 4.2 | 33.8 | 12.8 | 6.4 | 4.6 | 2.8 | 87.6 |
| 29 | 3.1 | 2.8 | 2.1 | 2.3 | 1.8 | 1.8 | 2.5 | 27.3 | 31.4 | 9.3 | 6.5 | 6.3 | 97.2 |
| 1930 | 5.6 | 4.1 | 3.1 | 2.8 | 2.0 | 2.1 | 6.5 | 23.9 | 15.2 | 6.3 | 7.0 | 5.6 | 84.2 |
| 31 | 5.5 | 3.4 | 2.8 | 2.5 | 1.9 | 2.0 | 2.7 | 4.3 | 5.5 | 2.8 | 2.3 | 1.9 | 42.6 |
| 32 | 2.0 | 1.9 | 1.8 | 1.8 | 1.7 | 1.7 | 2.0 | 24.5 | 18.3 | 8.3 | 5.6 | 4.4 | 74.0 |
| 33 | 3.6 | 2.7 | 1.7 | 1.5 | 1.3 | 1.3 | 1.3 | 9.3 | 15.4 | 4.6 | 3.6 | 2.2 | 48.5 |
| 34 | 1.8 | 1.5 | 1.3 | 1.3 | 1.1 | 1.2 | 3.8 | 7.8 | 3.5 | 2.5 | 3.0 | 2.5 | 31.3 |
| 1935 | 2.1 | 2.0 | 1.8 | 1.6 | 1.4 | 1.6 | 1.7 | 11.8 | 27.1 | 6.6 | 4.0 | 2.3 | 64.0 |
| 36 | 1.9 | 1.6 | 1.4 | 1.2 | 1.1 | 1.1 | 2.2 | 11.4 | 6.7 | 4.3 | 4.8 | 4.0 | 41.7 |
| 37 | 3.3 | 2.5 | 1.6 | 1.4 | 1.0 | 1.1 | 2.3 | 31.5 | 15.6 | 8.7 | 5.7 | 3.9 | 78.6 |
| 38 | 3.0 | 2.1 | 1.6 | 1.4 | 1.2 | 1.3 | 2.4 | 20.3 | 24.5 | 8.9 | 5.5 | 4.8 | 77.0 |
| 39 | 6.7 | 4.8 | 3.3 | 2.5 | 1.9 | 2.1 | 7.7 | 17.7 | 7.2 | 4.3 | 2.9 | 5.3 | 66.4 |
| 1940 | 5.6 | 3.5 | 2.2 | 1.6 | 1.3 | 1.4 | 4.6 | 17.5 | 6.9 | 4.1 | 2.2 | 3.0 | 53.9 |
| 41 | 4.8 | 3.3 | 2.3 | 1.9 | 1.6 | 1.7 | 1.6 | 30.2 | 22.3 | 7.9 | 5.7 | 6.0 | 89.3 |
| 42 | 9.4 | 6.2 | 4.0 | 2.6 | 1.8 | 1.8 | 6.0 | 22.4 | 25.3 | 8.4 | 5.0 | 2.7 | 95.6 |
| 43 | 2.6 | 1.9 | 1.6 | 1.3 | 1.0 | 1.1 | 8.8 | 16.6 | 10.5 | 5.7 | 3.8 | 2.1 | 57.0 |
| 44 | 2.2 | 1.7 | 1.5 | 1.3 | 1.1 | 1.1 | 1.2 | 23.0 | 36.1 | 10.8 | 5.1 | 2.8 | 87.9 |
| 1945 | 2.5 | 2.0 | 1.6 | 1.4 | 1.1 | 1.2 | 1.3 | 15.4 | 15.4 | 7.0 | 5.2 | 3.8 | 57.9 |
| 46 | 3.2 | 2.2 | 1.6 | 1.4 | 1.1 | 1.1 | 6.4 | 9.5 | 6.1 | 3.3 | 3.1 | 3.6 | 42.6 |
| 47 | 3.4 | 2.9 | 2.4 | 1.9 | 1.5 | 1.6 | 3.8 | 31.5 | 20.0 | 9.4 | 5.8 | 4.3 | 88.5 |
| 48 | 3.1 | 2.6 | 2.1 | 1.7 | 1.3 | 1.3 | 1.9 | 25.0 | 12.6 | 5.1 | 2.8 | 1.6 | 61.1 |
| 49 | 1.6 | 1.4 | 1.2 | 1.0 | .9 | .9 | 2.5 | 27.2 | 23.6 | 7.5 | 4.7 | 2.7 | 75.2 |
| 1950 | 2.9 | 2.4 | 1.8 | 1.7 | 1.2 | 1.4 | 5.6 | 25.1 | 22.5 | 9.6 | 4.8 | 3.7 | 82.7 |
| 51 | 2.5 | 2.0 | 1.8 | 1.6 | 1.2 | 1.2 | 1.2 | 15.9 | 12.1 | 6.0 | 5.4 | 4.1 | 55.0 |
| 52 | 3.3 | 2.3 | 1.9 | 1.8 | 1.5 | 1.4 | 4.2 | 36.3 | 23.2 | 8.5 | 9.4 | 5.1 | 98.9 |
| 53 | 3.0 | 2.3 | 2.1 | 1.8 | 1.4 | 1.4 | 1.8 | 9.5 | 17.2 | 5.6 | 2.8 | 1.8 | 50.7 |
| 54 | 1.9 | 1.7 | 1.7 | 1.6 | 1.1 | 1.1 | 3.9 | 18.8 | 7.1 | 4.8 | 3.2 | 2.3 | 49.2 |
| 1955 | 2.4 | 1.8 | 1.5 | 1.3 | 1.0 | 1.1 | 1.3 | 15.9 | 10.3 | 4.3 | 3.7 | 2.6 | 47.2 |
| 56 | 2.1 | 1.7 | 1.5 | 1.4 | 1.2 | 1.2 | 2.1 | 23.5 | 10.5 | 5.0 | 2.3 | 1.4 | 53.9 |
| 1925-56 Total | 113.9 | 85.5 | 65.9 | 56.4 | 45.0 | 46.7 | 111.8 | 653.1 | 502.6 | 207.9 | 146.7 | 121.7 | 2,157.2 |
| Mean | 3.6 | 2.7 | 2.0 | 1.8 | 1.3 | 1.5 | 3.5 | 20.4 | 15.7 | 6.5 | 4.6 | 3.8 | 67.4 |

1/ USGS records. Oaks Park Canal diverts from Brush Creek to Ashley Creek above this gage.

Table No. 6

Flow of Oaks Park Canal near Vernal 1/

Unit: 1000 a.f.

| Year | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1941 | | | | | | | | | | 1.4 | .9 | .8 | 3.1 |
| 42 | | | | | | | | | | 1.1 | 2.0 | 2.3 | 5.4 |
| 43 | .6 | | | | | | | | | 2.6 | 2.0 | 1.1 | 6.3 |
| 44 | | | | | | | | | | 1.3 | 3.2 | 1.4 | 5.9 |
| 1945 | .1 | | | | | | | | | 1.5 | 1.5 | 1.5 | 4.6 |
| 46 | .6 | .1 | | | | | | .1 | 1.9 | 1.8 | .2 | .2 | 4.9 |
| 47 | 0 | | | | | | | .1 | .1 | 1.2 | 1.2 | 1.1 | 3.7 |
| 48 | 1.3 | | | | | | | | .2 | 2.0 | 2.4 | .8 | 6.7 |
| 49 | .2 | | | | | | | | .2 | 1.3 | 2.5 | 1.0 | 5.2 |
| 1950 | .3 | | | | | | | | | .6 | 2.6 | 1.2 | 4.7 |
| 51 | .8 | | | | | | | | | 2.2 | 1.1 | .6 | 4.7 |
| 52 | .6 | | | | | | | | | 1.9 | .5 | .7 | 3.7 |
| 53 | 1.3 | .4 | | | | | | | | 2.5 | 2.7 | .5 | 7.4 |
| 54 | | | | | | | | | 1.0 | 2.2 | .7 | .3 | 4.2 |
| 1955 | | | | | | | | | .2 | 1.9 | .2 | .1 | 2.2 |
| 56 | | | | | | | | | | 2.3 | 1.5 | .6 | 4.4 |
| Total | 5.8 | .5 | | | | | | .2 | 3.6 | 27.8 | 25.2 | 14.2 | 77.3 |
| Mean | .4 | 0 | | | | | | 0 | .2 | 1.7 | 1.6 | .9 | 4.8 |

1/ May 1946 - 1953 USGS Records
July 1941 - 1946 Ashley Irrig. Co. Records

Reservoir from 1925 to 1955. Storable flow for 1942 to 1946 is based upon records of outflow and reservoir gage heights. Data for other years was estimated by correlation with "Ashley Creek near Vernal" minus Oaks Park Canal.

Ashley Creek near Jensen

The station is located immediately downstream from the U.S. Highway 40 bridge, 3 miles upstream from the junction of Ashley Creek and the Green River, 3 miles west of Jensen, Utah. Discharge records at this station are available from October 1946 to September 1956. Elevation of the station is 4795 feet and the drainage area is 386 square miles. The gage is below all stream diversions except for the Union Canal which diverts from Ashley Creek about 2,000 feet downstream from the gage. Table No. 7 gives the monthly summary of the flows of Ashley Creek near Jensen.

## Available Supply

The water supply for Ashley Valley is presently obtained from Ashley Creek which drains some 238 square miles above the valley. Runoff due to the nature of the water shed is rapid, resulting in wide fluctuations in stream flow as shown by the water records at the "Sign of the Maine" gage in Table No. 3. Winter and late summer flows are low compared to the spring flows. Average monthly flow for September through April is 2,600 acre-feet while the average for May is 29,000, June 27,800, July 9,800, and August 6,300 acre-feet for the period 1941 to 1956.

Past Diversions to Canals

By court decree all of the waters of Ashley Creek were divided among the Stanaker, Ashley Upper, Ashley Central, Colton, Hardy, Island, Dodds, and Rock Point Canals. Since that time and to the present these canals have diverted all of the flows of Ashley Creek up to the capacity of their respective canals and in the proportion granted under the decree. The Highline Canal was not included in the decree but has since acquired a high water filing on Ashley Creek. Under present operating conditions the Stanaker, Ashley Upper, Ashley Central, Dodds, Island, and Rock Point Canals divert all the water in Ashley Creek at the "Sign of the Maine" gage up to 500 cfs, with the Highline diverting such flows between 500 cfs and 682 cfs. The excess flows are diverted by the lower canals, River and Union, or spills into the Green River below Jensen.

Recorded data on the past diversions to the various canals is limited to fragmentary records developed from staff gage readings. The general practice is to divert water from Ashley Creek throughout the year. Irrigation begins in the latter part of March or early April and continues into November. Nonirrigation season flows are used for stock watering

Table No. 7

Runoff of Ashley Creek near Jensen*

Unit: 1000 a.f.

| Year | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1942 | | | | | | | | | | | .5 | .7 | |
| 43 | 1.4 | | | | | 1.7 | 2.5 | 5.5 | 6.0 | .5 | .6 | .5 | |
| 44 | .8 | | | | | | | | | | | | |
| 1945 | | | | | | | | | | | | | |
| 46 | | | | | | | | | | | | | |
| 47 | .4 | 1.2 | 2.2 | 3.4 | 3.2 | 3.0 | 1.1 | 31.3 | 30.1 | 2.2 | 1.6 | .9 | 80.6 |
| 48 | 1.8 | 2.8 | 3.3 | 2.9 | 3.1 | 4.0 | 2.1 | 12.4 | 5.4 | .5 | .3 | .2 | 38.8 |
| 49 | .5 | 1.0 | 1.5 | 2.0 | 2.3 | 4.0 | 1.3 | 11.4 | 30.9 | 2.0 | .5 | .6 | 58.0 |
| 1950 | 3.8 | 3.8 | 3.4 | 3.4 | 2.8 | 5.5 | 6.2 | 23.6 | 19.8 | 4.3 | .9 | 1.3 | 78.8 |
| 51 | 2.2 | 2.6 | 3.2 | 2.8 | 2.5 | 2.0 | .7 | 7.7 | 5.5 | .5 | .7 | 1.1 | 31.5 |
| 52 | 3.6 | 3.3 | 3.3 | 3.0 | 2.6 | 4.1 | 9.9 | 31.7 | 24.4 | 1.9 | 3.1 | 2.3 | 93.2 |
| 53 | 2.3 | 3.0 | 4.0 | 3.8 | 3.1 | 3.6 | 1.5 | 1.2 | 4.6 | .2 | .2 | .2 | 27.7 |
| 54 | .5 | 1.4 | 2.4 | 2.8 | 2.2 | 1.6 | .7 | 2.6 | 1.3 | .2 | .1 | .2 | 16.0 |
| 1955 | 1.0 | 1.2 | 2.1 | 2.2 | 1.9 | 3.1 | 1.3 | .9 | 1.6 | .1 | .1 | .1 | 15.6 |
| 1947-55 Total | 16.1 | 20.3 | 25.4 | 26.3 | 23.7 | 30.9 | 24.8 | 122.8 | 123.6 | 11.9 | 7.5 | 6.9 | 440.2 |
| Mean | 1.8 | 2.3 | 2.8 | 2.9 | 2.6 | 3.4 | 2.8 | 13.7 | 13.7 | 1.3 | .8 | .8 | 48.9 |

* USGS Records - 1947-1954
USBR Records - 1942-1944

Table No. 8

Summary of Diversions to Canals 1951-1955

Unit: A.F.

| Year | Month | Ashley Central Res. | Ashley Central Total | Island Total | Rock Point Res. | Rock Point Total | Dodds Total | Upper Ashley Res. | Upper Ashley Total | Highline Res. | Highline Total | Stanaker Res. | Stanaker Total | Total Res. | Total in Canals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1951 | May | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | June | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | July | 222 | 2011 | 457 | 77 | 1229 | 65 | 956 | 2948 | 851 | 990 | 12 | 151 | 2118 | 7851 |
| | Total | 222 | 2011 | 457 | 77 | 1229 | 65 | 956 | 2948 | 851 | 990 | 12 | 151 | 2118 | 7851 |
| 1952 | July | 250 | 2380 | 529 | - | 1458 | 105 | 853 | 2666 | 960 | 111 | - | 193 | 2063 | 7442 |
| | Aug. | 113 | 3197 | 712 | - | 944 | 99 | 383 | 3911 | 522 | 336 | - | 157 | 1018 | 9356 |
| | Sept. | 133 | 1819 | 417 | - | 988 | 61 | 448 | 1880 | 75 | 97 | 12 | 111 | 668 | 5373 |
| | Oct. | 177 | 1137 | 250 | - | 659 | 54 | 643 | 1305 | 36 | 54 | 14 | 69 | 870 | 3528 |
| | Total | 673 | 8533 | 1908 | - | 4049 | 319 | 2327 | 9762 | 1593 | 598 | 26 | 530 | 4619 | 25699 |
| 1953 | July | 365 | 1868 | 358 | 228 | 982 | 56 | 1192 | 2981 | 760 | 785 | 4 | 95 | 2549 | 7125 |
| | Aug. | 305 | 1568 | 274 | 313 | 1017 | 42 | 1176 | 2604 | 367 | 411 | 36 | 105 | 2197 | 6012 |
| | Sept. | 105 | 744 | 159 | 4 | 411 | 21 | 248 | 1029 | 38 | 14 | - | 36 | 395 | 2414 |
| | Total | 775 | 4180 | 791 | 545 | 2410 | 119 | 2616 | 6614 | 1165 | 1210 | 40 | 236 | 5141 | 15559 |
| 1954 | May | | 5367 | 754 | | 1967 | 113 | - | 9261 | - | - | | 284 | - | 17746 |
| | June | 117 | 2636 | 6758 | - | 1589 | 96 | 692 | 3780 | 553 | 172 | - | 193 | 1362 | 15224 |
| | July | 407 | 2102 | 3901 | 30 | 1067 | 60 | 934 | 2912 | 597 | 80 | 8 | 117 | 1976 | 10239 |
| | Aug. | 454 | 1464 | 219 | 44 | 619 | 32 | 391 | 1428 | 42 | 44 | 4 | 67 | 935 | 3873 |
| | Sept. | 79 | 714 | 135 | 26 | 406 | 16 | 89 | 908 | - | 16 | 4 | 36 | 198 | 2231 |
| | Total | 1057 | 12283 | 8767 | 100 | 5648 | 317 | 2106 | 18289 | 1192 | 312 | 16 | 697 | 4471 | 46313 |
| 1955 | June | 22 | 3689 | 781 | - | 1663 | 105 | 89 | 3578 | 516 | - | - | 210 | 627 | 10026 |
| | July | 430 | 1779 | 315 | 63 | 877 | 41 | 1000 | 2543 | 200 | 204 | - | 82 | 1693 | 5841 |
| | Aug. | 160 | 1289 | 238 | 46 | 650 | 27 | 274 | 1521 | 28 | 12 | 14 | 56 | 522 | 3793 |
| | Sept. | - | 810 | 202 | - | 529 | 26 | 10 | 1123 | - | - | - | 59 | 10 | 2809 |
| | Oct. | - | 422 | 95 | - | 573 | 8 | 167 | 573 | - | - | - | 57 | 167 | 1728 |
| | Total | 612 | 8049 | 1631 | 109 | 4292 | 207 | 1540 | 9338 | 744 | 216 | 14 | 464 | 3019 | 24197 |

Table 9

Monthly Discharge of Canals in Ashley Valley

| Stream | Year | Mar. | April | May | June | July | Aug. | Sept. | Oct. | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| High Line Canal | 1943 | 93 | 840 | 1,830 | 3,380 | 634 | 22 | 48 | | 6,847 |
| | 1944 | | | 2,405 | 5,900 | 3,820 | 625 | 304 | 60 | 13,114 |
| Ashley Upper Canal | 1942 | | | | | | 2,840 | 2,300 | 1,950 | 7,090 |
| | 1943 | 560 | 4,000 | 10,500 | 7,702 | 3,410 | 2,430 | 1,310 | | 29,912 |
| | 1944 | | | 7,410 | 12,290 | 6,540 | 3,370 | 1,500 | 1,142 | 32,252 |
| Ashley Central Canal | 1942 | | | | | | 2,030 | 1,820 | 1,040 | 4,890 |
| | 1943 | 415 | 1,930 | 5,870 | 3,920 | 2.380 | 1,921 | 960 | | 17,393 |
| | 1944 | | 298 | 4,560 | 7,180 | 3,980 | 2,390 | 1,340 | 970 | 20,718 |
| Rock Point Canal | 1942 | | | | | | 330 | 603 | 350 | 1,783 |
| | 1943 | 256 | 792 | 2,118 | 1,040 | 980 | 935 | 540 | | 6,661 |
| | 1944 | | 72 | 644 | 1,542 | 2,312 | 1,096 | 782 | 388 | 6,836 |
| Island Ditch | 1942 | | | | | | 308 | 243 | 247 | 798 |
| | 1943 | 34 | 404 | 800 | 694 | 395 | 270 | 153 | | 2,752 |
| | 1944 | | | 791 | 884 | 887 | 381 | 211 | 162 | 3.316 |
| Riverdale Canal | 1942 | | | | | | 194 | 122 | 41 | 357 |
| | 1943 | 0 | 284 | 630 | 358 | 164 | 103 | 71 | | 1,610 |
| | 1944 | | | | | | | | | |

purposes, or wasted. No attempt is made to control the use of water so long as the flow is above 500 cfs; consequently, it is common practice to apply more water than can be beneficially used. As the flow of water in the creek diminishes closer control is placed over diversions. Each canal having a right to use of water is entitled to a certain percentage of the total flow, and the practice is to apportion the limited supply as equitably as possible with limited measuring devices under the supervision of the River Commissioner. Available records of irrigation diversions during the periods 1942-44 and 1950-55 compared with estimated requirements reflect the practice of diverting excessive amounts of water during the high runoff period. These records are summarized in Table Nos. 8 and 9. Following the high runoff season (April to June) the natural flow of Ashley Creek diminishes rapidly, leaving the area with insufficient water for late season crops.

Supplemental water is provided by storage Oaks Park Reservoir, Long Park Reservoir, and a group of small glacial lakes. Total storage of these reservoirs is estimated to be 6,870 acre-feet. Oaks Park Reservoir with an active capacity of 5,740 acre-feet, stores the surplus spring flows of Brush Creek. This storage is released in the late summer months as given in Table No. 6. The reservoir capacity is divided among the various canals and municipal water uses in accordance with shares of Ashley Valley Reservoir Company stock owned by the water users. Table No. 10 gives the summary of Oaks Park Reservoir ownership for 1956.

Table 10
Ashley Valley Reservoir Company
Distribution of Stock by Canals
(for 1956)

| Canal | Shares of Stock |
|---|---|
| Stanaker | 108.00 |
| Highline | 4,407.46 |
| Ashley Upper | 9,991.50 |
| Ashley Central | 5,235.52 |
| Rock Point | 1,165.76 |
| Island | 20.00 |
| City Pipeline | 1,564.55 |
| Total | 22,492.79 |

Long Park Reservoir located on the headwaters of the North Fork of Ashley Creek has an estimated capacity of 520 acre-feet. An estimated 610 acre-feet of storage is contained in small glacial lakes in the headwaters of the South Fork of Ashley Creek.

Even with this supplemental supply the natural flow of Ashley Creek and storage releases are insufficient to supply adequately the needs of presently irrigated lands.

## Municipal water system

Municipal water for Vernal, Maeser, and Naples areas is diverted from Ashley Creek springs on Ashley Creek above all irrigation diversions, and about 9 miles above Vernal. The spring area has been enclosed in a large masonry box with an overflow section. The Geological Survey has kept a record of flows in the overflow channel below the spring for 1944 and 1945, and since August 1954. The records indicate a minimum flow of about 15 second-feet and a maximum of about 49 second-feet, in addition to the flow in the pipeline. The flows are shown as follows:

Unit: Acre-feet

| Year | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1944 | 1490 | 1300 | 1180 | 1010 | 883 | 928 | 996 | 2330 | 2810 | 2770 | 2590 | 1930 | 20,220 |
| 1945 | 1690 | 1490 | 1280 | 1180 | 1000 | 1100 | 1140 | 2440 | 2550 | 2570 | 2390 | 2180 | 21,060 |
| 1954 | | | | | | | | | | | 1830 | 1600 | -- |
| 1955 | 1600 | 1440 | 1330 | 1160 | 964 | 1010 | 1140 | 2480 | 2450 | 2240 | 1970 | 1670 | 19,450 |

A 12-inch steel pipeline conveys the water from the masonry box to a chlorination plant near the head of Ashley Valley. The capacity of the pipeline is about 7 second-feet. Under present operations the flow of the pipeline is varied from about 3 second-feet in the winter to about 5 second-feet in summer. After leaving the chlorination plant, which is operated only when there is evidence of pollution, the water is measured through a weir into a division box from which about 1/8 of the flow goes to the Maeser area. The remainder is piped to the Vernal City system, which consists of a 75,000 gallon concrete reservoir, a 500,000 gallon concrete reservoir, and the distribution pipelines. Excess water is spilled from the reservoir into Ashley Central Canal. The Naples system connects with the Vernal City pipeline near the southwest corner of Vernal. Records of flow at the measuring weir from May 1952, to September 1956, are summarized in Table 11.

Records of past water use were obtained for Vernal City, Maeser, and Naples for parts of the years 1953, 1954, and 1955, from a survey of meter readings as obtained from city officials. Actual meter readings were increased by 33 1/3% to account for leakage and unmetered connections and are summarized in Table 12.

Estimated population as served by the pipeline in 1956 is 4300 in Vernal, 912 in Maeser, and 608 in Naples. The average use for 1955 amounted to 224 gallons per person per day.

Rights to the use of Ashley Creek water are based upon the court decree of 1897, in which the entire flow of the stream was divided among the water users. In effect, each water user is entitled to a percentage

Table 11

Flow of Municipal Pipeline 1/
for Vernal City, Maeser, and Naples
at Chlorination Plant

Unit: Acre-feet

| Year | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1952 | | | | | 240 | 260 | 271 | 271 | 262 | 269 | 245 | 182 | |
| 1953 | 185 | 175 | 191 | 205 | 291 | 282 | 293 | 293 | 283 | 193 | 179 | 185 | 2,755 |
| 1954 | 185 | 167 | 185 | 245 | 295 | 298 | 307 | 306 | 244 | 290 | 178 | 173 | 2,873 |
| 1955 | 173 | 156 | 173 | 191 | 271 | 278 | 307 | 307 | 298 | 289 | 195 | 179 | 2,817 |
| 1956 | 179 | 167 | 188 | 236 | 224 | 249 | 307 | 307 | 297 | | | | |

1/ Measured over a weir at which a staff gage is read periodically. These figures are therefore only approximate.

Table 12

Past Municipal Water Use
Vernal City, Maeser, and Naples

Unit: Acre-feet

| Year | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Vernal City** | | | | | | | | | | | | | |
| 1953 | 38 | 37 | 54 | 75 | 91 | 147 | 156 | 123 | 108 | 66 | 49 | 53 | -- |
| 1954 | 53 | 48 | 55 | 102 | 158 | 136 | 155 | 138 | 84 | 54 | 46 | 59 | -- |
| 1955 | 59 | 54 | 57 | 98 | 137 | 164 | 165 | 133 | 127 | 93 | 53 | 53 | 1193 |
| **Maeser Area** | | | | | | | | | | | | | |
| 1954 | | | | | | | 22 | 20 | 12 | 11 | 9 | 9 | -- |
| 1955 | 9 | 8 | 8 | 13 | 20 | 23 | 19 | 15 | 15 | 17 | 9 | 9 | 165 |
| **Naples Area** | | | | | | | | | | | | | |
| 1953 | | | | | | | | | | | | 4 | -- |
| 1954 | 4 | 4 | 6 | 9 | 10 | 7 | 9 | 7 | 9 | 6 | 5 | 6 | -- |
| 1955 | 5 | 5 | 6 | 9 | 12 | 12 | 12 | 10 | 12 | 8 | 5 | 4 | 100 |
| **Total System** | | | | | | | | | | | | | |
| 1954 | | | | | | | 186 | 165 | 105 | 71 | 61 | 74 | -- |
| 1955 | 73 | 67 | 71 | 120 | 169 | 199 | 196 | 157 | 153 | 119 | 68 | 67 | 1459 |

of the total flow as measured at "Sign of the Maine" gage. Municipal water rights have been obtained by purchasing stock in the Ashley Upper and Ashley Central canal companies, plus the transfer to Vernal City of the A. J. Johnson right as set forth in the court decree. Municipal water rights are entitled to 4.34% of Ashley Creek flows as follows:

| Item | Percent of Ashley Creek Flow | | | |
|---|---|---|---|---|
| | Vernal | Maeser | Naples | Total |
| Ashley Upper Irrigation Co. | 0.39 | 0.18 | - | 0.57 |
| Ashley Central Irrigation Co. | 2.60 | 0.38 | 0.46 | 3.44 |
| A. J. Johnson Right | 0.33 | - | - | 0.33 |
| Total Direct Flow | 3.32 | 0.56 | 0.46 | 4.34 |

In addition to rights on Ashley Creek, the municipal water system owns stock in the Ashley Valley Reservoir Company, which has storage of 5,740 acre-feet in Oaks Park Reservoir, 520 acre-feet in Long Park Reservoir, 360 acre-feet in Twin Lakes, 150 acre-feet in Goose Lake, and 100 acre-feet in Mirror Lake, making a total of 6,870 acre-feet. In 1956 the company had about 22,493 shares of stock, of which the municipal water system owned about 1,565 shares. This is about 7% of the stock, or 480 acre-feet of storage.

Ashley Creek spring is an excellent source of municipal water, and physically, there is an abundance of water available for future growth of the municipal system. With respect to water rights, however, the municipal system owns only enough water for present requirements. If a year of runoff like 1934 were to occur, the Ashley Creek flow owned by the municipal system would fail to meet the demand similar to that of 1955 by 380 acre-feet. This shortage could possibly be made up from storage in the upstream reservoirs, provided the storage space filled during the spring runoff. It is very doubtful if runoff would be sufficient in a year like 1934 to fill the reservoir more than about 1/3 full.

## Quality of Water

Quality of water may be defined as the suitability of water for irrigation use. It is measured by the type and concentration of the dissolved and suspended constituents. Experience and research indicate that a minimum of three factors must be known in order to make an estimate of water quality for irrigation use: (1) The total concentration of dissolved solids, (2) the relative proportion of sodium to other cations, and (3) the concentration of boron.

A relatively simple method of classifying irrigation waters with regard to the first two factors has been developed by the Agriculture Research Service of the Department of Agriculture. With respect to total dissolved solids, as measured by conductivity, waters are divided into four classes. The dividing points between classes are at 250, 750, and 2,250 micromhos/cm. The classes are described as follows:

C1 Low-salinity water can be used for irrigation with most crops, on most soils with little likelihood that soil salinity will develop. Some leaching is required, but this occurs under normal irrigation practices, except in soils of extremely low permeability.

C2 Medium-salinity water can be used if a moderate amount of leaching occurs. Plants with moderate salt tolerance can be grown in most cases without special practices for salinity control.

C3 High-salinity water cannot be used on soils with restricted drainage. Even with adequate drainage, special management for salinity control may be required, and plants with good salt tolerance should be selected.

C4 Very High-salinity water is not suitable for irrigation under ordinary conditions, but may be used occasionally under very special circumstances. The soils must be permeable, drainage must be adequate, irrigation water must be applied in excess to provide considerable leaching and very salt-tolerant crops should be selected.

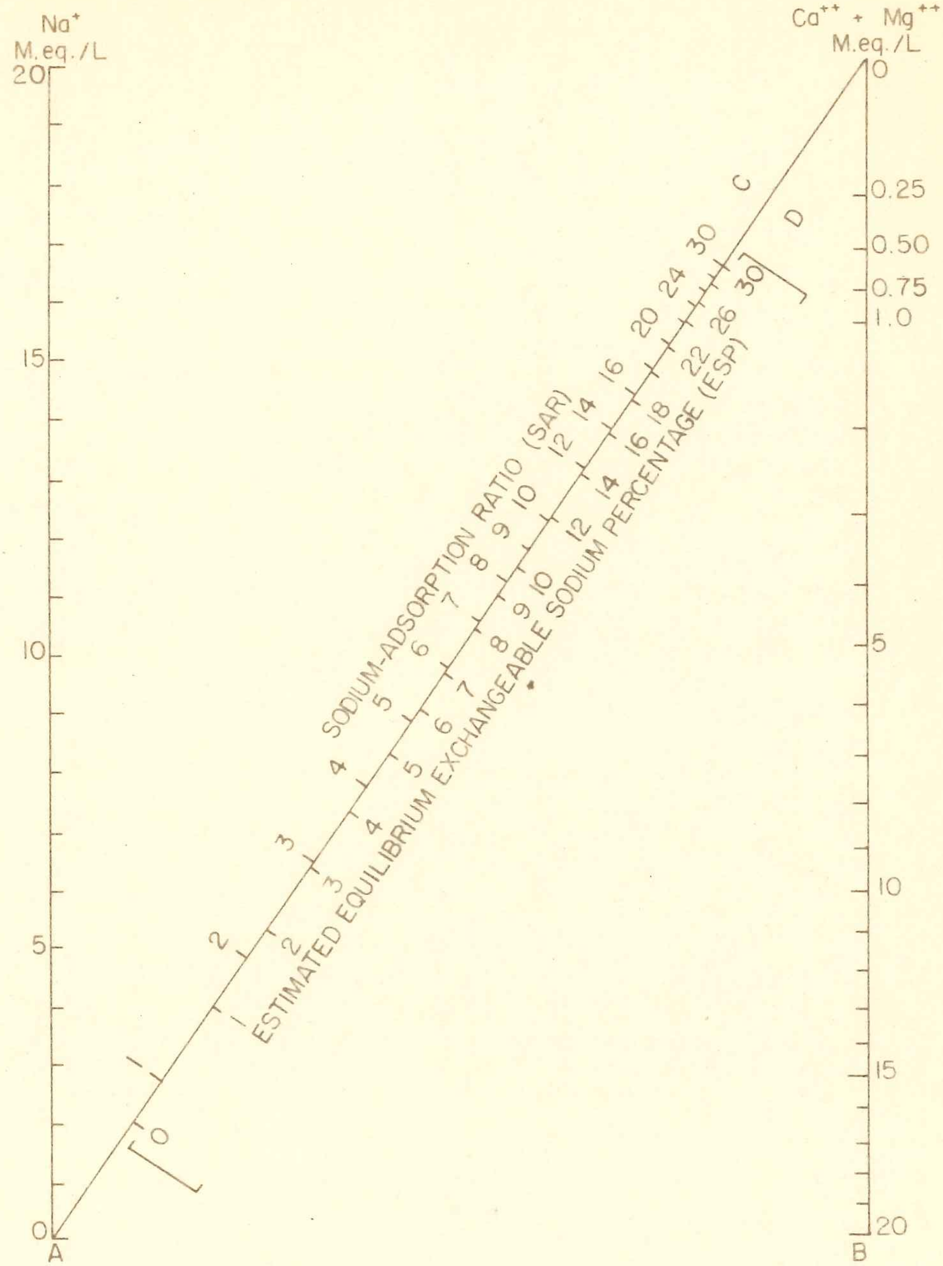
The relative proportion of sodium to other cations in an irrigation water is expressed in terms of "sodium-adsorption-ratio" (SAR) which is defined by the equation:

$$SAR = \frac{Na^+}{\sqrt{\frac{Ca^{++} + Mg^{++}}{2}}}$$

where $Na^+$, $Ca^{++}$, and $Mg^{++}$ represent the concentrations in milliequivalents per liter (m.e./l.) of sodium, calcium, and magnesium, respectively. The sodium-adsorption-ratio is more significant for interpreting water quality than the "percent sodium" formerly used because it relates more directly to the adsorption of sodium by the soil. A nomogram for estimating the SAR value of an irrigation water is shown in Figure 1. The SAR value may be calculated from the above equation or estimated by use of the nomogram. A very preliminary estimate of the exchangeable sodium percentage which may result in a well-drained soil at equilibrium with the irrigation water may be read on the D scale. Waters are divided into four classes, with respect to sodium hazard, the dividing points being at SAR values of 10, 18, and 26, see Figure 2. The classes are described as follows:

S1 Low-sodium water can be used for irrigation on almost all soils with little danger of the development of harmful levels of exchangeable sodium. However, sodium-sensitive crops such as stonefruit

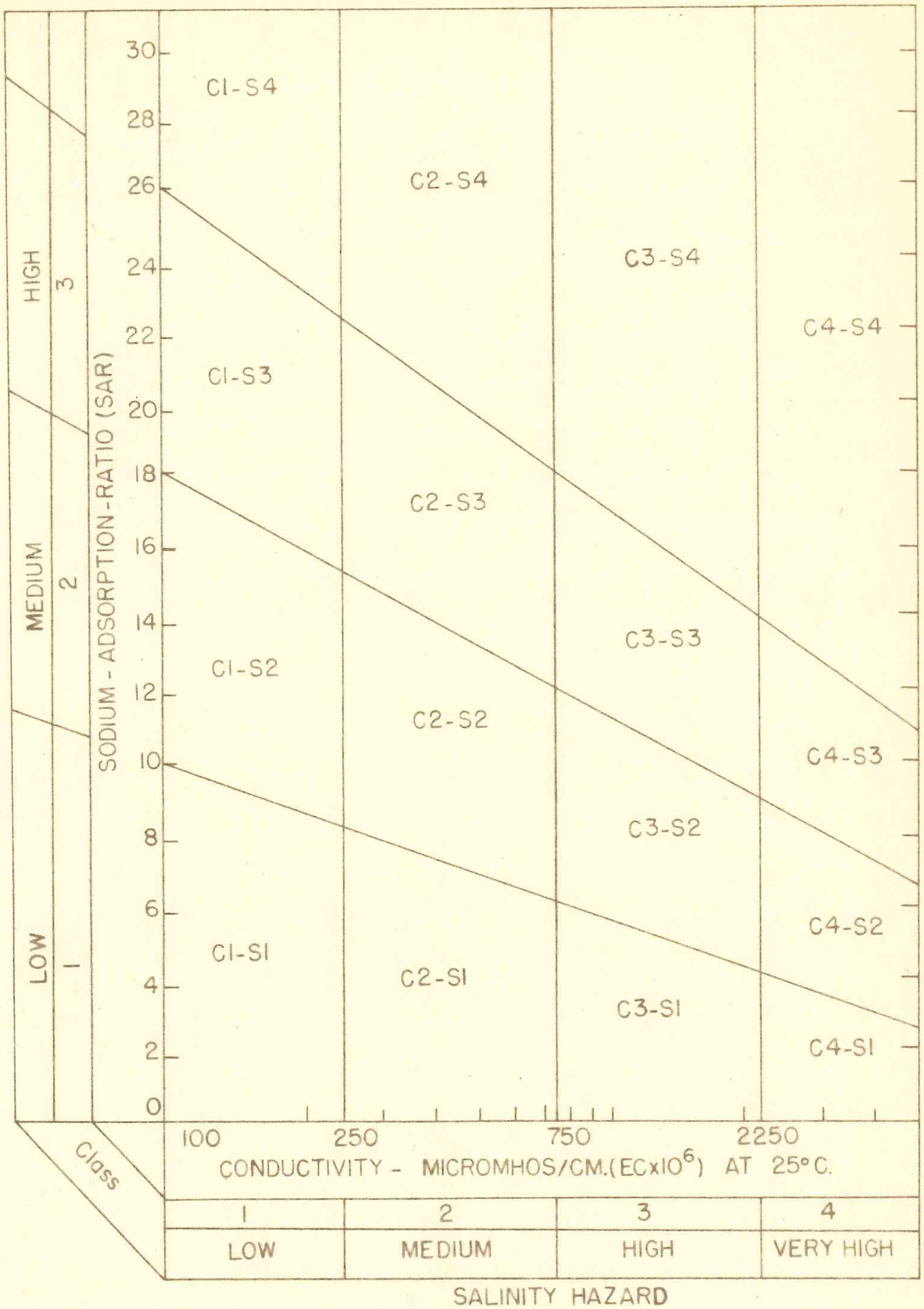
NOMOGRAM FOR ESTIMATING SODIUM ADSORPTION RATIO AND EXCHANGEABLE SODIUM PERCENTAGE*




* Source: "The Diagnosis and Improvement of Saline and Alkali Soils." U.S. Dept. Agr. Handbook (in process), 1953.

FIGURE I

DIAGRAM FOR USE IN INTERPRETING THE ANALYSIS OF IRRIGATION WATER*




* Source: "The Diagnosis and Improvement of Saline and Alkali Soils." U.S. Dept. Agr. Handbook (in process), 1953



FIGURE 2

trees and avacados may accumulate injurious concentrations of sodium.

S2 Medium-sodium water will present an appreciable sodium hazard in fine-textured soils having high cation-exchange-capacity, especially under low leaching conditions unless gypsum is present in the soil. This water may be used on coarse-textured or organic soils with good permeability.

S3 High-sodium water may produce harmful levels of exchangeable sodium in most soils and will require special soil management: good drainage, high leaching, and organic matter additions. Gypsiferous soils may not develop harmful levels of exchangeable sodium from such waters. Chemical amendments may be required for replacement of exchangeable sodium, except that amendments may not be feasible in the case of waters of very high salinity.

S4 Very High-sodium water is generally unsatisfactory for irrigation purposes, except at low and perhaps medium salinity where the solution of calcium from the soil or use of gypsum or other amendments may make the use of these waters feasible.

Boron is present in practically all waters. It is essential to plant growth, but is exceedingly toxic at concentrations only slightly above optimum. The permissible limits for boron vary largely with crop sensitivity and are summarized in the following table:

Table of boron content
permissible limits for irrigation water1/

| Classes of Water | | Boron, parts per million | | |
|---|---|---|---|---|
| Rating | Grade | Sensitive crops | Semitolerant crops | Tolerant crops |
| 1 | Excellent | 0.33 or less | 0.67 or less | 1.00 or less |
| 2 | Good | 0.33 to 0.67 | 0.67 to 1.33 | 1.00 to 2.00 |
| 3 | Permissible | 0.67 to 1.00 | 1.33 to 2.00 | 2.00 to 3.00 |
| 4 | Doubtful | 1.00 to 1.25 | 2.00 to 2.50 | 3.00 to 3.75 |
| 5 | Unsuitable | 1.25 or more | 2.50 or more | 3.75 or more |

1/ Wilcox, L. V., "The Quality of Water for Irrigation Use," U. S. Department of Agriculture, Technical Bulletin 962, 0. 40, 1948.

Crops have been grouped in accordance to their tolerance to boron as shown in Table 13. Most of the crops expected to be grown in the Vernal area fall within the Semitolerant group, so the ratings of this group have been applied to waters of Vernal Unit.

Table 13

Relative Tolerance of Crop Plants to Boron 1/

| Sensitive | Semitolerant | Tolerant |
|---|---|---|
| Lemon | Lima bean | Carrot |
| Grapefruit | Sweet potato | Lettuce |
| Avocado | Bell pepper | Cabbage |
| Orange | Tomato | Turnip |
| Thornless blackberry | Pumpkin | Onion |
| Apricot | Zinniz | Broadbean |
| Peach | Oat | Gladiolus |
| Cherry | Milo | Alfalfa |
| Persimmon | Corn | Garden beet |
| Kadota fig | Wheat | Mangel |
| Grape (Sultanina and Malaga) | Barley | Sugar beet |
| | Olive | Palm (Phoenix canariensis) |
| Apple | Ragged Robin rose | Date palm (P. dactylifera) |
| Pear | Field pea | Asparagus |
| Plum | Radish | Athel (Tamarix aphylla) |
| American elm | Sweet pea | |
| Navy bean | Pima cotton | |
| Jerusalem-artichoke | Acala cotton | |
| Persian (English) walnut | Potato | |
| Black walnut | Sunflower (native) | |
| Pecan | | |

1/ Eaton, F. M., "Boron in Soils and Irrigation Waters and its Effects on Plants, with Particular Reference to the San Joaquin Valley of California". U. S. Department of Agriculture, Technical Bulletin 448, p. 60, 1941.

## Sampling pattern

A network of water sampling stations was established in order to determine the quality of water at points on Ashley Creek and various canals and drains throughout Ashley Valley. Drawing No. 325-418-66 gives the location and number of each station.

## Analysis

Experience has shown that the water is of good quality when it enters Ashley Valley, but its quality decreases progressively as it flows through the valley and picks up return flows from irrigation. This is illustrated in Table 14.

Return flow to Ashley Creek is generally of poor quality and water entering Ashley Creek from both sides of the valley has a rather high salinity hazard. Table 15 summarizes the quality of water entering Ashley Creek from drains and seeps on each side of the stream.

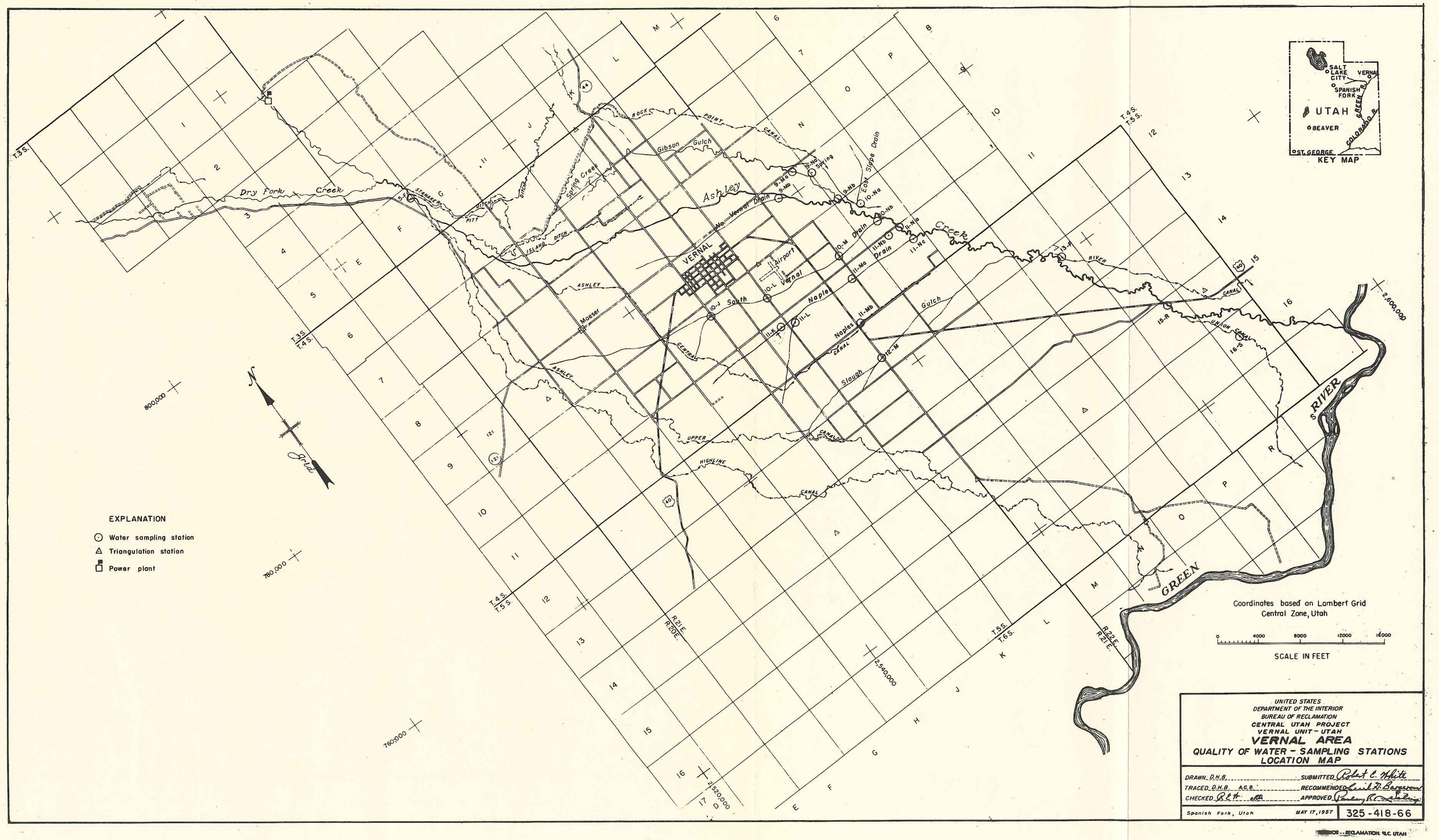
Two areas on the west side of Ashley Creek and one on the east side are producing water which is exceptionally high in salinity hazard. These are the South Fork of Naples Drain, a seep area near Ashley Creek upstream from Naples Drain, and a spring on the east side of Ashley Creek just south of the Diamond Mountain road. Water from the spring has reportedly caused sickness among cattle grazing in the area. Table 16 summarizes results of sampling of these stations. North Fork of Naples Drain is included in the table for comparison with the South Fork.

Laboratory analysis of all samples taken at each of the key sampling stations are given in Table 17.

From results of the sampling program it is evident that the total concentration of salts presents a much greater hazard than either the sodium or boron concentrations. It is also evident that the higher concentrations of salts occur during the latter part of the irrigation season when stream flows are lowest and when return flow constitutes the largest proportion of the stream flow of any time during the year.

The Union and River canals are located near the lower end of Ashley Valley. At the present time they are receiving a poor quality of water, especially during the late part of the irrigation season, as then supply consists almost entirely of return flow except for a short period during the high water season.

Construction of the Vernal Unit is not anticipated to cause any material change in the quality of return flow water, but due to the present poor quality, the sampling program will be continued in order that sufficient factual data will be available for evaluating the quality conditions with and without the Vernal Unit.



UTAH
SALT LAKE CITY
VERNAL
SPANISH FORK
BEAVER
ST. GEORGE
GREEN R.
COLORADO R.
KEY MAP
VERNAL
Ashley Creek
Dry Fork Creek
Gibson Gulch
Spring Creek
East Slope Drain
No. Vernal Drain
Airport
Vernal
South
Naples
Naples Drain
Slough
Gulch
Mosser
ROCK POINT CANAL
STEINAKER DITCH
ISLAND DITCH
ASHLEY
CENTRAL
ASHLEY
UPPER CANAL
HIGHLINE CANAL
UNION CANAL
RIVER
GREEN RIVER
T.3S.
T.4S.
T.5S.
T.6S.
R.21E.
R.20E.
R.22E.
800,000
780,000
760,000
2,600,000
2,540,000
2,520,000
N
Grid
EXPLANATION
Water sampling station
Triangulation station
Power plant
Coordinates based on Lambert Grid
Central Zone, Utah
0
4000
8000
12000
16000
SCALE IN FEET
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT
VERNAL UNIT – UTAH
VERNAL AREA
QUALITY OF WATER – SAMPLING STATIONS
LOCATION MAP
DRAWN D.H.B.
TRACED D.H.B. A.C.B.
CHECKED R.E.H.
SUBMITTED Robert C. White
RECOMMENDED Cecil D. Bargeron
APPROVED
Spanish Fork, Utah
MAY 17, 1957
325-418-66

Table 14

Quality of Water in Ashley Valley
Illustrating Decrease in Quality as Flow Proceeds Downstream

| | 5-F Ashley Creek at Sign of the Maine | | | | 11-Mb Ashley Central Canal at Naples | | | | 11-Na Ashley Creek above Naples Drain | | | | 13-P Ashley Creek at River Canal | | | | 15-R Ashley Creek near Jensen | | | | 16-S Union Canal at USBR Gage | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Class | | | | Class | | | | Class | | | | Class | | | | Class | | | | Class | | |
| Date | Flow | C | S | B | Flow | C | S | B | Flow | C | S | B | Flow | C | S | B | Flow | C | S | B | Flow | C | S | B |
| 7/21/55 | 103 | 1 | 1 | 1 | | | | | - | 3 | 1 | 1 | | | | | - | 4 | 2 | 3 | | | | |
| 9/26-27/55 | - | 1 | 1 | 1 | | | | | - | 3 | 1 | 1 | - | 4 | 2 | 1 | - | 4 | 2 | 1 | | | | |
| 3/13-14/56 | 27 | 2 | 1 | 1 | 5 | 3 | 1 | 1 | | | | | | | | | 29.3 | 3 | 1 | 1 | | | | |
| 5/24-25/56 | 797 | 1 | 1 | 1 | 10 | 2 | 1 | 1 | | | | | - | 2 | 1 | 1 | | | | | | | | |
| 7/9-10/56 | 125 | 1 | 1 | 1 | 9 | 3 | 1 | 1 | | | | | 4 | 4 | 1 | 1 | 8.47 | 4 | 1 | 2 | 4 | 4 | 1 | 2 |
| 8/ 7/56 | 59 | 1 | 1 | 1 | 7 | 2 | 1 | 1 | | | | | | | | | .98 | 4 | 2 | 2 | | | | |
| 9/17/56 | 28 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | |

C = Total concentration of salts.
S = Relative proportion of sodium to other cations.
B = Boron concentration.
Class 1 = Excellent to good, suitable for most plants under most conditions.
Class 2 = Good to injurious, probably harmful to more sensitive crops.
Class 3 = Injurious to unsatisfactory, probably harmful to most crops.
Class 4 = Unsuitable, probably harmful to all but the most tolerant crops.

Table 15

Quality of Water
Drains and Seeps Entering Ashley Creek
in Ashley Valley

| | West Side | | | | | | | | | | East Side | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 9-Mb North Vernal Drain at Mouth | | 10-Nb South Vernal Drain at Mouth | | 11-Nb Seep Area South-East of Vernal | | 11-Nc Naples Drain at Mouth | | 12-M Slaugh Gulch 3 mi above Mouth | | 9-Ma Gibson Gulch at Diamond Mtn. Road | | 9-Nb Gibson Gulch at Mouth | | 10-Na Gib. Gulch Ditch and East Slope Drain | |
| Date | Flow | Class C S B | Flow | Class C S B | Flow | Class C S B | Flow | Class C S B | Flow | Class C S B | Flow | Class C S B | Flow | Class C S B | Flow | Class C S B |
| 9/26-27/55 | - | 3 1 1 | - | 3 1 1 | - | | - | 4 1 2 | - | | | | | | | |
| 11/7-8/55 | | | | | - | 4 1 2 | | | | | - | 4 1 1 | - | 4 1 1 | - | 4 1 1 |
| 3/13/56 | 3 | 3 1 1 | | | | | | | 3 | 2 1 1 | | | | | | |
| 5/25/56 | | | | | | | | | 6 | 2 1 1 | | | | | | |
| 6/11/56 | 3 | 3 1 1 | | | - | 4 1 2 | | | - | | - | 3 1 1 | - | | 2 | 3 1 1 |
| 7/9-10/56 | 3 | 3 1 1 | 6 | 2 1 1 | | | 5 | 4 1 2 | 4 | 3 1 1 | | | 3 | 4 1 1 | 2 | 4 1 2 |
| 8/7/56 | 1.5 | 3 1 1 | .5 | 3 1 1 | | | 0.25 | 4 1 2 | 1.0 | 2 1 1 | | | 2 | 4 1 2 | 1 | 4 2 2 |
| 9/18/56 | .7 | 3 1 1 | | | | | 3 | 4 1 2 | 1.5 | 4 1 2 | 1 | 4 1 1 | | | .3 | |

C = Total concentration of salts.
S = Relative proportion of sodium to other cations.
B = Boron concentration.
Class 1 = Excellent to good, suitable for most plants under most conditions.
Class 2 = Good to injurious, probably harmful to more sensitive crops.
Class 3 = Injurious to unsatisfactory, probably harmful to most crops.
Class 4 = Unsuitable, probably harmful to all but the most tolerant crops.

Table 16

Quality of Water
Sampling Stations with Exceptionally
High Concentrations

| | 11-K North Fork Naples Drain | | | | 11-L South Fork Naples Drain | | | | 11-Nb Seep Area South-East of Vernal | | | | 9-Na Spring south of Diamond Mtn. Road | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Class | | | | Class | | | | Class | | | | Class | | |
| Date | Flow | C | S | B | Flow | C | S | B | Flow | C | S | B | Flow | C | S | B |
| 10/25/55 | | | | | | | | | | | | | - | 4 | 1 | 2 |
| 11/7-8/55 | 1 | 4 | 1 | 1 | 1 | 4 | 2 | 2 | - | 4 | 1 | 2 | - | 4 | 1 | 2 |
| 6/11/56 | 2.5 | 3 | 1 | 1 | 1 | 4 | 1 | 2 | - | 4 | 1 | 2 | | | | |
| 7/10/56 | 3 | 3 | 1 | 1 | 1 | 4 | 2 | 2 | | | | | | | | |
| 8/7/56 | 2 | 3 | 1 | 1 | - | 4 | 2 | 2 | | | | | | | | |
| 9/17/56 | 1 | | | | | | | | | | | | | | | |

C= Total concentration of salts.
S= Relative proportion of sodium to other cations.
B= Boron concentration.
Class 1 = Excellent to good, suitable for most plants under most conditions.
Class 2 = Good to injurious, probably harmful to more sensitive crops.
Class 3 = Injurious to unsatisfactory, probably harmful to most crops.
Class 4 = Unsuitable, probably harmful to all but the most tolerant crops.

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# WATER ANALYSIS

REGIONAL LABORATORY

Chemical analysis of water for irrigation

Table 17

Vernal Unit

Collected by ______ Date ______ Project ______

Submitted by ______ Date ______ Location ______

Analyzed by ______ Date ______

| Lab No. | Field No. | Sampling Date | EC x $10^6$ @ 25° C | pH | Total dissolved salts p.p.m. | Boron p.p.m. | % Sodium | Sodium Adsorption Ratio | Residual Carbonates | | Equivalents per million or milliequivalents per liter | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Cations | | | | Anions | | | |
| | | | | | | | | | | | Ca | Mg | Na | K | $CO_3$ | $HCO_3$ | Cl | $SO_4$ |
| Station 5-F - Ashley Creek at Sign of the Maine | | | | | | | | | | | | | | | | | | |
| CW33 | | 7/21/55 | 194 | 7.8 | 109 | .12 | 1.0 | .2 | | | 1.41 | .47 | .02 | .02 | None | 1.64 | .01 | .22 |
| CW47 | | 9/26/55 | 233 | 7.8 | 107 | .04 | 3.4 | .7 | | | 1.57 | .68 | .08 | .03 | .21 | 1.78 | .05 | .40 |
| CW73 | | 3/14/56 | 335 | 8.1 | 197 | .01 | 2.3 | .6 | | | 2.27 | 1.05 | .08 | .03 | .34 | 2.15 | .10 | .84 |
| CW84 | | 5/24/56 | 102 | 8.4 | 75 | None | 5.9 | .8 | | | .74 | .19 | .06 | .02 | None | .73 | .01 | .27 |
| CW116 | | 7/ 9/56 | 165 | 8.2 | 100 | .08 | 6.2 | .1 | | | 1.14 | .35 | .10 | .02 | None | 1.46 | .01 | .14 |
| CW120 | | 8/ 7/56 | 195 | 8.2 | 113 | .10 | 2.7 | .1 | | | 1.34 | .41 | .05 | .02 | None | 1.68 | None | .14 |
| CW155 | | 9/18/56 | 224 | 7.8 | 141 | .02 | 4.6 | .1 | | | 1.19 | .67 | .09 | .02 | None | 1.97 | None | None |
| | | | | | | | | | | | 200 | [illegible] | 230 | 391 | 300 | 610 | 355 | 480 |

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# WATER ANALYSIS
REGIONAL LABORATORY

Table 17 (Cont.)

Vernal Unit

Collected by ______ Date ______ Project ______

Submitted by ______ Date ______ Location ______

Analyzed by ______ Date ______

| Lab No | Field No. | Sampling Date | EC x $10^6$ @ 25° C | pH | Total dissolved salts ppm | Boron ppm | % Sodium | Sodium Adsorption Ratio | Residual Carbonates | | Ca | Mg | Na | K | $CO_3$ | $HCO_3$ | Cl | $SO_4$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Equivalents per million or milliequivalents per liter: Cations | | | | Anions | | | |
| Station 9-Ma - Gibson Gulch at Diamond Mountain Road | | | | | | | | | | | | | | | | | | |
| CW58 | | 11/8/55 | 2634 | 7.9 | 2380 | .37 | 19.6 | 1.9 | | | 16.28 | 10.87 | 6.66 | .24 | 1.57 | 5.52 | .80 | 26.16 |
| CW101 | | 6/11/56 | 1990 | 7.8 | 1718 | .32 | 16.9 | 1.3 | | | 11.87 | 8.52 | 4.20 | .22 | .00 | 6.27 | .46 | 18.07 |
| CW166 | | 9/18/56 | 3469 | 7.7 | 3540 | .55 | 18.7 | 2.3 | | | 21.79 | 16.68 | 8.85 | .11 | .92 | 5.77 | .80 | 39.94 |
| Station 9-Mb - North Vernal Drain at Mouth | | | | | | | | | | | | | | | | | | |
| CW52 | | 9/27/55 | 1167 | 8.1 | 826 | .10 | 11.2 | .6 | | | 6.72 | 5.70 | 1.58 | .13 | .81 | 6.56 | .54 | 6.22 |
| CW75 | | 3/13/56 | 934 | 7.7 | 664 | .08 | 11.1 | .6 | | | 5.08 | 3.99 | 1.15 | .11 | .40 | 5.00 | .49 | 4.44 |
| CW99 | | 6/11/56 | 847 | 7.5 | 593 | .30 | 9.5 | .4 | | | 4.71 | 4.08 | .93 | .08 | .00 | 5.42 | .22 | 4.16 |
| CW103 | | 7/10/56 | 987 | 8.0 | 707 | .18 | 10.4 | .5 | | | 5.52 | 4.80 | 1.21 | .10 | .00 | 6.66 | .38 | 4.59 |
| CW126 | | 8/7/56 | 1187 | 8.1 | 868 | .22 | 11.0 | .6 | | | 6.31 | 5.61 | 1.49 | .08 | .00 | 7.44 | .55 | 5.50 |
| Equivalent Weights | | | | | | | | | | | 200 | 122 | 230 | 391 | 300 | 610 | 355 | 480 |

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# WATER ANALYSIS
REGIONAL LABORATORY

Table 17 (cont.)

Vernal Unit

Collected by ______ Date ______ Project ______

Submitted by ______ Date ______ Location ______

Analyzed by ______ Date ______

| Lab No | Field No | Sampling Date | EC x 10^6 @ 25° C | pH | Total dissolved salts ppm | Boron ppm | % Sodium | Sodium Adsorption Ratio | Residual Carbonates | | Equivalents per million or milliequivalents per liter | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Cations | | | | Anions | | | |
| | | | | | | | | | | | Ca | Mg | Na | K | $CO_3$ | $HCO_3$ | Cl | $SO_4$ |
| Station 9-Na - Spring South of Diamond Mountain Road and East of Ashley Creek | | | | | | | | | | | | | | | | | | |
| CW56 | | 10/25/55 | 3512 | 8.0 | 3372 | .82 | 21.5 | 2.6 | | | 20.54 | 16.28 | 10.12 | .10 | 1.48 | 4.61 | .86 | 40.09 |
| CW57 | | 11/8/56 | 3555 | 7.6 | 3502 | .78 | 19.8 | 2.0, | | | 23.26 | 16.58 | 9.86 | .10 | 1.26 | 6.75 | .92 | 40.87 |
| Station 9-Nb - Gibson Gulch at Mouth | | | | | | | | | | | | | | | | | | |
| CW66 | | 11/8/55 | 3224 | 7.7 | 3102 | .50 | 22.8 | 2.0 | | | 18.39 | 15.51 | 10.08 | .15 | .85 | 6.96 | .98 | 35.34 |
| CW113 | | 7/9/56 | 3119 | 8.1 | 2986 | .53 | 20.7 | 2.1 | | | 18.56 | 14.34 | 8.64 | .24 | .00 | 6.48 | .82 | 34.48 |
| CW125 | | 8/7/56 | 3756 | 7.9 | 3792 | .70 | 20.6 | 2.4 | | | 23.20 | 18.27 | 10.83 | .19 | .06 | 7.23 | .98 | 44.22 |
| Station 10-J - South Vernal Drain 3½ Miles above Mouth | | | | | | | | | | | | | | | | | | |
| CW63 | | 11/7/55 | 1800 | 7.7 | 1599 | .25 | 3.5 | .2 | | | 14.44 | 8.16 | .82 | .04 | .57 | 4.61 | .23 | 18.05 |
| CW92 | | 6/11/56 | 808 | 7.7 | 619 | .09 | 4.2 | .2 | | | 5.92 | 3.32 | .41 | .03 | .08 | 2.87 | .03 | 6.70 |
| Station 10-L - South Vernal Drain 2½ Miles above Mouth | | | | | | | | | | | | | | | | | | |
| CW59 | | 11/7/55 | 1745 | 7.9 | 1550 | .26 | 3.6 | .2 | | | 13.61 | 8.06 | .82 | .06 | .87 | 3.57 | .28 | 17.83 |
| CW93 | | 6/11/56 | 935 | 7.7 | 727 | .09 | 4.9 | .2 | | | 6.44 | 4.29 | .55 | .05 | .13 | 3.47 | .06 | 7.67 |
| | | | | | | Equivalent weights | | | | | 200 | 122 | 230 | 391 | 300 | 610 | 355 | 480 |

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# WATER ANALYSIS
REGIONAL LABORATORY

Table 17 (cont.)
Vernal Unit

Collected by ______ Date ______ Project ______

Submitted by ______ Date ______ Location ______

Analyzed by ______ Date ______

| Lab No | Field No | Sampling Date | EC x $10^6$ @ 25°C | pH | Total dissolved salts p.p.m. | Boron ppm | % Sodium | Sodium Adsorption Ratio | Residual Carbonates | | Ca | Mg | Na | K | $CO_3$ | $HCO_3$ | Cl | $SO_4$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Equivalents per million or milliequivalents per liter | | | | | | | |
| | | | | | | | | | | | Cations | | | | Anions | | | |
| Station 10-M South Vernal Drain 1 Mile above Mouth | | | | | | | | | | | | | | | | | | |
| CW67 | | 11/7/55 | 1642 | 7.7 | 1436 | .29 | 5.6 | .4 | | | 10.82 | 9.11 | 1.19 | .06 | .92 | 4.53 | .33 | 15.40 |
| CW76 | | 3/13/56 | 1565 | 7.9 | 1350 | .22 | 4.5 | .2 | | | 10.96 | 8.27 | .90 | .04 | .63 | 4.24 | .35 | 14.95 |
| Station 10-Na Gibson Gulch Ditch and East Slope Drain below Junction | | | | | | | | | | | | | | | | | | |
| CW62 | | 11/8/55 | 3031 | 8.0 | 2914 | .56 | 24.6 | 2.6 | | | 14.77 | 15.61 | 9.96 | .15 | .60 | 3.17 | .88 | 35.84 |
| CW100 | | 6/11/56 | 1803 | 8.0 | 1522 | .55 | 28.2 | 2.2 | | | 8.03 | 7.81 | 6.28 | .14 | .00 | 5.00 | .40 | 16.86 |
| CW114 | | 7/9/56 | 3441 | 8.0 | 3388 | .70 | 22.1 | 2.5 | | | 20.07 | 16.68 | 10.48 | .18 | .40 | 5.78 | .78 | 40.45 |
| CW121 | | 8/7/56 | 3963 | 8.0 | 3968 | .76 | 24.0 | 2.9 | | | 21.82 | 19.59 | 13.12 | .16 | .49 | 5.71 | 1.04 | 47.45 |
| CW167 | | 9/18/56 | 4056 | 7.8 | 4240 | .75 | 25.8 | 3.2 | | | 21.09 | 19.80 | 14.25 | .12 | 1.00 | 5.46 | .94 | 47.86 |
| Station 10-Nb South Vernal Drain at Mouth | | | | | | | | | | | | | | | | | | |
| CW49 | | 9/26/55 | 1846 | 8.0 | 1578 | .14 | 8.2 | .1 | | | 11.18 | 6.35 | 1.37 | .08 | 1.07 | 4.20 | .36 | 13.55 |
| CW109 | | 7/10/56 | 1668 | 7.9 | 1464 | .30 | 6.4 | .4 | | | 10.53 | 9.57 | 1.37 | .05 | .00 | 5.12 | .28 | 16.12 |
| CW119 | | 8/7/56 | 1815 | 8.2 | 1644 | .40 | 6.9 | .5 | | | 10.41 | 11.10 | 1.59 | .05 | .16 | 4.03 | .22 | 18.74 |
| Equivalent Weights | | | | | | | | | | | 20.0 | 12.2 | 23.0 | 39.1 | 30.0 | 61.0 | 35.5 | 48.0 |

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# WATER ANALYSIS
REGIONAL LABORATORY

**Table 17 (cont.)**

**Vernal Unit**

Collected by ______ Date ______ Project ______

Submitted by ______ Date ______ Location ______

Analyzed by ______ Date ______

| Lab No | Field No | Sampling Date | EC x $10^6$ @ 25°C | pH | Total dissolved salts ppm | Boron ppm | % Sodium | Sodium Adsorption Ratio | Residual Carbonates | | Ca | Mg | Na | K | $CO_3$ | $HCO_3$ | Cl | $SO_4$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Equivalents per million or milliequivalents per liter | | | | | | | |
| | | | | | | | | | | | Cations | | | | Anions | | | |
| **Station 11-K North Fork of Naples Drain above Confluence with South Fork** | | | | | | | | | | | | | | | | | | |
| CW60 | | 11/7/55 | 2217 | 7.9 | 1864 | .33 | 13.2 | 1.1 | | | 14.20 | 10.08 | 3.70 | .08 | 1.10 | 4.26 | 1.02 | 21.68 |
| CW94 | | 6/11/55 | 2154 | 7.7 | 931 | .32 | 19.6 | 1.7 | | | 12.08 | 10.64 | 5.57 | .09 | .77 | 3.76 | 1.08 | 22.77 |
| CW102 | | 7/10/56 | 1990 | 7.9 | 1730 | .30 | 13.3 | 1.0 | | | 12.67 | 8.90 | 3.33 | .06 | .00 | 4.95 | .72 | 19.29 |
| CW132 | | 8/7/56 | 1842 | 8.1 | 1592 | .30 | 11.2 | .8 | | | 12.25 | 7.88 | 2.55 | .05 | .23 | 4.60 | .58 | 17.32 |
| CW161 | | 9/17/56 | 1991 | 7.9 | 1796 | .24 | 10.7 | .8 | | | 13.08 | 9.36 | 2.70 | .06 | .26 | 4.71 | .57 | 19.66 |
| **Station 11-L South Fork of Naples Drain above Confluence with North Fork** | | | | | | | | | | | | | | | | | | |
| CW68 | | 11/7/55 | 5538 | 7.7 | 6300 | 1.08 | 27.3 | - | | | 23.04 | 38.27 | 23.10 | .18 | .69 | 5.76 | 3.56 | 74.58 |
| CW95 | | 6/11/56 | 3442 | 7.9 | 3388 | .81 | 24.6 | 2.8 | | | 14.68 | 20.97 | 11.67 | .20 | .67 | 4.28 | 1.55 | 41.02 |
| CW104 | | 7/10/56 | 5917 | 8.0 | 6468 | 1.26 | 27.6 | 4.3 | | | 24.58 | 40.10 | 24.75 | .20 | .33 | 7.04 | 3.31 | 78.95 |
| CW131 | | 8/7/56 | 6595 | 8.0 | 7508 | 1.7 | 29.1 | 5.0 | | | 26.67 | 45.00 | 29.47 | .23 | .45 | 6.90 | 4.24 | 89.78 |
| CW162 | | 9/17/56 | 5877 | 7.9 | 6510 | 1.20 | 22.8 | 3.6 | | | 34.92 | 40.10 | 22.20 | .17 | 1.37 | 5.49 | 2.65 | 87.88 |
| Equivalent Weights | | | | | | | | | | | 200 | 122 | 230 | 391 | 300 | 610 | 355 | 480 |

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# WATER ANALYSIS
REGIONAL LABORATORY

Table 17 (cont.)

Vernal Unit

Collected by ______ Date ______ Project ______

Submitted by ______ Date ______ Location ______

Analyzed by ______ Date ______

| Lab. No | Field No | Sampling Date | EC x 10^6 @ 25° C | pH | Total dissolved salts ppm | Boron ppm | % Sodium | Sodium Adsorption Ratio | Residual Carbonates | | Equivalents per million or milliequivalents per liter: Cations | | | | Anions | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Ca | Mg | Na | K | $CO_3$ | $HCO_3$ | Cl | $SO_4$ |
| **Station 11-Ma Naples Drain ½ mile east of U.S. Highway 40** | | | | | | | | | | | | | | | | | | |
| CW64 | | 11/7/55 | 3053 | 7.6 | 3064 | .60 | 12.3 | 1.2 | | | 21.83 | 16.17 | 5.34 | .08 | .51 | 4.74 | .99 | 37.18 |
| CW77 | | 3/13/56 | 1977 | 8.3 | 1736 | .24 | 14.4 | 1.1 | | | 12.36 | 9.19 | 3.64 | .07 | .88 | 3.69 | .84 | 19.85 |
| **Station 11-Mb Ashley Central Canal at Naples** | | | | | | | | | | | | | | | | | | |
| CW65 | | 11/8/55 | 1380 | 7.7 | 1144 | .14 | 6.7 | .4 | | | 9.94 | 5.61 | 1.13 | .08 | .40 | 3.82 | .21 | 12.33 |
| CW78 | | 3/13/56 | 771 | 8.1 | 567 | .01 | 5.2 | .2 | | | 5.02 | 3.21 | .45 | .04 | .45 | 3.24 | .17 | 4.86 |
| CW90 | | 5/25/56 | 500 | 8.4 | 353 | .06 | 11.7 | .3 | | | 2.92 | 1.64 | .61 | .05 | .06 | 1.40 | .09 | 3.67 |
| CW108 | | 7/10/56 | 421 | 7.9 | 293 | .04 | 6.6 | .2 | | | 2.71 | 1.38 | .29 | .02 | .00 | 2.18 | .01 | 2.21 |
| CW127 | | 8/7/56 | 467 | 8.4 | 313 | .03 | 5.7 | .2 | | | 2.74 | 1.65 | .27 | .04 | .17 | 2.29 | .04 | 2.20 |
| CW160 | | 9/18/56 | 795 | 7.7 | 602 | .14 | 6.0 | .3 | | | 4.78 | 3.33 | .52 | .05 | None | .66 | .09 | 7.93 |
| Equivalent Weights | | | | | | | | | | | | | | | | | | |

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# WATER ANALYSIS
REGIONAL LABORATORY

Table 17 (cont.)

**Vernal Unit**

Collected by ______ Date ______ Project ______

Submitted by ______ Date ______ Location ______

Analyzed by ______ Date ______

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| Lab No | Field No | Sampling Date | EC x $10^6$ @ 25°C | pH | Total dissolved salts p.p.m. | Boron p.p.m. | % Sodium | Sodium Adsorption Ratio | Residual Carbonates | | Equivalents per million or milliequivalents per liter: Cations: Ca | Mg | Na | K | Anions: $CO_3$ | $HCO_3$ | Cl | $SO_4$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Station 11-Na Ashley Creek above Naples Drain** | | | | | | | | | | | | | | | | | | |
| CW32 | | 7/21/55 | 2082 | 8.0 | 1812 | .60 | 14.9 | 1.2 | | | 10.65 | 11.89 | 3.98 | .08 | .48 | 4.51 | .52 | 20.96 |
| CW48 | | 9/26/55 | 2123 | 8.0 | 1848 | .52 | 14.3 | 1.1 | | | 11.34 | 11.79 | 3.88 | .10 | .67 | 5.02 | .65 | 21.45 |
| CW97 | | 6/11/56 | 1510 | 7.7 | 1242 | .45 | 16.1 | 1.1 | | | 8.07 | 7.35 | 2.97 | .10 | .00 | 5.51 | .37 | 12.61 |
| **Station 11-Nb Seep Area ¼ mile North of Naples Drain and ¼ mile West of Ashley Creek** | | | | | | | | | | | | | | | | | | |
| CW61 | | 11/8/55 | 7384 | 7.5 | 5236 | 1.11 | 22.4 | - | | | 25.19 | 31.02 | 16.35 | .33 | 1.24 | 6.91 | 1.14 | 63.60 |
| CW96 | | 6/11/56 | 4547 | 7.5 | 4876 | .90 | 18.4 | 2.4 | | | 26.29 | 30.00 | 12.84 | .53 | .76 | 6.71 | 1.14 | 61.05 |
| **Station 11-Nc Naples Drain at Mouth** | | | | | | | | | | | | | | | | | | |
| CW51 | | 9/26/55 | 3428 | 8.1 | 3398 | .34 | 14.9 | 1.5 | | | 21.12 | 20.41 | 7.29 | .13 | .96 | 4.38 | 1.29 | 42.32 |
| CW110 | | 7/10/56 | 3415 | 7.9 | 3438 | .80 | 14.7 | 1.6 | | | 22.07 | 18.37 | 6.96 | .08 | .00 | 4.99 | 1.16 | 41.33 |
| CW133 | | 8/7/56 | 3740 | 8.1 | 3794 | .79 | 17.4 | 2.0 | | | 21.65 | 21.07 | 9.02 | .14 | .00 | 3.52 | 1.31 | 47.05 |
| CW156 | | 9/18/56 | 3692 | 7.7 | 2826 | .76 | 15.8 | 1.7 | | | 23.38 | 19.39 | 8.02 | .11 | .90 | 4.48 | 1.29 | 44.23 |

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# WATER ANALYSIS
REGIONAL LABORATORY

**Table 17 (cont.)**
**Vernal Unit**

Collected by ______ Date ______ Project ______

Submitted by ______ Date ______ Location ______

Analyzed by ______ Date ______

| Lab No | Field No | Sampling Date | EC x 10^6 @ 25° C | pH | Total dis-solved salts p.p.m. | Boron p.p.m. | % Sodium | Sodium Adsorption Ratio | Residual Carbonates | | Equivalents per million or milliequivalents per liter: Cations: Ca | Mg | Na | K | Anions: $CO_3$ | $HCO_3$ | Cl | $SO_4$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Station 3 Miles** | **12-M above** | **Slaugh Gulch Mouth** | | | | | | | | | | | | | | | | |
| CW80 | | 3/13/56 | 597 | 8.2 | 413 | .01 | 7.4 | .3 | | | 3.60 | 2.26 | .47 | .04 | .50 | 2.19 | .14 | 3.54 |
| CW91 | | 5/25/56 | 715 | 8.2 | 537 | .12 | 11.1 | .3 | | | 4.29 | 2.66 | .87 | .05 | .07 | 1.76 | .13 | 5.91 |
| CW107 | | 7/10/56 | 1171 | 7.8 | 940 | .21 | 11.5 | .6 | | | 7.66 | 4.29 | 1.56 | .05 | .00 | 2.92 | .28 | 10.36 |
| CW123 | | 8/7/56 | 630 | 8.1 | 443 | .05 | 8.5 | .3 | | | 4.01 | 1.90 | .55 | .03 | .00 | 2.47 | .11 | 3.91 |
| CW154 | | 9/17/56 | 2675 | 7.7 | 2608 | .78 | 15.5 | 1.4 | | | 18.11 | 10.87 | 5.34 | .07 | .87 | 3.85 | .82 | 29.65 |
| **Station at River** | **13-P Canal** | **Ashley Creek Diversion** | | | | | | | | | | | | | | | | |
| CW53 | | 9/27/55 | 2969 | 8.0 | 2788 | .27 | 20.3 | 2.3 | | | 15.12 | 16.73 | 8.16 | .15 | .99 | 3.92 | 1.08 | 34.17 |
| CW98 | | 6/11/56 | 2033 | 7.8 | 1776 | .44 | 18.1 | 1.4 | | | 10.83 | 10.20 | 4.68 | .13 | .00 | 5.17 | .63 | 20.04 |
| CW106 | | 7/10/56 | 2526 | 8.2 | 2348 | .54 | 21.1 | 1.9 | | | 11.62 | 13.57 | 6.76 | .13 | .23 | 2.28 | .88 | 28.69 |
| Equivalent Weights | | | | | | | | | | | 20.0 | 12.2 | 23.0 | 39.1 | 30.0 | 61.0 | 35.5 | 48.0 |

R4-403
Rev 6/56

# WATER ANALYSIS
REGIONAL LABORATORY

Table 17 (cont.)
Vernal Unit

Collected by ______ Date ______ Project ______

Submitted by ______ Date ______ Location ______

Analyzed by ______ Date ______

| Lab No | Field No | Sampling Date | $EC \times 10^6$ @ 25°C | pH | Total dis-solved salts ppm | Boron ppm | % Sodium | Sodium Adsorption Ratio | Residual Carbonates | | Ca | Mg | Na | K | $CO_3$ | $HCO_3$ | Cl | $SO_4$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Equivalents per million or milliequivalents per liter | | | | | | | |
| | | | | | | | | | | | Cations | | | | Anions | | | |
| **Station 15-R Ashley Creek near Jensen (at Gaging Station)** | | | | | | | | | | | | | | | | | | |
| CW31 | | 7/21/55 | 5366 | 8.0 | 5504 | 1.5 | 37.2 | - | | | 17.17 | 29.69 | 27.86 | .27 | 1.09 | 3.70 | 3.34 | 65.98 |
| CW54 | | 9/27/55 | 4235 | 8.1 | 4256 | .66 | 32.7 | 4.5 | | | 14.73 | 23.83 | 18.81 | .22 | .61 | 2.97 | 2.21 | 51.80 |
| CW74 | | 3/14/56 | 2000 | 8.1 | 1668 | .32 | 17.8 | 1.4 | | | 11.33 | 9.57 | 4.54 | .09 | .74 | 4.42 | .78 | 19.59 |
| CW88 | | 5/25/56 | 581 | 8.1 | 413 | .09 | 15.4 | .5 | | | 3.05 | 2.15 | .96 | .06 | .06 | 2.22 | .14 | 3.80 |
| CW111 | | 7/10/56 | 3555 | 8.1 | 3438 | .77 | 27.2 | 3.1 | | | 15.05 | 19.49 | 12.99 | .21 | .16 | 5.13 | 1.63 | 40.82 |
| CW128 | | 8/7/56 | 5300 | 8.1 | 5500 | 1.0 | 33.4 | 5.0 | | | 18.06 | 30.82 | 24.66 | .25 | .11 | 5.14 | 3.25 | 65.29 |
| CW157 | | 9/18/56 | 4385 | 7.9 | 4584 | 1.11 | 30.6 | 7.9 | | | 16.32 | 25.51 | 18.55 | .21 | .87 | 4.16 | 2.27 | 53.29 |
| **Station 16-S Union Canal at USBR Gage** | | | | | | | | | | | | | | | | | | |
| CW105 | | 7/10/56 | 3772 | 7.7 | 3672 | .96 | 29.6 | 3.6 | | | 15.55 | 20.05 | 15.08 | .22 | .00 | 5.43 | 1.87 | 43.60 |
| Equivalent Weights | | | | | | | | | | | 20.0 | 12.2 | 23.0 | 39.1 | 30.0 | 61.0 | 35.5 | 48.0 |

## Water Rights

Water for the Vernal Unit, along with other increased uses of water of the Colorado River Basin, is subject to limitations imposed by the Colorado River Compact and the Upper Colorado River Basin Compact. It is further subject to the Utah State water law, which is the law of appropriation.

### Colorado River Compact

The Green River, a tributary of the Colorado River, is subject to the terms of the Colorado River Compact. This compact provides principally for an apportionment from the Colorado River System in perpetuity to the upper basin and to the lower basin, respectively, the exclusive beneficial consumptive use of 7,500,000 acre-feet of water per annum. Articles II and III of the compact are quoted below for information.

ARTICLE II

"As used in this compact:

"(a) The term 'Colorado River System' means that portion of the Colorado River and its tributaries within the United States of America.

"(b) The term 'Colorado River Basin' means all of the drainage area of the Colorado River system and all other territory within the United States of America to which the waters of the Colorado River system shall be beneficially applied.

"(c) The term 'States of the upper division' means the States of Colorado, New Mexico, Utah, and Wyoming.

"(d) The term 'States of the lower division' means the States of Arizona, California, and Nevada.

"(e) The term 'Lee Ferry' means a point in the main stream of the Colorado River 1 mile below the mouth of the Paria River.

"(f) The term 'Upper Basin' means those parts of the States of Arizona, Colorado, New Mexico, Utah, and Wyoming within and from which waters naturally drain into the Colorado River system above Lee Ferry, and also all parts of said States located without the drainage area of the Colorado River system which are now or shall hereafter be beneficially served by waters diverted from the system above Lee Ferry.

"(g) The term 'Lower Basin' means those parts of the States of Arizona, California, Nevada, New Mexico, and Utah within and from which waters naturally drain into the Colorado River system below Lee Ferry, and also all parts of said States located without the drainage area of the Colorado River system which are now or shall hereafter be beneficially served by the waters diverted from the system below Lee Ferry.

"(h) The term 'domestic use' shall include the use of water for household, stock, municipal, mining, milling, industrial, and other like purposes, but shall exclude the generation of electrical power."

ARTICLE III

"(a) There is hereby apportioned from the Colorado River system in perpetuity to the upper basin and to the lower basin, respectively, the exclusive beneficial consumptive use of 7,500,000 acre-feet of water per annum, which shall include all water necessary for the supply of any rights which may now exist.

"(b) In addition to the apportionment in paragraph (a), the lower basin is hereby given the right to increase its beneficial consumptive use of such waters by 1,000,000 acre-feet per annum.

"(c) If, as a matter of international comity, the United States of America shall hereafter recognize in the United States of Mexico any right to the use of any waters of the Colorado River system, such waters shall be supplied first from the waters which are surplus over and above the aggregate of the quantities specified in paragraphs (a) and (b); and if such surplus shall prove insufficient for this purpose, then the burden of such deficiency shall be equally borne by the upper basin and the lower basin, and whenever necessary the States of the upper division shall deliver at Lee Ferry water to supply one-half of the deficiency so recognized in addition to that provided in paragraph (d).

"(d) The States of the upper division will not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75,000,000 acre-feet for any period of 10-consecutive years reckoned in continuing progressive series beginning with the first day of October next succeeding the ratification of this compact.

"(e) The States of the upper division shall not withhold water, and the States of the lower division shall not require the delivery of water, which cannot reasonably be applied to domestic and agricultural uses.

"(f) Further equitable apportionment of the beneficial uses of the waters of the Colorado River system unapportioned by paragraphs (a), (b), and (c) may be made in the manner provided in paragraph (g) at any time after October 1, 1963, if and when either basin shall have reached its total beneficial consumptive use as set out in paragraphs (a) and (b).

"(g) In the event of a desire for further apportionment as provided in paragraph (f) any two signatory States, acting through their governors, may give joint notice of such desire to the governors of the other signatory States, and to the President of the United States of America, and it shall be the duty of the governors of the signatory States and of the President of the United States of America forthwith to appoint representatives, whose duty it shall be to divide and apportion equitably between the upper basin and lower basin the beneficial use of the unapportioned water of the Colorado River system as mentioned in paragraph (f), subject to the legislative ratification of the signatory States and the Congress of the United States of America."

Upper Colorado River Basin Compact

Use of apportioned water in the upper basin is subject to certain restrictions, not definable at this time, to assure required deliveries to the lower basin and Mexico. Were it not for these restrictions, Utah's apportioned use would amount to 1,713,500 acre-feet annually or 23.0 percent of 7,450,000 acre-feet (the 7,500,000 acre-feet annually apportioned the upper basin less 50,000 acre-feet apportioned to Arizona). Utah's present uses measured in terms of long-time average depletions at Lee Ferry have been estimated by the Engineering Advisory Committee to the Upper Colorado River Basin Compact Commission to total 544,300 acre-feet annually for the period 1914-1945. Studies indicate anticipated depletions of about 83,700 acre-feet annually, which includes increases in depletions occurring since 1945 and anticipated use of water by authorized projects not yet constructed. Utah's total present and authorized uses, therefore, amount to 628,000 acre-feet annually. Utah's uses can thus be increased approximately 1,085,500 acre-feet annually in the future. The average needs of the Central Utah project have been estimated at 746,300 acre-feet annually at the sites of use, and there would remain for other uses about 339,200 acre-feet.

The water supply for the Vernal Unit is only a very small part of Utah's use apportioned under this compact.

### Utah State water law

Since 1903 when the Utah water law was enacted, water has been considered the property of the public, and rights to its use can be acquired only by actual diversion and application to beneficial use. Priority of a right is determined by the date of its initiation and "first in time is first in right."

Water rights may be initiated only by filing appropriate applications with the State Engineer and proceeding in accordance with specific statutory provisions. If there is unappropriated water in the source of supply described in an application to appropriate water, and if the use of water can be made under a feasible plan which will not prove detrimental to the public welfare and will not impair existing rights or interfere with a more beneficial use of water, it is the duty of the State Engineer to approve application. The approval of an application gives the applicant the right to proceed with the construction of the necessary works and to use the water in order of priority. When the necessary works are constructed and water is applied to beneficial use as contemplated by the application, written proof thereof must be filed with the State Engineer. Upon approval of the proof of beneficial use of water, the State Engineer issues a certificate of appropriation which is prima facie evidence of the water right therein described.

## Existing Rights

In November 1897, the waters of Ashley Creek were adjudicated in the Fourth Judicial District of the State of Utah as a result of a lawsuit involving the Ashley Central Irrigation Company, the Rock Point Irrigation Company, the Ashley Upper Irrigation Company, the White Wash and Spring Creek Irrigation and Canal Company, and numerous individuals. This decree allotted to each canal company and each individual the right to the use of a certain portion of all the waters of Ashley Creek. Individuals were given the right to have their water delivered through the canals of the irrigation companies, if they so desired, by paying their proportionate share of operation and maintenance costs. The following tabulation gives a summary of the percent of Ashley Creek flow decreed to water users served by each canal system. These rights have been more or less voluntarily restricted by the water users to apply only to the first 500 second-feet in Ashley Creek. Water in the stream in excess of the 500 second-feet has thus been made available to appropriation.

| Owner | Percent of flow |
|---|---|
| Ashley Upper Canal | 36.3 |
| Ashley Central Canal | 33.5 |
| Rock Point Canal | 19.8 |
| Island Ditch | 7.4 |
| Stanaker Ditch | 2.0 |
| Dodds Ditch | 1.0 |
| Total | 100.0 |

Other court decrees have been made on Ashley Creek at various times since 1897, most of them for seepage water which would not be affected by the project. Several of the decrees concern parties who would be participants in the Vernal unit, and their rights would be modified by contracts as explained under the section "Vernal Unit Rights." Table 18 summarizes court decrees for water in Ashley Valley with a short explanation of each.

Appropriations of Ashley Creek waters since 1903 are primarily for storage, and for use of seepage and flood flows. Table 19 lists applications by the Mosby Irrigation Company for a proposed diversion from the headwaters of Dry Fork Creek to Mosby Creek, which is tributary to Deep Creek and Uinta River. If these diversions are made, they will reduce the water available to the Vernal unit by a small amount. The diversions would not appreciably affect the Vernal unit due to the small amount of water that Dry Fork contributes to the streamflow.

Applications having their point of use upstream from Vernal unit area are listed in Table 20. Consumptive use resulting from these rights has already been reflected in the streamflow records of Ashley Creek at "Sign of the Maine" gage, and these rights will not affect the project.

Table 21 lists the applications which would be incorporated into the Vernal unit along with the users under the court decree of 1897. Whether the water rights are based on court decrees or on applications, these claimants to flows of Ashley Creek would benefit from construction of the Vernal unit. Application No. 4796 was made by the Highline Canal Company, which operates one of the six large canals serving the Vernal unit area. Application numbers 10,053 and 11,708 are for storage of Brush Creek water in Oaks Park Reservoir with later diversion to Ashley Creek. These rights are subsequent to natural flow rights of earlier priority on Brush Creek.

Table 18

Water Decrees on Ashley Creek

| Civil Case No. | Case | Date of Decree | Present Owners | Amount | Remarks |
|---|---|---|---|---|---|
| 18 | E. G. DeFriez et al vs Sterling D. Colton et al | Nov. 17, 1897 | Ashley Upper, Ashley Central & Rock Point Canal; Island Ditch, Stanaker Ditch, Dodds Ditch, Colton Ditch, Hardy Ditch | All the water of Ashley Creek at mouth and in South Fork | This suit was insituted by the plaintiffs to restrain the elected officers of Uintah County from administering the waters of Ashley Creek. Also they wished the court to quiet title to the waters of said stream and write a decree setting forth the rights to the use of water in Ashley Creek. This decree distributed to canals and individual owners all the waters of Ashley Creek at its mouth and that which seeps into or rises in the South Fork. |
| 67 | Richard James et al vs William Gibson et al | Nov. 11, 1897 | Private owners in the Spring Creek and Gibson Slough | All the waters of Spring Creek and Gibson Slough | This suit was brought into court for the express purpose of quieting title to the use of waters of Spring Creek, a tributary of Ashley Creek. This was considered a friendly suit and as a result of the filing of the complaint and answer to the same decree was written adjudicating the waters of Spring Creek. |
| 127-483 | Ashley Central Irrigation Co. et al vs Moroni Pitt et al | 1912-1915 | Stanley Jones Loren Pitt, Moroni Pitt, William Warby, Lulu N. Pitt, Reva McKee and Rex and Everett Pitt | 2 Second-feet | The plaintiff attempted to prohibit the defendant from diverting excessive quantities of water from Ashley Creek. The defendants claiming a right dating to 1900 were granted a flow of 2 second-feet after prior use requirements were satisfied. |

Table 18 (Cont.)

| Civil Case No. | Case | Date of Decree | Present Owners | Amount | Remarks |
|---|---|---|---|---|---|
| 637 | J. T. Rasmussen, Union Canal Co. et al vs Joseph Paulson | Dec. 1913 | Union Canal Co. | Sufficient water to irrigate 800 acres | This case was a friendly suit brought into court to quiet title to the water rights of the Union Canal Co. This decree and application No. 2428 to appropriate water cover the same rights. |
| 761 | River Irrigation Co. vs Union Canal Co. et al | Dec. 1915 | River Irrigation Company and Union Canal Co. | River Irrigation Co. 5 5/7 S.F. Union Canal Co. 10 6/7 S.F. Jensen Irrig. Co. 15 S.F. (Secondary high water right) | This suit was brought into court to quiet title to the waters of lower Ashley Creek. The decree differed from others because it specified definite quantities of water. Applications 2428 and 4041 to appropriate water and decree written in the case of J. T. Rasmussen et al vs. Joseph Paulson are covered by this decree. |
| 795 | O. D. Allen et al vs Ashley Central Irrigation Co. | June 1916 | J. M. Allen S. G. Oaks et al | 1 second-foot per 70 acres or 44/79 of a second-foot | This suit was instituted by the plaintiffs in order to establish their rights as against those of the Ashley Central Irrigation Co. The defendants and plaintiffs comingled their water as a result of a change in the point of diversion by the canal company. Later differences arose as to the amount the plaintiffs were entitled to divert from the joint canal. The canal company defaulted and the Court granted the plaintiffs a definite quantity of water for each acre of land. |

Table 18 (Cont.)

| Civil Case No. | Case | Date of Decree | Present Owners | Amount | Remarks |
|---|---|---|---|---|---|
| 806 | Nillie Fagan vs Micheal O. Nash et al | October 1916 | Jose H. Karren et al | Variable | This suit was instituted by the heirs of Charles E. Fagan for the express purpose of quieting title to the seepage water arising in Lybbert Gulch, located in the southern part of Ashley Valley. |
| 839 | George M. Hathaway vs Willard Williams et al | March 1919 | | Variable | Court action was taken by the plaintiff for the purpose of quieting title to seepage water flowing in Slaugh Gulch in southern Ashley Valley. Seepage water was prorated on the basis of stock owned in the Ashley Upper Canal Company, because the Gulch was also used as a lateral by the stock holders. |
| 848 | E. J. Young et al vs Geo. H. Southam | Dec. 1917 | | Variable | This action was brought into Court to quiet title to seepage water rising in an unnamed draw in the southern part of Ashley Valley first south of Slaugh Gulch. Water prorated to the various claimants on the basis of their holdings. |
| | Vernal City, a municipal corp. vs Ashley Upper Irrigation Co. | June 1920 | Vernal City | 15-99/320 shares in Ashley Central Canal Co. | Court action was taken by Vernal City for the purpose of changing the point of diversion of their domestic water supply. The supply was taken directly from the canal and was being contaminated by return flow from irrigated lands above the canal. A decree was written granting the city the right to change their diversion to a point on Ashley Creek above all irrigation diversions. |

Table 18 (Cont.)

| Civil Case No. | Case | Date of Decree | Present Owners | Amount | Remarks |
|---|---|---|---|---|---|
| 960 | Thomas Mantle et al vs John B. Eaton et al | June 1920 | | Variable | This suit was instituted by the plaintiffs for the purpose of quieting title to the seepage water rising along the McNaughton Gulch in the western part of Ashley Valley. A decree was written granting a percentage of the water to each of the plaintiffs and defendants. |

Table 19
ABSTRACT OF WATER RIGHT APPLICATIONS
ON DRY FORK FOR TRANSBASIN DIVERSION TO MOSBY CREEK

| File No. | Applicant | Use | Sec. Ft. | Acre Feet | Point of Diversion | Period of Use | Area to be Irrig. or Horse-power | Priority | Source | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 11795 | Mosby Irr. Co. | Irr | 100 | | 8250 ft. N. & 1133 ft. E. of the W ¼ Cor. Sec. 5, T.3 N. R. 1 E., USB&M | 4/1-11/1 | 8,527.45 | 11/18/38 | Dry Fork Creek | Proof due 9/20/56 1/ |
| 11796 | Mosby Irr. Co. | Irr | | 500 | 8325 ft. N. & 1285 ft. E. of the W ¼ Cor. Sec. 5, T. 3 N., R. 1 E. USB&M | 7/1-12/1 Store 11/1-7/1 | 4,880 | 1/6/36 | Dry Fork Creek | Proof due 9/20/56 1/ |
| 11797 | Mosby Irr. Co. | Irr | 50 | | 7850 ft. N. & 6357 ft. E. of W ¼ Cor. Sec. 5, T. 3 N. R. 1 E., USB&M | 4-1-11/1 | 4,880 | 11/18/38 | North Fork of Dry Fork | Proof due 9/20/56 1/ |
| 11798 | Mosby Irr. Co. | Irr | | 1,000 | 9670 ft. N. & 7012 ft. E. of W ¼ Cor. Sec. 5, T. 3 N., R. 1 E. USB&M | 7/1-12/1 Store 11/1-7/1 | 8,527.45 | 8/1/35 | North Fork of Dry Fork | Proof due 9/20/49 1/ |

1/ Extension of time protested. No decision to date by Utah State Engineer.

Table 20
ABSTRACT OF WATER RIGHT APPLICATIONS
ON ASHLEY CREEK AND DRY FORK FOR USE OR STORAGE UPSTREAM FROM PROJECT AREA

| File No. | Applicant | Use | Amount Sec.Ft. | Amount Ac.Ft. | Point of Diversion | Period of use | Area to be irrigated or horsepower | Priority | Source | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1227 | Vernal Milling & Light | Power | 55 | | N 33°21' W. 584.4 ft. from W 1/4 Cor. Sec. 7, T. 3 S., R. 21 E., SLB&M | 1/1-12/31 | 600 hp | 3/4/07 | Ashley Creek | Cert. # 71B |
| 2237 | Isabell M. Hacking | Irr | .28 | | N 42°5' W. 529 ft. from E 1/4 Cor. Sec. 12, T. 3 S., R. 20 E., SLB&M | 9/1-7/10 | 19.6 | 1/26/09 | Ashley Creek | Cert. #491 |
| 6026 | Murley A. Massey | Irr | 0.26 | | N. 12°55' W. 1041.9 ft. from SE. Cor. Sec. 8, T. 3 S., R. 20 E. SLB&M | 5/1-9/30 | 18 | 7/3/25 | Dry Fork | Cert. #1556 |
| 6081 | Massey, Ira D. etal | Irr | .85 | | N. 45°50' W. 932 ft. from E 1/4 Cor. Sec. 25, T. 3S., R. 20 E. SLB&M | 4/1-11/1 | 58.4 | 3/1/15 | Dry Fork | Cert. #950 |
| 6795 | Francis M. Caldwell | Irr | .36 | | N. 72°33' W. 480 ft. from N 1/4 Cor. Sec. 29, T. 3 S., R. 2 W., USB&M | 4/1-11/1 | 25.1 | 6/8/16 | Dry Fork | Cert. No. 1483 |
| 8250 | Ashley Res. Co. | Irr | | 2530 | Storage Res. at points (1) S 52°45' W. 24,200 ft; (2) S 56°45' W. 22380,ft., (3) S. 51°15' W. 22,000 ft. (4) S 6°30' E. 12,045 ft. (5) S. 79°20' W. 35,100 ft. all from NW Cor. T.1 S., R.20 E., SLB&M | Stored 1/1-12/31 | 44,800 | 11/23/35 | | **Extension granted to 12/19/58** |
| 8755 | Ashley Res. Co. | Irr | 14 | 1425 | (1) S. 75°50' W. 27,456 ft; (2) N 87°44' W., 11,458 ft., both from SW cor. Sec. 36 T. 1 N., R. 19 E., SLB&M | 5/1-10/1 Stored 1/1-12/31 | 44,800 | 11/23/35 | | **Extension granted to 12/19/58** |
| 10022 | George H. Luck | Irr | 1 | | S. 6°00' W. 1050 ft. from NE Cor. Sec. 31, T. 3 S., R. 21 E. SLB&M | 4/1-6/30 | 80 | 7/21/26 | Ashley Creek | Cert. #2427 |
| 11143 | High Line Canal Co. | Irr | 15 | 180 | 2150 ft. W. & 2440 ft. N. from NW Cor. Sec. 1, T. 1 S., R. 19 E. SLB&M | 4/15-11/15 Stored 1/1-12/31 | 6,000 | 9/14/38 | Unnamed Trib. of Ashley Cr. | **Extension granted to 5/11/60** |
| 13322 | Utah Power & Light | Power | 55 | | N. 41°15' W. 530 ft. from E 1/4 Cor. Sec. 12 T. 3 S., R 20 E. SLB&M | 10/15-4/15 | 2,400 hp | 2/9/40 | Ashley Creek | Pending cert. **Proof submitted** |

Table 21
ABSTRACT OF WATER RIGHT APPLICATIONS
ON ASHLEY CREEK AND BRUSH CREEK WHICH WOULD BE INCORPORATED INTO VERNAL UNIT

| File No. | Applicant | Use | Amount Sec.Ft. | Amount Ac.Ft. | Point of Diversion | Period of use | Area to be irrigated or horsepower | Priority | Source | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1932 | Allen, O. D. etal | Irr | .36 | | N. 59°42' W. 747 ft. from E 1/4 Cor. Sec. 8, T. 4 S., R. 21 E., SLB&M | 3/1-12/1 | 19.25 | 3/18/12 | Ashley Creek | Cert. # 633 |
| 4796 | Highline Canal Co. | Irr | 182 | | N. 13°10' E. 1782 ft. from NW Cor. Sec. 5, T. 4 S., R. 21 E. SLB&M | 3/1-10/31 | 13419.47 | 8/2/12 | Ashley Creek | Pending |
| 5156 | Morrison, Jane B. etal | Irr | 4-2/7 | | 1386 ft. S. & 363 ft. E. of the N 1/4 Cor. Sec. 14 T. 4 S. R. 21 E. SLB&M | 3/15-7/10 | 250 | 7/30/13 | Ashley Creek | Cert. #479 |
| 5985 | W. D. Newton | Irr | 2.5 | | N 5° E. 1020 ft. from S 1/4 Cor. Sec. 5, T. 4 S., R. 21 E. SLB&M | 3/1-11/1 | 175.8 | 12/3/14 | Ashley Creek | Cert. #1147 |
| a-532 | Vernal Irr. Co. | Irr | | | N. 26°15' W. 1940 ft. from the N 1/4 Cor. Sec. 8, T. 4 S., R. 21 E., SLB&M | 2/9/20 | | 2/9/20 | Ashley Creek | Certificate issued Segreg. of Appl. 4796 |
| a-1548 | Vernal City | Irr | 5 | | N. 58°30' E. 1570 ft. from the SW Cor. Sec. 19, T.3 S., R.21 E., SLB&M | 1/1-12/31 | | 9/4/40 | Ashley Creek | **Change on decreed right. Extension granted to 5/28/58** |
| 10053 | Resettlement Adm. | Irr | 4,500 | | N. 24° E. 1350 ft. from SW Cor. Sec. 32, T. 3 S., R.21 E. SLB&M | 6/1-10/30 Store 1/1-12/31 | 10,700 | 12/12/28 | Brush Creek | **Extension requested Feb. 13, 1957** |
| 11708 | Resettlement Adm. | Irr. | 3,000 | | Center of dam is located at a point S. 56° W. 1300 ft. from E 1/4 Cor. Sec. 12, T. 1 S., R. 20 E. SLB&M | 3/1-12/1 Store 1/1-12/31 | 20,000 | 3/1/35 | Brush Creek | **Water is conveyed to and distributed from Ashley Cr. Extension granted to Dec.6,1957** |
| 11303 | Highline Canal Assigned to Vernal City | | | 500 | 1000 ft. N. and 3900 ft. W of NW Cor. Sec. 1 T. 1 S. R. 19 E. SLB&M | | | 1/5/44 | | **Proof due Jan.20,1958** |
| 24219 | Vernal City | | 5 | | | | | 9/25/52 | | **Diversion from Ashley Creek Spring Application approved Nov. 28, 1956. Proof due Jan. 25, 1959** |

Table 22

ABSTRACT OF WATER RIGHT APPLICATIONS

FROM TRIBUTARIES OF ASHLEY CREEK IN ASHLEY VALLEY

| File No. | Applicant | Use | Sec. Ft. | Acre Feet | Point of Diversion | Period of Use | Area to be Irrig. or Horse-power | Priority | Source | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 5201 | Water Simper | Irr | .67 | | (1) 1320 ft. E. & 440 ft. N. from SW Cor. Sec. 9, (2) 570 ft. N. & 769 ft. E. of W $\frac{1}{4}$ Cor. Sec. 9, T. 5 S., R. 22 E., SLB&M | 4/1-12/1 | 46.6 | 5/9/13 | 2 Unnamed draws | Cert. #869 |
| 6800 | Hyrum E. Seeley | Irr | .25 | | N. 62°05' E. 2087 ft. from SW Cor. Sec. 12, T. 4 S., R. 21 E., SLB&M | 4/1-11/1 | 5.5 | 6/10/16 | Unnamed draw | Cert. #918 |
| 7376 | G. H. Southam | Irr | .75 | | S. 41°40' E.,1330 ft. from NW Cor. Sec. 10, T. 5 S., R. 22 E., SLB&M | 4/1-11/1 | 80 Ac. | 6/23/17 | Unnamed draw | Cert. #998 |

Table 23

ABSTRACT OF WATER RIGHT APPLICATIONS
FROM ASHLEY CREEK DOWNSTREAM FROM VERNAL UNIT AREA

| File No. | Applicant | Use | Sec. Ft. | Acre Feet | Point of Diversion | Period of Use | Area to be Irrig. or Horse-power | Priority | Source | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 2428 | John T. Rasmussen et al | Irr | 8 | | N. 85°34' W. 1294 ft. from E ¼ Cor. Sec. 23, T. 5 S. R. 22 E., SLB&M | 4/1-9/1 | 642.36 | 5/11/09 | Ashley Creek | Cert. #135 B |
| 4041 | Jensen Irr. Co. | Irr | 14.4 | | N. 44°50' W. 2899 ft. from E ¼ Cor. Sec. 10, T. 5 S., R. 22 E., SLB&M | 4/1-7/15 | 1023.4 | 6/5/11 | Ashley Creek | Cert. #1083 |
| a-509 | Jensen Irr. Co. | Irr | | | N. 42°38' W. 2332 ft. from E ¼ Cor. Sec. 10, T. 5 S., R. 22 E., SLB&M | 10/20/19 | | 10/20/19 | Ashley Creek | #1083 - Segregation of Appl. 4041 |

Three applications have been filed for water from tributaries to Ashley Creek, a considerable distance downstream from the head of Ashley Valley (see Table 22). These applications would have no effect on Vernal unit.

Table 23 lists water right applications for water from Ashley Creek downstream from the Vernal unit area. The source of supply to these applicants is return flow water from presently irrigated lands in the Vernal unit area. Water rights for Vernal unit would not be adversely affected by these lower rights. Vernal unit may be expected to improve the supply to these applicants by providing increased late-season water from return flow.

## Vernal Unit Rights

Present practices are to divert the Ashley Creek flow into the major canals at all times of the year. Winter flows are diverted through the canals for stock watering purposes, and high spring flows are diverted to the maximum capacity of the canals, which are in excess of the diversions necessary under normal reasonably efficient irrigation practices. Local water users recognize that present practices must be modified considerably if sufficient water is to be made available for operation of the Vernal unit. Meetings of water users of the Rock Point Irrigation Company, Ashley Central Irrigation Company, Ashley Upper Irrigation Company, Highline Irrigation Company, Island Ditch Company, and Dodds Ditch Company have resulted in the signing of Resolutions as follows:

RESOLUTION

"Be it resolved by the Board of Directors of ____________ ____________ Company, as follows:

"WHEREAS, at a meeting of the Board of Directors duly called and held ________________, 1956, at the director's room of the Uintah State Bank, Vernal, Utah, at ________p.m., a proposed form of contract between the United States and the Company relating to exchange and adjustment of water rights of the Company under the proposed Vernal unit of the Central Utah project to be constructed by the United States, was presented and considered.

"NOW, THEREFORE, the President and Secretary of the Company are hereby authorized to execute on behalf of the Company, the form of contract so presented with the changes reflected on the copy of the form, and it being understood that the form of contract with such changes is subject to further review and final approval as to form by the United States, the President and Secretary are further authorized and empowered to execute and deliver to the United States the form of contract as it may be revised after such review provided such revisions are satisfactory to the President and approved by the Company attorney."

CERTIFICATE

"I, ______________________, Secretary of the ____________ Company, do hereby certify that the foregoing resolution of the Board of Directors of the Company was passed by said board at a special meeting duly called and held on ________________. I further certify that there is a total of _______ directors in the Company, and that _____ directors voted in favor of the foregoing resolution and ____ directors voted against the foregoing resolution."

______________________________
Secretary of the

______________________________
Company

The form of contract contemplated by the Resolutions is to be executed between the United States and each of the six major canal companies. It relates to the exchange and adjustment of the decreed water rights. These contracts restrict the use of water under the decrees to a stipulated annual irrigation demand properly distributed by months. The water in Ashley Creek in excess of these monthly requirements is considered divertible by the unit. The annual irrigation demand set out in the contracts is for the purpose of defining the maximum permissible use of water under the decrees only, and is not to be confused with the ideal annual irrigation demand used in the operation studies to determine the demand for Vernal unit water. A blank form of contract is included as follows:

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL UTAH PROJECT, UTAH
VERNAL UNIT

CONTRACT BETWEEN THE UNITED STATES
AND ________________ COMPANY
RELATING TO EXCHANGE AND ADJUSTMENT OF WATER RIGHTS

THIS CONTRACT, made this day of , 1957, in pursuance of the Act of June 17, 1902 (32 Stat. 388) and acts amendatory thereof or supplementary thereto, particularly the Act of April 11, 1956 (Public Law 485, 84th Congress), between THE UNITED STATES OF AMERICA, herein styled the United States, acting in this behalf by the Regional Director, Region 4, Bureau of Reclamation, Department of the Interior, hereinafter referred to as the Regional Director, and the ______________ COMPANY, a corporation organized under the laws of the State of Utah with its place of business at Utah, herein styled the Company:

WITNESSETH, That:

2. WHEREAS, the United States is planning the construction of the Vernal unit as part of the Central Utah Project, herein styled unit, including facilities which will be used, among other purposes, to deliver water into the Company canal, commonly known as the _______ Canal, permitting an exchange of Company water as hereinafter described for unit water delivered from the proposed Steinaker Reservoir.

3. WHEREAS, the Company has certain water rights in the flow of Ashley Creek as referred to in that certain decree entered by Judge Warren H. Dusenberry on November 17, 1897, Uintah County Case No. 18, and

4. WHEREAS, in order that there will be adequate water supply for the unit, it is necessary to establish the amount of water that the Company will receive under the above-mentioned decree when said unit is constructed and in operation.

5. NOW, THEREFORE, in consideration of the mutual and dependent stipulations herein contained, it is agreed by and between the parties hereto as follows:

6. Pursuant to and by virtue of continued diversions under and in accordance with the above-mentioned decree, the Company claims _____ percent of the flow of Ashley Creek at USGS Gaging Station "Sign of the Maine" corrected for diversions to Steinaker Ditch and the

Vernal City pipeline for its water users and the Company agrees with respect to its water right as follows:

a. The irrigation season is from April 1 to October 31 of each year. The irrigable land served by the Company canal is _______ acres, and the annual irrigation demand for such land as it applies to decreed water, is _______ acre-feet per acre for April and May and _______ acre-feet for the remaining months of the irrigation season, measured at the Company's headgate diversion point. During the nonirrigation season the Company's use for domestic and stock watering purposes is _______ acre-feet for each month of said nonirrigation season.

b. Under unit operation and within the limits of its decreed right in Ashley Creek, the Company must call for its water according to the following schedule:

(1) during April, not to exceed ____ percent of its annual irrigation demand,
(2) during May, not to exceed ____ percent of its annual irrigation demand,
(3) during June, not to exceed ____ percent of its annual irrigation demand,
(4) during July through October, not to exceed its decreed water rights in Ashley Creek,
(5) during the nonirrigation season (November through March), not to exceed ____ c.f.s. of the flow of Ashley Creek.

c. It is understood that the above amounts of water have been established on the assumption that the United States will construct as part of the unit, a nonirrigation season water-saving pipe system as shown on Exhibit A attached hereto and made a part hereof so that the stockholders of the Company can run connections therefrom to their property to receive Company water during the nonirrigation season.

d. The amount of water that the Company will call for as provided above is hereinafter called Company water and the Company hereby quitclaims to the United States its right to amounts of water in excess thereof and agrees that such excess water will become part of the unit water supply, and further agrees to execute any appropriate conveyance or assignment to the United States of its water rights representing such excess water.

7. The Company hereby grants the United States the right and the United States agrees without expense to the Company, to

construct facilities as part of the Unit, to deliver Company water through the water-savings pipe system as shown on Exhibit A. The Company agrees to acquire and donate to the United States by appropriate deed of conveyance, all right-of-way needed for the water-savings pipe system. The United States agrees that during construction of the above-mentioned facilities there shall be a minimum of interference with the delivery of Company water.

8. The United States agrees, in the operation of the Unit, to deliver Company water, as established by this agreement, at the locations shown on the detail map, Exhibit B, or at such location hereafter agreed upon by the parties hereto, through facilities constructed by the United States.

9. The United States shall install a measuring device to regulate and measure the flow of water into the said Company canal and into the water-savings pipe system.

10. It is understood and agreed by the parties hereto that certain actions will have to be taken as follows:

a. The Company shall make application to the State Engineer of Utah for a change in the point of diversion of its Ashley Creek water as may be necessitated by the construction of the facilities by the United States. The United States will furnish the engineering information and detail necessary for the application.

b. The United States will make application to the State Engineer of Utah for exchange of Unit water for Company water.

c. The Company will accept delivery of Unit water in exchange for Company water that may be diverted and used on Unit lands above the Stanaker Service Canal at such times as such Unit water of equal quality and quantity can be delivered at the same locations as its Company water.

d. Upon completion of the construction of the facilities to serve the Company and after the action described in subarticles a. and b. above have been taken, the United States and the Company will advise the Water Commissioner of all actions taken and furnish him operating criteria to be followed in satisfying the Company's rights, and the exchange to be made pursuant to this contract.

11. The Company canal may need some rehabilitation and lining. The extent of such rehabilitation and lining shall be determined by the United States after consultation with the board of directors of the Company and shall be performed without expense to the Company. Should it be necessary to convey the title of the Company's canal to the United States in order to undertake the rehabilitation and lining, the Company

agrees to make such conveyance, provided, however, that the Company shall operate and maintain such canal at its own expense after such rehabilitation work has been performed.

12. The liability of the United States under this contract is contingent on the necessary appropriation and reservation of funds being made therefor.

13. It is understood that the convenants and agreements herein are made in anticipation of and are conditional upon, the completion of the planning, the finding of feasibility, and the eventual construction of the Unit.

14. The Company warrants that no person or selling agency has been employed or retained to solicit or secure this contract upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee, excepting bona fide employees or bona fide established commercial or selling agencies maintained by the Company for the purpose of securing business. For breach or violation of this warranty the United States shall have the right to annul this contract without liability or in its discretion to require the Company to pay, in addition to the contract price or consideration, the full amount of such commission, percentage, or contingent fee.

15. No member of or Delegate to Congress or Resident Commissioner shall be admitted to any share or part of this contract or to any benefit that may arise herefrom, but this restriction shall not be construed to extend to this contract if made with a corporation or company for its general benefit.

16. The provisions of this contract shall apply to and bind the successors and assigns of the parties hereto, but no assignment or transfer of this contract, or any part thereof, or interest therein shall be valid until approved by the United States.

IN WITNESS WHEREOF, the parties hereto have caused these presents to be signed by their proper officers thereunto duly authorized, the day and year first above written.

THE UNITED STATES OF AMERICA

By____________________________________
Regional Director
Bureau of Reclamation

______________________________ COMPANY

(SEAL)

By____________________________________
President

ATTEST:

____________________________________
Secretary

Thus, the winter flows and high spring flows of Ashley Creek over and above beneficial use requirements would be available for Vernal unit. Studies show that the direct flow required to meet the decreed rights as modified by these contracts would result in reduced flow requirement from 682 c.f.s. to a maximum of about 325 c.f.s. as indicated in the discussion of flows available to Vernal unit.

Application No. 16387 was made by the Bureau of Reclamation for the development of the Vernal unit. This application, for the storage of 50,000 acre-feet of Ashley Creek flow in Stanaker Reservoir for use on Vernal unit land, has been approved by the State Engineer.

WATER SUPPLY

# CHAPTER III

## WATER REQUIREMENTS

Water requirements of the Vernal unit consist of irrigation requirements for 14,041 productive acres of presently irrigated land and municipal water supply for a present population of 5,820 which is estimated to increase by 206 percent in the next 25 years.

### Irrigation Requirements

The detailed land classification as contained in the Project Lands Appendix lists the total area classified as 41,697 acres. Of this total 15,653 acres are class 6, 918 acres are in right-of-way and 845 acres are classified as within Vernal townsite, leaving a total area classified as irrigated of 24,281 acres. This area includes 289 acres of irrigated land under the Stanaker and Pitt Ditches above the Stanaker Reservoir normal water surface elevation.

From economic analysis Vernal unit water delivery has been limited to an acreage of class 1, 2 and 3 lands amounting to 14,781 acres. This acreage includes farmsteads, farm ditches and farm roads which are nonproductive areas. These nonproductive areas were deleted from the land classification summary as shown in the following tabulation to obtain the productive acreage (14,041 acres) requiring an irrigation supply. As the farm ditch losses are accounted for in the farm efficiency, the nonproductive area was estimated to amount to 5% of the total classified area in class 1, 2, 3, and 6W. Productive acreage amounting to 95% of the total acreage for the Vernal unit is given in Table 24. Water Supply studies contained in this appendix are based on these productive acreages.

Vernal Unit Land

| | Gross Acreage | Less R. of W. | Net Acreage | Productive acreage (95% net) |
|---|---|---|---|---|
| Vernal unit area | 14,310 | 241 | 14,069 | 13,365 |
| Vernal townsite | 337 | 0 | 337 | 320 |
| River Bottom area | 375 | 0 | 375 | 356 |
| Total | 15,022 | 241 | 14,781 | 14,041 |

Consumptive use

Consumptive use for the Vernal unit is estimated at 1.67 acre-feet per acre. The annual consumptive use is defined as the sum of the volume of water used both by the vegetative growth of the area in transpiration or building of plant tissue and by that evaporated from adjacent soil. Consumptive water requirements of the unit area are largely dependent upon the climate, available water supply and crops grown. Although

Table 24
Central Utah Project
Vernal Unit
1956 DETAILED LAND CLASSIFICATION
PRODUCTIVE ACREAGE SUMMARY 1/

| Area | Class 1 | Class 2 | Class 3 | Vernal unit productive acreage | Class 6W | Total productive acreage |
|---|---|---|---|---|---|---|
| Highline Canal | 149 | 411 | 430 | 990 | 751 | 1741 |
| Area above Stanaker Service Canal excluding Highline Canal | 2003 | 1669 | 452 | 4124 | 1052 | 5176 |
| Area below Stanaker Service Canal | 954 | 2927 | 4370 | 8251 2/ | 5106 | 13357 2/ |
| **Subtotal** | 3106 | 5007 | 5252 | 13365 | 6909 | 20274 |
| **River Bottom area** | 16 | 82 | 258 | 356 | 963 | 1319 |
| Total Productive Area | 3122 | 5089 | 5510 | 13721 2/ | 7872 | 21593 2/ |

1/ Productive acreage is 95% of net acreage. Net acreage is the gross acreage minus Vernal unit right-of-way for drains and Stanaker Service Canal.

2/ Vernal Townsite, estimated to contain 320 productive acres, is not included in this table. It is served by the Ashley Central Canal. Adding this acreage raises the Vernal unit productive acreage below Stanaker Service Canal to 8,571 acres, the total Vernal unit productive acreage to 14,041 acres, the total productive acreage below Stanaker Service Canal to 13,677 acres, and the total productive acreage to 21,913 acres.

water requirements for irrigated projects are often computed by various methods, in the case of Ashley Valley a three-year study has been made in the area during 1948-1950. The results of this study are available in Special Report No. 8, Utah Agricultural Experiment Station, entitled "Consumptive Water Use and Requirements in the Colorado River Area of Utah". Thus, actual measurements were used as a guide in setting up water requirement figures for the Vernal unit.

The reported values in Special Report No. 8 are somewhat higher for the major crops grown in the area than values computed by the Blaney-Criddle, and Lowry-Johnson methods of consumptive determinations. It is therefore believed that the figures used in the report for Ashley Valley are high in regard to average water needs of some crops. Thus the consumptive use as found in the Special Report No. 8 have been reduced for alfalfa and pasture as shown in the following table:

| | Consumptive use | | | |
|---|---|---|---|---|
| | Special Report No. 8 | | Recommended for Vernal Unit | |
| | Frost Free Period (Inches) | Pre and Post Frost Free Period (Inches) | Frost Free Period (Inches) | Pre and Post Frost Free Period (Inches) |
| Alfalfa | 23 | 7 | 21 | 4 |
| Pasture | 21 | 7 | 19 | 4 |
| Corn | 17 | - | 19 | - |
| Small pasture | 17 | - | 17 | 1 |

In determining the amount of water requirements that would be supplied by precipitation consideration was given to the effectiveness of single storms, carry-over of winter precipitation in the form of soil moisture, and effective growing season precipitation. A conservative estimate for the net effective precipitation was considered as being 90 percent of the average precipitation occurring during the 10 driest growing seasons of record which is for the period 1920 to 1955. These data are shown in Column 6 of Table 25.

Consumptive water requirements, minus effective precipitation, gives the net amount of water that must be supplied to the crop from irrigation sources. The net consumptive use requirement for the Vernal unit is shown in Column 7 of Table 25.

The consumptive use in Special Report No. 8 is given for the major crops in the area. Estimated future cropping pattern for the unit is given in Columns 1 and 2, Table 25. In the cropping pattern it was assumed that some of the pasture would include mixtures of grass and legumes in various proportions. It was also assumed that small grains, etc. would include a small percentage of land planted to garden crops and certain other annual crops with seasonal water requirements somewhat similar to the small grains of wheat, oats, and barley.

Table No. 25
Central Utah Project
**Vernal Unit**
Consumptive Irrigation Water Requirement 1/

| Crop | Percent of Area | Frost Free Period (Inches) | Pre & Post Frost Free Period (Inches) | Total Growing Period (Inches) | Effective Precipitation 2/ (Inches) | Net Consumptive Irrigation Requirement (Inches) |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Alfalfa | 37 | 21 3/ | 4 5/ | 25 | 3 | 22 |
| Pasture | 26 | 19 4/ | 4 5/ | 23 | 3 | 20 |
| Corn | 9 | 19 6/ | - | 19 | 2 | 17 |
| Small grain, etc. | 28 | 17 | 1 7/ | 18 | 1 | 17 |
| Weighted Average | 100 | | | | | 20 |

1/ Based on Table 11, page 22, Utah Agricultural Experiment Station, Special Report No. 8 "Consumptive Water Use and Requirements in the Colorado River Area of Utah".

2/ Estimated at 90 percent of lowest 10 years of growing season precipitation for the period 1920 to 1955.

3/ Adjusted from 23" to 21" to bring use in line with data from other methods.

4/ Adjusted from 21" to 19" to bring use in line with data from other methods.

5/ Adjusted from 7" to 4" to bring use in line with data from other methods.

6/ Adjusted from 17 to 19 to allow for maturity of crop for grain. Experimental data assumed corn would be harvested for silage.

7/ Added to take care of early planted winter grains that do consume water before the end of the growing season.

## Farm delivery

Farm delivery for the Vernal unit is estimated at 3.03 acre-feet per acre. Losses of irrigation water on the farm may be placed under three classes: (a) farm ditch losses, (b) surface runoff, (c) deep percolation. Table No. 26 gives the estimated farm irrigation water losses and efficiencies for the Vernal unit. Farm ditch losses are dependent upon slope, intake rate of the soils, and water holding capacities of the soils. Surface runoff is dependent upon slope and allowed soil moisture levels. Deep percolation is dependent upon intake rate of the soils, water holding capacities of the soils, root zone depths of the crops, and minimum soil moisture levels allowed. These limitations were used as a guide for estimating the efficiencies shown in Table 26. These estimates show from 15 to 20 percent of the water applied is lost by deep percolation which should be adequate to prevent any harmful salt accumulation within the root zone.

## Diversion requirements

Diversion requirements for the Vernal unit are estimated to be 3.7 acre-feet per acre. In addition to the farm losses, the conveyance losses incident to conveying the water from the point of diversion to the farm headgate is estimated to be 18% for the Vernal unit. In estimating these losses consideration has been given to operational losses, such as leaky headgates, change of turn loss, etc., and seepage losses in the canal banks. The administrative loss was estimated at 5% whereas the seepage loss which is dependent upon the soils through which the canals pass, the shapes, carrying capacities and length of canals is estimated at 13%, making a total weighted average conveyance loss of 18%. It is recognized that present conveyance losses are somewhat higher than 13%, and some canal lining work must be accomplished in order to bring the losses within this limitation. It is expected that losses within the Stanaker Service Canal would approximate those in the present canals after lining inasmuch as the distance the water must travel in the canal would be about the same whether it is supplied through present diversions or through the Stanaker Service Canal. Table 27 summarizes the estimated conveyance loss for the Vernal Unit.

Table 26
Central Utah Project
Vernal Unit
Estimated Farm Irrigation Water Losses and Efficiencies for Ashley Valley

| U.S.B.R. Land Class | Slope | Intake Rate | TRAM 1/ in 4' Root Zone | Usable Soil Depth | Seepage in Farm Ditch | Losses: Surface Waste | Losses: Deep percolation | Total | Farm Efficiency |
|---|---|---|---|---|---|---|---|---|---|
| | Percent | In/hr | Inches | Inches | Percent | Percent | Percent | Percent | Percent |
| 1 (23% of land) | 0.5-3.0 | 0.5-1.0 | 4.5+ | 36 to 60 | 7 | 15 | 15 | 37 | 63 |
| 2 (41% of land) | 0 -0.5 | 0.25-0.5 | 3.75-4.5 | 30 to 48 | 7 | 25 | 15 | 46 | 54 |
| | 3-7 | 1.0 -1.5 | | | 10 | 15 | 20 | | |
| 3 (36% of land) | 7-11 | 0.15-0.25 | 3.50-3.75 | 24 to 36 | 7 | 30 | 15 | 49.5 | 50.5 |
| | | 1.5 -2.5 | | | 12 | 15 | 20 | | |
| | | | | | | Weighted average | | | 55 |

1/ Total Readily Available Moisture

Table 27
Central Utah Project
Vernal Unit
Estimated Canal Seepage Losses in Ashley Valley

| Canal | Length | Capacity | Loss Per Mile | Loss Total |
|---|---|---|---|---|
| | Mi | cfs | Percent | Percent |
| Highline | 17 | 50 | 2.0 | 34 |
| Ashley, Upper | 17 | 300 | 0.75 | 13 |
| Ashley, Central | 12 | 250 | 0.75 | 9 |
| Rock Point | 12 | 80 | 1.0 | 12 |
| Island | 5 | 30 | 2.0 | 10 |
| Dodds | 2 | 5 | 4.0 | 8 |
| Weighted average seepage loss | | | | 13 |
| Administrative loss | | | | 5 |
| Total conveyance loss | | | | 18 |

A summary of diversion requirements is as follows:

| | | Acre-feet per acre |
|---|---|---|
| Consumptive use | | 1.67 |
| Farm efficiency | 55% | |
| Farm delivery requirement | | 3.03 |
| Conveyance efficiency | 82% | |
| Diversion requirements | | 3.70 |

The estimated monthly diversion requirements are given in Table 28. This distribution is based on data obtained from the Moon Lake Project area which has a full water supply, modified to fit the expected type of crops, length of growing season, and need for early season water for the Vernal unit.

Table 28
Estimated Monthly Diversion Requirements

| | April | May | June | July | Aug. | Sept. | Oct. | Total |
|---|---|---|---|---|---|---|---|---|
| Percent | 4.8 | 17.0 | 20.2 | 23.0 | 18.0 | 12.0 | 5.0 | 100.0 |
| Acre-foot per acre | .18 | .63 | .75 | .85 | .67 | .44 | .18 | 3.70 |

## Return flow

The pattern of return flow under present practices is complex. Water diverted from Ashley Creek through the higher canals returns to lower canals and is rediverted, along with direct flow water. A few natural drainage ways are used sometimes as laterals and at other times as drains. Numerous small diversion dams on the natural drainage channels redivert seepage water onto the land. On the lower reaches of Ashley Creek the water supply for the River and Union canals consists entirely of return flow, except for a short time during the high runoff season when some water spills past the diversion dams at the head of the valley.

In view of the general poor quality of present return flow water, the operation studies provided direct flow or reservoir water for all Vernal unit land, and return flow was not considered as being available for use. The River and Union canals, which are not within the Vernal unit irrigable area, would perhaps benefit from increased flow during the late irrigation season. Water now being used by these two canals is Class 3 or 4, or worse. It is not anticipated that operation of Vernal unit will have any appreciable effect on the quality of water for these two canals, but the desirability of using return flow can only be determined after Vernal unit is in operation. The samping program will be continued to provide factual data for future use.

Past stream gaging records provide very little information regarding return flow. The gage Ashley Creek at "Sign of the Maine" measures runoff of Ashley Creek at the head of the valley, and the station Ashley Creek near Jensen is located in the lower part of the valley, three miles upstream from the mouth. However, the River Canal diverts about 2½ miles upstream from this gage, and the Union Canal diverts about ¼ mile downstream from the gage. Hence, some of the return flow from the Vernal unit area is diverted to the River Canal before it reaches the gage, and part of the flow passing the gage during high water spills past the Union Canal diversion into the Green River. High flows measured near Jensen undoubtedly consist of spills past upstream diversion dams, return flow from water supplied to the land, surface runoff from the land, and water wasted directly into drainage channels. Surface runoff and waste is believed to be large during the early part of the year, as a result of the large streams diverted into the canals.

Flows at the lower station from July through October may be considered as return flow, but those during the rest of the year are not all return flow, especially during the high water period in May and June. Adequate records are not available at this time for a reasonable evaluation of present return flow. However, a program of stream flow measurement has been initiated, so that records will be available for determining present return flow at the lower diversions prior to completion of construction.

Under Vernal unit operations the re-use of return flow within the unit area may be expected to decrease from what it is under present practice, due to the provision for direct flow or reservoir water for all of the Vernal unit land, and to the general poor quality of return flow. It is estimated that usable return flow from Vernal unit land will amount to about 25% of the 3.70 acre-feet per acre irrigation-season diversion requirement, or about 12,000 acre-feet from the 14,041 acres. Based on the assumption that 60% of the return flow would occur during the month of application and 40% would occur the following month, return flow from unit land by months is estimated as follows:

| Month | Acre-feet | Month | Acre-feet |
|---|---|---|---|
| April | 350 | August | 2,400 |
| May | 1,450 | September | 1,720 |
| June | 2,270 | October | 940 |
| July | 2,630 | November | 240 |
| Total | | | 12,000 |

Return flow from Class 6W land within Vernal unit area would occur in addition to that from the unit land as discussed above. The unit operation should have no appreciable effect upon its amount or time of appearance. As at present, this return flow would come principally from early season irrigation water and would reduce rapidly after the high water season of May and June. It would appear in the same drainage channels as return flow from Vernal unit land, and would commingle with that water. No attempt has been made to evaluate return flow from Class 6W land.

## Evaporation

The evaporation rate is estimated to be the same at the Stanaker Reservoir site (elevation 5500) as used in Special Report No. 8, Agricultural Experiment Station, Utah State Agricultural College, "Consumptive Water Use and Requirements in the Colorado River Area of Utah". In the above report the consumptive use or evaporation from water surfaces were estimated as follows:

| Period | Evaporation (inches) |
|---|---|
| Frost-free period | 23.4 |
| Pre & Part Frost-free period | 8.5 |
| Dormant season | 7.8 |
| Total for year | 39.7 inches or 3.31 feet |

The yearly total evaporation of 3.31 feet was distributed over the year in the same percentage by months as has been determined for Utah Lake near Lehi, Utah. Distribution percentage and monthly evaporation is given in the following table.

| Month | % for Month | Evaporation for Month (Feet) |
|---|---|---|
| Jan. | 0.8 | .027 |
| Feb. | 1.0 | .033 |
| March | 4.6 | .152 |
| April | 9.1 | .301 |
| May | 13.4 | .444 |
| June | 16.2 | .536 |
| July | 17.7 | .583 |
| Aug. | 15.9 | .526 |
| Sept. | 11.6 | .384 |
| Oct. | 6.6 | .218 |
| Nov. | 2.3 | .076 |
| Dec. | 0.8 | .027 |
| Total | 100.0 | 3.31 |

Evaporation was applied to the reservoir area on a monthly basis in the Stanaker Reservoir operation study resulting in a mean annual loss of 2,100 acre-feet over the 27-year period of study.

Evaporation at Oaks Park Reservoir (elevation 9,200) is known to be less than that at the lower elevation. A rate of 2 feet was conservatively applied to the maximum water surface area of 400 acres. Distribution throughout the year was made as follows:

| Period | Acre-Feet |
|---|---|
| Oct. 1 to April 30 | 100 |
| May | 100 |
| June | 200 |
| July | 200 |
| August | 100 |
| September | 100 |
| Total | 800 |

## Sedimentation

Reservoir sedimentation in the offstream Stanaker Reservoir is considered to be minor, largely because of the lack of stream flow within the Stanaker drainage basin and the good quality of water to be imported from the Ashley Creek. The estimate of sediment deposition in the reservoir was derived from available sampling data and by comparison with sediment production rates of other watersheds in the general vicinity.

No sediment sampling nor stream flow data is available from Stanaker draw, as the overall contribution to the reservoir water supply is considered to be insignificant. Occasional stream flow probably occurs in Stanaker Draw as a result of cloudburst or low intensity rainstorms throughout the summer and some minor snowmelt in the early spring.

Geology of the drainage area shows Jurassic and Cretaceous rocks which form the flanks of the Uinta Mountains. They consist of fairly resistant sandstone and softer shales. Erosion of these formations resulted in ridges, sandstone and valleys in the shale. Stanaker Draw is an erosional valley weathered out of the soft Morrison and Aspen shales. Soil in the valley floor appears to be sandy silt loam, sandy loam and clay.

Based upon a unit yield of .19 acre-feet per square mile, sediment contribution to Stanaker Reservoir would be 3.6 acre-feet annually.

Two sediment samples have been obtained on Ashley Creek near the point of diversion. These showed a concentration of 320 ppm of suspended sediment on May 24, 1956, with a discharge of 797 cfs and a concentration of 50 ppm on March 3, 1956, at a discharge of 24 cfs. Diversions to Stanaker Reservoir would occur usually from November to June of each year. The water supply study shows a mean annual diversion of 28,200 acre-feet although a portion of this shows as spills which would not be diverted under actual operating conditions. Excess stream flow is often available during the spring runoff over and above the diversion canal capacity of 400 cfs.

It is assumed the concentration of about 320 ppm is representative of flows diverted during the months of May and June and the concentration of 50 ppm is representative of the flow during the remainder of the year. These figures are believed to be on the safe side.

Transported sediment would amount to about 5.6 acre-feet for May-June and about .6 acre-feet for the remainder of the diversions. Diverted sediment from Ashley Creek would total 6.2 acre-feet. This, together with the 3.6 acre-feet from within the basin, totals 9.8 acre-feet annually or about 980 acre-feet in a 100-year protection period.

Based upon a Type II sediment disposition curve approximately 30% of the sediment would be deposited in the dead storage pool of Stanaker Reservoir leaving 70% or 686 acre-feet to be accommodated in the active capacity. This amount comprises approximately 2% of the active capacity.

## Municipal Requirements

The Vernal unit will provide additional water to the existing municipal pipeline system that serves the towns of Vernal, Maeser, and Naples. The unit plan does not include a municipal supply for the rural areas. However, municipal requirements for Vernal unit were considered for the two different areas, are served by the present municipal water system, and the rural Ashley Valley area.

Table 29
Past Municipal Water Use 1/
Vernal City, Maeser, and Naples

Unit: 1,000 gallons

| Year | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vernal City | | | | | | | | | | | | | |
| 1953 | 12,241 | 12,247 | 17,592 | 24,516 | 29,533 | 47,955 | 50,832 | 39,968 | 35,209 | 21,581 | 15,868 | 17,320 | 324,862 |
| 1954 | 17,320 | 15,643 | 18,017 | 33,263 | 51,613 | 44,189 | 50,504 | 44,835 | 27,420 | 17,660 | 15,128 | 19,325 | 354,917 |
| 1955 | 19,325 | 17,456 | 18,716 | 31,593 | 44,776 | 53,239 | 53,959 | 43,199 | 41,389 | 30,425 | 17,620 | 17,181 | 388,878 |
| Maeser Area | | | | | | | | | | | | | |
| 1954 | | | | | | | 7,208 | 6,505 | 3,868 | 3,655 | 3,028 | 2,912 | -- |
| 1955 | 2,911 | 2,629 | 2,640 | 4,429 | 6,460 | 7,568 | 6,069 | 4,824 | 4,669 | 5,440 | 3,125 | 3,010 | 53,774 |
| Naples Area | | | | | | | | | | | | | |
| 1953 | | | | | | | | | | | | 1,376 | -- |
| 1954 | 1,376 | 1,237 | 1,667 | 3,076 | 3,548 | 2,416 | 2,768 | 2,453 | 2,973 | 1,913 | 1,631 | 1,883 | 26,941 |
| 1955 | 1,883 | 1,703 | 1,672 | 2,840 | 4,017 | 3,853 | 3,907 | 3,124 | 3,704 | 2,720 | 1,576 | 1,533 | 32,532 |
| Total System | | | | | | | | | | | | | |
| 1954 | | | | | | | 60,480 | 53,793 | 34,261 | 23,228 | 19,787 | 24,120 | -- |
| 1955 | 24,119 | 21,788 | 23,028 | 38,862 | 55,253 | 64,660 | 63,935 | 51,147 | 49,762 | 38,585 | 22,321 | 21,724 | 475,184 |

1/ Meter readings plus 33-1/3% to account for losses and unmetered connections.

Present Municipal Water System Requirements

The municipal water system previously described in more detail serves Vernal City, Maeser and Naples. A survey of present uses from the system was made, in which meter readings were obtained for 1953, 1954, and 1955. Nineteen fifty-five was the only full year of complete records for all three communities.

There is no master meter to measure the total flow of water into the system below the storage tanks and overflow. Records of Provo, Utah, however, indicate that about 77% of the water passing the master meter reaches the metered connections throughout the city. A slightly lower efficiency of 75% was assumed for the Vernal, Maeser, and Naples system, and the meter readings were increased accordingly by 33-1/3% to obtain the total use by the system. Table 12 summarizes the past municipal use in acre-feet and Table 29 shows the total use in 1,000 gallons.

Population of Vernal City was estimated in December 1956, by the Vernal Chamber of Commerce, utilizing records of the Utah Power and Light Company, church records, and a school census. Populations of the Maeser and Naples areas served by the pipeline were obtained by an actual count. Population for years prior to 1956 were obtained from the United States Census. Table 30 summarizes the population of each area for past years.

Table 30
Population for Past Years
Vernal City, Maeser and Naples

| Area | Population | | | | | |
|---|---|---|---|---|---|---|
| | 1910 | 1920 | 1930 | 1940 | 1950 | 1956 |
| Vernal City | 836 | 1,309 | 1,744 | 2,119 | 2,845 | 4,300 |
| Maeser | | | | 770 | 873 | 912 |
| Naples | | 605 | 518 | 620 | 608 | 608 |
| Total | | | | 3,509 | 4,326 | 5,820 |

Using the figures of water use and populations obtained above, the average daily use for 1955 was computed and shown in Table 31. Average daily use is summarized as follows:

| | | |
|---|---|---|
| Vernal City | 248 | gallons/person/day |
| Maeser | 162 | do |
| Naples | 147 | do |
| Weighted average for communities | 224 | do |

For the purpose of estimating future requirements (Table 32), it was assumed that the average daily use would increase from 224 gallons per person in 1956 to 230 gallons per person by 1970, and to 240 gallons per person by 1980, after which there would be no further increase.

Table 31

Past Municipal Water Use[1/]

Vernal City, Maeser, and Naples

Unit: Gallons per person per day

| Year | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Mean | Population |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vernal City - 4,300 population | | | | | | | | | | | | | | |
| 1953 | 92 | 102 | 132 | 190 | 222 | 372 | 381 | 300 | 273 | 162 | 123 | 130 | 207 | 4,300 |
| 1954 | 130 | 130 | 135 | 258 | 387 | 343 | 379 | 336 | 213 | 132 | 117 | 145 | 226 | 4,300 |
| 1955 | 145 | 145 | 140 | 245 | 336 | 413 | 405 | 324 | 321 | 228 | 137 | 129 | 248 | 4,300 |
| Maeser Area - 912 Population | | | | | | | | | | | | | | |
| 1954 | | | | | | | 255 | 230 | 141 | 129 | 111 | 103 | - | 912 |
| 1955 | 103 | 103 | 93 | 162 | 228 | 277 | 215 | 171 | 171 | 192 | 114 | 106 | 162 | 912 |
| Naples Area - 608 Population | | | | | | | | | | | | | | |
| 1953 | | | | | | | | | | | | 73 | - | 608 |
| 1954 | 73 | 73 | 88 | 169 | 188 | 132 | 147 | 130 | 163 | 101 | 89 | 100 | 121 | 608 |
| 1955 | 100 | 100 | 89 | 156 | 213 | 211 | 207 | 166 | 203 | 144 | 86 | 81 | 147 | 608 |
| Total System - 5,820 Population | | | | | | | | | | | | | | |
| 1954 | | | | | | | 335 | 298 | 196 | 129 | 113 | 134 | - | 5,820 |
| 1955 | 134 | 134 | 128 | 222 | 306 | 370 | 354 | 283 | 285 | 214 | 128 | 120 | 224 | 5,820 |

1/ Based on meter readings plus 33-1/3% to account for losses and unmetered connections.

A report on population trends was made by Howard C. Nielsen of the Stanford University Research Institute dated August 1955. Mr. Nielsen stated that the mountain region is expected to grow 66 percent in population between 1954 and 1975 or keeping about the same annual increase. Based on the assumption of Mr. Nielsen which did not take into consideration any unusual conditions which might increase the rate of population growth such as abundant electric energy and water as will be the result of the Colorado River storage project and participating projects construction, it was considered that the growth of Vernal and the surrounding area would continue as shown by the curves in Figure 3.

The ownership of Ashley Creek water by the municipal system is based upon a percent of the total stream flow, and it is not possible to evaluate the available municipal water in any year without first knowing the total stream flow for that year. For 1935, an average annual runoff year for Ashley Creek, the municipal portion of Ashley Creek flows would fail to supply the 1955 requirement by about 140 acre-feet. Municipal ownership in the Ashley Valley Reservoir Company was about 7% of the total stock in 1956, or approximately 480 acre-feet in Oaks Park and Long Park Reservoirs, Twin Lakes, Goose Lake, and Mirror Lake. For the 1935 average runoff year of Ashley Creek, the deficiency to municipal users, based on the population demand of 1955, could be made up from the storage in the reservoirs. However, with stream flows similar to those of 1934, municipal water available from Ashley Creek would fail to meet the 1955 requirement by about 380 acre-feet. It is very doubtful in such a year that the reservoirs would supply more than one-third of their average yield, or about 160 acre-feet of the 380 acre-feet shortage. Thus, as far as ownership of water is concerned, the dependable municipal supply is not equal to the present requirements.

<u>Future requirement.</u>--The determination of a demand for municipal water for future expansion is based on the following: (a) the anticipated population growth as shown on population curves in Figure 3, the basis of which has previously been explained, (b) the quantity of water that can be obtained from the natural flows of Ashley Creek under rights of the municipalities, (c) water obtainable from storage in Oaks Park Reservoir, Long Park Reservoir, Twin Lakes, Goose Lake, and Mirror Lake under rights of the municipalities would not exceed 380 acre-feet in normal runoff years and not more than 160 acre-feet in dry years such as 1934 and 1955.

Municipal requirements projected to years 1960, 1970, 1980, 1990, and 2000 have been compared with the supply available from Ashley Creek under present rights during the high runoff year of 1929, the medium runoff year of 1935, and the low runoff years of 1955 and 1934. These comparisons are shown in Tables 32-35. Table 32 shows that in a high runoff year like 1929 the winter flows divertible to municipal use under present rights would be inadequate to supply the water requirements of the increased population by 1970. Table 33 shows that in a normal year

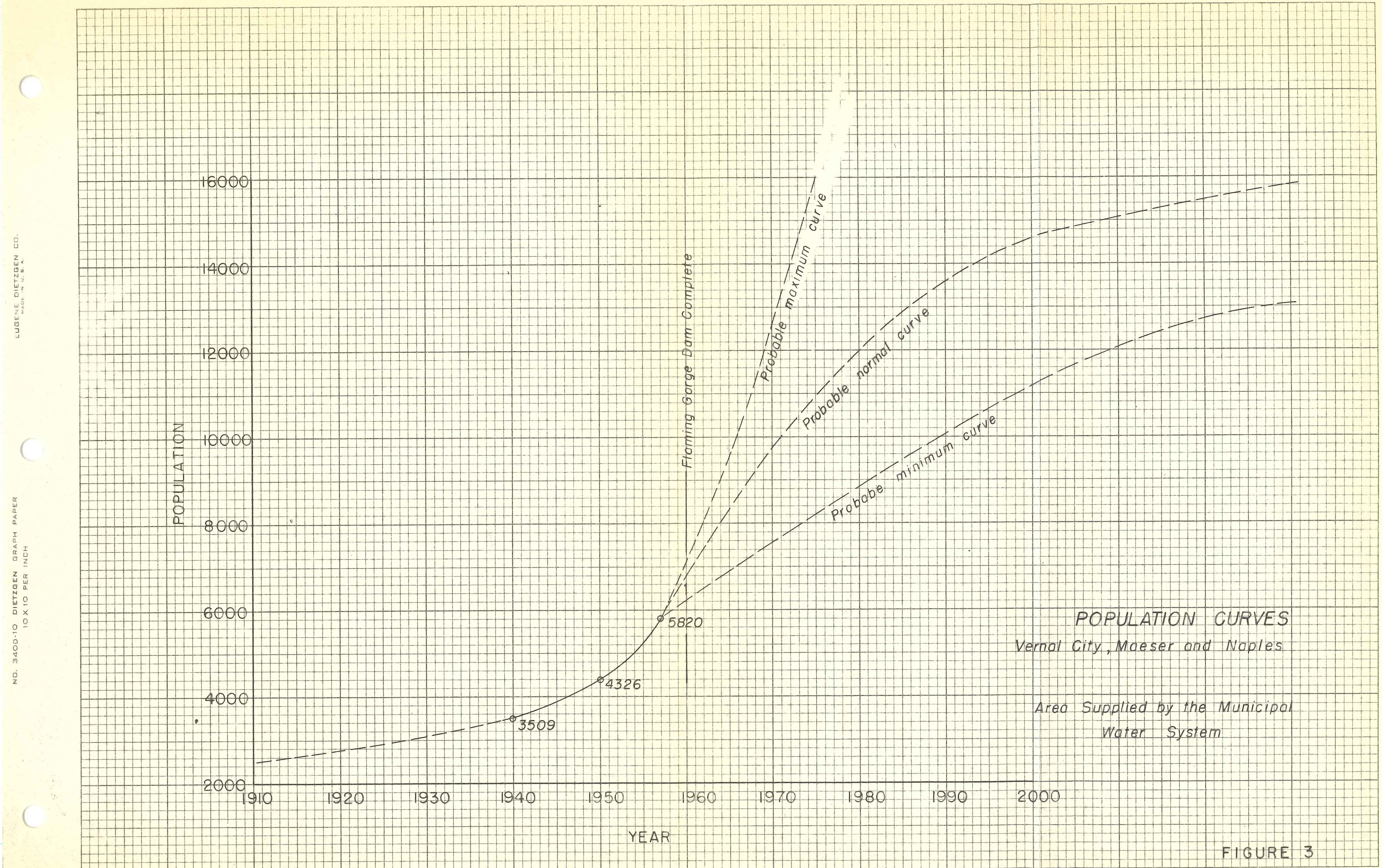

POPULATION
16000
14000
12000
10000
8000
6000
4000
2000
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
YEAR
3509
4326
5820
Flaming Gorge Dam Complete
Probable maximum curve
Probable normal curve
Probabe minimum curve
POPULATION CURVES
Vernal City, Maeser and Naples
Area Supplied by the Municipal
Water System
FIGURE 3
NO. 340D-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH
EUGENE DIETZGEN CO.
MADE IN U.S.A.

Table 32
Central Utah Project
Vernal Unit
Municipal Water Requirement in Addition to Ashley Creek Supply
for a Runoff Year like 1929
(High Runoff Year)

| Year | Item | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1929 | Streamflow owned | 109 | 86 | 91 | 104 | 1662 | 2431 | 565 | 321 | 312 | 238 | 187 | 143 | 6249 |
| 1960 | Demand | 86 | 79 | 84 | 140 | 198 | 233 | 229 | 185 | 179 | 138 | 80 | 79 | 1710 |
| | Shortage | | | | 36 | | | | | | | | | 36 |
| 1970 | Demand | 126 | 116 | 123 | 207 | 292 | 343 | 338 | 272 | 265 | 204 | 118 | 116 | 2520 |
| | Shortage | 17 | 30 | 32 | 103 | | | | | | | | | 182 |
| 1980 | Demand | 161 | 148 | 158 | 265 | 375 | 439 | 433 | 349 | 339 | 262 | 152 | 149 | 3230 |
| | Shortage | 52 | 62 | 67 | 161 | | | | 28 | 27 | 24 | | 6 | 427 |
| 1990 | Demand | 183 | 168 | 179 | 300 | 425 | 498 | 491 | 395 | 384 | 297 | 172 | 168 | 3660 |
| | Shortage | 74 | 82 | 88 | 196 | | | | 74 | 72 | 59 | | | 645 |
| 2000 | Demand | 196 | 181 | 193 | 322 | 456 | 534 | 527 | 424 | 413 | 318 | 185 | 181 | 3930 |
| | Shortage | 87 | 95 | 102 | 218 | | | | 103 | 101 | 80 | | 38 | 824 |
| | Demand % | 5.0 | 4.6 | 4.9 | 8.2 | 11.6 | 13.6 | 13.4 | 10.8 | 10.5 | 8.1 | 4.7 | 4.6 | 100.0 |

Table 33
Municipal water requirement in addition to Ashley Creek supply
for a runoff year like 1935
(Medium runoff year)

| Year | Item | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1935 | Owned | 83 | 74 | 83 | 78 | 577 | 2,066 | 312 | 164 | 92 | 86 | 83 | 74 | 3,772 |
| 1960 | Demand | 86 | 79 | 84 | 140 | 198 | 233 | 229 | 185 | 179 | 138 | 80 | 79 | 1,710 |
| | Shortage | 3 | 5 | 1 | 62 | | | | 21 | 87 | 52 | | 5 | 236 |
| 1970 | Demand | 126 | 116 | 123 | 207 | 292 | 343 | 338 | 272 | 265 | 204 | 118 | 116 | 2,520 |
| | Shortage | 43 | 42 | 40 | 129 | | | 26 | 108 | 173 | 118 | 35 | 42 | 756 |
| 1980 | Demand | 161 | 148 | 158 | 265 | 375 | 439 | 433 | 349 | 339 | 262 | 152 | 149 | 3,230 |
| | Shortage | 78 | 74 | 75 | 187 | | | 121 | 185 | 247 | 176 | 69 | 75 | 1,287 |
| 1990 | Demand | 183 | 168 | 179 | 300 | 425 | 498 | 491 | 395 | 384 | 297 | 172 | 168 | 3,660 |
| | Shortage | 100 | 94 | 96 | 222 | | | 179 | 231 | 292 | 211 | 89 | 94 | 1,608 |
| 2000 | Demand | 196 | 181 | 193 | 322 | 456 | 534 | 527 | 424 | 413 | 318 | 185 | 181 | 3,930 |
| | Shortage | 113 | 107 | 110 | 244 | | | 215 | 260 | 321 | 232 | 102 | 107 | 1,811 |

Table 34

Central Utah Project

Municipal Water Requirement in Addition to Ashley Creek Supply for a Runoff Year Like 1955

| Year | Item | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1955 | Streamflow owned | 69 | 55 | 59 | 67 | 758 | 476 | 143 | 163 | 105 | 104 | 76 | 77 | 2152 |
| 1960 | Demand | 86 | 79 | 84 | 140 | 198 | 233 | 229 | 185 | 179 | 138 | 80 | 79 | 1710 |
| | Shortage | 17 | 24 | 25 | 73 | | | 86 | 22 | 74 | 34 | 4 | 2 | 361 |
| 1970 | Demand | 126 | 116 | 123 | 207 | 292 | 343 | 338 | 272 | 265 | 204 | 118 | 116 | 2520 |
| | Shortage | 57 | 61 | 64 | 140 | | | 195 | 109 | 160 | 100 | 42 | 39 | 967 |
| 1980 | Demand | 161 | 148 | 158 | 265 | 375 | 439 | 433 | 349 | 339 | 262 | 152 | 149 | 3230 |
| | Shortage | 92 | 93 | 99 | 198 | | | 290 | 186 | 234 | 158 | 76 | 72 | 1498 |
| 1990 | Demand | 183 | 168 | 179 | 300 | 425 | 498 | 491 | 395 | 384 | 297 | 172 | 168 | 3660 |
| | Shortage | 114 | 113 | 120 | 233 | | 22 | 348 | 232 | 279 | 193 | 96 | 91 | 1741 |
| 2000 | Demand | 196 | 181 | 193 | 322 | 456 | 534 | 527 | 424 | 413 | 318 | 185 | 181 | 3930 |
| | Shortage | 127 | 126 | 134 | 255 | | 58 | 384 | 261 | 308 | 214 | 109 | 104 | 2080 |

Table 35
Central Utah Project
Vernal Unit
Municipal Water Requirement in Addition to Ashley Creek Supply
for a Runoff Year like 1934
(Low Runoff Year)

| Year | Item | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1934 | Streamflow owned | 69 | 61 | 65 | 152 | 312 | 86 | 69 | 113 | 100 | 95 | 78 | 74 | 1274 |
| 1960 | Demand | 86 | 79 | 84 | 140 | 190 | 233 | 229 | 185 | 179 | 138 | 80 | 79 | 1710 |
| | Shortage | 17 | 18 | 19 | | | 147 | 160 | 72 | 79 | 43 | 2 | 5 | 562 |
| 1970 | Demand | 126 | 116 | 123 | 207 | 292 | 343 | 338 | 272 | 265 | 204 | 118 | 116 | 2520 |
| | Shortage | 57 | 55 | 58 | 55 | | 257 | 269 | 159 | 165 | 109 | 40 | 42 | 1266 |
| 1980 | Demand | 161 | 148 | 158 | 265 | 375 | 439 | 430 | 349 | 339 | 262 | 152 | 149 | 3230 |
| | Shortage | 92 | 87 | 93 | 113 | 63 | 353 | 361 | 236 | 239 | 167 | 74 | 75 | 1953 |
| 1990 | Demand | 183 | 168 | 179 | 300 | 425 | 498 | 491 | 395 | 384 | 297 | 172 | 168 | 3660 |
| | Shortage | 114 | 107 | 114 | 148 | 113 | 412 | 422 | 282 | 284 | 202 | 94 | 94 | 2386 |
| 2000 | Demand | 196 | 181 | 193 | 322 | 456 | 534 | 527 | 424 | 413 | 318 | 185 | 181 | 3930 |
| | Shortage | 127 | 120 | 128 | 170 | 144 | 448 | 458 | 311 | 313 | 233 | 107 | 107 | 2666 |

Table 36

Annual Summary

Municipal Water Requirement in Addition to Present Ashley Creek Supply for Vernal City, Maeser and Naples Areas

Unit: Acre-feet

| Year | Population | Total Requirement 1/ | | Requirement in Addition to Supply Available 2/ from Ashley Creek with 1956 Water Rights for a Runoff Year Similar to: | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Gallons per person per day | Acre-feet | 1929 3/ | 1934 4/ | 1935 5/ | 1954 6/ | 1955 7/ |
| 1956 | 5,820 | 224 | 1460 | 20 | 380 | 140 | 110 | 180 |
| 1960 | 6,800 | 225 | 1710 | 40 | 560 | 240 | 250 | 360 |
| 1970 | 9,800 | 230 | 2520 | 180 | 1270 | 760 | 850 | 970 |
| 1980 | 12,000 | 240 | 3230 | 430 | 1950 | 1290 | 1480 | 1500 |
| 1990 | 13,600 | 240 | 3660 | 650 | 2390 | 1610 | 1860 | 1740 |
| 2000 | 14,600 | 240 | 3930 | 820 | 2670 | 1810 | 2090 | 2080 |

1/ Includes present (1956) requirement.

2/ Determined from a monthly study. This supply does not include storage right of Ashley Valley Reservoir Company totalling 480 acre-feet.

3/ 1929 was the year of highest annual runoff.

4/ 1934 was the year of lowest annual runoff.

5/ 1935 was the year of about average annual runoff. (1925-1955).

6/ 1954 runoff was about 63% of average annual runoff (1925-1955).

7/ 1955 runoff was about 57% of average annual runoff (1925-1955).

like 1935 winter and summer flows divertible to municipal use would be inadequate by 1960 and that by 1980 an additional 1,290 acre-feet, annually, would be required to supply municipal requirements. Table 34 shows that in a low year such as 1955 (57 percent normal runoff) approximately 1,500 acre-feet of additional water above present rights would be required to supply the municipal demand that would occur by 1980. In a low water year such as 1934 (34 percent of normal runoff), Table 35, the demand for additional water by 1980 would be about 2,000 acre-feet.

Allowing for 160 acre-feet of storage water available for municipal use from Oaks Park Reservoir, etc., the net requirement for additional water by 1980 in dry years such as 1955 and 1934 would be about 1,340 acre-feet and 1840 acre-feet, respectively. Of these amounts about 870 acre-feet in 1955 and 1,420 acre-feet in 1934 would be diverted during the irrigation season and would be exchanged for by releases of storage water from Stanaker Reservoir.

Table 36 shows an annual summary of the comparisons described above. On the basis of these studies and separate studies by the municipalities, resolutions have been passed by the city authorities indicating a desire and a willingness to contract with the United States for 1,500 acre-feet of unit water. Copies of the resolutions follow:

## MUNICIPAL WATER RESOLUTION OF VERNAL

WHEREAS; the anticipated growth of Vernal and its surrounding area in Ashley Valley within the next twenty-five years will render the present water supply for the area inadequate; and,

WHEREAS; according to the best estimates available, it will be necessary for the present municipal and culinary systems serving the present area and the projected growth for the future years therein to be extended; and approximately fifteen hundred acre feet per annum additional water acquired to adequately serve the area; and,

WHEREAS; additional water for municipal culinary use would be made available by the construction of Vernal Unit of the Central Utah Project by the U. S. Bureau of Reclamation.

NOW, THEREFORE, BE IT RESOLVED:

1. That Vernal City recognizes the need for additional culinary water to meet the needs of its future development.

2. That Vernal City desires its future water needs to be considered by the U. S. Bureau of Reclamation in its planning of the Vernal Unit, of the Central Utah Project.

3. That Vernal City is desirous and will be willing to contract with the proper body for the procurement of the additional needed water for its future growth and development, provided it is economically feasible.

Adopted at a regular meeting of the Vernal City Council this 20th day of February, 1957.

ATTEST:

/s/ Dixie B. Hacking

/s/ Ralph Siddoway
MAYOR

# MUNICIPAL WATER RESOLUTION OF MAESER

WHEREAS; since the growth of the Vernal Area of the Ashley Valley within the next twenty-five years will render the present water supply for the area inadequate and incapable of supplying the needs of the future growth; and,

WHEREAS; according to the best estimates available, it will be necessary for the present municipal and culinary systems serving the present area and the projected growth for the future years therein to be extended; and additional water acquired in the amount of Fifteen Hundred Acre Feet per annum to adequately serve the area; and,

WHEREAS; since Maeser Town is presently participating in and is being served by the present existing municipal culinary water system. And its future expansion thereof must be be considered prior to the building of the Vernal Unit of the Central Utah Project by the U. S. Bureau of Reclamation.

NOW, THEREFORE, BE IT RESOLVED:

1. That Maeser Town recognizes the need for water for culinary use for its future development to exist.

2. That Maeser Town desires its future water needs to be considered by the U. S. Bureau of Reclamation in its planning of the Vernal Unit, of the Central Utah Project.

3. That Maeser Town is desirous and will be willing to contract with the proper body for the procurement of the additional needed water for its future growth and development, provided it is economically feasible and acceptable to the Maeser Town.

Adopted in council assembled this 14th day of February, 1957.

MAESER TOWN BOARD

By: /s/ J. Fenon Hacking
President

## MUNICIPAL WATER RESOLUTION OF NAPLES

WHEREAS; since the growth of the Vernal Area of the Ashley Valley within the next twenty-five years will render the present water supply for area inadequate and incapable of supplying the needs of the future growth; and,

WHEREAS; according to the best estimates available, it will be necessary for the present municipal and culinary systems serving the present area and the projected growth for the future years therein to be extended; and additional water acquired in the amount of Fifteen Hundred Acre Feet per annum to adequately serve the area; and,

WHEREAS; since the Naples Water Company is presently participating in and is being served by the present existing municipal culinary water system. And its future expansion thereof must be considered prior to the building of the Vernal Unit of the Central Utah Project by the U. S. Bureau of Reclamation.

NOW, THEREFORE, BE IT RESOLVED;

1. That the Naples Water Company recognizes the need for water for culinary use for its future development to exist.

2. That the Naples Water Company desires its future water needs to be considered by the U. S. Bureau of Reclamation in its planning of the Vernal Unit, of the Central Utah Project.

3. That the Naples Water Company is desirous and will be willing to contract with the proper body for the procurement of the additional needed water for its future growth and development, provided it is economically feasible and acceptable to the Naples Water Company.

Adopted at the regular monthly meeting of the Directors of the Naples Water Company held this 18th day of February, 1957 at the home of Charles E. Olsen.

Attest: NAPLES WATER COMPANY

/s/ Linus V. Openshaw
Secretary

By: /s/ Lloyd T. Pope
President

## Requirements for Ashley Valley Rural Areas

Rural residents living outside the three areas now supplied by the municipal water either haul culinary water to their homes or take it from irrigation ditches. Neither method provides an adequate, convenient, or sanitary water supply for culinary use.

Domestic water requirements were determined for the population as it now exists, assuming that this area will remain agricultural and that the size of farms will increase with a resultant decrease in farm population. A survey indicates that 300 families live in the Ashley Valley area. Assuming 4.22 persons per family (U.S. Census Bureau), the total population would be 1,270 persons. The Maeser town uses about 162 gallons of water per ~~person per~~ day and is fairly representative of the Ashley Valley rural area. Allowing a slight future increase in use, it was assumed that 175 gallons of water per person per day would be a reasonable use in the Ashley Valley area. With this figure the domestic requirement would amount to about 250 acre-feet per year. The per capita water requirements in Maeser, upon which the estimate is based, include some water for domestic livestock. A greater number of animals in proportion to the number of people is found in the other rural areas, however, so that additional water will be required for stockwatering. The additional stockwatering requirement will be needed only in the nonirrigation season. During the irrigation season many of the livestock will be on summer range away from the farm, and those remaining will be supplied from irrigation ditches. Livestock requirements were based upon the expected number and rates of water use as follows:

| Livestock | Number | Ave. rate of water use |
|---|---|---|
| Cattle | 16,500 | 10 gallons per day |
| Sheep | 25,000 | 3 gallons per day |
| Poultry | 40,000 | 2-1/2 gal. per day per 100 birds |

Total livestock requirements would average 268 acre-feet for the entire year, and would amount to 126 acre-feet for the time they were on the farm.

The monthly distribution of domestic and stockwatering requirements of the rural areas are shown in the following table.

Rural area water requirements (acre-feet)

| Month | Domestic | Stockwatering | Total |
|---|---|---|---|
| January | 13 | 20 | 33 |
| February | 11 | 21 | 32 |
| March | 12 | 22 | 34 |
| April | 21 | 22 | 43 |
| May | 29 | -- | 29 |
| June | 34 | -- | 34 |
| July | 34 | -- | 34 |
| August | 27 | -- | 27 |
| September | 26 | -- | 26 |
| October | 20 | -- | 20 |
| November | 12 | 21 | 33 |
| December | 11 | 20 | 31 |
| Total | 250 | 126 | 376 |
| Total (Nov.-April) | | | 206 |

Water-saving pipe system.--During the winter months a majority of the rural homes throughout Ashley Valley obtain their stock water supply from the canals. In supplying these needs, the entire winter flow of Ashley Creek is diverted into the canals. Only a small portion of the water diverted is necessary for these uses, and the rest of the water runs to waste, resulting in a high water table and waterlogged land. The water-savings pipe system would supplant this present wasteful practice by supplying the stock water requirements, and approximately 10,000 acre-feet of water would be available for diversion to Stanaker Reservoir in the nonirrigation months.

The water-savings pipe system would begin at the Maeser-Vernal City division box of the present municipal pipeline. It would be supplied from Ashley Creek spring through the present municipal pipeline, which has about a 4 c.f.s. excess capacity during the winter months. From the division box an 8-inch steel pipe would convey the water southward for about 1/2 mile, where it would branch into two lines, one a 4-inch pipe, and the other a 6-inch pipe. The 4-inch branch would run eastward about 5 miles into the Ashley area north of Vernal. The 6-inch branch would run south and southeast for about 9 miles to the Naples area. The system would be within about a mile of all houses in the area served. Individual farmers would be required to provide their own water lines connecting their farms to the branch line.

WATER SUPPLY

CHAPTER IV

# WATER UTILIZATION

## Plan of Operation

Water rights on Ashley Creek at the head of Ashley Valley divide the entire flow among the water users under the Stanaker, Ashley Upper, Ashley Central, Rock Point, Island, and Dodds canals, when the flow is less than 500 cfs. Users under the Highline Canal are entitled to the flows between 500 cfs and 682 cfs.

The gaging station Ashley Creek at "Sign of the Maine" measures the stream at the head of Ashley Valley. The diversions to the municipal pipe line serving the Vernal, Maeser and Naples area are made above the "Sign of the Maine" gage and therefore are not reflected in the recorded flows at the gage. There is a small quantity of water wasted from the municipal pipe system into the irrigation system near Vernal. This waste water has not been accounted for in the operation studies because of the irregular nature of the flows and the minor volumes of water involved. Stanaker Ditch is upstream from the gaging station and diversions to this ditch do not pass the gaging station. Stanaker Ditch was therefore eliminated from the unit operation studies. It can be assumed, then, that water measured at the gaging station belongs to the other six canals.

Unit operations would be in accordance with the water rights stated briefly above. Ashley Creek flows would be used first to meet irrigation demands of presently irrigated land (Class 1, 2, 3 and 6W). Flows in excess of the irrigation demand would be diverted to Stanaker Reservoir and stored for use later when the stream flow is less than the irrigation demand. Storage water would be released to supplement stream flow on unit land (Class 1, 2 and 3) and to replace direct flow water diverted into the City pipe line that normally would be required to supply downstream prior rights.

Irrigation demand would be limited to a beneficial use of 4.0 acre-feet per acre each year for the purpose of determining surplus flows available for storage, and to 3.7 acre-feet per acre each year for the purpose of determining unit demands for storage water. In the operation study water was delivered each month of the year in accordance with the following percentages:

| | | | |
|---|---|---|---|
| April | 4.8 | August | 18.0 |
| May | 17.0 | September | 12.0 |
| June | 20.2 | October | 5.0 |
| July | 23.0 | Total | 100.0% |

Water would be delivered from Ashley Creek to Stanaker Reservoir through the Stanaker Feeder Canal, with a capacity of 400 cfs. Water from the reservoir would be delivered to some lands under the present canals, except Highline Canal, through the Stanaker Service Canal. Only about 63% of the unit land can be reached directly by water from the reservoir. The remaining 37% is located above the Service Canal in elevation and must be irrigated by exchange. Direct flows of Ashley Creek that are owned by users below the Service Canal would be delivered to land above the Service Canal, and storage water would be released from Stanaker Reservoir to replace the direct flows thus used.

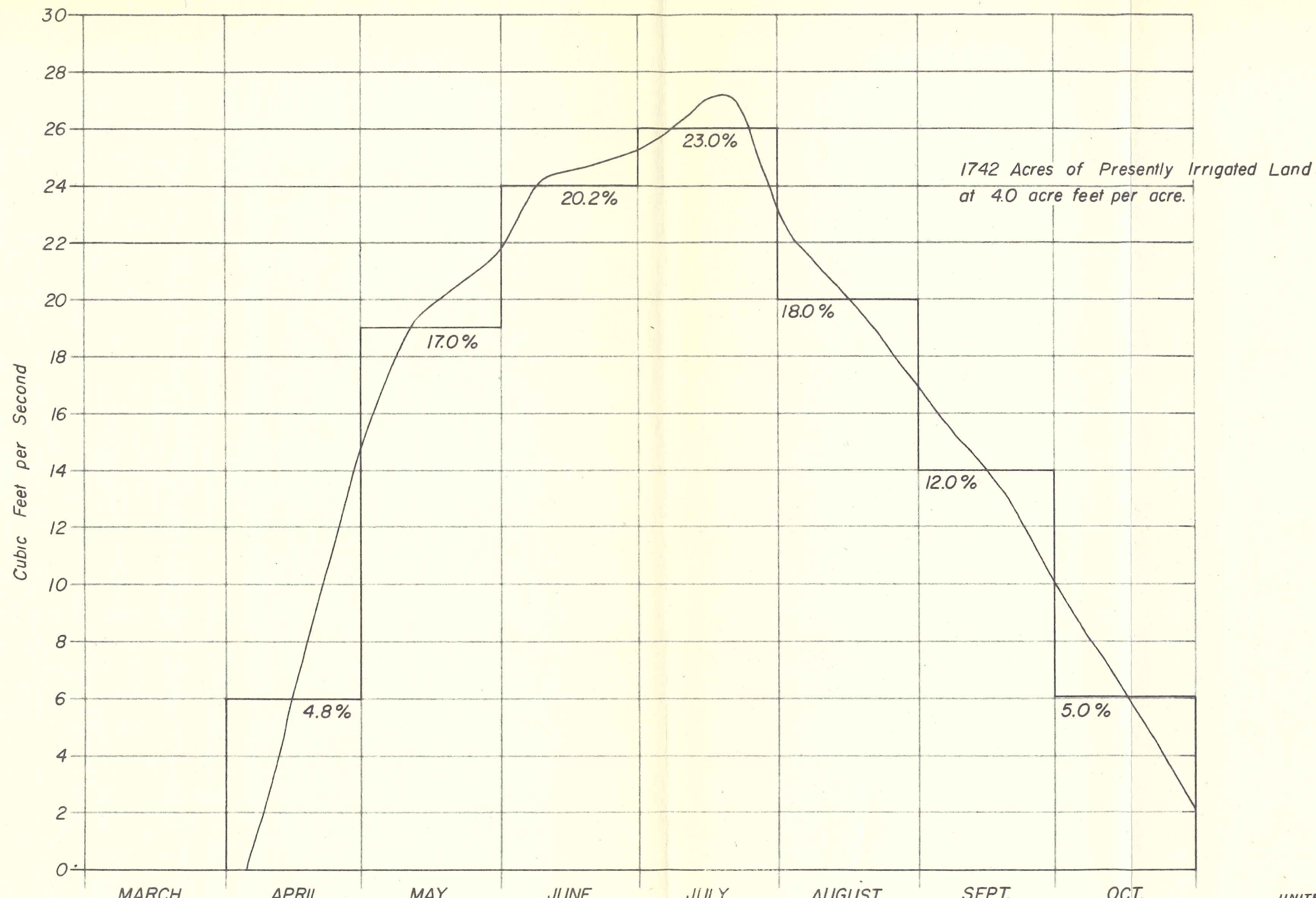
A similar exchange would be made with water from the Oaks Park Reservoir on Brush Creek. Stockholders in the company which owns Oaks Park are located both above and below the Stanaker Service Canal. To make most efficient use of the available water supply, the Oaks Park water would be delivered to land above the Service Canal, and an exchange release made from Stanaker Reservoir.

## Ashley Creek Water Available for Vernal Unit

This is the flow of Ashley Creek at "Sign of the Maine" (not including Oaks Park Reservoir water) which is in excess of the average irrigation demand for presently irrigated land under the Highline, Ashley Upper, Ashley Central, Rock Point, Island and Dodds canals, limited during the high runoff period to a beneficial use rate of 4.0 acre-feet per acre per year, allowing 4.8% of this amount to be diverted in April, 17.0% in May, and 20.2% in June provided the water is available. The available water includes nonirrigation season runoff of Ashley Creek, which would be made available by supplying nonirrigation season stockwater needs through the proposed water-savings pipe system. Deliveries from the pipe system would be small in comparison to present deliveries accomplished by the wasteful practices of diverting the entire flow of Ashley Creek into the canals throughout the nonirrigation season. Water available to Vernal unit is assured by contracts with the major canal companies restricting their use of water to the 4 acre-feet per acre annual rate during the flood season.

For determining the water available for the unit, the Vernal unit acreage was considered in two areas: land under the Highline Canal, and land under the other 5 canals combined. For each area the average irrigation demand in cubic feet per second was determined on a daily basis for the irrigation season. This was accomplished by drawing in the monthly irrigation demand in block form in accordance with the monthly percentages given above, then sketching in a daily demand curve as shown on the drawing for the Highline Canal in Figure 4. The curve was varied until the sum of the daily demands equalled the total demand for the month.

Figure 5 illustrates the method of determing the flow in excess of the average irrigation demand. Beginning in April, when the irrigation



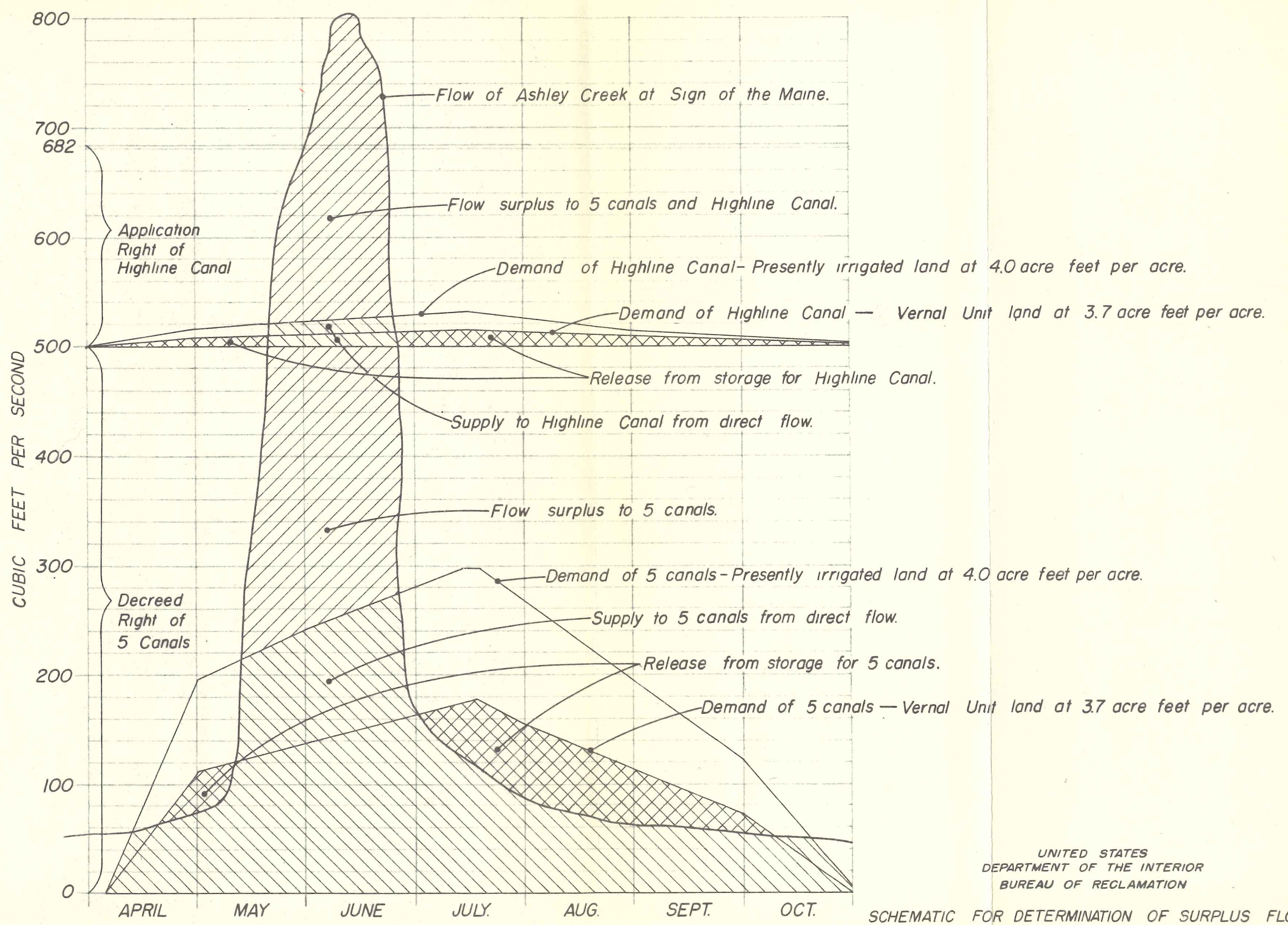

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

AVERAGE IRRIGATION DEMAND
HIGHLINE CANAL

DECEMBER 14, 1956



FIGURE 4




UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

SCHEMATIC FOR DETERMINATION OF SURPLUS FLOWS
ASHLEY CREEK AT SIGN OF THE MAINE
NOVEMBER 15, 1956



FIGURE 5

season normally begins, irrigators under the 5 lower canals would take all the flow of Ashley Creek until the flow exceeded the 4.0 acre-foot per acre demand line for the presently irrigated land. The flow above that demand line and below 500 cfs would be available for diversion to Stanaker Reservoir under Vernal unit operation. When the stream flow reaches 500 cfs, the rights of Highline Canal users become effective, and they would be entitled to the flow between 500 cfs and their 4.0 acre-foot per acre demand line for the presently irrigated land. Flow exceeding that demand line would be available for diversion by Vernal Unit, along with the excess flow available from the 5 lower canals. When Ashley Creek flows during the irrigation season were less than the 3.7 acre-feet per acre demand of the Vernal unit land in each area, reservoir water would be released to supply the demand up to the 3.7 acre-foot demand line. Table 37 illustrates further the determination of Ashley Creek flow available for Vernal unit for the years 1952, 1953, and 1954. Water available for Vernal unit from 1925-1956 is summarized in Table 38.

All of the water available to Vernal unit would not be diverted to Stanaker Reservoir. Flows in excess of the Stanaker Feeder canal capacity would be by-passed at the Fort Thornburgh diversion dam, and future municipal diversions would be made at Ashley Springs above the diversion point. A portion of these municipal diversions would be flow available to Vernal unit, and the remainder would be made at times when no water was available for Vernal unit, and would be replaced from Stanaker Reservoir.

## Vernal Unit Water Divertible

That portion of the Ashley Creek flow available for Vernal unit, which could be diverted to Stanaker Reservoir by Stanaker Feeder Canal in accordance with the contracts with the canal companies has been termed the divertible flow. It was determined for the high water period utilizing mean daily flows.

Diurnal fluctuations of stream flow would cause spilling at the diversion dam when the mean daily flow was the same, or nearly the same, as the canal capacity. To account for such spills, the divertible flow was determined for the 400 c.f.s. Feeder Canal in accordance with the following schedule:

| Mean Daily Flow | | |
|---|---|---|
| From | To | Divertible Flow |
| 0 | 300 | Mean daily flow |
| 301 | 500 | 75% of mean daily flow |
| 501 | up | 400 c.f.s. |

Table 39 summarizes the divertible flow of Ashley Creek at "Sign of the Maine".

Table 37
DETERMINATION OF ASHLEY CREEK FLOW
Available to Vernal Unit
1952, 1953, and 1954

April 1952

| Day | Ashley Creek Sign of the Maine | Five Canals: Demand | Five Canals: Divert to Five Canals | Five Canals: Available to Vernal Unit (Below 500 cfs) | Flow Above 500 cfs | Highline Canal: Demand | Highline Canal: Divert to Highline Canal | Highline Canal: Available to Vernal Unit | Total Available to Vernal Unit |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1 | 34 | 0 | | 34 | | 0 | | | 34 |
| 2 | 33 | 0 | | 33 | | 0 | | | 33 |
| 3 | 34 | 0 | | 34 | | 0 | | | 34 |
| 4 | 40 | 0 | | 40 | | 0 | | | 40 |
| 5 | 47 | 0 | | 47 | | 0 | | | 47 |
| 6 | 55 | 2 | 2 | 53 | | 0 | | | 53 |
| 7 | 57 | 6 | 6 | 51 | | 1 | | | 51 |
| 8 | 56 | 10 | 10 | 46 | | 1 | | | 46 |
| 9 | 48 | 13 | 13 | 35 | | 2 | | | 35 |
| 10 | 43 | 18 | 18 | 25 | | 2 | | | 25 |
| 11 | 48 | 23 | 23 | 25 | | 3 | | | 25 |
| 12 | 44 | 27 | 27 | 17 | | 3 | | | 17 |
| 13 | 43 | 31 | 31 | 12 | | 4 | | | 12 |
| 14 | 43 | 35 | 35 | 8 | | 5 | | | 8 |
| 15 | 47 | 40 | 40 | 7 | | 5 | | | 7 |
| 16 | 40 | 46 | 40 | | | 6 | | | |
| 17 | 38 | 50 | 38 | | | 6 | | | |
| 18 | 41 | 53 | 41 | | | 7 | | | |
| 19 | 44 | 58 | 44 | | | 7 | | | |
| 20 | 53 | 75 | 53 | | | 8 | | | |
| 21 | 60 | 77 | 60 | | | 8 | | | |
| 22 | 55 | 90 | 55 | | | 9 | | | |
| 23 | 53 | 101 | 53 | | | 9 | | | |
| 24 | 55 | 113 | 55 | | | 10 | | | |
| 25 | 65 | 136 | 65 | | | 11 | | | |
| 26 | 87 | 148 | 87 | | | 11 | | | |
| 27 | 151 | 161 | 151 | | | 12 | | | |
| 28 | 194 | 172 | 172 | 22 | | 12 | | | 22 |
| 29 | 214 | 186 | 186 | 28 | | 13 | | | 28 |
| 30 | 244 | 200 | 200 | 44 | | 14 | | | 44 |
| Total | 2066 | 1871 | 1505 | 561 | | 169 | | | 561 |
| A. F. | 3932 | | 2865 | | | | 0 | | 1068 |
| 1000 AF | 3.9 | | 2.9 | | | | 0 | | 1.1 |

Explanation:

Col. 3 Equal to or less than Col. 2.
Col. 4 Col. 1 minus Col. 3 when Col. 1 is 500 cfs or less; 500 cfs minus Col. 3 when Col. 1 is greater than 500 cfs.
Col. 5 Col. 1 minus 500 cfs.
Col. 7 Equal to or less than Col. 6.
Col. 8 Col. 5 minus Col. 7.
Col. 9 Col. 4 plus Col. 8.

Table 37
DETERMINATION OF ASHLEY CREEK FLOW
Available to Vernal Unit
1952, 1953, and 1954

May 1952

| Day | Ashley Creek Sign of the Maine | Five Canals: Demand | Five Canals: Divert to Five Canals | Five Canals: Available to Vernal Unit (Below 500 cfs) | Flow Above 500 cfs | Highline Canal: Demand | Highline Canal: Divert to High-line Canal | Highline Canal: Avail-able to Vernal Unit | Total Avail-able to Vernal Unit |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1 | 292 | 200 | 200 | 92 | | 15 | | | 92 |
| 2 | 370 | 200 | 200 | 170 | | 15 | | | 170 |
| 3 | 611 | 201 | 201 | 299 | 111 | 16 | 16 | 95 | 394 |
| 4 | 889 | 201 | 201 | 299 | 389 | 16 | 16 | 373 | 672 |
| 5 | 1070 | 201 | 201 | 299 | 570 | 17 | 17 | 553 | 852 |
| 6 | 1230 | 201 | 201 | 299 | 730 | 17 | 17 | 713 | 1012 |
| 7 | 1230 | 201 | 201 | 299 | 730 | 18 | 18 | 712 | 1011 |
| 8 | 1140 | 201 | 201 | 299 | 640 | 18 | 18 | 622 | 921 |
| 9 | 940 | 201 | 201 | 299 | 440 | 18 | 18 | 422 | 721 |
| 10 | 730 | 201 | 201 | 299 | 230 | 19 | 19 | 211 | 510 |
| 11 | 647 | 202 | 202 | 298 | 147 | 19 | 19 | 128 | 426 |
| 12 | 714 | 203 | 203 | 297 | 214 | 19 | 19 | 195 | 492 |
| 13 | 947 | 204 | 204 | 296 | 447 | 19 | 19 | 428 | 724 |
| 14 | 1090 | 207 | 207 | 293 | 590 | 20 | 20 | 570 | 863 |
| 15 | 1040 | 208 | 208 | 292 | 540 | 20 | 20 | 520 | 812 |
| 16 | 763 | 210 | 210 | 290 | 263 | 20 | 20 | 243 | 533 |
| 17 | 590 | 212 | 212 | 288 | 90 | 20 | 20 | 70 | 358 |
| 18 | 500 | 216 | 216 | 284 | | 20 | | | 284 |
| 19 | 479 | 218 | 218 | 261 | | 20 | | | 261 |
| 20 | 558 | 220 | 220 | 280 | 58 | 20 | 20 | 38 | 318 |
| 21 | 558 | 223 | 223 | 277 | 58 | 20 | 20 | 38 | 315 |
| 22 | 496 | 224 | 224 | 272 | | 21 | | | 272 |
| 23 | 450 | 225 | 225 | 225 | | 21 | | | 225 |
| 24 | 467 | 226 | 226 | 241 | | 21 | | | 241 |
| 25 | 548 | 227 | 227 | 273 | 48 | 21 | 21 | 27 | 300 |
| 26 | 642 | 228 | 228 | 272 | 142 | 21 | 21 | 121 | 393 |
| 27 | 657 | 229 | 229 | 271 | 157 | 21 | 21 | 136 | 407 |
| 28 | 746 | 230 | 230 | 270 | 246 | 21 | 21 | 225 | 495 |
| 29 | 953 | 232 | 232 | 268 | 453 | 21 | 21 | 432 | 700 |
| 30 | 1050 | 235 | 235 | 265 | 550 | 21 | 21 | 529 | 794 |
| 31 | 1080 | 238 | 238 | 262 | 580 | 22 | 22 | 558 | 820 |
| Total | 23477 | 6625 | 6625 | 8429 | | 597 | 464 | 7959 | 16388 |
| A. F. | 44688 | | 12610 | | | | 883 | | 31194 |
| 1000 AF | 44.7 | | 12.6 | | | | 0.9 | | 31.2 |

Explanation:

Col. 3 Equal to or less than Col. 2.
Col. 4 Col. 1 minus Col. 3 when Col. 1 is 500 cfs or less; 500 cfs minus Col. 3 when Col. 1 is greater than 500 cfs.
Col. 5 Col. 1 minus 500 cfs.
Col. 7 Equal to or less than Col. 6.
Col. 8 Col. 5 minus Col. 7.
Col. 9 Col. 4 plus Col. 8.

Table 37
DETERMINATION OF ASHLEY CREEK FLOW
Available to Vernal Unit
1952, 1953, and 1954

June 1952

| Day | Ashley Creek Sign of the Maine | Five Canals: Demand | Five Canals: Divert to Five Canals | Five Canals: Available to Vernal Unit (Below 500 cfs) | Flow Above 500 cfs | Highline Canal: Demand | Highline Canal: Divert to High-line Canal | Highline Canal: Avail-able to Vernal Unit | Total Avail-able to Vernal Unit |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1 | 1090 | 238 | 238 | 262 | 590 | 22 | 22 | 568 | 830 |
| 2 | 1090 | 242 | 242 | 258 | 590 | 22 | 22 | 568 | 826 |
| 3 | 1240 | 244 | 244 | 256 | 740 | 22 | 22 | 718 | 974 |
| 4 | 1260 | 245 | 245 | 255 | 760 | 22 | 22 | 738 | 993 |
| 5 | 1260 | 246 | 246 | 254 | 760 | 22 | 22 | 738 | 992 |
| 6 | 1300 | 248 | 248 | 252 | 800 | 23 | 23 | 777 | 1029 |
| 7 | 1210 | 249 | 249 | 251 | 710 | 23 | 23 | 687 | 938 |
| 8 | 1040 | 251 | 251 | 249 | 540 | 23 | 23 | 517 | 766 |
| 9 | 934 | 252 | 252 | 248 | 434 | 23 | 23 | 411 | 659 |
| 10 | 914 | 254 | 254 | 246 | 414 | 23 | 23 | 391 | 637 |
| 11 | 719 | 254 | 254 | 246 | 219 | 23 | 23 | 196 | 442 |
| 12 | 647 | 256 | 256 | 244 | 147 | 24 | 24 | 123 | 367 |
| 13 | 576 | 259 | 259 | 241 | 76 | 24 | 24 | 52 | 293 |
| 14 | 513 | 260 | 260 | 240 | 13 | 24 | 13 | | 240 |
| 15 | 467 | 262 | 262 | 205 | | 24 | | | 205 |
| 16 | 411 | 264 | 264 | 147 | | 24 | | | 147 |
| 17 | 366 | 265 | 265 | 101 | | 24 | | | 101 |
| 18 | 338 | 266 | 266 | 72 | | 24 | | | 72 |
| 19 | 308 | 268 | 268 | 40 | | 24 | | | 40 |
| 20 | 295 | 270 | 270 | 25 | | 24 | | | 25 |
| 21 | 273 | 271 | 271 | 2 | | 24 | | | 2 |
| 22 | 252 | 273 | 252 | | | 24 | | | |
| 23 | 238 | 274 | 238 | | | 24 | | | |
| 24 | 331 | 276 | 276 | 55 | | 24 | | | 55 |
| 25 | 366 | 277 | 277 | 89 | | 25 | | | 89 |
| 26 | 411 | 279 | 279 | 132 | | 25 | | | 132 |
| 27 | 442 | 280 | 280 | 162 | | 25 | | | 162 |
| 28 | 399 | 282 | 282 | 117 | | 25 | | | 117 |
| 29 | 305 | 284 | 284 | 21 | | 25 | | | 21 |
| 30 | 282 | 284 | 282 | | | 25 | | | |
| Total | 19277 | 7873 | 7814 | 4670 | | 710 | 309 | 6484 | 11154 |
| A. F. | 36693 | | 14874 | | | | 588 | | 21231 |
| 1000 AF | 36.7 | | 14.9 | | | | 0.6 | | 21.2 |

Explanation:

Col. 3 Equal to or less than Col. 2.
Col. 4 Col. 1 minus Col. 3 when Col. 1 is 500 cfs or less;
500 cfs minus Col. 3 when Col. 1 is greater than 500 cfs.
Col. 5 Col. 1 minus 500 cfs.
Col. 7 Equal to or less than Col. 6.
Col. 8 Col. 5 minus Col. 7.
Col. 9 Col. 4 plus Col. 8.

Table 37
DETERMINATION OF ASHLEY CREEK FLOW
Available to Vernal Unit
1952, 1953, and 1954

April 1953

| Day | Ashley Creek Sign of the Maine | Five Canals: Demand | Five Canals: Divert to Five Canals | Five Canals: Available to Vernal Unit (Below 500 cfs) | Flow Above 500 cfs | Highline Canal: Demand | Highline Canal: Divert to Highline Canal | Highline Canal: Available to Vernal Unit | Total Available to Vernal Unit |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1 | 32 | 0 | | 32 | | 0 | | | 32 |
| 2 | 31 | 0 | | 31 | | 0 | | | 31 |
| 3 | 31 | 0 | | 31 | | 0 | | | 31 |
| 4 | 31 | 0 | | 31 | | 0 | | | 31 |
| 5 | 31 | 0 | | 31 | | 0 | | | 31 |
| 6 | 31 | 2 | 2 | 29 | | 0 | | | 29 |
| 7 | 31 | 6 | 6 | 25 | | 1 | | | 25 |
| 8 | 30 | 10 | 10 | 20 | | 1 | | | 20 |
| 9 | 29 | 13 | 13 | 16 | | 2 | | | 16 |
| 10 | 31 | 18 | 18 | 13 | | 2 | | | 13 |
| 11 | 31 | 23 | 23 | 8 | | 3 | | | 8 |
| 12 | 31 | 27 | 27 | 4 | | 3 | | | 4 |
| 13 | 29 | 31 | 29 | | | 4 | | | |
| 14 | 30 | 35 | 30 | | | 5 | | | |
| 15 | 28 | 40 | 28 | | | 5 | | | |
| 16 | 28 | 46 | 28 | | | 6 | | | |
| 17 | 29 | 50 | 29 | | | 6 | | | |
| 18 | 28 | 53 | 28 | | | 7 | | | |
| 19 | 28 | 58 | 28 | | | 7 | | | |
| 20 | 28 | 75 | 28 | | | 8 | | | |
| 21 | 29 | 77 | 29 | | | 8 | | | |
| 22 | 31 | 90 | 31 | | | 9 | | | |
| 23 | 35 | 101 | 35 | | | 9 | | | |
| 24 | 40 | 113 | 40 | | | 10 | | | |
| 25 | 42 | 136 | 42 | | | 11 | | | |
| 26 | 46 | 148 | 46 | | | 11 | | | |
| 27 | 60 | 161 | 60 | | | 12 | | | |
| 28 | 72 | 172 | 72 | | | 12 | | | |
| 29 | 66 | 186 | 66 | | | 13 | | | |
| 30 | 62 | 200 | 62 | | | 14 | | | |
| Total | 1081 | 1871 | 810 | 271 | | 169 | | | 271 |
| A. F. | 2058 | | 1542 | | | | 0 | | 516 |
| 1000 AF | 2.1 | | 1.5 | | | | 0 | | 0.5 |

Explanation:

Col. 3 Equal to or less than Col. 2.
Col. 4 Col. 1 minus Col. 3 when Col. 1 is 500 cfs or less;
500 cfs minus Col. 3 when Col. 1 is greater than 500 cfs.
Col. 5 Col. 1 minus 500 cfs.
Col. 7 Equal to or less than Col. 6.
Col. 8 Col. 5 minus Col. 7.
Col. 9 Col. 4 plus Col. 8.

Table 37
DETERMINATION OF ASHLEY CREEK FLOW
Available to Vernal Unit
1952, 1953, and 1954

May 1953

| Day | Ashley Creek Sign of the Maine | Five Canals: Demand | Five Canals: Divert to Five Canals | Five Canals: Available to Vernal Unit (Below 500 cfs) | Flow Above 500 cfs | Highline Canal: Demand | Highline Canal: Divert to High-line Canal | Highline Canal: Avail-able to Vernal Unit | Total Avail-able to Vernal Unit |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1 | 57 | 200 | 57 | | | 15 | | | |
| 2 | 51 | 200 | 51 | | | 15 | | | |
| 3 | 48 | 201 | 48 | | | 16 | | | |
| 4 | 47 | 201 | 47 | | | 16 | | | |
| 5 | 44 | 201 | 44 | | | 17 | | | |
| 6 | 46 | 201 | 46 | | | 17 | | | |
| 7 | 53 | 201 | 53 | | | 18 | | | |
| 8 | 67 | 201 | 67 | | | 18 | | | |
| 9 | 76 | 201 | 76 | | | 18 | | | |
| 10 | 69 | 201 | 69 | | | 19 | | | |
| 11 | 71 | 202 | 71 | | | 19 | | | |
| 12 | 68 | 203 | 68 | | | 19 | | | |
| 13 | 63 | 204 | 63 | | | 19 | | | |
| 14 | 62 | 207 | 62 | | | 20 | | | |
| 15 | 58 | 208 | 58 | | | 20 | | | |
| 16 | 62 | 210 | 62 | | | 20 | | | |
| 17 | 64 | 212 | 64 | | | 20 | | | |
| 18 | 84 | 216 | 84 | | | 20 | | | |
| 19 | 103 | 218 | 103 | | | 20 | | | |
| 20 | 129 | 220 | 129 | | | 20 | | | |
| 21 | 140 | 223 | 140 | | | 20 | | | |
| 22 | 185 | 224 | 185 | | | 21 | | | |
| 23 | 188 | 225 | 188 | | | 21 | | | |
| 24 | 319 | 226 | 226 | 93 | | 21 | | | 93 |
| 25 | 256 | 227 | 227 | 29 | | 21 | | | 29 |
| 26 | 287 | 228 | 228 | 59 | | 21 | | | 59 |
| 27 | 256 | 229 | 229 | 27 | | 21 | | | 27 |
| 28 | 404 | 230 | 230 | 174 | | 21 | | | 174 |
| 29 | 392 | 232 | 232 | 160 | | 21 | | | 160 |
| 30 | 316 | 235 | 235 | 81 | | 21 | | | 81 |
| 31 | 382 | 238 | 238 | 144 | | 22 | | | 144 |
| Total | 4447 | 6625 | 3680 | 767 | | 597 | | | 767 |
| A. F. | 8465 | | 7005 | | | | 0 | | 1460 |
| 1000 AF | 8.5 | | 7.0 | | | | 0 | | 1.5 |

Explanation:

Col. 3 Equal to or less than Col. 2.
Col. 4 Col. 1 minus Col. 3 when Col. 1 is 500 cfs or less;
500 cfs minus Col. 3 when Col. 1 is greater than 500 cfs.
Col. 5 Col. 1 minus 500 cfs.
Col. 7 Equal to or less than Col. 6.
Col. 8 Col. 5 minus Col. 7.
Col. 9 Col. 4 plus Col. 8.

Table 37
DETERMINATION OF ASHLEY CREEK FLOW
Available to Vernal Unit
1952, 1953, and 1954

June 1953

| Day | Ashley Creek Sign of the Maine | Five Canals: Demand | Five Canals: Divert to Five Canals | Five Canals: Available to Vernal Unit (Below 500 cfs) | Flow Above 500 cfs | Highline Canal: Demand | Highline Canal: Divert to High-line Canal | Highline Canal: Avail-able to Vernal Unit | Total Avail-able to Vernal Unit |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1 | 392 | 238 | 238 | 154 | | 22 | | | 154 |
| 2 | 338 | 242 | 242 | 96 | | 22 | | | 96 |
| 3 | 332 | 244 | 244 | 88 | | 22 | | | 88 |
| 4 | 332 | 245 | 245 | 87 | | 22 | | | 87 |
| 5 | 374 | 246 | 246 | 128 | | 22 | | | 128 |
| 6 | 354 | 248 | 248 | 106 | | 23 | | | 106 |
| 7 | 436 | 249 | 249 | 187 | | 23 | | | 187 |
| 8 | 421 | 251 | 251 | 170 | | 23 | | | 170 |
| 9 | 399 | 252 | 252 | 147 | | 23 | | | 147 |
| 10 | 562 | 254 | 254 | 308 | | 23 | | | 308 |
| 11 | 719 | 254 | 254 | 246 | 219 | 23 | 23 | 196 | 442 |
| 12 | 797 | 256 | 256 | 244 | 297 | 24 | 24 | 273 | 517 |
| 13 | 940 | 259 | 259 | 241 | 440 | 24 | 24 | 416 | 657 |
| 14 | 763 | 260 | 260 | 240 | 263 | 24 | 24 | 239 | 479 |
| 15 | 590 | 262 | 262 | 238 | 90 | 24 | 24 | 66 | 304 |
| 16 | 451 | 264 | 264 | 187 | | 24 | | | 187 |
| 17 | 388 | 265 | 265 | 123 | | 24 | | | 123 |
| 18 | 354 | 266 | 266 | 88 | | 24 | | | 88 |
| 19 | 322 | 268 | 268 | 54 | | 24 | | | 54 |
| 20 | 278 | 270 | 270 | 8 | | 24 | | | 8 |
| 21 | 241 | 271 | 241 | | | 24 | | | |
| 22 | 214 | 273 | 214 | | | 24 | | | |
| 23 | 194 | 274 | 194 | | | 24 | | | |
| 24 | 199 | 276 | 199 | | | 24 | | | |
| 25 | 192 | 277 | 192 | | | 25 | | | |
| 26 | 181 | 279 | 181 | | | 25 | | | |
| 27 | 173 | 280 | 173 | | | 25 | | | |
| 28 | 164 | 282 | 164 | | | 25 | | | |
| 29 | 152 | 284 | 152 | | | 25 | | | |
| 30 | 142 | 284 | 142 | | | 25 | | | |
| Total | 11394 | 7873 | 6945 | 3140 | | 710 | 119 | 1190 | 4330 |
| A. F. | 21688 | | 13220 | | | | 227 | | 8242 |
| 1000 AF | 21.7 | | 13.2 | | | | 0.2 | | 8.2 |

Explanation:

Col. 3 Equal to or less than Col. 2.
Col. 4 Col. 1 minus Col. 3 when Col. 1 is 500 cfs or less;
500 cfs minus Col. 3 when Col. 1 is greater than 500 cfs.
Col. 5 Col. 1 minus 500 cfs.
Col. 7 Equal to or less than Col. 6.
Col. 8 Col. 5 minus Col. 7.
Col. 9 Col. 4 plus Col. 8.

Table 37
DETERMINATION OF ASHLEY CREEK FLOW
Available to Vernal Unit
1952, 1953, and 1954

April 1954

| Day | Ashley Creek Sign of the Maine | Five Canals: Demand | Five Canals: Divert to Five Canals | Five Canals: Available to Vernal Unit (Below 500 cfs) | Flow Above 500 cfs | Highline Canal: Demand | Highline Canal: Divert to High-line Canal | Highline Canal: Avail-able to Vernal Unit | Total Avail-able to Vernal Unit |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1 | 22 | | | 22 | | | | | 22 |
| 2 | 22 | | | 22 | | | | | 22 |
| 3 | 22 | | | 22 | | | | | 22 |
| 4 | 22 | | | 22 | | | | | 22 |
| 5 | 22 | | | 22 | | | | | 22 |
| 6 | 23 | 2 | 2 | 21 | | | | | 21 |
| 7 | 22 | 6 | 6 | 16 | | | | | 16 |
| 8 | 21 | 10 | 10 | 11 | | | | | 11 |
| 9 | 20 | 13 | 13 | 7 | | | | | 7 |
| 10 | 21 | 18 | 18 | 3 | | | | | 3 |
| 11 | 21 | 23 | 21 | | | | | | |
| 12 | 21 | 27 | 21 | | | | | | |
| 13 | 22 | 31 | 22 | | | | | | |
| 14 | 23 | 35 | 23 | | | | | | |
| 15 | 25 | 40 | 25 | | | | | | |
| 16 | 25 | 46 | 25 | | | | | | |
| 17 | 26 | 50 | 26 | | | | | | |
| 18 | 28 | 53 | 28 | | | | | | |
| 19 | 34 | 58 | 34 | | | | | | |
| 20 | 42 | 75 | 42 | | | | | | |
| 21 | 49 | 77 | 49 | | | | | | |
| 22 | 62 | 90 | 62 | | | | | | |
| 23 | 76 | 101 | 76 | | | | | | |
| 24 | 92 | 113 | 92 | | | | | | |
| 25 | 123 | 136 | 123 | | | | | | |
| 26 | 125 | 148 | 125 | | | | | | |
| 27 | 130 | 161 | 130 | | | | | | |
| 28 | 170 | 172 | 170 | | | | | | |
| 29 | 170 | 186 | 170 | | | | | | |
| 30 | 148 | 200 | 148 | | | | | | |
| Total | 1629 | 1871 | 1461 | 168 | | | | | 168 |
| A. F. | 3231 | 3711 | 2898 | 333 | | | 0 | | 333 |
| 1000 AF | 3.2 | 3.1 | 2.9 | .3 | | | 0 | | .3 |

Explanation:

Col. 3 Equal to or less than Col. 2.
Col. 4 Col. 1 minus Col. 3 when Col. 1 is 500 cfs or less;
500 cfs minus Col. 3 when Col. 1 is greater than 500 cfs.
Col. 5 Col. 1 minus 500 cfs.
Col. 7 Equal to or less than Col. 6.
Col. 8 Col. 5 minus Col. 7.
Col. 9 Col. 4 plus Col. 8.

Table 37
DETERMINATION OF ASHLEY CREEK FLOW
Available to Vernal Unit
1952, 1953, and 1954

May 1954

| Day | Ashley Creek Sign of the Maine | Five Canals: Demand | Five Canals: Divert to Five Canals | Five Canals: Available to Vernal Unit (Below 500 cfs) | Flow Above 500 cfs | Highline Canal: Demand | Highline Canal: Divert to High-line Canal | Highline Canal: Avail-able to Vernal Unit | Total Avail-able to Vernal Unit |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1 | 127 | 200 | 127 | | | | | | |
| 2 | 116 | 200 | 116 | | | | | | |
| 3 | 108 | 201 | 108 | | | | | | |
| 4 | 125 | 201 | 125 | | | | | | |
| 5 | 177 | 201 | 177 | | | | | | |
| 6 | 221 | 201 | 201 | 20 | | | | | 20 |
| 7 | 304 | 201 | 201 | 103 | | | | | 103 |
| 8 | 371 | 201 | 201 | 170 | | | | | 170 |
| 9 | 428 | 201 | 201 | 227 | | | | | 227 |
| 10 | 432 | 201 | 201 | 231 | | | | | 231 |
| 11 | 382 | 202 | 202 | 180 | | | | | 180 |
| 12 | 428 | 203 | 203 | 225 | | | | | 225 |
| 13 | 467 | 204 | 204 | 263 | | | | | 263 |
| 14 | 487 | 207 | 207 | 280 | | | | | 280 |
| 15 | 496 | 208 | 208 | 288 | | | | | 288 |
| 16 | 455 | 210 | 210 | 245 | | | | | 245 |
| 17 | 451 | 212 | 212 | 239 | | 20 | | | 239 |
| 18 | 487 | 216 | 216 | 271 | | 20 | | | 271 |
| 19 | 558 | 218 | 218 | 282 | 58 | 20 | 20 | 38 | 320 |
| 20 | 540 | 220 | 220 | 280 | 40 | 20 | 20 | 20 | 300 |
| 21 | 599 | 223 | 223 | 277 | 99 | 20 | 20 | 79 | 356 |
| 22 | 826 | 224 | 224 | 276 | 326 | 21 | 21 | 305 | 581 |
| 23 | 576 | 225 | 225 | 275 | 76 | 21 | 21 | 55 | 330 |
| 24 | 432 | 226 | 226 | 206 | | 21 | | | 206 |
| 25 | 399 | 227 | 227 | 172 | | 21 | | | 172 |
| 26 | 371 | 228 | 228 | 143 | | | | | 143 |
| 27 | 313 | 229 | 229 | 84 | | | | | 84 |
| 28 | 278 | 230 | 230 | 48 | | | | | 48 |
| 29 | 259 | 232 | 232 | 27 | | | | | 27 |
| 30 | 248 | 235 | 235 | 13 | | | | | 13 |
| 31 | 262 | 238 | 238 | 24 | | | | | 24 |
| Total | 11723 | 6625 | 6275 | 4849 | 599 | | 102 | 497 | 5346 |
| A. F. | 23252 | 13140 | 12446 | 9618 | 1188 | | 202 | 986 | 10604 |
| 1000 AF | 23.3 | 13.1 | 12.4 | 9.6 | 1.2 | | .2 | 1.0 | 10.6 |

Explanation:

Col. 3 Equal to or less than Col. 2.
Col. 4 Col. 1 minus Col. 3 when Col. 1 is 500 cfs or less;
500 cfs minus Col. 3 when Col. 1 is greater than 500 cfs.
Col. 5 Col. 1 minus 500 cfs.
Col. 7 Equal to or less than Col. 6.
Col. 8 Col. 5 minus Col. 7.
Col. 9 Col. 4 plus Col. 8.

Table 37
DETERMINATION OF ASHLEY CREEK FLOW
Available to Vernal Unit
1952, 1953, and 1954

June 1954

| Day | Ashley Creek Sign of the Maine | Five Canals: Demand | Five Canals: Divert to Five Canals | Five Canals: Available to Vernal Unit (Below 500 cfs) | Flow Above 500 cfs | Highline Canal: Demand | Highline Canal: Divert to High-line Canal | Highline Canal: Avail-able to Vernal Unit | Total Avail-able to Vernal Unit |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1 | 251 | 238 | 238 | 13 | | | | | 13 |
| 2 | 214 | 242 | 214 | | | | | | |
| 3 | 192 | 244 | 192 | | | | | | |
| 4 | 175 | 245 | 175 | | | | | | |
| 5 | 170 | 246 | 170 | | | | | | |
| 6 | 168 | 248 | 168 | | | | | | |
| 7 | 168 | 249 | 168 | | | | | | |
| 8 | 162 | 251 | 162 | | | | | | |
| 9 | 152 | 252 | 152 | | | | | | |
| 10 | 144 | 254 | 144 | | | | | | |
| 11 | 140 | 254 | 140 | | | | | | |
| 12 | 136 | 256 | 136 | | | | | | |
| 13 | 129 | 259 | 129 | | | | | | |
| 14 | 130 | 260 | 130 | | | | | | |
| 15 | 136 | 262 | 136 | | | | | | |
| 16 | 134 | 264 | 134 | | | | | | |
| 17 | 129 | 265 | 129 | | | | | | |
| 18 | 125 | 266 | 125 | | | | | | |
| 19 | 119 | 268 | 119 | | | | | | |
| 20 | 116 | 270 | 116 | | | | | | |
| 21 | 116 | 271 | 116 | | | | | | |
| 22 | 108 | 273 | 108 | | | | | | |
| 23 | 95 | 274 | 95 | | | | | | |
| 24 | 110 | 276 | 110 | | | | | | |
| 25 | 123 | 277 | 123 | | | | | | |
| 26 | 130 | 279 | 130 | | | | | | |
| 27 | 166 | 280 | 166 | | | | | | |
| 28 | 177 | 282 | 177 | | | | | | |
| 29 | 144 | 284 | 144 | | | | | | |
| 30 | 136 | 284 | 136 | | | | | | |
| Total | 4395 | 7873 | 4382 | 13 | | | | | 13 |
| A. F. | 8717 | 15616 | 8692 | 26 | | | 0 | | 26 |
| 1000 AF | 8.7 | 15.6 | 8.7 | | | | 0 | | 0 |

Explanation:

Col. 3 Equal to or less than Col. 2.
Col. 4 Col. 1 minus Col. 3 when Col. 1 is 500 cfs or less;
500 cfs minus Col. 3 when Col. 1 is greater than 500 cfs.
Col. 5 Col. 1 minus 500 cfs.
Col. 7 Equal to or less than Col. 6.
Col. 8 Col. 5 minus Col. 7.
Col. 9 Col. 4 plus Col. 8.

Table 38
Summary of Ashley Creek flow available for Vernal unit
(Unit--1,000 acre-feet)

| Year | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1930 | 2.0 | 4.3 | 3.3 | 3.0 | 2.3 | 2.4 | 2.7 | 17.2 | 10.0 | | | | 47.2 |
| 31 | 1.9 | 3.6 | 3.0 | 2.7 | 2.1 | 2.3 | | 1.2 | | | | | 16.8 |
| 32 | | 2.1 | 2.1 | 2.0 | 2.0 | 2.0 | .5 | 22.1 | 14.0 | | | | 46.8 |
| 33 | | 2.8 | 2.0 | 1.8 | 1.6 | 1.6 | .4 | 4.4 | 13.1 | | | | 27.7 |
| 34 | | 1.8 | 1.7 | 1.6 | 1.4 | 1.5 | .7 | | | | | | 8.7 |
| 1935 | | 2.2 | 2.1 | 1.9 | 1.7 | 1.9 | .5 | 4.0 | 31.7 | | | | 46.0 |
| 36 | | 1.9 | 1.7 | 1.5 | 1.4 | 1.4 | .4 | 2.3 | | | | | 10.6 |
| 37 | | 2.7 | 1.9 | 1.7 | 1.3 | 1.4 | .4 | 32.2 | 9.5 | | | | 51.1 |
| 38 | | 2.3 | 1.9 | 1.7 | 1.4 | 1.6 | .4 | 14.4 | 26.0 | | | | 49.7 |
| 39 | 3.5 | 5.1 | 3.5 | 2.7 | 2.1 | 2.4 | 4.1 | 9.8 | .6 | | | | 33.8 |
| 1940 | 1.9 | 3.4 | 2.4 | 1.8 | 1.4 | 1.5 | 1.2 | 8.5 | | | | | 22.1 |
| 41 | 1.0 | 3.3 | 2.4 | 2.0 | 1.6 | 1.6 | .4 | 32.9 | 23.6 | | | | 68.8 |
| 42 | 7.8 | 6.9 | 4.4 | 2.9 | 2.1 | 2.2 | 2.7 | 18.1 | 25.1 | | | | 72.2 |
| 43 | | 2.4 | 2.1 | 1.8 | 1.5 | 1.6 | 5.5 | 11.3 | 2.7 | | | | 28.9 |
| 44 | | 2.0 | 1.8 | 1.5 | 1.2 | 1.4 | .5 | 27.9 | 48.5 | 1.0 | | | 85.8 |
| 1945 | | 2.2 | 1.8 | 1.7 | 1.5 | 1.6 | .4 | 7.7 | 8.6 | | | | 25.5 |
| 46 | | 2.4 | 2.0 | 1.7 | 1.4 | 1.4 | 3.3 | .6 | | | | | 12.8 |
| 47 | | 3.2 | 2.9 | 2.4 | 1.7 | 2.1 | .7 | 38.0 | 18.2 | | | | 69.2 |
| 48 | | 2.6 | 2.3 | 1.9 | 1.5 | 1.6 | .4 | 21.4 | 5.5 | | | | 37.2 |
| 49 | | 1.7 | 1.6 | 1.4 | 1.2 | 1.3 | .3 | 16.9 | 24.5 | | | | 48.9 |
| 1950 | | 2.8 | 2.2 | 2.0 | 1.7 | 2.0 | .9 | 23.4 | 21.3 | | | | 56.3 |
| 51 | | 2.2 | 2.0 | 1.8 | 1.4 | 1.5 | .3 | 13.3 | 7.5 | | | | 30.0 |
| 52 | | 2.3 | 1.9 | 1.8 | 1.5 | 1.6 | 1.1 | 31.2 | 21.2 | | | | 62.6 |
| 53 | | 2.9 | 2.3 | 2.2 | 1.8 | 2.0 | .5 | 1.5 | 8.2 | | | | 21.4 |
| 54 | | 2.0 | 2.0 | 1.8 | 1.4 | 1.4 | .3 | 10.6 | | | | | 19.5 |
| 1955 | | 2.1 | 1.8 | 1.6 | 1.2 | 1.4 | .4 | 5.8 | | | | | 14.3 |
| 56 | | 1.7 | 1.8 | 1.6 | 1.3 | 1.4 | .3 | 15.4 | 3.7 | | | | 27.2 |
| Total | 18.1 | 74.9 | 60.9 | 52.5 | 42.7 | 46.1 | 29.3 | 392.1 | 323.5 | 1.0 | | | 1,041.1 |
| Mean | .7 | 2.8 | 2.3 | 1.9+ | 1.6 | 1.7 | 1.1 | 14.5 | 11.9 | 0 | | | 38.5 |

Table 39
Vernal unit water divertible to Stanaker Reservoir1/
(Unit--1,000 acre-feet)

| Year | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1930 | 1.2 | 4.3 | 3.3 | 3.0 | 2.3 | 2.4 | 2.7 | 11.5 | 7.8 | | | | 38.5 |
| 31 | 1.9 | 3.6 | 3.0 | 2.7 | 2.1 | 2.3 | | 1.2 | | | | | 16.8 |
| 32 | | 2.1 | 2.1 | 2.0 | 2.0 | 2.0 | .5 | 12.1 | 12.4 | | | | 35.2 |
| 33 | | 2.8 | 2.0 | 1.8 | 1.6 | 1.6 | .4 | 3.1 | 7.6 | | | | 20.9 |
| 34 | | 1.8 | 1.7 | 1.6 | 1.4 | 1.5 | .7 | | | | | | 8.7 |
| 1935 | | 2.2 | 2.1 | 1.9 | 1.7 | 1.9 | .5 | 3.5 | 15.4 | | | | 29.2 |
| 36 | | 1.9 | 1.7 | 1.5 | 1.4 | 1.4 | .4 | 2.3 | | | | | 10.6 |
| 37 | | 2.7 | 1.9 | 1.7 | 1.3 | 1.4 | .4 | 16.5 | 8.6 | | | | 34.5 |
| 38 | | 2.3 | 1.9 | 1.7 | 1.4 | 1.6 | .4 | 9.6 | 14.8 | | | | 33.7 |
| 39 | 2.0 | 5.1 | 3.5 | 2.7 | 2.1 | 2.4 | 3.8 | 8.5 | .6 | | | | 30.7 |
| 1940 | 1.4 | 3.4 | 2.4 | 1.8 | 1.4 | 1.5 | 1.2 | 7.8 | | | | | 20.9 |
| 41 | 1.0 | 3.3 | 2.4 | 2.0 | 1.6 | 1.6 | .4 | 16.8 | 17.2 | | | | 46.3 |
| 42 | 4.5 | 6.9 | 4.4 | 2.9 | 2.1 | 2.2 | 2.7 | 8.2 | 14.0 | | | | 47.9 |
| 43 | | 2.4 | 2.1 | 1.8 | 1.5 | 1.6 | 5.2 | 9.9 | 2.5 | | | | 27.0 |
| 44 | | 2.0 | 1.8 | 1.5 | 1.2 | 1.4 | .5 | 12.6 | 23.5 | .5 | | | 45.0 |
| 1945 | | 2.2 | 1.8 | 1.7 | 1.5 | 1.6 | .4 | 7.7 | 8.0 | | | | 24.9 |
| 46 | | 2.4 | 2.0 | 1.7 | 1.4 | 1.4 | 3.3 | .6 | | | | | 12.8 |
| 47 | | 3.2 | 2.9 | 2.4 | 1.7 | 2.1 | .7 | 21.6 | 15.4 | | | | 50.0 |
| 48 | | 2.6 | 2.3 | 1.9 | 1.5 | 1.6 | .4 | 12.6 | 4.6 | | | | 27.5 |
| 49 | | 1.7 | 1.6 | 1.4 | 1.2 | 1.3 | .3 | 12.6 | 16.4 | | | | 36.5 |
| 1950 | | 2.8 | 2.2 | 2.0 | 1.7 | 2.0 | .9 | 11.4 | 14.3 | | | | 37.3 |
| 51 | | 2.2 | 2.0 | 1.8 | 1.4 | 1.5 | .3 | 7.3 | 7.2 | | | | 23.7 |
| 52 | | 2.3 | 1.9 | 1.8 | 1.5 | 1.6 | 1.1 | 20.1 | 12.5 | | | | 42.8 |
| 53 | | 2.9 | 2.3 | 2.2 | 1.8 | 2.0 | .5 | 1.5 | 7.1 | | | | 20.3 |
| 54 | | 2.0 | 2.0 | 1.8 | 1.4 | 1.4 | .3 | 9.7 | | | | | 18.6 |
| 1955 | | 2.1 | 1.8 | 1.6 | 1.2 | 1.4 | .4 | 5.8 | | | | | 14.3 |
| 56 | | 1.7 | 1.8 | 1.6 | 1.3 | 1.4 | .3 | 13.2 | 3.6 | | | | 24.9 |
| Total | 12.0 | 74.9 | 60.9 | 52.5 | 42.7 | 46.1 | 28.7 | 247.7 | 213.5 | .5 | | 0 | 779.5 |
| Mean | .4 | 2.8 | 2.3 | 1.9 | 1.6 | 1.7 | 1.1 | 9.2 | 7.9 | 0 | | | 28.9 |

1/ Flow available for Vernal unit which may be diverted to Stanaker Reservoir with a capacity of 400 cfs in Stanaker Feeder Canal. Includes surplus water diverted to future municipal use.

This divertible flow does not correspond to the flow diverted to Stanaker Reservoir due to the future municipal diversions made at Ashley Spring upstream from the feeder canal. Part of these diversions would be made at times when flow was available for Vernal unit, and part would require exchange water from Stanaker Reservoir.

## Vernal Unit Operation Study

The operation study for Vernal unit involved Ashley Creek, Oaks Park Reservoir located on Brush Creek, and Stanaker Reservoir. It was based on the 1930 through 1956 period of time. This period begins immediately following the excessively wet years of 1927 through 1929, because it was apparent from the runoff records that the reservoir would have spilled during those years. The excessively dry years of 1931 through 1936 are included in the study period.

To facilitate the study, the Vernal unit land was divided into three areas as follows:

Area 1. Land above Stanaker Service Canal excluding Highline Canal

This area is presently served by each of the 5 canals (Ashley Upper, Ashley Central, Rock Point, Island and Dodds). It cannot be reached directly by releases from Stanaker Reservoir, but would be irrigated by stream flow of Ashley Creek and by releases from Oaks Park Reservoir. It has the first water rights on Ashley Creek, along with Area 3, and these two areas were given the same priority to the use of Ashley Creek water.

Area 2. Land under Highline Canal

Like Area 1, the Highline Canal cannot be served directly from Stanaker Reservoir, but must depend on stream flow of Ashley Creek and Oaks Park Reservoir releases. This area has the junior right on Ashley Creek, and so was given lowest priority to Ashley Creek water. It has equal rights, however, to Oaks Park water, and users under this canal owned 21.6% of Oaks Park stock in 1956.

Area 3. Land below Stanaker Service Canal

This area is also presently served by each of the 5 canals. It can be reached directly by releases from Stanaker Reservoir, and comprises about 63% of the Vernal unit area. Direct flows of Ashley Creek which are owned by users in this area would be used on the two areas above Stanaker Service Canal, and reservoir water would be released in exchange for it. Part of the Oaks Park Reservoir stock is also owned by users in this area. All of the Oaks Park water would be used above the Stanaker Service Canal, and exchange water would be released from Stanaker Reservoir.

Under the operation study, the two upper areas were supplied water first from the direct flow of Ashley Creek to which they were entitled by water rights; second, from Oaks Park Reservoir; and third, by exchange from Stanaker Reservoir by using direct flow of Ashley Creek which was owned by users below Stanaker Service Canal, and which was replaced by Stanaker Reservoir releases. Vernal unit land (Class 1, 2, and 3) and Class 6W land were each allowed their proportionate share of the direct flow of Ashley Creek, but exchange water was supplied only to unit land. Shortages which occurred to both these areas were due either to there not being sufficient water physically available in Ashley Creek to meet the demand, or because there was not sufficient water in Stanaker Reservoir to replace that which was owned by the lower area and may have been used above the service canal, or to both causes.

Land in the River Bottom Area, located along Ashley Creek north of Vernal, was given 300 acre-feet of storage releases from the reservoir. This area, containing 356 productive acres, obtains its present supply from return flows and springs within the area and is in need of late season water.

## Oaks Park Reservoir

This reservoir was operated to supply water to the two areas above Stanaker Service Canal. Flow of Brush Creek at Oaks Park Reservoir, which is inflow to the reservoir, was computed for November through June for the years 1952 to 1956 inclusive, from records of reservoir content and releases. Flow for other years was estimated by correlation with Ashley Creek near Vernal (not including Oaks Park Canal). Storable flow of Brush Creek at Oaks Park Reservoir is given in Table 40. Releases were made for land above the service canal from July through September. Evaporation was considered at the rate of 2. feet per year, and a loss of ten percent was allowed for transmission losses in Oaks Park Canal and Ashley Creek. Oaks Park Reservoir active capacity was rounded to 5,700 acre-feet for purposes of the operation study.

## Stanaker Reservoir Operation

A capacity of 400 second-feet was selected for Stanaker Feeder canal, along with an active capacity of 33,200 acre-feet for Stanaker Reservoir. Releases from Stanaker Reservoir averaged 18,800 acre-feet annually, as follows:

| | | |
|---|---|---|
| Replacement for Oaks Park exchange | 2,200 | acre-feet |
| River Bottom area | 300 | " " |
| Vernal unit land | 16,300 | " " |
| Total release | 18,800 | " " |

Table No. 40
Estimated Storable Flow of Brush Creek at Oaks Park Reservoir
(Unit--1000 a.f.)

| Year | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | Nov.-June Total |
|---|---|---|---|---|---|---|---|---|---|
| 1930 | .6 | .5 | .4 | .3 | .3 | 1.0 | 3.7 | 2.4 | 9.2 |
| 31 | .5 | .4 | .3 | .3 | .3 | .4 | 1.3 | 0.8 | 4.3 |
| 32 | .3 | .3 | .3 | .3 | .3 | .3 | 3.7 | 2.7 | 8.2 |
| 33 | .4 | .3 | .2 | .2 | .2 | .2 | 1.3 | 2.2 | 5.0 |
| 34 | .2 | .2 | .2 | .2 | .1 | .5 | 1.0 | 0.4 | 2.8 |
| 1935 | .3 | .3 | .2 | .2 | .2 | .3 | 1.8 | 4.1 | 7.4 |
| 36 | .2 | .2 | .2 | .2 | .2 | .3 | 1.5 | 0.9 | 3.7 |
| 37 | .4 | .2 | .2 | .2 | .2 | .3 | 4.8 | 2.4 | 8.7 |
| 38 | .3 | .2 | .2 | .2 | .2 | .4 | 3.1 | 3.7 | 8.3 |
| 39 | .7 | .5 | .4 | .3 | .3 | 1.2 | 2.6 | 1.1 | 7.1 |
| 1940 | .5 | .3 | .2 | .2 | .2 | .7 | 2.6 | 1.0 | 5.7 |
| 41 | .5 | .4 | .3 | .2 | .3 | .2 | 4.7 | 3.4 | 10.0 |
| 42 | 1.0 | .6 | .4 | .3 | .3 | .9 | 3.5 | 3.9 | 10.9 |
| 43 | .3 | .2 | .2 | .1 | .2 | 1.3 | 2.5 | 1.6 | 6.4 |
| 44 | .2 | .2 | .2 | .2 | .2 | .2 | 3.5 | 5.5 | 10.2 |
| 1945 | .3 | .2 | .2 | .1 | .2 | .2 | 2.3 | 2.3 | 5.8 |
| 46 | .3 | .2 | .2 | .2 | .2 | 0.9 | 1.3 | 0.8 | 4.1 |
| 47 | .4 | .4 | .3 | .2 | .2 | .6 | 4.9 | 3.1 | 10.1 |
| 48 | .4 | .3 | .3 | .2 | .2 | .3 | 3.7 | 1.9 | 7.3 |
| 49 | .2 | .2 | .2 | .1 | .1 | .4 | 4.2 | 3.6 | 9.0 |
| 1950 | .3 | .3 | .2 | .2 | .2 | .9 | 3.9 | 3.5 | 9.5 |
| 51 | .3 | .3 | .2 | .2 | .2 | .2 | 2.3 | 1.7 | 5.4 |
| 52 | .4 | .3 | .3 | .2 | .2 | .6 | 5.7 | 3.6 | 11.3 |
| 53 | .3 | .3 | .3 | .2 | .2 | .3 | 1.4 | 2.5 | 5.5 |
| 54 | .3 | .2 | .2 | .2 | .2 | .6 | 2.7 | 1.0 | 5.4 |
| 1955 | .3 | .2 | .2 | .1 | .2 | .2 | 2.3 | 1.5 | 5.0 |
| 56 | .3 | .2 | .2 | .2 | .2 | .3 | 3.5 | 1.6 | 6.5 |
| Total | 10.2 | 7.9 | 6.7 | 5.5 | 5.8 | 13.7 | 79.8 | 63.2 | 192.8 |
| Mean | .4 | .3 | .2 | .2 | .2 | .5 | 3.0 | 2.3 | 7.1 |

Vernal Unit shortages

With the total demand averaging 51,700 acre-feet annually, Vernal unit shortages averaged 2,000 acre-feet annually, or 4% of the total demand. The maximum shortage occurred in 1934, and amounted to 23,100 acre-feet, or 45% of the total demand.

Summary

Table 41 is a copy of the Vernal unit operation study by months for the years 1952, 1953, and 1954. An annual summary of the Vernal unit operation study is given in Table 42, and Figure 6 illustrates the behavior of Stanaker Reservoir under the operation study. The water supply of Vernal unit land under Vernal unit conditions is summarized in Table 43.

## Capacity of Stanaker Service Canal

Design capacity of the Stanaker Service Canal was based upon a study of actual diversions made to canals of the Strawberry Valley, Provo River, and Moon Lake projects. Maximum mean daily flows in each canal were expressed as a decimal fraction of the mean monthly flow, for the month of maximum diversion for each year of the 1945 to 1954 period. Results of this study are tabulated below.

| Project | Canal | Max. Mean Daily Flow / Mean Monthly Flow | |
|---|---|---|---|
| Strawberry Valley | Springville-Mapleton | 1.39 | |
| | Highline | 1.39 | |
| | East Bench | 1.55 | |
| | Lake Shore | 1.55 | |
| | Salem | 1.15 | |
| | Average | | 1.41 |
| Provo River | Provo Bench | 1.12 | |
| | Murdock | 1.09 | |
| | West Union | 1.22 | |
| | Provo City | 1.16 | |
| | Average | | 1.15 |
| Moon Lake | U. S. Lakefork | 1.10 | |
| | Red Cap | 1.49 | |
| | Farnsworth | 1.26 | |
| | Dry Gulch No. 1 | 1.27 | |
| | Average | | 1.28 |
| Total | | | 3.84 |
| Average | | | 1.28 |

Table 41
Central Utah Project
Vernal Unit
Operation study for the years 1952, 1953, and 1954

(Units: 1,000 acre-feet)

Columns 1–16: ASHLEY CREEK AT "SIGN OF MAINE" – DIVISION OF STREAMFLOW (1–5) and AVAILABLE FOR VERNAL UNIT (6–8); CLASS 6W LAND (9–13); LAND ABOVE STANAKER SERVICE (EXCLUDING HIGHLINE CANAL) – VERNAL UNIT LAND (14–)

| Year/Month | 1 Total flow | 2 Future increase municipal diversion* | 3 To land above Stanaker Service Canal | 4 To land below Stanaker Service Canal | 5 Highline Canal | 6 Flow in excess of needs 1/ | 7 Diverted 2/ | 8 Bypass 3/ | 9 Demand at 3.7 a.f. per acre | 10 Supply: By direct diversion | 11 Supply: Owned in Oaks Park Reservoir | 12 Shortage 4/ | 13 Excess early water supplied at 4.0 a.f./acre 5/ | 14 Demand at 3.7 a.f./acre | 15 Supply: Direct diversion | 16 Supply: Oaks Park Owned |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1952 Oct. | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 1952 Nov. | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 1952 Dec. | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 1952 Jan. | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 1952 Feb. | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 1952 Mar. | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 1952 Apr. | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 1952 May | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 1952 June | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 1952 July | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 1952 Aug. | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 1952 Sept. | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 1952 Total | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 1953 Oct. | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 1953 Nov. | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 1953 Dec. | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 1953 Jan. | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 1953 Feb. | 1.8 | .1 | | | | 1.7 | 1.7 | | | | | | | | | |
| 1953 Mar. | 2.0 | .1 | | | | 1.9 | 1.9 | | | | | | | | | |
| 1953 Apr. | 2.1 | .1 | .4 | 1.2 | | .4 | .4 | | .2 | .1 | | .1 | | .7 | .3 | |
| 1953 May | 8.8 | .1 | 2.0 | 5.3 | | 1.4 | 1.4 | | .7 | .4 | | .3 | | 2.6 | 1.6 | |
| 1953 June | 22.6 | .2 | 3.9 | 10.3 | .2 | 8.0 | 7.1 | .9 | .8 | .8 | | .0 | | 3.1 | 3.1 | |
| 1953 July | 5.9 | .2 | 1.6 | 4.1 | | | | | .9 | .3 | .1 | .5 | | 3.5 | 1.3 | .3 |
| 1953 Aug. | 2.6 | .2 | .7 | 1.7 | | | | | .7 | .1 | .1 | .5 | | 2.8 | .6 | .3 |
| 1953 Sept. | 1.8 | .1 | .5 | 1.2 | | | | | .4 | .1 | .0 | .3 | | 1.8 | .4 | .2 |
| 1953 Total | 58.1 | 1.5 | 9.9 | 26.0 | .2 | 20.5 | 19.6 | .9 | 3.9 | 1.9 | .2 | 1.8 | | 15.3 | 8.0 | .8 |
| 1954 Oct. | 1.8 | .1 | .5 | 1.2 | | | | | .2 | .1 | | .1 | | .8 | .4 | |
| 1954 Nov. | 2.0 | .1 | | | | 1.9 | 1.9 | | | | | | | | | |
| 1954 Dec. | 2.0 | .1 | | | | 1.9 | 1.9 | | | | | | | | | |
| 1954 Jan. | 1.8 | .1 | | | | 1.7 | 1.7 | | | | | | | | | |
| 1954 Feb. | 1.4 | .1 | | | | 1.3 | 1.3 | | | | | | | | | |
| 1954 Mar. | 1.4 | .1 | | | | 1.3 | 1.3 | | | | | | | | | |
| 1954 Apr. | 3.2 | .1 | .8 | 2.1 | | .2 | .2 | | .2 | .2 | | | | .7 | .6 | |
| 1954 May | 23.3 | .1 | 3.4 | 9.1 | .2 | 10.5 | 9.7 | .8 | .7 | .7 | | | | 2.6 | 2.7 | |
| 1954 June | 7.7 | .2 | 2.1 | 5.4 | | | | | .8 | .4 | | .4 | | 3.1 | 1.7 | |
| 1954 July | 4.6 | .2 | 1.2 | 3.2 | | | | | .9 | .2 | .1 | .6 | | 3.5 | 1.0 | .3 |
| 1954 Aug. | 3.0 | .2 | .8 | 2.0 | | | | | .7 | .2 | .1 | .4 | | 2.8 | .6 | .3 |
| 1954 Sept. | 2.2 | .1 | .6 | 1.5 | | | | | .4 | .1 | .0 | .3 | | 1.8 | .5 | .2 |
| 1954 Total | 54.4 | 1.5 | 9.4 | 24.5 | .2 | 18.8 | 18.0 | .8 | 3.9 | 1.9 | .2 | 1.8 | | 15.3 | 7.5 | .8 |

Columns 17–40: LAND ABOVE STANAKER SERVICE (EXCLUDING HIGHLINE CANAL) – VERNAL UNIT LAND (–20) and TOTAL LAND (21–24); LAND UNDER HIGHLAND CANAL – CLASS 6W LAND (25–29), VERNAL UNIT LAND (30–36), TOTAL LAND (37–40)

| Year/Month | 17 Oaks Park exchange 6/ | 18 Vernal unit exchange | 19 Shortage 4/ | 20 Excess early water supplied at 4.0 a.f./acre 5/ | 21 Demand at 3.7 a.f./acre | 22 Supply | 23 Shortage 4/ | 24 Excess early water supplied at 4.0 a.f./acre 5/ | 25 Demand at 3.7 a.f./acre | 26 Supply: Ashley Creek high flows | 27 Supply: Oaks Park water owned | 28 Shortage 4/ | 29 Excess early water supplied at 4.0 a.f./acre 5/ | 30 Demand at 3.7 a.f./acre | 31 Ashley Creek high flows | 32 Oaks Park: Owned | 33 Oaks Park: Exchange 6/ | 34 Vernal unit exchange | 35 Shortage 4/ | 36 Excess early water supplied at 3.0 a.f./acre 5/ | 37 Demand at 3.7 a.f./acre | 38 Supply | 39 Shortage 4/ | 40 Excess early water supplied at 40 a.f./acre 5/ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1952 Oct. | | .2 | | | 1.0 | 1.0 | | | .1 | | | .1 | | .2 | | | | .2 | | | .3 | .2 | .1 | |
| 1952 Nov. | | | | | | | | | | | | | | | | | | | | | | | | |
| 1952 Dec. | | | | | | | | | | | | | | | | | | | | | | | | |
| 1952 Jan. | | | | | | | | | | | | | | | | | | | | | | | | |
| 1952 Feb. | | | | | | | | | | | | | | | | | | | | | | | | |
| 1952 Mar. | | | | | | | | | | | | | | | | | | | | | | | | |
| 1952 Apr. | | .1 | | | .9 | .9 | | | .1 | | | .1 | | .2 | | | | .2 | | | .3 | .2 | .1 | |
| 1952 May | | | | .6 | 3.3 | 4.0 | | .7 | .5 | .4 | | .1 | | .6 | .5 | | | .1 | | | 1.1 | 1.0 | .1 | |
| 1952 June | | | | .5 | 3.9 | 4.5 | | .6 | .6 | .3 | | .3 | | .7 | .3 | | | .4 | | | 1.3 | 1.0 | .3 | |
| 1952 July | .8 | .3 | | | 4.4 | 4.1 | .3 | | .7 | | .2 | .5 | | .9 | | .2 | .2 | .5 | | | 1.6 | 1.1 | .5 | |
| 1952 Aug. | .0 | | | .0 | 3.5 | 3.5 | | .0 | .5 | | .1 | .4 | | .7 | | .1 | .3 | .3 | | | 1.2 | .8 | .4 | |
| 1952 Sept. | .3 | | | .0 | 2.2 | 2.2 | | .0 | .3 | | .2 | .1 | | .4 | | .2 | .2 | | | | .7 | .6 | .1 | |
| 1952 Total | [illegible] | .6 | | 1.1 | 19.2 | 20.2 | .3 | 1.3 | 2.8 | .7 | .5 | 1.6 | | 3.7 | .8 | .5 | .7 | 1.7 | | | 6.5 | 4.9 | 1.6 | |
| 1953 Oct. | | .1 | | | 1.0 | .9 | .1 | | .1 | | | .1 | | .2 | | | | .2 | | | .3 | .2 | .1 | |
| 1953 Nov. | | | | | | | | | | | | | | | | | | | | | | | | |
| 1953 Dec. | | | | | | | | | | | | | | | | | | | | | | | | |
| 1953 Jan. | | | | | | | | | | | | | | | | | | | | | | | | |
| 1953 Feb. | | | | | | | | | | | | | | | | | | | | | | | | |
| 1953 Mar. | | | | | | | | | | | | | | | | | | | | | | | | |
| 1953 Apr. | | .4 | | | .9 | .8 | .1 | | .1 | | | .1 | | .2 | | | | .2 | | | .3 | .2 | .1 | |
| 1953 May | | 1.0 | | | 3.3 | 3.0 | .3 | | .5 | | | .5 | | .6 | | | | .6 | | | 1.1 | .6 | .5 | |
| 1953 June | | | | | 3.9 | 3.9 | .0 | | .6 | .1 | | .5 | | .7 | .1 | | | .6 | | | 1.3 | .8 | .5 | |
| 1953 July | .8 | 1.1 | | | 4.4 | 3.9 | .5 | | .7 | | .2 | .5 | | .9 | | .2 | .2 | .5 | | | 1.6 | 1.1 | .5 | |
| 1953 Aug. | .8 | 1.1 | | | 3.5 | 3.0 | .5 | | .5 | | .2 | .3 | | .7 | | .2 | .2 | .3 | | | 1.2 | .9 | .3 | |
| 1953 Sept. | .3 | .9 | | | 2.2 | 1.9 | .3 | | .3 | | .1 | .2 | | .4 | | .1 | .1 | .2 | | | .7 | .5 | .2 | |
| 1953 Total | 1.9 | 4.6 | | | 19.2 | 17.4 | 1.8 | | 2.8 | .1 | .5 | 2.2 | | 3.7 | .1 | .5 | .5 | 2.6 | | | 6.5 | 4.3 | 2.2 | |
| 1954 Oct. | | .4 | | | 1.0 | .9 | .1 | | .1 | | | .1 | | .2 | | | | .2 | | | .3 | .2 | .1 | |
| 1954 Nov. | | | | | | | | | | | | | | | | | | | | | | | | |
| 1954 Dec. | | | | | | | | | | | | | | | | | | | | | | | | |
| 1954 Jan. | | | | | | | | | | | | | | | | | | | | | | | | |
| 1954 Feb. | | | | | | | | | | | | | | | | | | | | | | | | |
| 1954 Mar. | | | | | | | | | | | | | | | | | | | | | | | | |
| 1954 Apr. | | .1 | | | .9 | .9 | | | .1 | | | .1 | | .2 | | | | .2 | | | .3 | .2 | .1 | |
| 1954 May | | | | .1 | 3.3 | 3.4 | | .1 | .5 | .1 | | .4 | | .6 | .1 | | | .5 | | | 1.1 | .7 | .4 | |
| 1954 June | | 1.4 | | | 3.9 | 3.5 | .4 | | .6 | | | .6 | | .7 | | | | .7 | | | 1.3 | .7 | .6 | |
| 1954 July | .8 | 1.4 | | | 4.4 | 3.8 | .6 | | .7 | | .2 | .5 | | .9 | | .2 | .2 | .5 | | | 1.6 | 1.1 | .5 | |
| 1954 Aug. | .8 | 1.1 | | | 3.5 | 3.1 | .4 | | .5 | | .2 | .3 | | .7 | | .2 | .2 | .3 | | | 1.2 | .9 | .3 | |
| 1954 Sept. | .2 | .9 | | | 2.2 | 1.9 | .3 | | .3 | | .0 | .3 | | .4 | | .1 | | .3 | | | .7 | .3 | .4 | |
| 1954 Total | 1.8 | 5.3 | | .1 | 19.2 | 17.5 | 1.8 | .1 | 2.8 | .1 | .4 | 2.3 | | 3.7 | .1 | .5 | .4 | 2.7 | | | 6.5 | 4.1 | 2.4 | |

Columns 41–62: OAKS PARK RESERVOIR (41–50, RELEASES 43–47); LAND BELOW STANAKER SERVICE CANAL – CLASS 6W LAND (51–59), VERNAL UNIT LAND (60–)

| Year/Month | 41 Flow of Brush Creek (inflow) | 42 Evaporation | 43 To Highline Canal | 44 To land above Stanaker Service Canal | 45 Exchange to land above Stanaker Service Canal 6/ | 46 To land below Stanaker Service Canal | 47 Total releases | 48 Conveyance loss | 49 Spill | 50 Active reservoir content at end of month | 51 Ashley Creek exchange water: Available 7/ | 52 Used above Service Canal | 53 Demand at 3.7 a.f./acre | 54 Oaks Park water owned | 55 Total owned | 56 Ashley Creek direct flow: Used below Stanaker Service Canal | 57 Exchanged to land above Stanaker Service Canal | 58 Shortages 4/ | 59 Excess early water supplied at 4.0 a.f./acre 5/ | 60 Demand at 3.7 a.f./acre | 61 Oaks Park water owned | 62 Total owned |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1952 Oct. | | | | | | | | | | .0 | 2.1 | .4 | .9 | | .8 | .8 | | .1 | | 1.6 | | 1.3 |
| 1952 Nov. | .4 | | | | | | | | | .4 | | | | | | | | | | | | |
| 1952 Dec. | .3 | | | | | | | | | .7 | | | | | | | | | | | | |
| 1952 Jan. | .3 | | | | | | | | | 1.0 | | | | | | | | | | | | |
| 1952 Feb. | .2 | | | | | | | | | 1.2 | | | | | | | | | | | | |
| 1952 Mar. | .2 | | | | | | | | | 1.4 | | | | | | | | | | | | |
| 1952 Apr. | .6 | .1 | | | | | | | | 1.9 | 2.2 | .3 | .9 | | .8 | .8 | | .1 | | 1.6 | | 1.4 |
| 1952 May | 5.7 | .1 | | | | | | | 1.8 | 5.7 | 10.5 | .1 | 3.2 | | 3.9 | 3.9 | | | .7 | 5.5 | | 6.6 |
| 1952 June | 3.6 | .2 | | | | | | | 3.4 | 5.7 | 11.9 | .4 | 3.8 | | 4.4 | 4.4 | | | .6 | 6.5 | | 7.5 |
| 1952 July | | .2 | .4 | .4 | 1.0 | | 1.8 | .2 | | 3.5 | 6.8 | .8 | 4.3 | .4 | 2.6 | 2.6 | | 1.3 | | 7.5 | .6 | 4.2 |
| 1952 Aug. | | .1 | .2 | .1 | .3 | | .6 | .2 | | 2.6 | 8.9 | .3 | 3.4 | .1 | 3.3 | 3.3 | | | | 5.8 | .2 | 5.6 |
| 1952 Sept. | | .1 | .4 | .4 | .5 | | 1.3 | .2 | | 1.0 | 3.8 | .0 | 2.3 | .4 | 1.4 | 1.4 | | .5 | | 3.9 | .1 | 2.4 |
| 1952 Total | 11.3 | .8 | 1.0 | .9 | 1.8 | | 3.7 | .6 | 5.2 | | 46.2 | 2.3 | 18.8 | .9 | 17.2 | 17.2 | | 2.0 | 1.3 | 32.4 | .9 | 29.0 |
| 1953 Oct. | | | | | | | | | | 1.0 | 2.2 | .3 | .9 | | .8 | .8 | | .1 | | 1.6 | | 1.4 |
| 1953 Nov. | .3 | | | | | | | | | 1.3 | | | | | | | | | | | | |
| 1953 Dec. | .3 | | | | | | | | | 1.6 | | | | | | | | | | | | |
| 1953 Jan. | .3 | | | | | | | | | 1.9 | | | | | | | | | | | | |
| 1953 Feb. | .2 | | | | | | | | | 2.1 | | | | | | | | | | | | |
| 1953 Mar. | .2 | | | | | | | | | 2.3 | | | | | | | | | | | | |
| 1953 Apr. | .3 | .1 | | | | | | | | 2.5 | 1.2 | .6 | .9 | | .4 | .4 | | .5 | | 1.6 | | .8 |
| 1953 May | 1.4 | .1 | | | | | | | | 3.8 | 5.3 | 1.6 | 3.2 | | 2.0 | 2.0 | | 1.2 | | 5.5 | | 3.3 |
| 1953 June | 2.5 | .2 | | | | | | | .4 | 5.7 | 10.3 | .6 | 3.8 | | 3.8 | 3.8 | | | | 6.5 | | 6.5 |
| 1953 July | | .2 | .4 | .4 | 1.0 | | 1.8 | .2 | | 3.5 | 4.1 | 1.6 | 4.3 | .4 | 1.5 | 1.5 | | 2.4 | | 7.5 | .6 | 2.6 |
| 1953 Aug. | | .1 | .4 | .4 | 1.0 | | 1.8 | .2 | | 1.4 | 1.7 | 1.4 | 3.4 | .4 | .6 | .3 | .3 | 2.4 | | 5.8 | .6 | 1.1 |
| 1953 Sept. | | .1 | .2 | .2 | .4 | | .8 | .1 | | .4 | 1.2 | 1.1 | 2.3 | .2 | .4 | .1 | .3 | 1.7 | | 3.9 | .2 | .8 |
| 1953 Total | 5.5 | .8 | 1.0 | 1.0 | 2.4 | | 4.4 | .5 | .4 | | 26.0 | 7.2 | 18.8 | 1.0 | 9.5 | 8.9 | .6 | 8.3 | | 32.4 | 1.4 | 16.5 |
| 1954 Oct. | | | | | | | | | | .4 | 1.2 | .6 | .9 | | .5 | .5 | | .4 | | 1.6 | | .7 |
| 1954 Nov. | .3 | | | | | | | | | .7 | | | | | | | | | | | | |
| 1954 Dec. | .2 | | | | | | | | | .9 | | | | | | | | | | | | |
| 1954 Jan. | .2 | | | | | | | | | 1.1 | | | | | | | | | | | | |
| 1954 Feb. | .2 | | | | | | | | | 1.3 | | | | | | | | | | | | |
| 1954 Mar. | .2 | | | | | | | | | 1.5 | | | | | | | | | | | | |
| 1954 Apr. | .6 | .1 | | | | | | | | 2.0 | 2.1 | .3 | .9 | | .8 | .8 | | .1 | | 1.6 | | 1.3 |
| 1954 May | 2.7 | .1 | | | | | | | | 4.6 | 9.1 | .5 | 3.2 | | 3.4 | 3.4 | | | .2 | 5.5 | | 5.7 |
| 1954 June | 1.0 | .2 | | | | | | | | 5.4 | 5.4 | 2.1 | 3.8 | | 2.0 | 2.0 | | 1.8 | | 6.5 | | 3.4 |
| 1954 July | | .2 | .4 | .4 | 1.0 | | 1.8 | .2 | | 3.2 | 3.2 | 1.9 | 4.3 | .4 | 1.2 | 1.2 | | 2.7 | | 7.5 | .6 | 2.0 |
| 1954 Aug. | | .1 | .4 | .4 | 1.0 | | 1.8 | .2 | | 1.1 | 2.0 | 1.4 | 3.4 | .4 | .7 | .6 | .1 | 2.3 | | 5.8 | .6 | 1.3 |
| 1954 Sept. | | .1 | .1 | .2 | .2 | | .5 | .1 | | .4 | 1.5 | 1.2 | 2.3 | .1 | .6 | .3 | .3 | 1.6 | | 3.9 | .1 | [illegible] |
| 1954 Total | 5.4 | .8 | .9 | 1.0 | 2.2 | | 4.1 | .5 | | | 24.5 | 8.0 | 18.8 | .9 | 9.2 | 8.8 | .4 | 8.9 | .2 | 32.4 | 1.3 | 15.3 |

Columns 63–80: LAND BELOW STANAKER SERVICE CANAL – VERNAL UNIT LAND (–67), TOTAL LAND (68–71); STANAKER RESERVOIR OPERATION (72–79, RELEASES 74–77)

| Year/Month | 63 Ashley Creek direct flow: Used below Stanaker Service Canal | 64 Stanaker Reservoir: Exchanged to land above Stanaker Service Canal | 65 Direct release | 66 Shortage 4/ | 67 Excess early water supplied at 4.0 a.f./acre | 68 Demand at 3.7 a.f./acre | 69 Supply | 70 Shortage 4/ | 71 Excess early water supplied at 4.0 a.f./acre 5/ | 72 Inflow | 73 Evaporation | 74 Replacement for Oaks Park exchange water | 75 Irrigation for River Bottom area | 76 Vernal unit irrigation 8/ | 77 Total releases | 78 Spill | 79 Active content at end of month | 80 Water not used (bypass plus Stanaker Reservoir (spill)) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1952 Oct. | .9 | .4 | .3 | | | 2.5 | 2.4 | .1 | | | .1 | | | .7 | .7 | | 15.7 | |
| 1952 Nov. | | | | | | | | | | 2.2 | | | | | | | 17.9 | |
| 1952 Dec. | | | | | | | | | | 1.8 | | | | | | | 19.7 | |
| 1952 Jan. | | | | | | | | | | 1.7 | | | | | | | 21.4 | |
| 1952 Feb. | | | | | | | | | | 1.4 | | | | | | | 22.8 | |
| 1952 Mar. | | | | | | | | | | 1.5 | .2 | | | | | | 24.1 | |
| 1952 Apr. | 1.1 | .3 | .2 | | | 2.5 | 2.4 | .1 | | 1.0 | .2 | | | .5 | .5 | | 24.4 | |
| 1952 May | 6.5 | .1 | | | 1.1 | 8.7 | 10.5 | | 1.8 | 20.1 | .4 | | | .1 | .1 | 10.8 | 33.2 | 20.6 |
| 1952 June | 7.1 | .4 | | | 1.0 | 10.3 | 11.9 | | 1.6 | 12.5 | .5 | | | .4 | .4 | 11.6 | 33.2 | 19.8 |
| 1952 July | 3.4 | .8 | 2.7 | | | 11.8 | 10.5 | 1.3 | | | .5 | 1.0 | .1 | 3.5 | 4.6 | | 28.1 | |
| 1952 Aug. | 5.3 | .3 | | | | 9.2 | 9.2 | | | | .4 | .3 | .1 | .3 | .7 | | 27.0 | |
| 1952 Sept. | 2.4 | | 1.4 | | | 6.2 | 5.7 | .5 | | | .3 | .5 | .1 | 1.4 | 2.0 | | 24.7 | |
| 1952 Total | 26.7 | 2.3 | 2.6 | | 2.1 | 51.2 | 52.6 | 2.0 | 3.4 | 42.2 | 2.6 | 1.8 | .3 | 6.9 | 9.0 | 22.4 | | 40.4 |
| 1953 Oct. | 1.1 | .3 | .2 | | | 2.5 | 2.4 | .1 | | | .2 | | | .5 | .5 | | 24.0 | |
| 1953 Nov. | | | | | | | | | | 2.8 | | | | | | | 26.8 | |
| 1953 Dec. | | | | | | | | | | 2.2 | | | | | | | 29.0 | |
| 1953 Jan. | | | | | | | | | | 2.1 | | | | | | | 31.1 | |
| 1953 Feb. | | | | | | | | | | 1.7 | | | | | | | 32.8 | |
| 1953 Mar. | | | | | | | | | | 1.9 | .2 | | | | | 1.3 | 33.2 | .4 |
| 1953 Apr. | .2 | .6 | .8 | | | 2.5 | 2.0 | .5 | | .4 | .3 | | | 1.4 | 1.4 | | 31.9 | 2.4 |
| 1953 May | 1.7 | 1.6 | 2.2 | | | 8.7 | 7.5 | 1.2 | | 1.4 | .3 | | | 3.8 | 3.8 | | 29.2 | |
| 1953 June | 5.9 | .6 | | | | 10.3 | 10.3 | | | 7.1 | .4 | | | .6 | .6 | 2.1 | 33.2 | |
| 1953 July | 1.0 | 1.6 | 4.3 | | | 11.8 | 9.4 | 2.4 | | | .5 | 1.0 | .1 | 5.9 | 7.0 | | 25.7 | |
| 1953 Aug. | | 1.1 | 4.1 | | | 9.2 | 6.8 | 2.4 | | | .3 | 1.0 | .1 | 5.5 | 6.5 | | 18.8 | |
| 1953 Sept. | | .8 | 2.9 | | | 6.2 | 4.5 | 1.7 | | | .2 | .4 | .1 | 4.0 | 4.5 | | 14.1 | |
| 1953 Total | 9.9 | 6.6 | 14.5 | | | 51.2 | 42.9 | 8.3 | | 19.6 | 2.4 | 2.4 | .3 | 21.7 | 24.4 | 3.4 | | 2.8 |
| 1954 Oct. | .1 | .6 | .9 | | | 2.5 | 2.1 | .4 | | | .1 | | | 1.5 | 1.5 | | 12.5 | |
| 1954 Nov. | | | | | | | | | | 1.9 | | | | | | | 14.4 | |
| 1954 Dec. | | | | | | | | | | 1.9 | | | | | | | 16.3 | |
| 1954 Jan. | | | | | | | | | | 1.7 | | | | | | | 18.0 | |
| 1954 Feb. | | | | | | | | | | 1.3 | | | | | | | 19.3 | |
| 1954 Mar. | | | | | | | | | | 1.3 | .2 | | | | | | 20.4 | |
| 1954 Apr. | 1.0 | .3 | .3 | | | 2.5 | 2.4 | .1 | | .2 | .2 | | | .6 | .6 | | 19.8 | |
| 1954 May | 5.2 | .5 | | | .2 | 8.7 | 9.1 | | .4 | 9.7 | .3 | | | .5 | .5 | | 28.7 | .8 |
| 1954 June | 1.3 | 2.1 | 3.1 | | | 10.3 | 8.5 | 1.8 | | | .4 | | | 5.2 | 5.2 | | 23.1 | |
| 1954 July | .1 | 1.9 | 4.9 | | | 11.8 | 9.1 | 2.7 | | | .4 | 1.0 | .1 | 6.8 | 7.9 | | 14.8 | |
| 1954 Aug. | | 1.3 | 3.9 | | | 9.2 | 6.9 | 2.3 | | | .2 | 1.0 | .1 | 5.3 | 6.4 | | 8.2 | |
| 1954 Sept. | .0 | .9 | 2.9 | | | 6.2 | 4.6 | 1.6 | | | .1 | .2 | | 4.1 | 4.4 | | 3.7 | |
| 1954 Total | 7.7 | 7.6 | 16.0 | | .2 | 51.2 | 42.7 | 8.9 | .4 | 18.0 | 1.9 | 2.2 | .2 | 24.0 | 26.5 | | | .8 |

* Vernal unit water diverted to municipal pipeline above "Sign of the Maine" gage.

1/ That portion of the flow of Ashley Creek at "Sign of the Maine" which is in excess of the irrigation demand of presently irrigated land under the Highline, Ashley Upper, Ashley Central, Rock Point, Island, and Dodds Canals, limited to 4.0 acre-feet per acre annually, and to a future municipal demand of 1,900 acre-feet annually.

2/ That portion of the flow available for Vernal unit which may be diverted to Stanaker Reservoir with a capacity of 400 c.f.s. in Stanaker Feeder Canal.

3/ Water which could not be diverted by the Stanaker Feeder Canal due to its limited capacity. Additional water is shown as spill from Stanaker Reservoir (column 78) which under actual conditions would perhaps be bypassed at the diversion dam rather than spilled from Stanaker Reservoir.

4/ Based on an annual demand of 3.7 acre-feet per acre annually.

5/ Flows diverted to Ashley Creek were determined after allowing an irrigation diversion of 4.0 acre-feet per acre annually directly from Ashley Creek during the high water period. Water supplied from the reservoir was released at the rate of 3.7 acre-feet per acre annually. This column represents the amount of water supplied in excess of the 3.7 acre-feet per acre, but within the 4.0 acre-feet per acre allowance. In order to check the operation study this column must be considered (demand + supply plus shortage minus this column).

6/ Oaks Park Reservoir water owned by land below Stanaker Service Canal but used on Vernal unit land above Stanaker Service Canal, when it can be replaced from Stanaker Reservoir by Vernal unit. Shown as being available in columns 45, used in columns 17 and 33, and replaced in column 74.

7/ Ashley Creek water owned by land below Stanaker Service Canal, and available for use above Stanaker Service Canal, provided it can be replaced from Stanaker Reservoir by Vernal unit. Shown as being used in columns 18 and 34.

8/ Includes releases for irrigation and exchange water for future municipal water diverted above the Sign of the Maine gage in months during the irrigation season when replacement is necessary.

9/ Computed by dividing total shortages (column 86) by total demand (column 80).


EXPLANATION

Inflow

Spill

Release

Active reservoir content

*Note:*
*Active reservoir capacity - 33,200 acre feet*
*Feeder canal capacity - 400 cubic feet per second*

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

**VERNAL UNIT OPERATION STUDY**

**STANAKER RESERVOIR HYDROGRAPHS**

SPANISH FORK, UTAH — MAY 10, 1957



FIGURE 6

Stanaker Reservoir Active Capacity: 33,200 acre-feet
Stanaker Feeder Canal Capacity: 400 cubic feet per second

Table 42
Central Utah Project
Vernal Unit
Annual Summary of Operation Study

**Ashley Creek at Sign of the Maine**

| Year | Total Flow 1 | Division of Streamflow: Future Increase in Municipal Diversion 2 | Land above Stanaker Service Canal 3 | Land below Stanaker Service Canal 4 | Highline Canal 5 | 1/ Surplus flow 6 | Available for Vernal Unit: 2/ Diverted 7 | 3/ Bypass 8 |
|---|---|---|---|---|---|---|---|---|
| 1929 | | | | | | | | |
| 1930 | 102.7 | 1.5 | 15.0 | 38.9 | 1.1 | 46.2 | 37.8 | 8.4 |
| 31 | 40.8 | 1.5 | 6.5 | 16.7 | | 16.1 | 16.1 | |
| 32 | 99.0 | 1.5 | 13.9 | 36.5 | 1.2 | 45.9 | 34.6 | 11.3 |
| 33 | 58.0 | 1.5 | 8.0 | 21.1 | .6 | 26.8 | 20.3 | 6.5 |
| 34 | 27.2 | 1.3 | 5.0 | 12.8 | | 8.1 | 8.1 | |
| 1935 | 87.8 | 1.5 | 11.2 | 28.9 | 1.1 | 45.1 | 28.6 | 16.5 |
| 36 | 43.7 | 1.5 | 8.8 | 23.5 | | 9.9 | 9.9 | |
| 37 | 105.9 | 1.5 | 14.6 | 38.6 | 1.0 | 50.2 | 33.9 | 16.3 |
| 38 | 106.1 | 1.5 | 14.9 | 39.6 | 1.3 | 48.8 | 33.1 | 15.7 |
| 39 | 72.0 | 1.5 | 10.3 | 27.2 | .2 | 32.8 | 30.0 | 2.8 |
| 1940 | 55.3 | 1.5 | 8.9 | 23.4 | .2 | 21.3 | 20.3 | 1.0 |
| 41 | 125.2 | 1.5 | 14.7 | 39.3 | 1.9 | 67.8 | 45.6 | 22.2 |
| 42 | 122.4 | 1.5 | 13.3 | 35.3 | 1.1 | 71.2 | 47.3 | 23.9 |
| 43 | 74.6 | 1.5 | 12.2 | 32.5 | .4 | 28.0 | 26.5 | 1.5 |
| 44 | 136.4 | 1.5 | 13.2 | 34.9 | 2.1 | 84.7 | 44.4 | 40.3 |
| 1945 | 75.2 | 1.5 | 13.5 | 35.4 | .2 | 24.6 | 24.2 | .4 |
| 46 | 44.2 | 1.5 | 8.5 | 22.1 | | 12.1 | 12.1 | |
| 47 | 130.3 | 1.5 | 16.0 | 42.3 | 2.2 | 68.3 | 49.4 | 18.9 |
| 48 | 74.4 | 1.5 | 9.8 | 25.9 | .9 | 36.3 | 26.8 | 9.5 |
| 49 | 99.4 | 1.5 | 13.4 | 34.9 | 1.6 | 48.0 | 35.9 | 12.1 |
| 1950 | 113.6 | 1.5 | 15.2 | 40.1 | 1.4 | 55.4 | 36.7 | 18.7 |
| 51 | 71.1 | 1.5 | 10.9 | 29.1 | .5 | 29.1 | 23.1 | 6.0 |
| 52 | 128.5 | 1.5 | 17.6 | 46.2 | 1.5 | 61.7 | 42.2 | 19.5 |
| 53 | 58.1 | 1.5 | 9.9 | 26.0 | .2 | 20.5 | 19.6 | .9 |
| 54 | 54.4 | 1.5 | 9.4 | 24.5 | .2 | 18.8 | 18.0 | .8 |
| 55 | 49.0 | 1.5 | 9.4 | 24.5 | | 13.6 | 13.6 | |
| 56 | 65.3 | 1.5 | 10.0 | 26.8 | .7 | 26.3 | 24.2 | 2.1 |
| Total | 2,220.6 | 40.3 | 314.1 | 827.0 | 21.6 | 1,017.6 | 762.3 | 255.3 |
| Mean | 82.2 | 1.5 | 11.6 | 30.6 | .8 | 37.7 | 28.2 | 9.5 |

**Land above Stanaker Service Canal (Excluding Highline Canal)**

| Year | Class 6W Land: Demand at 3.7 a.f. per acre 9 | Supply: By Direct Diversion 10 | Owned in Oaks Park Reservoir 11 | Shortage 4/: 1000 Acre-Feet 12-a | Percent 12-b | 5/ Excess Early Water Supplied at 4.0 a.f./acre 13 |
|---|---|---|---|---|---|---|
| 1930 | 3.9 | 3.0 | .2 | .7 | 18 | |
| 31 | 3.9 | 1.3 | .2 | 2.4 | 61 | |
| 32 | 3.9 | 2.8 | .2 | 1.0 | 26 | .1 |
| 33 | 3.9 | 1.7 | .2 | 2.0 | 51 | |
| 34 | 3.9 | 1.0 | .1 | 2.8 | 72 | |
| 1935 | 3.9 | 2.2 | .1 | 1.5 | 38 | |
| 36 | 3.9 | 1.8 | .1 | 2.0 | 51 | |
| 37 | 3.9 | 2.9 | .2 | .8 | 20 | |
| 38 | 3.9 | 3.1 | .2 | .7 | 18 | .1 |
| 39 | 3.9 | 2.1 | .2 | 1.6 | 41 | |
| 1940 | 3.9 | 1.8 | .2 | 1.9 | 49 | |
| 41 | 3.9 | 3.0 | .2 | .8 | 20 | .1 |
| 42 | 3.9 | 2.6 | .2 | 1.1 | 28 | |
| 43 | 3.9 | 2.4 | .2 | 1.3 | 33 | |
| 44 | 3.9 | 2.6 | .1 | 1.2 | 31 | |
| 1945 | 3.9 | 2.7 | .1 | 1.0 | 26 | |
| 46 | 3.9 | 1.7 | .2 | 2.0 | 51 | |
| 47 | 3.9 | 3.1 | .2 | .7 | 18 | .1 |
| 48 | 3.9 | 2.1 | .2 | 1.6 | 41 | |
| 49 | 3.9 | 2.5 | .3 | 1.1 | 28 | |
| 1950 | 3.9 | 3.2 | .3 | .5 | 13 | .1 |
| 51 | 3.9 | 2.2 | .2 | 1.5 | 38 | |
| 52 | 3.9 | 3.6 | .2 | .3 | 8 | .2 |
| 53 | 3.9 | 1.9 | .2 | 1.8 | 46 | |
| 54 | 3.9 | 1.9 | .2 | 1.8 | 46 | |
| 55 | 3.9 | 1.9 | .2 | 1.8 | 46 | |
| 56 | 3.9 | 2.1 | .2 | 1.8 | 46 | .2 |
| Total | 105.3 | 63.2 | 5.3 | 37.7 | | .9 |
| Mean | 3.9 | 2.3 | .2 | 1.4 | 36% | 0 |

| Year | Vernal Unit Land: Demand at 3.7 a.f. per acre 14 | Supply: Direct Diversion 15 | Oaks Park Reservoir: Owned 16 | 6/ Exchange 17 | Vernal unit Exchange 18 | Shortage 4/: 1000 Acre-feet 19-a | Percent 19-b | 5/ Excess Early Water Supplied at 4.0 a.f./acre 20 |
|---|---|---|---|---|---|---|---|---|
| 1930 | 15.3 | 12.0 | .8 | 1.7 | 1.1 | | | .3 |
| 31 | 15.3 | 5.2 | .6 | 1.6 | 6.8 | 1.1 | 7 | |
| 32 | 15.3 | 11.1 | .8 | 2.2 | 1.5 | | | .3 |
| 33 | 15.3 | 6.3 | .6 | 1.7 | 6.7 | | | |
| 34 | 15.3 | 4.0 | .3 | | 1.5 | 9.5 | 62 | |
| 1935 | 15.3 | 9.0 | .8 | 2.2 | 3.2 | .3 | 2 | .2 |
| 36 | 15.3 | 7.0 | .5 | | 2.8 | 5.0 | 33 | |
| 37 | 15.3 | 11.7 | .8 | 2.0 | 1.0 | .1 | 1 | .3 |
| 38 | 15.3 | 11.8 | .8 | 2.0 | 1.0 | | | .3 |
| 39 | 15.3 | 8.2 | .8 | 1.9 | 4.6 | | | .2 |
| 1940 | 15.3 | 7.1 | .8 | 2.0 | 5.2 | .3 | 2 | .1 |
| 41 | 15.3 | 11.7 | .8 | 2.0 | 1.1 | | | .3 |
| 42 | 15.3 | 10.7 | .8 | 2.2 | 1.9 | | | .3 |
| 43 | 15.3 | 9.8 | .8 | 2.2 | 2.9 | | | .4 |
| 44 | 15.3 | 10.6 | .8 | 1.4 | 3.3 | | | .8 |
| 1945 | 15.3 | 10.8 | .8 | 2.1 | 1.9 | | | .3 |
| 46 | 15.3 | 6.8 | .5 | 1.5 | 6.6 | | | .1 |
| 47 | 15.3 | 12.9 | .8 | 2.2 | .5 | | | 1.1 |
| 48 | 15.3 | 7.7 | .8 | 2.2 | 4.6 | | | |
| 49 | 15.3 | 10.9 | .8 | 2.2 | 2.0 | | | .6 |
| 1950 | 15.3 | 12.0 | .8 | 2.2 | 1.1 | | | .8 |
| 51 | 15.3 | 8.7 | .7 | 1.8 | 4.2 | | | .1 |
| 52 | 15.3 | 14.0 | .7 | 1.1 | .5 | | | 1.1 |
| 53 | 15.3 | 8.0 | .8 | 1.9 | 4.6 | | | |
| 54 | 15.3 | 7.5 | .8 | 1.8 | 5.3 | | | .1 |
| 55 | 15.3 | 7.5 | .7 | .8 | 3.5 | 2.8 | 18 | |
| 56 | 15.3 | 7.9 | .8 | 1.6 | 4.3 | 1.5 | 10 | .8 |
| Total | 413.1 | 250.9 | 19.8 | 46.5 | 83.8 | 20.6 | -- | 8.5 |
| Mean | 15.3 | 9.3 | .7 | 1.7 | 3.1 | .8 | 5% | .3 |

| Year | Total Land: Demand at 3.7 a.f. Per Acre 21 | Supply 22 | Shortage 4/: 1000 Acre-Feet 23-a | Percent 23-b | 5/ Excess Early Water Supplied at 4.0 a.f./acre 24 |
|---|---|---|---|---|---|
| 1930 | 19.2 | 18.8 | .7 | 4 | .3 |
| 31 | 19.2 | 15.7 | 3.5 | 20 | |
| 32 | 19.2 | 18.6 | 1.0 | 5 | .4 |
| 33 | 19.2 | 17.2 | 2.0 | 11 | |
| 34 | 19.2 | 6.9 | 12.3 | 62 | |
| 1935 | 19.2 | 17.6 | 1.8 | 9 | .2 |
| 36 | 19.2 | 12.2 | 7.0 | 37 | |
| 37 | 19.2 | 18.5 | .9 | 5 | .3 |
| 38 | 19.2 | 18.9 | .7 | 4 | .4 |
| 39 | 19.2 | 17.9 | 1.6 | 8 | .2 |
| 1940 | 19.2 | 17.1 | 2.2 | 11 | .1 |
| 41 | 19.2 | 18.8 | .8 | 4 | .4 |
| 42 | 19.2 | 18.4 | 1.1 | 6 | .3 |
| 43 | 19.2 | 18.3 | 1.3 | 7 | .4 |
| 44 | 19.2 | 18.3 | 1.2 | 6 | .8 |
| 1945 | 19.2 | 18.5 | 1.0 | 5 | .3 |
| 46 | 19.2 | 17.3 | 2.0 | 10 | .1 |
| 47 | 19.2 | 19.7 | .7 | 4 | 1.2 |
| 48 | 19.2 | 17.6 | 1.6 | 8 | |
| 49 | 19.2 | 18.7 | 1.1 | 6 | .6 |
| 1950 | 19.2 | 19.6 | .5 | 3 | .9 |
| 51 | 19.2 | 17.8 | 1.5 | 8 | .1 |
| 52 | 19.2 | 20.2 | .3 | 2 | 1.3 |
| 53 | 19.2 | 17.4 | 1.8 | 9 | |
| 54 | 19.2 | 17.5 | 1.8 | 9 | .1 |
| 55 | 19.2 | 14.6 | 4.6 | 24 | |
| 56 | 19.2 | 16.9 | 3.3 | 17 | 1.0 |
| Total | 518.4 | 469.5 | 58.3 | -- | 9.4 |
| Mean | 19.2 | 17.4 | 2.2 | 11% | .3 |

**Land Under Highline Canal**

| Year | Class 6W Land: Demand at 3.7 a.f. Per Acre 25 | Supply: Ashley Creek High Flows 26 | Oaks Park Water Owned 27 | Shortage 4/: 1000 Acre-Feet 28-a | Percent 28-b | 5/ Excess Early Water Supplied at 4.0 a.f./acre 29 |
|---|---|---|---|---|---|---|
| 1930 | 2.8 | .5 | .5 | 1.8 | 64 | |
| 31 | 2.8 | | .4 | 2.4 | 86 | |
| 32 | 2.8 | .6 | .5 | 1.7 | 61 | |
| 33 | 2.8 | .3 | .4 | 2.1 | 75 | |
| 34 | 2.8 | | .2 | 2.5 | 93 | |
| 1935 | 2.8 | .5 | .5 | 1.8 | 64 | |
| 36 | 2.8 | | .3 | 2.5 | 89 | |
| 37 | 2.8 | .4 | .5 | 1.9 | 68 | |
| 38 | 2.8 | .6 | .5 | 1.7 | 61 | |
| 39 | 2.8 | .1 | .5 | 2.2 | 79 | |
| 1940 | 2.8 | .1 | .5 | 2.2 | 79 | |
| 41 | 2.8 | .5 | .5 | 1.5 | 54 | |
| 42 | 2.8 | .5 | .5 | 1.8 | 64 | |
| 43 | 2.8 | .9 | .5 | 2.2 | 79 | |
| 44 | 2.8 | .1 | .5 | 1.7 | 70 | |
| 1945 | 2.8 | | .5 | 2.2 | 79 | |
| 46 | 2.8 | 1.0 | .3 | 2.5 | 89 | |
| 47 | 2.8 | .4 | .5 | 1.3 | 46 | |
| 48 | 2.8 | .7 | .4 | 1.9 | 68 | |
| 49 | 2.8 | .6 | .4 | 1.7 | 61 | |
| 1950 | 2.8 | .2 | .4 | 1.7 | 64 | |
| 51 | 2.8 | .7 | .5 | 2.2 | 79 | |
| 52 | 2.8 | .1 | .5 | 2.2 | 57 | |
| 53 | 2.8 | .1 | .5 | 2.2 | 79 | |
| 54 | 2.8 | | .4 | 2.3 | 82 | |
| 55 | 2.8 | .3 | .5 | 2.4 | 86 | |
| 56 | 2.8 | | .5 | 2.0 | 71 | |
| Total | 75.6 | 9.6 | 12.1 | 53.9 | -- | |
| Mean | 2.8 | .4 | .4 | 2.0 | 71% | |

| Year | Vernal Unit Land: Demand at 3.7 a.f. Per Acre 30 | Supply: Ashley Creek High Flows 31 | Oaks Park Reservoir: Owned 32 | 6/ Exchange 33 | Vernal Unit Exchange 34 | Shortage 4/: 1000 Acre-feet 35-a | Percent 35-b | 5/ Excess Early Water Supplied at 4.0 a.f./acre 36 |
|---|---|---|---|---|---|---|---|---|
| 1930 | 3.7 | .6 | .6 | .7 | 1.8 | | | |
| 31 | 3.7 | | .4 | .4 | 1.6 | 1.3 | 35 | |
| 32 | 3.7 | .6 | .6 | .5 | 2.0 | | | |
| 33 | 3.7 | .3 | .4 | .4 | 2.3 | .3 | 8 | |
| 34 | 3.7 | | .2 | | 1.9 | 2.5 | 68 | |
| 1935 | 3.7 | .6 | .6 | .5 | 1.8 | .2 | 5 | |
| 36 | 3.7 | | .3 | | 1.7 | 1.7 | 46 | |
| 37 | 3.7 | .6 | .5 | .7 | 1.7 | .2 | 5 | |
| 38 | 3.7 | .7 | .5 | .7 | 1.8 | | | |
| 39 | 3.7 | .1 | .5 | .7 | 2.0 | .4 | 11 | |
| 1940 | 3.7 | .1 | .5 | .5 | 2.3 | .3 | 8 | |
| 41 | 3.7 | 1.1 | .5 | .7 | 1.4 | | | |
| 42 | 3.7 | .6 | .5 | .5 | 2.1 | | | |
| 43 | 3.7 | .3 | .5 | .5 | 2.3 | | | |
| 44 | 3.7 | 1.2 | .5 | 1.0 | 1.1 | | | .1 |
| 1945 | 3.7 | .1 | .4 | .5 | 2.5 | | | |
| 46 | 3.7 | | .5 | .5 | 2.6 | .2 | 5 | |
| 47 | 3.7 | 1.2 | .5 | .5 | 1.5 | | | |
| 48 | 3.7 | .5 | .5 | .5 | 2.2 | | | |
| 49 | 3.7 | .9 | .4 | .5 | 1.3 | | | |
| 1950 | 3.7 | .8 | .5 | .6 | 1.9 | | | |
| 51 | 3.7 | .3 | .5 | .5 | 2.4 | | | |
| 52 | 3.7 | .3 | .5 | .7 | 1.7 | | | |
| 53 | 3.7 | .1 | .5 | .5 | 2.6 | | | |
| 54 | 3.7 | .1 | .5 | .4 | 2.7 | | | |
| 55 | 3.7 | | .5 | .3 | 2.0 | 1.0 | 27 | |
| 56 | 3.7 | .4 | .6 | .4 | 1.6 | .7 | 19 | |
| Total | 99.9 | 12.0 | 13.0 | 13.7 | 52.5 | 8.8 | -- | .1 |
| Mean | 3.7 | .4 | .5 | .5 | 2.0 | .3 | 9% | 0 |

| Year | Total Land: Demand at 3.7 a.f. per acre 37 | Supply 38 | Shortage 4/: 1000 Acre-Feet 39-a | Percent 39-b | 5/ Excess Early Water Supplied at 4.0 a.f./acre 40 |
|---|---|---|---|---|---|
| 1930 | 6.5 | 4.7 | 1.8 | 28 | |
| 31 | 6.5 | 2.8 | 3.7 | 57 | |
| 32 | 6.5 | 4.8 | 1.7 | 29 | |
| 33 | 6.5 | 4.1 | 2.4 | 37 | |
| 34 | 6.5 | 1.4 | 5.1 | 78 | |
| 1935 | 6.5 | 4.5 | 2.0 | 31 | |
| 36 | 6.5 | 2.3 | 4.2 | 65 | |
| 37 | 6.5 | 4.4 | 2.1 | 32 | |
| 38 | 6.5 | 4.8 | 1.7 | 26 | |
| 39 | 6.5 | 3.9 | 2.6 | 40 | |
| 1940 | 6.5 | 4.0 | 2.5 | 38 | |
| 41 | 6.5 | 5.0 | 1.5 | 23 | |
| 42 | 6.5 | 4.7 | 1.8 | 28 | |
| 43 | 6.5 | 4.3 | 2.2 | 34 | |
| 44 | 6.5 | 5.2 | 1.4 | 21 | .1 |
| 1945 | 6.5 | 4.3 | 2.2 | 34 | |
| 46 | 6.5 | 3.8 | 2.7 | 42 | |
| 47 | 6.5 | 5.2 | 1.3 | 20 | |
| 48 | 6.5 | 4.6 | 1.9 | 29 | |
| 49 | 6.5 | 4.8 | 1.7 | 26 | |
| 1950 | 6.5 | 4.7 | 1.8 | 28 | |
| 51 | 6.5 | 4.3 | 2.2 | 34 | |
| 52 | 6.5 | 4.9 | 1.6 | 25 | |
| 53 | 6.5 | 4.3 | 2.2 | 34 | |
| 54 | 6.5 | 4.2 | 2.3 | 35 | |
| 55 | 6.5 | 3.1 | 3.4 | 52 | |
| 56 | 6.5 | 3.8 | 2.7 | 42 | |
| Total | 175.5 | 112.9 | 62.7 | -- | .1 |
| Mean | 6.5 | 4.2 | 2.3 | 36% | 0 |

**Oaks Park Reservoir and Stanaker Reservoir**

| Year | Oaks Park Reservoir: Flow of Brush Creek (inflow) 41 | Evaporation 42 | Releases: to Highline Canal 43 | to Land above Stanaker Service Canal 44 | 6/ Exchange to land above Stanaker Service Canal 45 | to land below Stanaker Service Canal 46 | Total Releases 47 | Conveyance Loss 48 | Spill 49 | Stanaker Reservoir Active Content: Max 50-a | Min 50-b | End of Year 50-c |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1929 | | | | | | | | | | | | .5 |
| 1930 | 9.2 | .8 | 1.1 | 1.0 | 2.4 | | 4.5 | .5 | 3.6 | 5.7 | .3 | .3 |
| 31 | 4.3 | .6 | .8 | .8 | 2.0 | | 3.6 | .4 | | 4.2 | 0 | 0 |
| 32 | 8.2 | .8 | 1.1 | 1.0 | 2.7 | | 4.8 | .5 | 2.3 | 5.7 | 0 | 0 |
| 33 | 5.0 | .8 | .8 | .8 | 2.1 | | 3.7 | .5 | | 4.6 | 0 | 0 |
| 34 | 2.8 | .7 | .4 | .4 | | | 1.9 | .2 | | 2.4 | 0 | 0 |
| 1935 | 7.4 | .8 | 1.1 | 1.0 | 2.7 | 1.1 | 4.8 | .5 | 1.3 | 5.7 | 0 | 0 |
| 36 | 3.7 | .8 | .6 | .6 | | | 2.7 | .3 | | 3.3 | -.1 | -.1 |
| 37 | 8.7 | .8 | 1.0 | 1.0 | 2.7 | 1.5 | 4.7 | .6 | 2.5 | 5.7 | 0 | 0 |
| 38 | 8.3 | .8 | 1.0 | 1.0 | 2.7 | | 4.7 | .5 | 2.2 | 5.7 | 0 | 0 |
| 39 | 7.1 | .8 | 1.0 | 1.0 | 2.6 | | 4.6 | .6 | 1.0 | 5.7 | 0 | .1 |
| 1940 | 5.7 | .8 | 1.0 | 1.0 | 2.5 | | 4.5 | .5 | | 5.4 | 0 | 0 |
| 41 | 10.0 | .8 | 1.0 | 1.0 | 2.7 | | 4.7 | .5 | 3.9 | 5.7 | 0 | 0 |
| 42 | 10.9 | .8 | 1.0 | 1.0 | 2.7 | | 4.7 | .6 | 4.8 | 5.7 | 0 | 0 |
| 43 | 6.4 | .8 | 1.0 | 1.0 | 2.7 | | 4.8 | .5 | .3 | 5.7 | 0 | 0 |
| 44 | 10.2 | .8 | 1.0 | 1.0 | 2.4 | | 4.3 | .6 | 4.1 | 5.7 | 0 | .4 |
| 1945 | 5.8 | .8 | 1.0 | .9 | 2.6 | | 4.6 | .4 | .1 | 5.7 | .3 | .3 |
| 46 | 4.1 | .8 | .7 | .8 | 2.0 | | 3.4 | .3 | | 4.0 | -.1 | -.1 |
| 47 | 10.1 | .8 | 1.0 | .7 | 2.7 | | 4.1 | .6 | 3.9 | 5.7 | -.1 | 0 |
| 48 | 7.3 | .8 | 1.0 | 1.0 | 2.7 | | 4.7 | .5 | 1.2 | 5.7 | 0 | 0 |
| 49 | 9.0 | .8 | .8 | 1.0 | 2.7 | | 4.7 | .6 | 2.9 | 5.7 | 0 | 0 |
| 1950 | 9.5 | .8 | .8 | 1.1 | 2.8 | | 4.7 | .5 | 3.4 | 5.7 | 0 | 0 |
| 51 | 5.4 | .8 | .9 | 1.1 | 2.3 | | 4.1 | .5 | | 5.0 | 0 | 0 |
| 52 | 11.3 | .8 | 1.0 | .9 | 1.8 | | 4.7 | .6 | 5.2 | 5.7 | 0 | 1.0 |
| 53 | 5.5 | .8 | 1.0 | 1.0 | 2.4 | | 4.4 | .5 | .4 | 5.7 | .4 | .4 |
| 54 | 5.4 | .8 | .9 | .9 | 2.2 | | 4.1 | .5 | | 5.4 | .4 | .4 |
| 55 | 5.0 | .8 | .9 | .9 | 1.1 | 1.3 | 4.1 | .5 | | 5.0 | 0 | 0 |
| 56 | 6.5 | .8 | 1.1 | 1.0 | 2.0 | .7 | 4.8 | .5 | .4 | 5.7 | 0 | 0 |
| Total | 192.8 | 21.3 | 25.1 | 25.1 | 60.2 | 4.6 | 115.0 | 13.7 | 43.3 | | | |
| Mean | 7.1 | .8 | .9 | .9 | 2.2 | .2 | 4.3 | .5 | 1.6 | | | |

**Land below Stanaker Service Canal**

| Year | 7/ Available 51 | Ashley Creek Exchange Water: Used above Stanaker Service Canal 52 | Class 6W Land: Demand at 3.7 a.f./acre 53 | Oaks Park Water Owned 54 | Ashley Creek Direct Flow: Total Owned 55 | Used below Stanaker Service Canal 56 | Exchange to land above Stanaker Service Canal 57 | Shortage 4/: 1000 Acre-Feet 58-a | Percent 58-b | 5/ Excess Early Water Supplied at 4.0 a.f./acre 59 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1930 | 38.9 | 2.9 | 18.8 | 1.0 | 14.4 | 14.4 | | 3.7 | 20 | .3 |
| 31 | 16.7 | 8.4 | 18.8 | .8 | 6.1 | 3.8 | 2.3 | 11.9 | 63 | |
| 32 | 36.5 | 3.5 | 18.8 | 1.1 | 13.5 | 13.5 | | 4.5 | 24 | .3 |
| 33 | 21.1 | 9.0 | 18.8 | .8 | 7.8 | 6.9 | .9 | 10.2 | 54 | |
| 34 | 12.8 | 2.5 | 18.8 | .4 | 4.7 | 4.7 | | 13.7 | 73 | |
| 1935 | 28.9 | 5.0 | 18.8 | 1.1 | 10.7 | 10.7 | | 7.2 | 38 | .2 |
| 36 | 23.5 | 4.5 | 18.8 | .6 | 8.7 | 8.7 | | 9.5 | 50 | |
| 37 | 38.6 | 2.7 | 18.8 | 1.1 | 14.3 | 14.3 | | 3.7 | 20 | .3 |
| 38 | 39.6 | 2.8 | 18.8 | 1.1 | 14.6 | 14.6 | | 3.5 | 19 | .4 |
| 39 | 27.2 | 6.6 | 18.8 | 1.0 | 10.0 | 8.7 | 1.3 | 8.1 | 43 | .3 |
| 1940 | 23.4 | 7.5 | 18.8 | 1.0 | 8.6 | 7.8 | .8 | 9.4 | 50 | .2 |
| 41 | 39.3 | 2.5 | 18.8 | 1.1 | 14.5 | 14.5 | | 3.6 | 19 | .4 |
| 42 | 35.3 | 4.0 | 18.8 | 1.1 | 13.1 | 13.1 | | 4.9 | 26 | .3 |
| 43 | 32.5 | 5.2 | 18.8 | 1.1 | 11.9 | 11.9 | | 6.2 | 33 | .4 |
| 44 | 34.9 | 4.4 | 18.8 | .7 | 12.7 | 12.7 | | 5.7 | 30 | .3 |
| 1945 | 35.4 | 4.5 | 18.8 | 1.0 | 13.1 | 12.9 | .2 | 5.0 | 27 | .3 |
| 46 | 22.1 | 9.2 | 18.8 | .8 | 8.2 | 6.8 | 1.4 | 9.8 | 52 | |
| 47 | 42.3 | 2.0 | 18.8 | 1.1 | 15.5 | 15.5 | | 2.8 | 15 | .6 |
| 48 | 25.9 | 6.8 | 18.8 | 1.1 | 9.6 | 9.2 | .4 | 8.1 | 43 | |
| 49 | 34.9 | 3.8 | 18.8 | 1.1 | 12.9 | 12.9 | | 5.5 | 29 | .7 |
| 1950 | 40.1 | 3.0 | 18.8 | 1.1 | 14.9 | 14.9 | | 3.3 | 18 | .5 |
| 51 | 29.1 | 6.6 | 18.8 | .9 | 10.9 | 10.6 | .3 | 7.2 | 38 | .2 |
| 52 | 46.2 | 2.3 | 18.8 | .9 | 17.2 | 17.2 | | 2.0 | 11 | 1.3 |
| 53 | 26.0 | 7.2 | 18.8 | 1.0 | 9.5 | 8.9 | .6 | 8.3 | 44 | |
| 54 | 24.5 | 8.0 | 18.8 | .9 | 9.2 | 8.8 | .4 | 8.9 | 47 | .2 |
| 55 | 24.5 | 5.5 | 18.8 | .9 | 9.0 | 8.0 | 1.0 | 8.9 | 47 | |
| 56 | 26.8 | 5.9 | 18.8 | 1.1 | 9.8 | 9.1 | .7 | 8.9 | 47 | 1.0 |
| Total | 827.0 | 136.3 | 507.6 | 25.9 | 305.4 | 295.1 | 10.3 | 184.5 | -- | 8.2 |
| Mean | 30.6 | 5.0 | 18.8 | 1.0 | 11.3 | 10.9 | .4 | 6.8 | 36% | .3 |

| Year | Vernal Unit Land: Demand at 3.7 a.f./acre 60 | Oaks Park Water Owned 61 | Ashley Creek Direct Flow: Total Owned 62 | Used below Stanaker Service Canal 63 | Exchange to land above Stanaker Service Canal 64 | Stanaker Reservoir: Direct Releases 65 | Shortage 4/: 1000 Acre-Feet 66-a | Percent 66-b | 5/ Excess Early Water Supplied at 4.0 a.f./acre 67 |
|---|---|---|---|---|---|---|---|---|---|
| 1930 | 32.4 | 1.1 | 24.5 | 21.6 | 2.9 | 6.8 | | | .3 |
| 31 | 32.4 | 1.2 | 10.6 | 4.5 | 6.1 | 20.6 | | | |
| 32 | 32.4 | 1.6 | 23.0 | 19.5 | 3.5 | 8.4 | | | .6 |
| 33 | 32.4 | 1.3 | 13.3 | 5.2 | 8.1 | 17.8 | | | |
| 34 | 32.4 | .7 | 8.1 | 5.6 | 2.5 | 13.0 | 10.6 | 33 | |
| 1935 | 32.4 | 1.6 | 18.2 | 13.2 | 5.0 | 12.3 | .7 | 2 | .4 |
| 36 | 32.4 | .9 | 14.8 | 10.3 | 4.5 | 10.8 | 5.8 | 18 | |
| 37 | 32.4 | 1.6 | 24.3 | 21.6 | 2.7 | 6.8 | .2 | 1 | .5 |
| 38 | 32.4 | 1.6 | 25.0 | 22.2 | 2.8 | 6.4 | | | .6 |
| 39 | 32.4 | 1.6 | 17.2 | 11.9 | 5.3 | 14.0 | | | .4 |
| 1940 | 32.4 | 1.5 | 14.8 | 8.2 | 6.6 | 16.3 | | | .2 |
| 41 | 32.4 | 1.6 | 24.8 | 22.3 | 2.5 | 6.6 | | | .6 |
| 42 | 32.4 | 1.6 | 22.2 | 18.3 | 3.9 | 9.0 | | | .4 |
| 43 | 32.4 | 1.6 | 20.6 | 15.4 | 5.2 | 10.9 | | | .7 |
| 44 | 32.4 | 1.0 | 22.2 | 17.8 | 4.4 | 9.8 | | | .6 |
| 1945 | 32.4 | 1.6 | 22.3 | 18.0 | 4.3 | 9.0 | | | .5 |
| 46 | 32.4 | 1.2 | 13.9 | 6.1 | 7.8 | 17.3 | | | |
| 47 | 32.4 | 1.6 | 26.8 | 24.8 | 2.0 | 4.8 | [illegible] | 1 | 1.0 |
| 48 | 32.4 | 1.6 | 16.3 | 9.9 | 6.4 | 14.5 | | | |
| 49 | 32.4 | 1.7 | 22.0 | 18.2 | 3.8 | 9.6 | | | .9 |
| 1950 | 32.4 | 1.7 | 25.2 | 22.2 | 3.0 | 6.1 | | | .6 |
| 51 | 32.4 | 1.4 | 18.2 | 11.9 | 6.3 | 13.0 | | | .2 |
| 52 | 32.4 | .9 | 29.0 | 26.7 | 2.3 | 4.6 | | | 2.1 |
| 53 | 32.4 | 1.4 | 16.5 | 9.9 | 6.6 | 14.5 | | | |
| 54 | 32.4 | 1.3 | 15.3 | 7.7 | 7.6 | 16.0 | | | .2 |
| 55 | 32.4 | 1.4 | 15.5 | 11.0 | 4.5 | 10.0 | 5.5 | 17 | |
| 56 | 32.4 | 1.6 | 17.0 | 11.8 | 5.2 | 14.7 | .7 | 2 | 1.6 |
| Total | 874.8 | 38.2 | 521.6 | 395.8 | 125.8 | 303.6 | 23.4 | -- | 12.4 |
| Mean | 32.4 | 1.4 | 19.3 | 14.6 | 4.7 | 11.2 | .9 | 3% | .4 |

| Year | Total Land: Demand at 3.7 a.f./acre 68 | Supply 69 | Shortage 9/: 1000 Acre-Feet 70-a | Percent 70-b | 5/ Excess Early Water Supplied at 4.0 a.f./acre 71 | Stanaker Reservoir: Inflow 72 | Evaporation 73 | Releases: Replacement for Oaks Park Exchange Water 74 | 8/ 75 | Irrigation 76 | Total Releases 77 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1930 | 51.2 | 48.1 | 3.7 | 7 | .6 | 37.8 | 2.8 | 2.4 | .3 | 9.7 | 12.4 |
| 31 | 51.2 | 39.3 | 11.9 | 23 | | 16.1 | 1.8 | 2.0 | .3 | 29.0 | 31.3 |
| 32 | 51.2 | 47.6 | 4.5 | 9 | .9 | 34.6 | 1.9 | 2.7 | .3 | 11.9 | 14.9 |
| 33 | 51.2 | 41.0 | 10.2 | 20 | | 20.3 | 2.1 | 2.1 | .3 | 26.8 | 29.2 |
| 34 | 51.2 | 26.9 | 24.3 | 47 | | 8.1 | 1.2 | | | 15.5 | 15.5 |
| 1935 | 51.2 | 43.9 | 7.9 | 15 | .6 | 28.6 | 1.6 | 2.7 | .3 | 17.3 | 20.3 |
| 36 | 51.2 | 35.8 | 15.4 | 30 | | 9.9 | 1.1 | | | 15.3 | 15.3 |
| 37 | 51.2 | 48.1 | 3.9 | 8 | .8 | 33.9 | 1.3 | 2.7 | .3 | 9.5 | 12.5 |
| 38 | 51.2 | 48.7 | 3.5 | 7 | 1.0 | 33.1 | 2.5 | 2.7 | .3 | 9.2 | 12.2 |
| 39 | 51.2 | 43.8 | 8.1 | 16 | .7 | 30.0 | 2.3 | 2.6 | .3 | 20.6 | 23.5 |
| 1940 | 51.2 | 42.2 | 9.4 | 18 | .4 | 20.3 | 1.8 | 2.5 | .3 | 23.7 | 26.5 |
| 41 | 51.2 | 48.6 | 3.6 | 7 | 1.0 | 45.6 | 2.0 | 2.7 | .3 | 9.1 | 12.1 |
| 42 | 51.2 | 47.0 | 4.9 | 10 | .7 | 47.3 | 2.7 | 2.7 | .3 | 12.9 | 15.9 |
| 43 | 51.2 | 46.1 | 6.2 | 12 | 1.1 | 26.5 | 2.5 | 2.7 | .3 | 16.1 | 19.1 |
| 44 | 51.2 | 46.4 | 5.7 | 11 | .9 | 44.4 | 2.4 | 2.4 | .3 | 14.2 | 16.9 |
| 1945 | 51.2 | 47.0 | 5.0 | 10 | .8 | 24.2 | 2.4 | 2.6 | .3 | 13.5 | 16.4 |
| 46 | 51.2 | 41.4 | 9.8 | 19 | | 12.1 | 1.8 | 2.0 | .3 | 26.5 | 28.8 |
| 47 | 51.2 | 49.8 | 3.0 | 6 | 1.6 | 49.4 | 2.2 | 2.7 | .3 | 6.5 | 10.0 |
| 48 | 51.2 | 43.1 | 8.1 | 16 | | 26.8 | 2.6 | 2.7 | .3 | 21.3 | 24.3 |
| 49 | 51.2 | 47.3 | 5.5 | 11 | 1.6 | 35.9 | 2.5 | 2.8 | .3 | 13.4 | 16.5 |
| 1950 | 51.2 | 49.0 | 3.3 | 6 | 1.1 | 36.7 | 2.4 | 2.8 | .3 | 9.1 | 12.2 |
| 51 | 51.2 | 44.4 | 7.2 | 14 | .4 | 23.1 | 2.3 | 2.3 | .3 | 19.6 | 22.2 |
| 52 | 51.2 | 52.6 | 2.0 | 4 | 3.4 | 42.2 | 2.6 | 1.8 | .3 | 6.9 | 9.0 |
| 53 | 51.2 | 42.9 | 8.3 | 16 | | 19.6 | 2.4 | 2.4 | .3 | 21.7 | 24.4 |
| 54 | 51.2 | 42.7 | 8.9 | 17 | .4 | 18.0 | 1.9 | 2.2 | .3 | 24.0 | 26.5 |
| 55 | 51.2 | 36.8 | 14.4 | 28 | | 13.6 | .9 | 1.0 | | 15.5 | 16.5 |
| 56 | 51.2 | 44.2 | 9.6 | 19 | 2.6 | 24.2 | 1.3 | 2.0 | .2 | 20.6 | 22.8 |
| Total | 1,382.4 | 1,194.7 | 208.3 | -- | 20.6 | 762.3 | 55.3 | 60.2 | 7.1 | 439.4 | 507.2 |
| Mean | 51.2 | 44.2 | 7.7 | 15% | .8 | 28.2 | 2.1 | 2.2 | .3 | 16.3 | 18.8 |

1/ Flow of Ashley Creek at Sign of the Maine in excess of downstream rights supplied at rate of 4.0 acre-feet per acre less 1,500 acre-feet annually, that will be diverted above gage to supply future municipal requirements.

2/ Flow available for Vernal Unit which may be diverted to Stanaker Reservoir with a capacity of 400 cfs in Stanaker Feeder Canal.

3/ Surplus water which could not be diverted by the 400 cfs Stanaker Feeder Canal. Water shown as spill from Stanaker Reservoir (col. 78) under actual conditions would perhaps also be bypassed at the diversion dam rather than spilled from Stanaker Reservoir.

4/ Based on an annual demand of 3.7 acre-feet per acre.

5/ Surplus flows divertible from Ashley Creek to Stanaker Reservoir are flows in excess of those required to supply prior irrigation rights at the rate of 4.0 acre-feet per acre annually. Vernal Unit operation was based on an ideal demand of 3.7 acre-feet per acre. Figures in this column show water supplied from direct flow in excess of ideal requirements (3.7

6/ Oaks Park Reservoir water owned by land below Stanaker Service Canal, but used on Vernal Unit land above Stanaker Service Canal when it can be replaced from Stanaker Reservoir by Vernal Unit. Shown as being available in column 45 and used in columns 17 and 33. Column 74 shows it being replaced.

7/ Ashley Creek water owned by land below Stanaker Service Canal and available for use above Stanaker Service Canal, provided it can be replaced from Stanaker Reservoir by Vernal Unit. Shown as being used in columns 18 and 34.

8/ Includes an average of 800 acre-feet of water released in exchange for future municipal diversions from Ashley Springs during the irrigation season. The remaining 700 acre-feet of municipal diversions would be made during the nonirrigation season when exchange would not be necessary.

9/ Irrigation shortage based on demand of 51,700 acre-feet annually.

| ...ir Operation | | | | Shortage | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Active reservoir content | | | Irrigation Shortage | | | | | | Municipal Shortage | | | |
| | | | | | | | | 9/ Total Irrigation Shortage | | | | | |
| Spill | Max | Min | End of year | Irrigation for River Bottom Area | Land above Stanaker Service Canal | Highline Canal | Land below Stanaker Service Canal | 1000 Acre-feet | Percent | 1000 Acre-feet | Percent | Water not Used (Bypass plus Stanaker Reservoir Spill) | Year |
| 78 | 79-a | 79-b | 79-c | 80 | 81 | 82 | 83 | 84-a | 84-b | 85-a | 85-b | 86 | |
| | | | 25.8 | | | | | | | | | | |
| 27.0 | 33.2 | 21.2 | 21.2 | | | | | | | | | 35.4 | 1930 |
| 2.5 | 33.2 | 1.7 | 1.7 | | 1.1 | 1.3 | | 2.4 | 5 | | | 2.5 | 31 |
| | 31.2 | .4 | 19.5 | | | | | | | | | 11.3 | 32 |
| | 28.3 | 8.5 | 8.5 | | | .3 | | .3 | 1 | | | 6.5 | 33 |
| | 14.5 | -.1 | -.1 | .3 | 9.5 | 2.5 | 10.6 | 23.1 | 45 | .2 | 13 | | 34 |
| | 23.6 | -.1 | 6.6 | | .3 | .2 | .7 | 1.2 | 2 | | | 16.5 | 1935 |
| | 12.5 | .1 | .1 | .3 | 5.0 | 1.7 | 5.9 | 12.9 | 25 | | | | 36 |
| | 31.5 | .1 | 20.2 | | .1 | .2 | .2 | .5 | 1 | | | 16.3 | 37 |
| 16.3 | 33.2 | 19.4 | 22.8 | | | | | | | | | 32.0 | 38 |
| 16.8 | 33.2 | 9.7 | 9.7 | | | .4 | | .4 | 1 | | | 19.6 | 39 |
| | 28.0 | 1.7 | 1.7 | | .3 | .3 | | .6 | 1 | | | 1.0 | 1940 |
| 10.9 | 33.2 | 2.4 | 27.3 | | | | | | | | | 33.1 | 41 |
| 33.3 | 33.2 | 17.7 | 17.7 | | | | | | | | | 57.2 | 42 |
| 7.4 | 33.2 | 15.2 | 15.2 | | | | | | | | | 8.9 | 43 |
| 17.1 | 33.2 | 14.1 | 23.2 | | | | | | | | | 57.4 | 44 |
| 8.7 | 33.2 | 19.9 | 19.9 | | | | | | | | | 9.1 | 1945 |
| | 30.3 | 1.4 | 1.4 | | | .2 | | .2 | 0 | | | | 46 |
| 15.4 | 33.2 | .9 | 23.2 | | | | .2 | .2 | 0 | | | 34.3 | 47 |
| 9.8 | 33.2 | 13.3 | 13.3 | | | | | | | | | 19.3 | 48 |
| 11.8 | 33.2 | 11.8 | 18.4 | | | | | | | | | 23.9 | 49 |
| 19.4 | 33.2 | 17.8 | 21.1 | | | | | | | | | 38.1 | 1950 |
| 3.2 | 33.2 | 16.5 | 15.5 | | | | | | | | | 9.2 | 51 |
| 22.4 | 33.2 | 15.7 | 24.7 | | | | | | | | | 41.9 | 52 |
| 3.4 | 33.2 | 14.1 | 14.1 | | | | | | | | | 4.3 | 53 |
| | 28.7 | 3.7 | 3.7 | | | | | | | | | .8 | 54 |
| | 13.9 | -.1 | -.1 | .3 | 2.8 | 1.0 | 5.5 | 2.6 | 19 | | | | 1955 |
| | 18.9 | -.1 | 0 | .1 | 1.5 | .7 | .7 | 3.0 | 6 | | | 2.1 | 56 |
| 225.4 | -- | -- | -- | 1.0 | 20.6 | 8.8 | 23.8 | 54.4 | -- | .2 | | 480.7 | Total |
| 8.3 | -- | -- | -- | 0 | .8 | .3 | .9 | 2.0 | 4% | 0 | 0% | 17.8 | Mean |

Stanaker Reservoir active capacity: 33,200 acre-feet
Stanaker Feeder Canal capacity: 400 cubic feet per second

Table 43
Annual water supply summary--Vernal unit lands
(Unit--1,000 acre-feet)

| Year | Streamflow: Ashley Creek flow at "Sign of the Maine"1/ | Streamflow: Future increase in municipal diversions | Streamflow: Required for prior rights2/ | Streamflow: Surplus flow at Ft. Thornburgh Diversion Dam3/ | Streamflow: Bypass4/ | Stanaker Reservoir operation: Diverted to Stanaker Reservoir | Stanaker Reservoir operation: Evaporation | Stanaker Reservoir operation: Total release | Stanaker Reservoir operation: Spill | Active reservoir content: Maximum | Active reservoir content: End of year |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 1929 | | | | | | | | | | | 25.6 |
| 1930 | 102.7 | 1.5 | 55.0 | 46.2 | 8.4 | 37.8 | 2.8 | 12.4 | 2.5 | 33.2 | 21.2 |
| 31 | 40.8 | 1.5 | 23.2 | 16.1 | | 16.1 | 1.8 | 31.3 | | 33.2 | 1.7 |
| 32 | 99.0 | 1.5 | 51.6 | 45.9 | 11.3 | 34.6 | 1.9 | 14.9 | | 31.2 | 19.5 |
| 33 | 58.0 | 1.5 | 29.7 | 26.8 | 6.5 | 20.3 | 2.1 | 29.2 | | 28.3 | 8.5 |
| 34 | 27.2 | 1.3 | 17.8 | 8.1 | | 8.1 | 1.2 | 15.5 | | 14.5 | -.1 |
| 1935 | 87.8 | 1.5 | 41.2 | 45.1 | 16.5 | 28.6 | 1.6 | 20.3 | | 23.6 | 6.6 |
| 36 | 43.7 | 1.5 | 32.3 | 9.9 | | 9.9 | 1.1 | 15.3 | | 12.5 | .1 |
| 37 | 105.9 | 1.5 | 54.2 | 50.2 | 16.3 | 33.9 | 1.3 | 12.5 | | 31.5 | 20.2 |
| 38 | 106.1 | 1.5 | 55.8 | 48.8 | 15.7 | 33.1 | 2.5 | 12.2 | 16.3 | 33.2 | 22.3 |
| 39 | 72.0 | 1.5 | 37.7 | 32.8 | 2.8 | 30.0 | 2.3 | 23.5 | 16.8 | 33.2 | 9.7 |
| 1940 | 55.3 | 1.5 | 32.5 | 21.3 | 1.0 | 20.3 | 1.8 | 26.5 | | 28.0 | 1.7 |
| 41 | 125.2 | 1.5 | 55.9 | 67.8 | 22.2 | 45.6 | 2.0 | 12.1 | 10.9 | 33.2 | 22.3 |
| 42 | 122.4 | 1.5 | 49.7 | 71.2 | 23.9 | 47.3 | 2.7 | 15.9 | 33.3 | 33.2 | 17.7 |
| 43 | 74.6 | 1.5 | 45.1 | 28.0 | 1.5 | 26.5 | 2.5 | 19.1 | 7.4 | 33.2 | 15.2 |
| 44 | 136.4 | 1.5 | 50.2 | 84.7 | 40.3 | 44.4 | 2.4 | 16.9 | 17.1 | 33.2 | 23.2 |
| 1945 | 75.2 | 1.5 | 49.1 | 24.6 | .4 | 24.2 | 2.4 | 16.4 | 8.7 | 33.2 | 19.9 |
| 46 | 44.2 | 1.5 | 30.6 | 12.1 | | 12.1 | 1.8 | 28.8 | | 30.3 | 1.4 |
| 47 | 130.3 | 1.5 | 60.5 | 68.3 | 18.9 | 49.4 | 2.2 | 10.0 | 15.4 | 33.2 | 23.2 |
| 48 | 74.4 | 1.5 | 36.6 | 36.3 | 9.5 | 26.8 | 2.6 | 24.3 | 9.8 | 33.2 | 13.3 |
| 49 | 99.4 | 1.5 | 49.9 | 48.0 | 12.1 | 35.9 | 2.5 | 16.5 | 11.8 | 33.2 | 18.4 |
| 1950 | 113.6 | 1.5 | 56.7 | 55.4 | 18.7 | 36.7 | 2.4 | 12.2 | 19.4 | 33.2 | 21.1 |
| 51 | 71.1 | 1.5 | 40.5 | 29.1 | 6.0 | 23.1 | 2.3 | 22.2 | 3.2 | 33.2 | 16.5 |
| 52 | 128.5 | 1.5 | 65.3 | 61.7 | 19.5 | 42.2 | 2.6 | 9.0 | 22.4 | 33.2 | 24.7 |
| 53 | 58.1 | 1.5 | 36.1 | 20.5 | .9 | 19.6 | 2.4 | 24.4 | 3.4 | 33.2 | 14.1 |
| 54 | 54.4 | 1.5 | 34.1 | 18.8 | .8 | 18.0 | 1.9 | 26.5 | | 28.7 | 3.7 |
| 1955 | 49.0 | 1.5 | 33.9 | 13.6 | | 13.6 | .9 | 16.5 | | 13.9 | -.1 |
| 56 | 65.3 | 1.5 | 37.5 | 26.3 | 2.1 | 24.2 | 1.3 | 22.8 | | 18.9 | 0 |
| Total | 2,220.6 | 40.3 | 1,162.7 | 1,017.6 | 255.3 | 762.3 | 55.3 | 507.2 | 198.4 | -- | -- |
| Mean | 82.2 | 1.5 | 43.1 | 37.7 | 9.5 | 28.2 | 2.1 | 18.8 | 7.3 | -- | -- |

| Year | Land above Stanaker Service Canal exclusive of land under Highline Canal5/ — Water supply1/: Present supply within ideal demand (3.7 ac.-ft. per acre) | Water supply: Additional water from Vernal unit6/ | Shortage: 1,000 acre-feet | Shortage: Percent of annual demand | Additional water at rate of 4 ac.-ft. per acre7/ | Land under Highline Canal8/ — Water supply: Present supply within ideal demand (3.7 ac.-ft. per acre) | Water supply: Additional water from Vernal unit6/ | Shortage: 1,000 acre-feet | Shortage: Percent of annual demand | Additional water at rate of 4 ac.-ft. per acre7/ |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 1929 | | | | | | | | | | |
| 1930 | 12.5 | 2.8 | | | 0.3 | 1.2 | 2.5 | | | |
| 31 | 5.8 | 8.4 | 1.1 | 7 | | .4 | 2.0 | 1.3 | 35 | |
| 32 | 11.6 | 3.7 | | | .3 | 1.2 | 2.5 | | | |
| 33 | 6.9 | 8.4 | | | | .7 | 2.7 | .3 | 8 | |
| 34 | 4.3 | 1.5 | 9.5 | 62 | | .2 | 1.0 | 2.5 | 68 | |
| 1935 | 9.6 | 5.4 | .3 | 2 | .2 | 1.2 | 2.3 | .2 | 5 | |
| 36 | 7.5 | 2.8 | 5.0 | 33 | | .3 | 1.7 | 1.7 | 46 | |
| 37 | 12.2 | 3.0 | .1 | 1 | .3 | 1.1 | 2.4 | .2 | 5 | |
| 38 | 12.3 | 3.0 | | | .3 | 1.2 | 2.5 | | | |
| 39 | 8.8 | 6.5 | | | .2 | .6 | 2.7 | .4 | 11 | |
| 1940 | 7.8 | 7.2 | .3 | 2 | .1 | .6 | 2.8 | .3 | 8 | |
| 41 | 12.2 | 3.1 | | | .3 | 1.6 | 2.1 | | | |
| 42 | 11.2 | 4.1 | | | .3 | 1.1 | 2.6 | | | |
| 43 | 10.2 | 5.1 | | | .4 | .9 | 2.8 | | | |
| 44 | 10.6 | 4.7 | | | .8 | 1.6 | 2.1 | | | .1 |
| 1945 | 11.3 | 4.0 | | | .3 | .6 | 3.1 | | | |
| 46 | 7.2 | 8.1 | | | .1 | .4 | 3.1 | .2 | 5 | |
| 47 | 12.6 | 2.7 | | | 1.1 | 1.7 | 2.0 | | | |
| 48 | 8.5 | 6.8 | | | | 1.0 | 2.7 | | | |
| 49 | 11.1 | 4.2 | | | .6 | 1.3 | 2.4 | | | |
| 1950 | 12.0 | 3.3 | | | .8 | 1.2 | 2.5 | | | |
| 51 | 9.3 | 6.0 | | | .1 | .8 | 2.9 | | | |
| 52 | 13.6 | 1.7 | | | 1.1 | 1.3 | 2.4 | | | |
| 53 | 8.8 | 6.5 | | | | .6 | 3.1 | | | |
| 54 | 8.2 | 7.1 | | | .1 | .6 | 3.1 | | | |
| 1955 | 8.2 | 4.3 | 2.8 | 18 | | .5 | 2.2 | 1.0 | 27 | |
| 56 | 7.9 | 5.9 | 1.5 | 10 | .8 | 1.0 | 2.0 | .7 | 19 | |
| Total | 262.2 | 130.3 | 20.6 | -- | 8.5 | 24.9 | 66.2 | 8.8 | -- | .1 |
| Mean | 9.7 | 4.8 | .8 | 5% | .3 | .9 | 2.5 | .3 | 8% | 0 |

| Year | Land below Stanaker Service Canal9/ — Water supply: Present supply within ideal demand (3.7 ac.-ft. per acre) | Water supply: Additional water from Vernal unit9/10/ | Shortage: 1,000 acre-feet | Shortage: Percent of annual demand | Additional water at rate of 4 ac.-ft. per acre7/ | Total for land under major canals11/ — Water supply: Present supply within ideal demand (3.7 ac.-ft. per acre) | Water supply: Additional water from Vernal unit6/12/ | Shortage: 1,000 acre-feet | Shortage: Percent of annual demand | Additional water at rate of 4 ac.-ft. per acre7/ |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| 1929 | | | | | | | | | | |
| 1930 | 25.6 | 6.8 | | | 0.3 | 39.3 | 12.1 | | | 0.6 |
| 31 | 11.8 | 20.6 | | | | 18.0 | 31.0 | 2.4 | 5 | |
| 32 | 24.0 | 8.4 | | | .6 | 36.8 | 14.6 | | | .9 |
| 33 | 14.6 | 17.8 | | | | 22.2 | 28.9 | .3 | 1 | |
| 34 | 8.8 | 13.0 | 10.6 | 33 | | 13.3 | 15.5 | 22.6 | 44 | |
| 1935 | 19.4 | 12.3 | .7 | 2 | .4 | 30.2 | 20.0 | 1.2 | 2 | .6 |
| 36 | 15.7 | 10.8 | 5.9 | 18 | | 23.5 | 15.3 | 12.6 | 25 | |
| 37 | 25.4 | 6.8 | .2 | 1 | .5 | 38.7 | 12.2 | .5 | 1 | .8 |
| 38 | 26.0 | 6.4 | | | .6 | 39.5 | 11.9 | | | .9 |
| 39 | 18.4 | 14.0 | | | .4 | 27.8 | 23.2 | .4 | 1 | .6 |
| 1940 | 16.1 | 16.3 | | | .2 | 24.5 | 26.3 | .6 | 1 | .3 |
| 41 | 25.8 | 6.6 | | | .6 | 39.6 | 11.8 | | | .9 |
| 42 | 23.4 | 9.0 | | | .4 | 35.7 | 15.7 | | | .7 |
| 43 | 21.5 | 10.9 | | | .7 | 32.6 | 18.8 | | | 1.1 |
| 44 | 22.6 | 9.8 | | | .6 | 34.8 | 16.6 | | | 1.5 |
| 1945 | 23.4 | 9.0 | | | .5 | 35.3 | 16.1 | | | .8 |
| 46 | 15.1 | 17.3 | | | | 22.7 | 28.5 | .2 | 0 | .1 |
| 47 | 27.4 | 4.8 | .2 | 1 | 1.0 | 41.7 | 9.5 | .2 | 0 | 2.1 |
| 48 | 17.9 | 14.5 | | | | 27.4 | 24.0 | | | |
| 49 | 22.8 | 9.6 | | | .9 | 35.2 | 16.2 | | | 1.5 |
| 1950 | 26.3 | 6.1 | | | .6 | 39.5 | 11.9 | | | 1.4 |
| 51 | 19.4 | 13.0 | | | .2 | 29.5 | 21.9 | | | .3 |
| 52 | 27.8 | 4.6 | | | 2.1 | 42.7 | 8.7 | | | 3.2 |
| 53 | 17.9 | 14.5 | | | | 27.3 | 24.1 | | | |
| 54 | 16.4 | 16.0 | | | .2 | 25.2 | 26.2 | | | .3 |
| 1955 | 16.9 | 10.0 | 5.5 | 17 | | 25.6 | 16.5 | 9.3 | 18 | |
| 56 | 17.0 | 14.7 | .7 | 4 | 1.6 | 25.9 | 22.6 | 2.9 | 6 | 2.4 |
| Total | 547.4 | 303.6 | 23.8 | -- | 12.4 | 834.5 | 500.1 | 53.2 | -- | 21.0 |
| Mean | 20.3 | 11.2 | .9 | 3% | .5 | 30.9 | 18.5 | 2.0 | 4% | .8 |

| Year | River Bottom area: Water supplied from Vernal unit 12/13/ | River Bottom area: Shortage | Total unit shortages — Irrigation14/: 1,000 acre-feet | Irrigation14/: Percent of demand | Municipal water: 1,000 acre-feet | Municipal water: Percent of demand |
|---|---|---|---|---|---|---|
| Year | 32 | 33 | 34 | 35 | 36 | 37 |
| 1929 | | | | | | |
| 1930 | .3 | | | | | |
| 31 | .3 | | 2.4 | 5 | | |
| 32 | .3 | | | | | |
| 33 | .3 | | .3 | 1 | | |
| 34 | | 0.3 | 23.1 | 45 | .2 | 13% |
| 1935 | .3 | | 1.2 | 2 | | |
| 36 | | .3 | 12.9 | 25 | | |
| 37 | .3 | | .5 | 1 | | |
| 38 | .3 | | | | | |
| 39 | .3 | | .4 | 1 | | |
| 1940 | .3 | | .6 | 1 | | |
| 41 | .3 | | | | | |
| 42 | .3 | | | | | |
| 43 | .3 | | | | | |
| 44 | .3 | | | | | |
| 1945 | .3 | | | | | |
| 46 | .3 | | .2 | 0 | | |
| 47 | .3 | | .2 | 0 | | |
| 48 | .3 | | | | | |
| 49 | .3 | | | | | |
| 1950 | .3 | | | | | |
| 51 | .3 | | | | | |
| 52 | .3 | | | | | |
| 53 | .3 | | | | | |
| 54 | .3 | | | | | |
| 1955 | | .3 | 9.6 | 19 | | |
| 56 | .2 | .1 | 3.0 | 6 | | |
| Total | 7.1 | 1.0 | 54.4 | -- | .2 | |
| Mean | .3 | 0 | 2.0 | 4% | 0 | 0% |

1/ Exclusive of upstream diversions to Stanaker Ditch and the municipal pipeline.
2/ Required for all presently irrigated land, with diversions limited to a rate of 4 acre-feet per acre annually by agreements made for Vernal unit operation.
3/ Flow of Ashley Creek at "Sign of the Maine" in excess of downstream rights supplied at rate of 4 acre-feet per acre annually less 1,500 acre-feet annually that will be diverted above gage to supply municipal requirements.
4/ Bypass is available flow in excess of capacity of Stanaker Feeder Canal. In actual practice bypass may be increased to reduce reservoir spill, Column 9.
5/ Demand is 15,500 acre-feet annually.
6/ Supplied under annual demand of 3.7 acre-feet per acre.
7/ Water in excess of ideal requirements (3.7 acre-feet per acre) divertible by prior rights from natural streamflow during high water periods under agreements limiting prior rights to 4 acre-feet per acre.
8/ Demand is 3,700 acre-feet annually.
9/ Demand is 32,400 acre-feet annually.
10/ Includes an average of 800 acre-feet of water released in exchange for future municipal diversion from Ashley Springs during the irrigation season. The remaining 700 acre-feet of municipal diversions would be made during the nonirrigation season when exchange would not be necessary.
11/ Demand is 51,400 acre-feet annually.
12/ Total water supplied would be:

| | | |
|---|---|---|
| Reservoir release (Col. 28 & 32) | 18,800 | acre-feet |
| Less municipal exchange | 800 | " " |
| Irrigation supply | 18,000 | " " |
| Vernal Unit municipal supply | 1,500 | " " |
| Total | 19,500 | " " |

13/ River Bottom area comprises 356 acres, which require 300 acre-feet of Vernal unit water for a full supply.
14/ Total irrigation demand is 51,700 acre-feet including 51,400 for land under major canals and 300 acre-feet for land in River Bottom area.

Due to its location in the Uinta Basin, the factors of the Moon Lake project were considered to be more applicable to Ashley Valley, and a factor of 1.30 was selected for the Vernal unit.

Twenty-three percent of the annual demand would be delivered during July, the month of maximum demand, or 0.85 acre-feet per acre for the month. Using the 1.30, one second-foot of flow would be required for each 55 acres of land. The initial capacity of Stanaker Service Canal would be 250 cfs for approximately 13,700 acres under the canal. However, the portion of the canal between Stanaker Dam and Ashley Creek is being designed as a spillway for the reservoir, and will have an initial capacity of 300 cfs, well above that required for irrigation. After crossing Ashley Creek, the service canal would be designed to irrigate 11,500 acres, with an initial capacity of 210 second-feet.

## New Water Supplied by Vernal Unit

New water supplied by the unit would amount to the difference between the average water supply under unit conditions and that under present conditions, limited to theoretical demand during months of high runoff. The water supply under present conditions was determined by a daily study. Diversions with the unit were obtained from the results of the Stanaker Reservoir operation study (Table 42), for unit land (Class 1, 2, and 3). To this was added the present supply for nonunit land (Class 6W) to obtain the total supply with the unit in operation. New water supplied by the unit would amount to 18,000 acre-feet per acre for irrigation and 1,500 acre-feet per year for municipal use. Table 44 summarizes the new water supplied.

Table 44
Central Utah Project
Vernal Unit
New water supplied by Vernal unit

| Area | Acre-feet annually |
|---|---|
| Land under Highline Canal | 2,500 |
| Land above Stanaker Service Canal | 4,800 |
| Land below Stanaker Service Canal | 11,200 |
| River Bottom area | 300 |
| Subtotal | 18,800 |
| Less Municipal exchange | 800 |
| Irrigation supply | 18,000 |
| Municipal supply | 1,500 |
| Total | 19,500 |

WATER SUPPLY

CHAPTER V

COLORADO RIVER DEPLETIONS

## Present Streamflow Depletions

As a result of present development in the Ashley Creek drainage basin the available water supply for Ashley Valley is depleted by evaporation from reservoirs, by domestic water consumption and by consumptive use of water resulting from irrigation applications. The presently constructed reservoirs on Ashley Creek are very small and are located high in the drainage area. The evaporation is therefore small and was neglected in the present stream depletion estimates. The present diversion for domestic use is 1,460 acre-feet annually, of which one half is estimated to be consumed. Under unit development the estimated consumptive use is estimated at 2.00 acre-feet per acre or 54% of the diversion requirements. Present practices use more of the early spring runoff applied to the land in an apparent attempt to create soil holdover storage for late season use. Thus the consumptive use would be less under present practices than with unit development. Present diversions are estimated at 50,000 acre-feet and a 45% consumptive use. Thus, present stream flow depletions would amount to about 730 acre-feet for domestic water and 22,500 acre-feet for irrigation, or a total of 23,230 acre-feet.

## Future Streamflow Depletions

Streamflow depletions under unit development include evaporation from reservoirs, domestic water consumption, and consumptive use of water resulting from irrigation application.

### Reservoir evaporation

Increased depletions under unit development include evaporation from Stanaker Reservoir which is estimated at 2,100 acre-feet annually as shown in column 73, Table 42. Other evaporation losses would remain essentially the same as at present.

### Domestic use

Additional municipal and industrial water uses in the Vernal area are expected to amount to 1,500 acre-feet annually with a consumptive use of 700 acre-feet. Present winter flows that are being diverted into canals for stockwater use will, by exchange, be conveyed to some areas by the Water Savings pipe system. This will reduce the present nonirrigation season diversion for stockwater from an estimated 10,000 acre-feet to 126 acre-feet with an estimated savings in consumptive use of from 1,100 to 100 or a net savings of 1,000 acre-feet.

Irrigation use

Operation studies show the average reservoir release for irrigation as 18,000 acre-feet. Under unit development the consumptive use is estimated at 54% of the diversion requirements or 10,000 acre-feet which includes the irrigation consumptive use and uses incidental to irrigation.

Summary of increased depletion

A summary of the increased Colorado River depletion attributable to unit development is as follows:

| Purpose | Increase in depletion (acre-feet per year) |
|---|---|
| Reservoir evaporation | 2,100 |
| Domestic use (Vernal, Maeser, and Naples) | 700 |
| Irrigation and uses incident to irrigation | 10,000 |
| Subtotal | 12,800 |
| Saving by Water Savings Pipeline | 1,000 |
| Total | 11,800 |

WATER SUPPLY

# CHAPTER VI

## FLOOD CONTROL

### Previous Studies

Little damage is caused by floods on Ashley Creek, according to Amos W. Hoggard, Associate Engineer of the U. S. Engineers Office who made a reconnaissance flood control survey of Uinta Basin streams in February 1943. He estimates that the annual flood damage to diversion dams does not exceed $300 to $400 annually. He reported that the old U. S. Highway Bridge had been damaged some, but not since the construction of the new bridge.

Mr. Hoggard's report was very preliminary in nature and was not intended as a unit report. Therefore, it connection with preparation of the Vernal unit report, Mr. F. N.Cronholm of the U. S.Engineers Office in Salt Lake City made a detailed inspection of the unit area for the purpose of making recommendations regarding further flood control studies. He considered the flood damages to be of greater magnitude than was indicated in the report by Mr. Hoggard and recommended that a more detailed study be made

In connection with the Vernal unit investigations, the Bureau of Reclamation made the flood control study recommended by Mr. Cronholm. This study is reported below.

### Flood Flows

Floods on Ashley Creek are confined almost entirely to those resulting from snowmelt in the high Uinta Mountains during the spring months. As temperatures increase in the spring stream flows rise rapidly and remain at a high level for about 15 days then decrease to normal summer flows. Climatic factors such as snow cover, temperature, humidity, wind, and rain affect the occurrence and duration of peak flows. Summer cloudbursts, usually on the lower mountain slopes, occasionally produce high flows but seldom do any damage because of their short duration.

### Historical Floods

In 1900 discharge records were started on Ashley Creek near Vernal above the confluence with Dry Fork. This record continued until 1904 when it was discontinued. In 1912 and 1913 partial records were kept during the winter season, although no records of flood flows were obtained. A record was started again in 1915 which has been continuous since then except for short periods.

A gage was established below the confluence with Dry Fork at the "Sign of the Maine" in June 1939. A continuous record is available since that time. Peak flow for the period of record occurred on July 21, 1945, with a maximum discharge of 2,650 second-feet.

The peak flood at the gage near Vernal occurred in May 1921, the maximum instantaneous flow reaching 2,051 second-feet on May 29. It was concluded from newspaper clippings and discussion with old-time residents that this was the maximum flood since 1890. A flood of considerable magnitude occurred between 1880 and 1890 which caused the Ashley Creek channel to change its location for a distance of 8 miles. Data from which estimates of the magnitude of this flood could be made are lacking. It was believed by one of the old-time residents that the old diversion for the central canal was a contributing cause of the stream changing its channel. Ashley Creek has remained in this new channel except for minor changes since then.

## Flood Damages

Past flood damages have consisted of the complete channel changes that occurred in the 1880's and damages to canals and diversion structures, roads and bridges, land adjacent to the channel, improvements such as fences and farm buildings. Using these past damages as a basis and considering new improvements and increased values, the average annual future flood damage on Ashley Creek is estimated as follows:

| | Average annual damage |
|---|---|
| Canals and diversion structures . . . . . . . | $1,620 |
| Roads and bridges . . . . . . . . . . . . . . . | 4,080 |
| Land adjacent to channel. . . . . . . . . . . | 800 |
| Shifting of channel . . . . . . . . . . . . . . | 2,550 |
| Total | 9,530 |

Amortized at 3 percent over 50 years, this damage would amount to $245,000.

## Flood Control Measures

To provide complete flood protection on Ashley Creek in the Vernal unit it would be necessary to provide a feeder canal of sufficient capacity to carry the maximum probable flood flow in excess of the safe carrying capacity of Ashley Creek and to have sufficient capacity in Stanaker Reservoir to hold the volume of water during the maximum flood in excess of the volume that could be safely by-passed by Ashley Creek.

In determining the safe carrying capacity of Ashley Creek, cross-sections were taken at critical sections along the channel through the flood danger area. From these the slope and the average minimum cross-sectional area were determined. From observation it was found that the predominant size of rock in the streambed is about 2 inches in diameter. An average velocity of approximately 6 feet per second is required to move material of this size. It was therefore concluded that if the average velocity is below this amount aggradation of the channel would cease and the possibility of the stream changing courses would be eliminated. To maintain the velocity below 6 feet per second the flow should not exceed 700 second-feet. However, peaks of short duration (less than 12 hours) in excess of 700 second-feet were considered allowable. It is noted from the hydrograph of the 1921 flood at "Sign of the Maine" that all peaks above 2,700 second-feet are less than 12 hours in duration. It was therefore assumed that the channel would carry these peaks in excess of the 700 second-feet without damage. The required feeder canal capacity to carry the flow between these limits is then 2,000 second-feet. A reservoir capacity of 68,000 acre-feet would be required to hold the excess flow of the 1921 flood.

## Regulation Costs

To provide regulation for floods in the Vernal unit plan would require increasing the capacity of the feeder canal from 400 to 2,000 second-feet and the capacity of the reservoir from 37,000 to 68,000 acre-feet. The spillway and the wasteway canal from Stanaker Reservoir would also have to be enlarged to carry an additional 1,600 second-feet. Rough comparative cost estimates showed that these additional features would cost approximately $3,100,000 based on 1956 prices. The estimated benefits over 50 years as outlined above totaled $245,000. Because of this great excess in costs over benefits detailed studies were not made and flood control works were excluded from the unit plan.

## U. S. Army Corps of Engineers Report

A summary of the Corps Report which is included in the Definite Plan Report is as follows:

> "Floods on Ashley Creek damage irrigation structures, roads, and bridges, and erode farmlands for about 8 miles in the Central Part of the valley. About 2,700 acres of farmland are affected. However, most of the project lands are free from any flood menace. Present flood damage has been estimated by the Bureau of Reclamation at $9,500 annually. Results of investigations indicate that the benefits from preventing this damage would not justify either the construction of local protection works in the project area or the provision of flood control storage space in a reservoir on Ashley Creek above the Valley. The conclusion is reached, therefore, that the construction of flood control features as part of the Vernal Unit is infeasible."

## Inflow Design Flood for Stanaker Dam Site

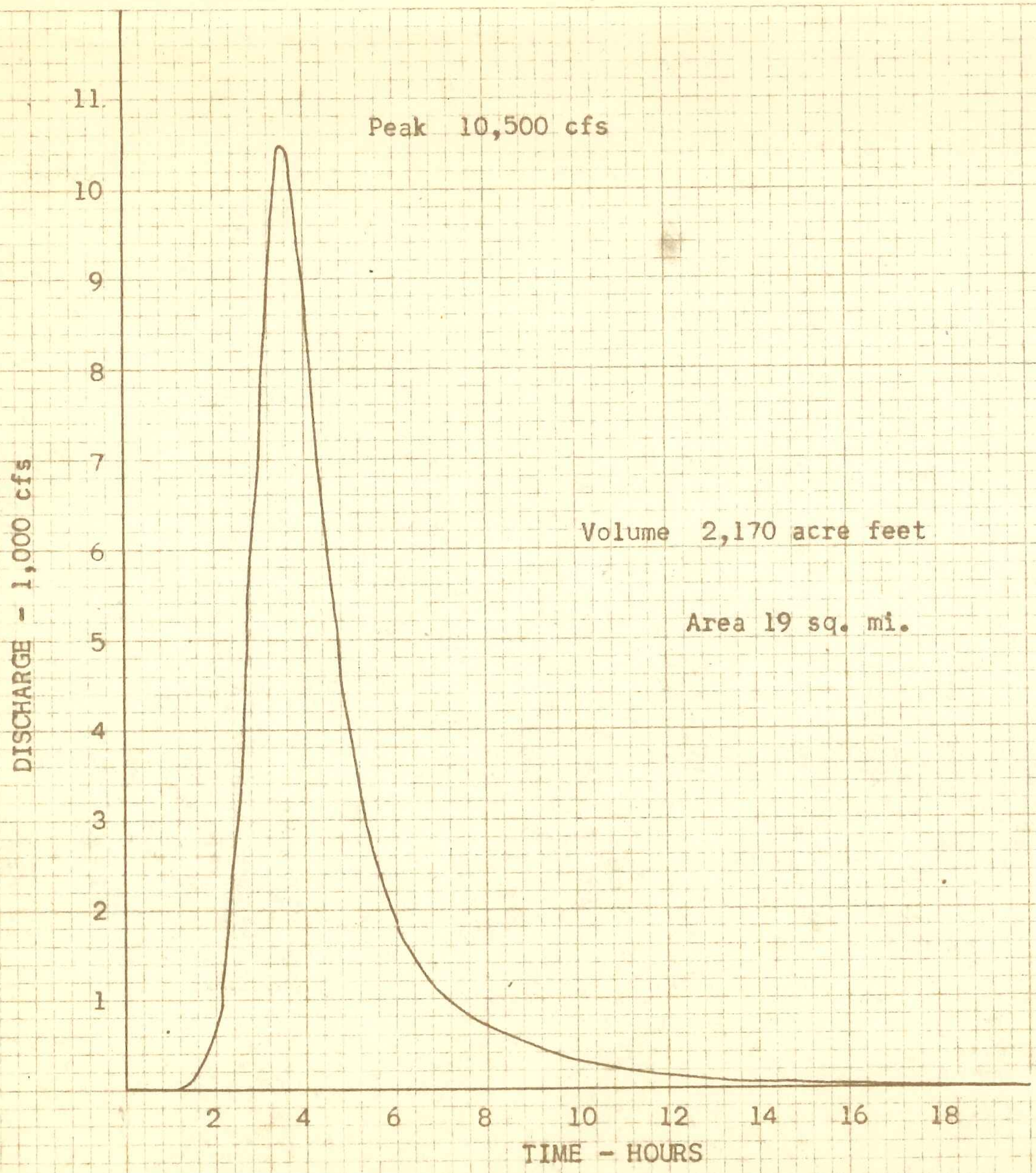
An inflow design flood study has been made on the Stanaker Draw drainage area for the Stanaker Dam site by the Denver Project Investigations Division in June 1956. The inflow design flood derived in this study has a peak of 10,500 second-feet and an 18-hour volume of 2,170 acre-feet, as shown in Figure 7.

Diversion requirement hydrographs having a recurrence interval of once in 5, 10, and 25 years, are presented graphically in Figure 8 which have the following characteristics:

| Frequency in years | Peak discharge cfs | Volume (12-hour) acre-feet |
|---|---|---|
| 5 | 400 | 70 |
| 10 | 1,300 | 230 |
| 25 | 2,250 | 400 |

## Flood Frequency Study Ft. Thornburgh Diversion Dam

A flood frequency study to determine the peak flow at the Ft. Thornburgh diversion dam site was made in July 1950 and reviewed in November 1956. This study recommended a design peak of 3,400 cfs.




United States
Department of the Interior
Bureau of Reclamation
DIVISION OF PROJECT INVESTIGATIONS
Central Utah Project - Vernal Unit

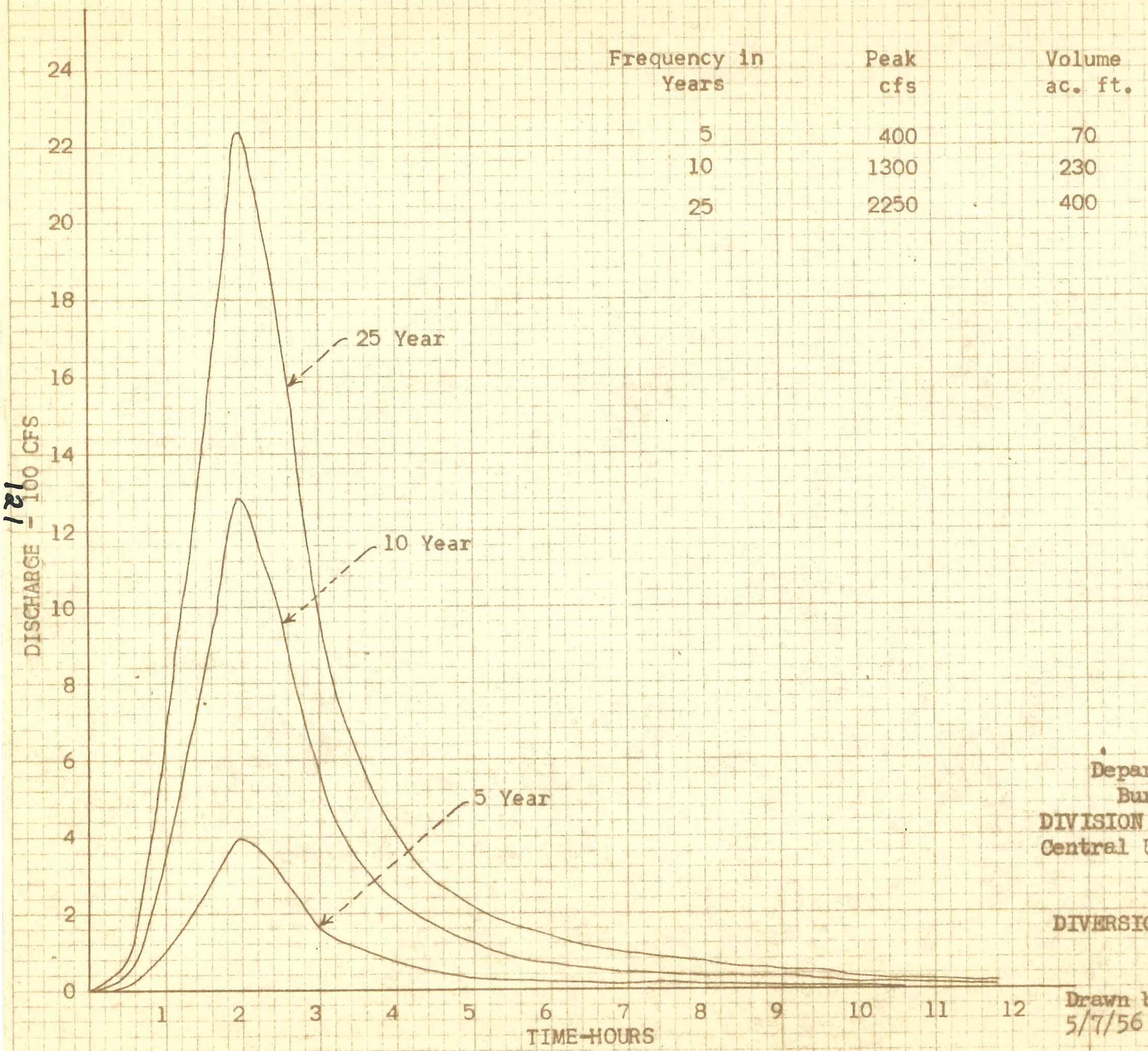
**STANAKER DAM SITE**

**INFLOW DESIGN FLOOD**

Drawn by D.L.M. 6-6-56

Traced by L.M.N. Denver, Colo.

Figure 7




United States
Department of the Interior
Bureau of Reclamation
DIVISION OF PROJECT INVESTIGATIONS
Central Utah Project - Vernal Unit

STANAKER DAM SITE
DIVERSION REQUIREMENT HYDROGRAPHS
(SUMMER SEASON)

Drawn by D.L.M. Traced by L.M.N.
5/7/56 Denver, Colo.

Figure 8